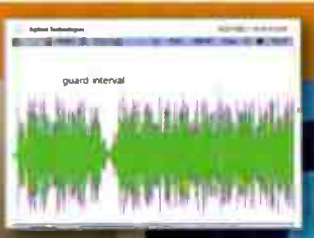
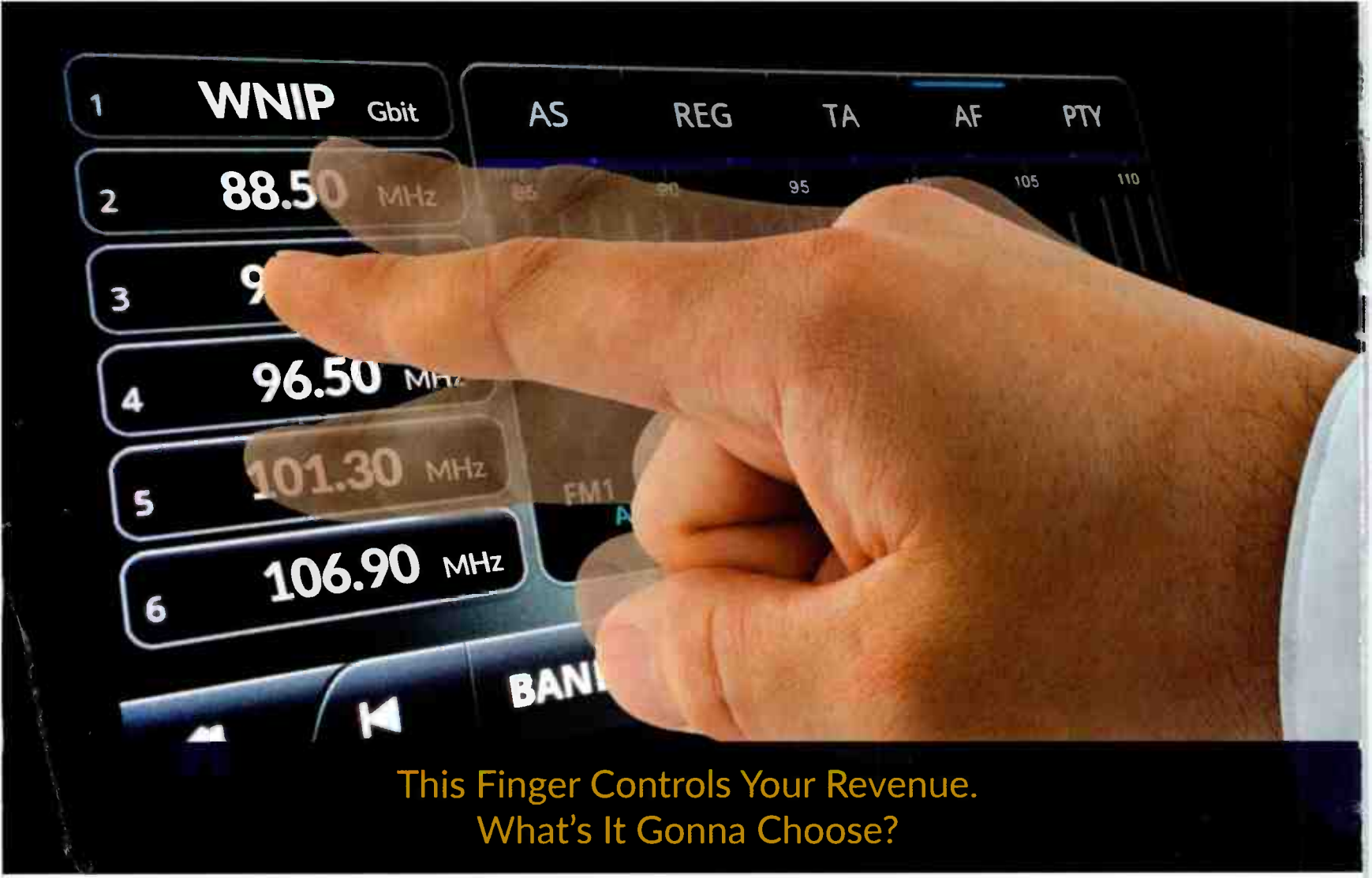


Radio

THE RADIO TECHNOLOGY LEADER

Hubbard Radio Phoenix Fits Five Diverse Stations Under One Roof

OCTOBER 2016 | RADIOMAGONLINE.COM NewBay Media



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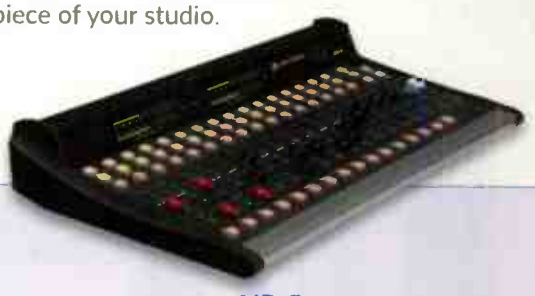

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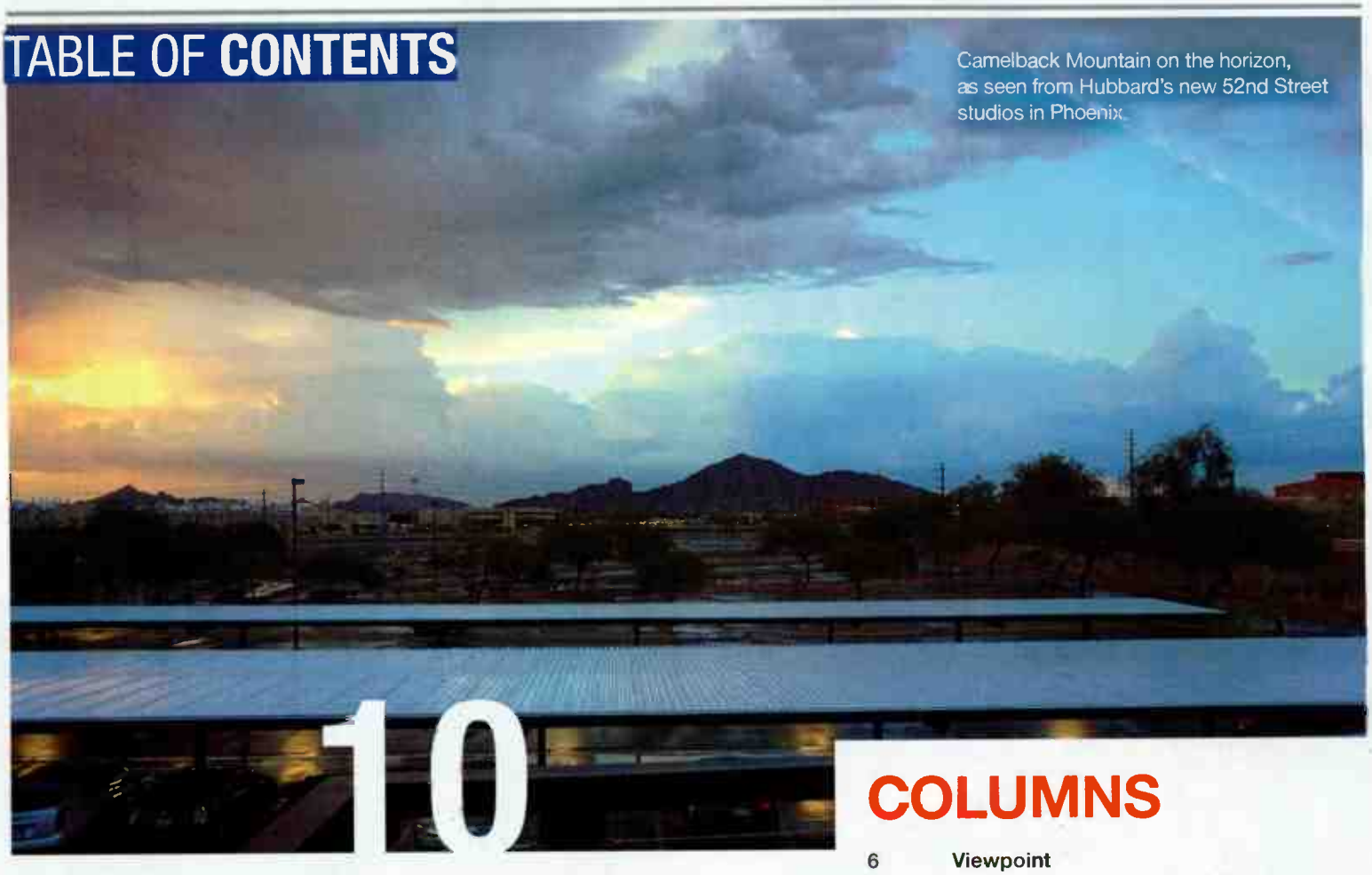


Camelback Mountain on the horizon, as seen from Hubbard's new 52nd Street studios in Phoenix.

FEATURES

On the cover: Hubbard Radio's new studios in Phoenix house five stations under one roof.

COLUMNS

DEPARTMENTS

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 **Hosa CBT-500 Audio Cable Tester**. Send your entry to radio@RadioMagOnline.com by **Nov. 10**. Be sure to include your guess, name, job title, company name, mailing address and phone number. No purchase necessary. For complete rules, go to *RadioMagOnline.com*.

VIEWPOINT

What's Wrong With Radio (Magazine)?

Our yearly Salary Survey results are one of the highlights of this month's issue. They garner quite a bit of attention, so if you are a new reader initially drawn in by that article: Welcome! If you have an interest in the technology behind radio (and its derivatives), then you've found a unique resource.

Once again, many thanks if you took the time for the survey. Towards its end, as you may recall, were places to write in comments about what you like and don't like in the magazine itself. There were many positive comments but in reality, to get better, we need to be more concerned about the things you *don't* like.

For example: "... *I think I actually liked it better when it was coming in paper form.*" You may be holding your own paper copy right now; but if you are reading the digital edition, wishing for your own paper copy, please use the URL at the bottom of this page. It will take you to a free subscription form, and qualified subscribers may sign up for the print delivery.

"*Needs more articles for my entry level people.*" We actually include articles for entry level people in every issue. Our series Trends in Technology is often (almost always) aimed at beginners and entry level people. Our facility showcases and field reports are geared towards readers of all levels.

"*Some technical articles do not drill down to the finer details.*" To the extent practical, we're addressing this concern, which I saw last year as well.

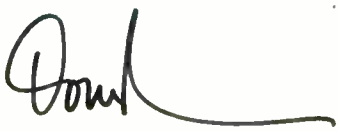
The survey results are not all we have for you this time. Hubbard Radio has built a great new facility for their five stations in Phoenix — we're covering it here as our Facility Showcases.

Even though Trends in Technology is often aimed at beginners, this time we're covering a complex subject — digital radio single-frequency networks. KUSC has built one in southern California, and we've got the details on how it's put together. Interestingly, single-frequency networks (also known as on-channel boosters) are more likely to work nearly seamlessly with digital radio, due to the nature of the receivers and the decoding of the data (ones and zeros are *so much* easier to understand).

Other regulars are back this month. Lee Petro explains the latest changes in the FCC's rules about station ownership — yes, there have been some. Tech Tips is our series of articles on new ways to accomplish the things commonly done around a station. It's meant to be an exchange of ideas among radio engineers and toward that end if you want to share something you've done, by all means, please forward your ideas to us. (You can write it up, or we can do it for you.)

This issue of Radio is one of the most feature-packed and detail-oriented of all we've created during my tenure as technical editor. To finish it off, on the very last page, is the Wandering Engineer. He/she has read the Salary Survey results, with some interesting insights and comments. You won't want to skip it.

As usual, thanks for reading Radio magazine!



Doug Irwin, CPBE AMD DRB | Technical Editor

P.S. To subscribe to the magazine, go to *http://tinyurl.com/zdtec5g.*

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Radio
THE RADIO TECHNOLOGY LEADER

October 2016 | Vol. 22 No. 10

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Member: American Business Media

A NewBay Media Publication

NewBay Media, LLC
28 East 28th Street, 12th floor
New York, NY 10016

SUBSCRIPTIONS: Free and controlled circulation to qualified subscribers. Customer Service can be reached at: newbay@computerfulfillment.com or by calling 888-266-5828 (USA only) or 978-667-0352 (Outside US) or write us at Radio Magazine, P.O. Box 1884, Lowell, MA 01853, USA. Back issues are available by calling Customer Service.

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Radio, Volume 22, Number 10, (ISSN 1542-0620) is published monthly by NewBay Media LLC, 28 East 28th Street, 12th floor, New York, NY 10016. Periodical postage paid at New York, NY and additional mailing offices. Postmaster: Send address changes to Radio, PO Box 1884, Lowell, MA 01853.

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Commission Overhauls Media Ownership Rules — Or Not

by Lee Petro

In August 2016, the Federal Communications Commission adopted a second report and order in its review of the media ownership rules. This order terminated the statutorily required quadrennial review of the media ownership rules that commenced in 2010, along with the quadrennial review that commenced in 2014. It also was necessitated by the May 2016 Prometheus Radio decision by the US Court of Appeals, wherein the court directed the FCC to issue an order by the end of 2016.

By way of background, the FCC is obligated to review its media ownership rules on a regular basis to determine if the rules are necessary. This obligation, imposed by Congress in 1996, originally called for a review every two years, but was subsequently revised in 2004 to require a review every four years. Over the past 12 years, the FCC has not seen much luck at the Third Circuit Court of Appeals, which previously remanded aspects of the 2002 and 2006 quadrennial review orders.

Then, in May 2016, the court remanded the FCC's efforts to address the 2010 ad 2014 quadrennial review obligations. Most of the 2016 Prometheus decision discussed the FCC's failure to develop an "eligible entity" definition that would both (i) satisfy the FCC's goal of encouraging minority and female ownership in media and (ii) survive judicial review. The court noted the long delay and ordered the FCC make a prompt decision. The court also directed the FCC to fulfill a promise made during oral arguments that the 2010 and 2014 quadrennial reviews would be completed by the end of 2016.

In the August 2016 order, the FCC adopted rules intended to address both the 2010/2014 quadrennial review, and adopted an "eligible entity" standard. With regard to the local radio ownership rules, the FCC elected not to modify the caps on the number of radio stations one entity may own or control in the local market. Also, the FCC decided not to modify the local radio "subcaps," which limit the number of AM and FM stations within the cap (i.e., in markets with 45 or more radio stations, a company may own eight stations, only five of which may be in one class — AM or FM.)

SMALL CHANGES, OR NOT

The FCC did change the way that the "local radio market" would be defined for radio stations in Puerto Rico.

Historically, first Arbitron, and now Nielsen Audio, has treated the entire island of Puerto Rico as one radio market, despite the fact that it impossible for radio stations to serve the entire island due to terrain shielding. Thus, under the local radio ownership rule, one company was limited to the ownership of eight radio stations.

More recently, the FCC has granted waivers of the strict application of this approach, and has permitted parties to use the "interim" contour-overlap method, which defines the local radio market based on the number of stations that overlap with the stations to be under common ownership. The August 2016 order affirms this informal approach, and eliminates the uncertainty that a waiver request may be denied.

The FCC also addressed an exception to the local ownership rules with respect to community of license changes and the two-year waiting period. Currently, a party may not receive the benefit (e.g., acquire an additional station) that results from a community of license change or change in a station's "home" designation, for a period of two years after the change.

One possible loophole has been the change in station's community of license to a community outside the metro market's boundaries, but which did not contemplate the actual change in facilities, i.e., the station's existing signal provided the requisite coverage to the new community of license. To eliminate the loophole, the FCC will now require that there be a physical change in the station's coverage before the owner can avoid the two-year waiting period.

Finally, the FCC adopted a revenue-based eligible entity standard to encourage "small business participation in the broadcast industry." The FCC determined that the record in the proceeding could not justify the adoption of racial or gender-based classifications. Instead, the commission will permit parties which comply with the revenue-based eligible entity standard to seek an extension of an unbuilt station's construction period for an additional 18 months, comply with a relaxed equity-debt plus attribution standard, acquire grandfathered clusters of radio stations that do not comply with the local radio ownership rules, and/or obtain stations involved in a "distress" sale.

It is not clear whether the Third Circuit will be satisfied with the FCC's action in the August 2016 order, or whether further modification of these rules will be made down the road. Also, the new rules have yet to be published in the Federal Register, so parties are not yet able to take advantage of the eligible entity preference.

Petro is of counsel at Drinker Biddle & Reath LLP. Email: lee.petro@dbr.com.

DATELINE

Nov. 14, 2016 – Radio stations file Form Three in EAS Test Reporting System.

Dec. 1, 2016 - Stations with five or more full-time employees in Alabama, Colorado, Connecticut, Georgia, Maine, Massachusetts, Minnesota, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota and Vermont must place their Annual EEO Public File Reports in the station's public inspection file.

Dec. 1, 2016 – Stations with 11 or more full-time employees in Colorado, Minnesota, Montana, North Dakota and South Dakota file their Mid-Term EEO Report (FCC Form 397) with the FCC.

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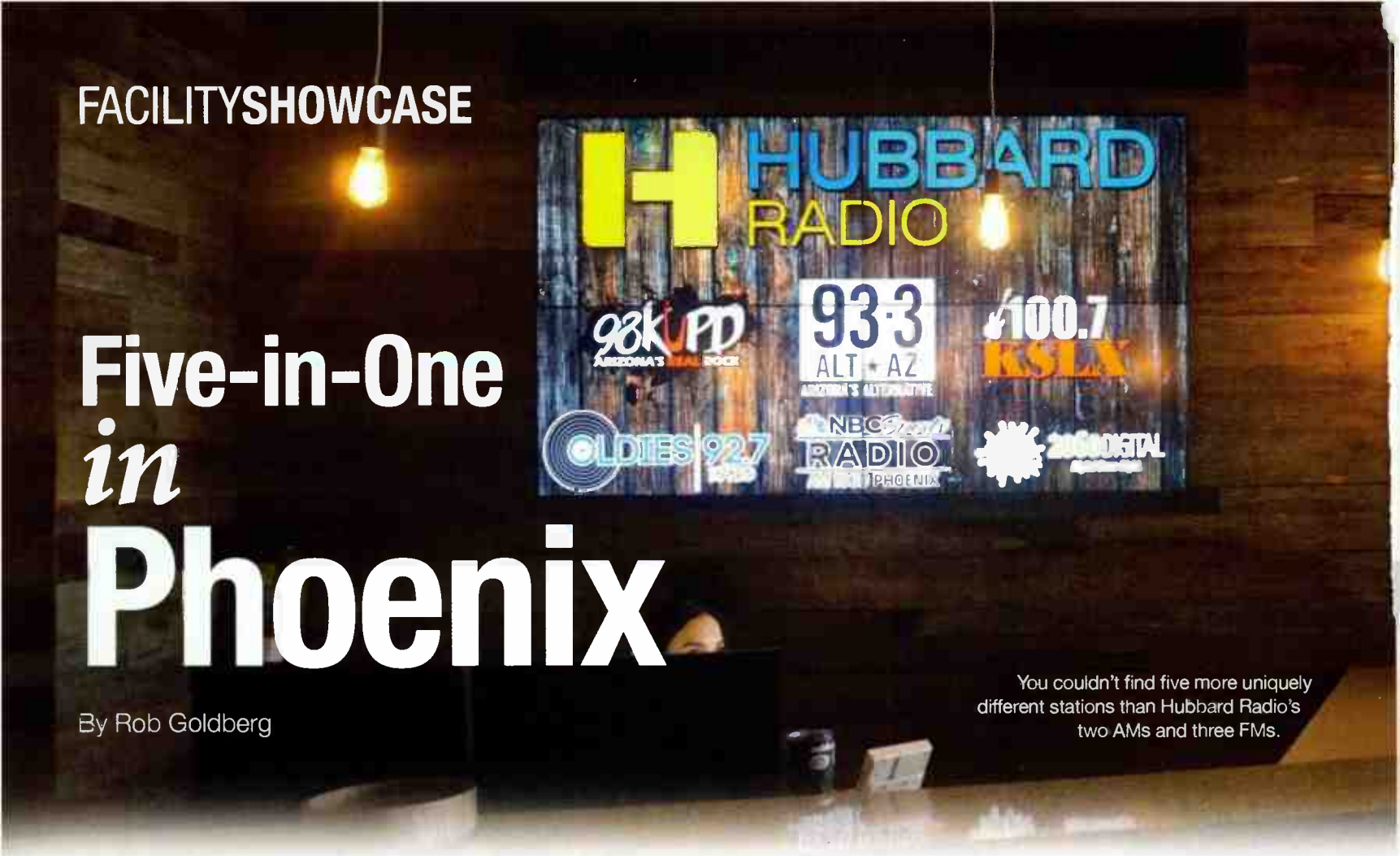
Five-in-One *in* Phoenix

By Rob Goldberg



You couldn't find five more uniquely different stations than Hubbard Radio's two AMs and three FMs.

Hubbard Radio's new studios in Phoenix, Ariz., bring together some unlikely characters. Just a few blocks from the new, built-to-suit facility on 52nd Street is a former Motorola plant that once made transistors. Also close by in another direction is Camelback Mountain, which is, as its name suggests, shaped like a camel, though a kneeling one in this case.

And inside the 23,000 square-foot facility you couldn't find five more different stations than Hubbard Radio's two AM and three FMs.

On the FM side, it's cool and easy alternative 93.3 KDKB, hard-hitting 98 KUPD and classic rocker KSLX 100.7. On the AM side, it's NBC sports affiliate KDUS 1060 and oldies KAZG 1440.

Each station is a unique brand, and each is accustomed to running its own show. That worked fine when they were scattered throughout the Valley of the Sun in three separate locations. Bringing all the stations together was a drastic change for all.

My compnay radio DNA is broadcast enginering service company based in Minneapolis. My job as the system integrator on the project was to bring them under one roof, and my planning started in June of 2015 with a visit to the recently built-out Hubbard facility in St. Louis, where I was able to formulate ideas. That started a series of weekly meetings used to narrow down the studio design and finalize the equipment order.

We started the project with just a rough layout given to us of the two-story facility. After meeting with Hubbard corporate engineers, local programmers and Trip Reeb, the market manager, an equipment list was made. The list included WideOrbit automation, Wheatstone LX-24 control surfaces for the main studios, L-8 control surfaces for the dub rooms, L-12 control surfaces for the production rooms, TS-4 talent stations and WheatNet-IP audio networking throughout.

STUDIOS

There are 12 studios for the five stations, each with a main control room and a dub and production studio off to the side. The ratings leader KUPD has a large air staff, and for it we built a larger studio with six on-air positions. The AM studios required a different configuration with two control rooms and one shared talk studio. The best views of Camelback Mountain are from the KDKB and KSLK studios. All the studios, while standardized on the same equipment, are very much different in personality and how they are used.

The furniture was designed by Studio Technology, and as usual, they delivered a great product. Also, Fender's R&D offices are just a few miles away in Scottsdale, Ariz., and Trip Reed has been able to score an impressive collection of Stratocasters and amps that are found in the lobby and elsewhere.

A new video studio complete with green room is in the process of being added and will network into the facility for all video production, which is becoming a bigger deal at Hubbard Radio with the growing importance of social media.

The studios all look familiar on the surface; however, beneath the surface of each is

a whole different set of operating parameters. We spent a lot of time watching how talent used the boards and then configured the LX-24s to match. Each talent, each studio and each show has changeable presets for their specific needs. Any jock can punch up his or her profile settings and feel right at home. In all control rooms we used the SS8 OLED button panels for various ease of use and added functionality. This controlled our 25-Seven delay units, station routing and monitor selection. We were able to use the OLED displays to put up station logos and other visual aids, another very powerful tool each studio has.

The studios include between two and six mic positions using my favorite EV RE20 mic, situated at TS-4 talent stations, which are countertop IP turrets that have cough button, a few source select buttons, and level adjustment. This was a small, easy alternative to separate announcer booths, which would have cost time and money to design and would have occupied more real estate than was available.

USB ports on studio talent stations wire directly back to Wheatstone M4-IP mic processors.

At my request, Wheatstone added USB connectivity to the TS-4 cases so studio guests would be able to plug in their laptops and other devices. Wheatstone built a case with a USB jack at each talent station that is wired back to an M4-IP four-channel mic processor through a USB port — something I discussed with the engineers while at the Wheatstone factory during system staging. The USB ports are a really cool addition that Wheatstone now offers standard with the M4-IP mic processor, and represent a good example of the relationship and teamwork between the station, the factory, and radioDNA.

In the studios we wanted to give the users unlimited access to get audio in and out of the systems, so we installed a multi-port interface that had XLR male and female, RCA, 1/4-inch and 1/8-inch jacks with routable audio to each port at any level needed. This is great for news crews, bands, special guests and so on. This idea came from Hubbard's corporate engineer Dave Garner and is something I plan to use again.

We paid special attention to sight lines in the

studios (as some of Hubbard's shows are now streamed online) by recessing speakers into the ceiling and using some interesting on-air lights. All cabling was neatly packed into cabinetry on wheels that can be pulled out, with automatic lighting that shines on cabling, D rings and power distribution for easy maintenance — making life easier for the engineering staff.

SIGNALING

All parties involved agreed to keep the facility all digital. All system I/Os are AES digital or WheatNet-IP drivers. When connecting signaling through Wheatstone's WheatNet-IP AoIP system, all I/O available anywhere in building is accessible with perfect sound quality. This is true for logic too and allows for simple wiring.

Hubbard built out similar studios in Minneapolis, and although each market is free to choose the networking and studio gear of their preference, Hubbard Radio in Phoenix chose the Wheatstone systems because of the manufacturer's ability to integrate well with other systems, like WideOrbit. The convenience of AoIP and reliability of WheatNet-IP were also key factors.

To implement the studio from the ground up, we designed the networking, then had the Wheatstone factory stage the full system comprising 84 I/O BLADEs, 30 TS-4 talent stations, five LX-24, three L-12 and four L-8 consoles, a four-stack core switch and 12 studio edge switches. I was able to visit the system along with the Hubbard corporate engineers for some valuable pre-configuration time. I had signal names, rack elevations and IP addresses ready for system input while there. Another thing we did to make setup more plug-and-play was to have all mic poles shipped to our facility in Minneapolis, where they were assembled and wired.

Built-in equipment rack lighting is a major plus.

We also pre-made countertop cabling: We drilled holes in the cabinets, dropped in the cables and terminated them where needed. Because of this prep work we were able to ship a system that was as "plug-and-play" as possible. Once on-site, we unboxed, racked up, plugged in and powered up. Shortly thereafter, audio was available in all studios.

Even with all the prep, our staff of four field engineers was onsite in Phoenix installing the system for the better part of five months, ensuring a smooth launch and handover. The IT for Hubbard Radio is handled locally by Marcus Meng, who put in a tremendous effort and worked under the direction of John Spaulding, who played a key role in making all systems communicate. The radioDNA team put in 12-hour days for five months straight as the norm. DNA team members are: Bryan Goldberg, Amber Stone, Adam VanConant and Rhea Tolck.

RACK ROOMS

A year of planning started with the proposed signal flow in and out of studios and through the rack room. I started by determining the number of drops into the rack room based on the number of I/O BLADEs and stations and tallied up the equipment needed, which then gave me the number of racks and a good idea of signal flow and wire management.

The rack room has 18 racks in total. Each station has two racks, with signals propagating from the top to the bottom of the racks. I like to make things logical so that in the event of an emergency, the station engineer can find a solution to their problem easily. For each station, key components are laid out exactly the same. We color code different network functions and light up all the racks for easy service. Again, making these standards across the facility allows for easy and well thought-out

maintenance and troubleshooting.

In total, WheatNet-IP required six rack tie drops from each station's rack to the core switch rack. We also have dedicated drops in these racks for WideOrbit automation, the house network and a video system. Patch panels are located in the back of each rack and it's easy to see the neatly dressed wire paths and the color code scheme.

Four Cisco Stackwise 3750s were installed as the core network switch and each studio has its own Cisco edge switch with POE; this simplifies connections for the TS-4 and TS-22 talent stations. I would highly recommend this. We also installed a Cisco Mini virtualized server platform for the WideOrbit automation,

Custom Wheatstone Screenbuilder touchscreen.

partitioned for each of the five stations. The WideOrbit machines are located in the climate controlled rack room and are extended into the studios by way of Adderlink.

In the racks, we installed automatic lighting, something I like to do with all facilities. The color coding of the cabling isn't much good if you can't see it. In fact, wherever there are racks or cabling of any kind, I like to include automatic lighting so that it's one less thing to worry about when doing maintenance and repairs. Our firm's color code standard is orange for WheatNet-IP connections, green for automation connections, yellow for video extenders, blue for house network, white for IP phones and black for BLADE I/O.

Documentation is a key feature and I put a lot of effort into it. A map of the entire WheatNet-IP system is both printed and kept digitally; documentation also includes a signal flow block diagram for each station showing the full signal chain from studio to transmitter, along with an explanation of how each salvo works for switching studios or going into automation mode.

With Dave Adkins starting his new duties as chief engineer near the end of the project, it was important to turn over complete instructions that would help Adkins and the IT staff easily understand the system.

CHILLIN' IN PHOENIX

Obviously, we needed a way to keep the

equipment and the rack room cool in one of the hottest spots in the United States. Initially, we had planned to install corner fans that could circulate exhaust, but we quickly realized that we needed to place cooling near the gear instead. We met with the company APC to talk about their unique rack cooling solution.

This is the first broadcast facility that I know of using this efficient cooling system. We placed a chiller between every fourth rack and it is a part of the racks' exhaust plenum space. All equipment exhaust is cycled in the chillers. It is then cooled, sent back to the rack, and the cycle is repeated. Each rack has a temperature monitor that looks at the input air and as the temperature rises, the system then forces out more chilled air.

The result is great; putting the cooling right where it's needed and capturing the exhaust ensures that very little equipment heat ever enters the room. After looking at many different vendors' solutions to rack room cooling, we found this to be the most effective and efficient, and perfect for the Phoenix heat.

Rackroom gear is cooled directly at the source.

SCREENBUILDER

Three ISDN codecs, a Tieline Merlin and four Comrex Access rack mount codecs are installed in a rack behind a glass door in the hall that we named "Public Rack." I mounted a touchscreen monitor to this rack as an easy means to steer remote traffic to each codec when needed. I worked with Wheatstone's Kelly Parker to design an easy interface using the WheatNet-IP ScreenBuilder app, giving staff an accessible, simple interface to change routing without having to go through a crosspoint matrix.

The ScreenBuilder app has faders, meters, labels, buttons, clocks, timers and other widgets that are tied to network elements and can be arranged on a PC screen to create custom control panels and quick-access buttons for level adjusting, monitoring and talkback controls. After working with ScreenBuilder and seeing what it can do, we plan to use this for other applications such as remote consoles and virtual studios. It's proving to be a very powerful and cost effective tool for us.

INTEGRATION OF AUTOMATION AND ROUTING

Automation and routing are two of the most important aspects of the technical plant in the Hubbard Phoenix stations. The two need to be tightly integrated, which we did by incorporating WheatNet-IP's Automation Control Interface into the WideOrbit automation so that talent could trigger salvos and commands from the automation system and vice versa.

Working with Chris Fonte from WideOrbit we were able to fully integrate audio routing and logic control between both systems. It was a perfect marriage, and both systems play well together. This level of integration simplifies the user experience, letting talent focus on content rather than the technical operation of the studio.

Use of WheatNet-IP's audio routing and built-in utility mixers allowed us to make studios "hot" when needed for air, and to bypass them when needed for production or voice tracking. Studio availability is sometimes tight, and we can now increase the number of studios from which production can be done. Through the utility mixers and routing functions we are also able to create special WideOrbit-only mixes for automation purposes. Talent can send regular programming out to air as usual, but at the same time, use the same studio for production.

The BLADE-3's built-in gain control, EQ and other audio processing features were used to create pre-air feeds for talent wanting processed air checks. In the past, I cannibalized old audio processors, removing the pre-emphasis, in order to do the same thing. Now with audio processing as part of the WheatNet-IP BLADE, all I had to do was route compression, limiting and EQ to mics and for headphones and speakers.

We use Glass E for onsite and remote administration — a very useful tool in managing a site like this. We have also set up a machine for offsite access by the radioDNA team, allowing us to connect remotely and make any changes the users may need.

Bob Goldberg is the founder and CEO of radioDNA.

Understanding Compensation by the Numbers

We provide the Salary Survey and its subsequent analysis every year because, in part, we want to help you determine if your compensation is correct for the market level in which you work.

It's true that, as you move up in market level, your compensation increases, but other aspects of the job change as well. For that reason, we always look at respondents' answers within the context of their market size.

The topic of salary increases is almost important as that of salary. How many respondents received raises, and of those who did, what was the percentage?

There are other important elements that we're studying this year. Is there a looming retirement crisis? Is job satisfaction at an all-time low? Do our colleagues in other departments have any idea what it is what we really do? Read on to find the answers.

SALARY VARIES WITH MARKET SIZE

One concern we hear from engineers often is that salaries aren't high enough, considering the typical duties, skill sets and the time needed to do the job right. The urgent nature of our business makes it different from many other lines of work, of course.

There are two basic ways to make more

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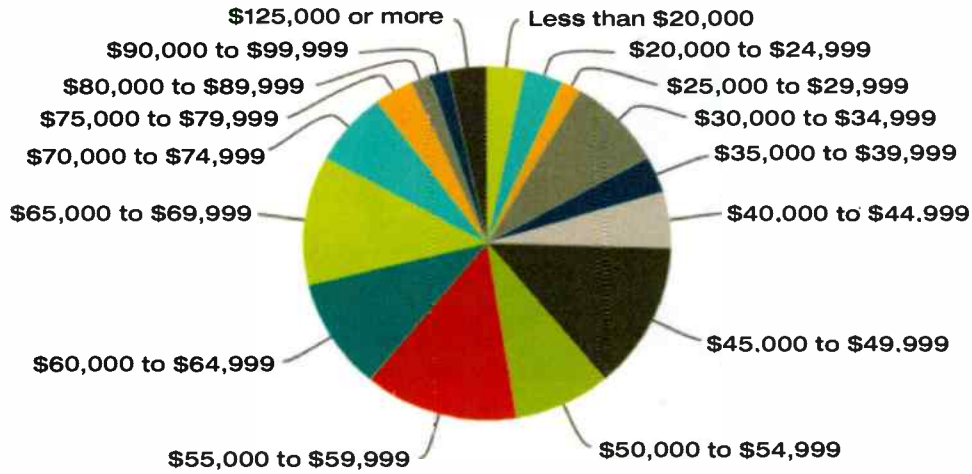
SALARYSURVEY



Salary distribution among respondents, Markets 101 and below. Median is $55-59.9K.

money in this business: The first is to consider moving up the ladder, and becoming the department head (assuming you work in a department of more than one person). The second is to move up in market size.

Yes — both moves require big changes in life — but that's part of the nature of our work. It is show business after all — and more money can be made were the audience is larger. Our survey results show a clear relationship between market size and salary.

IS ANYONE GETTING A RAISE?

Whether or not you got a raise appears to be related to market size once again. The last 12 months not appear to have been very favorable on this aspect of compensation, unless you are in the top 10 markets. For those who did get raises (and those hoping to receive one next year), we're showing the average amount of the raises reported on page 17.

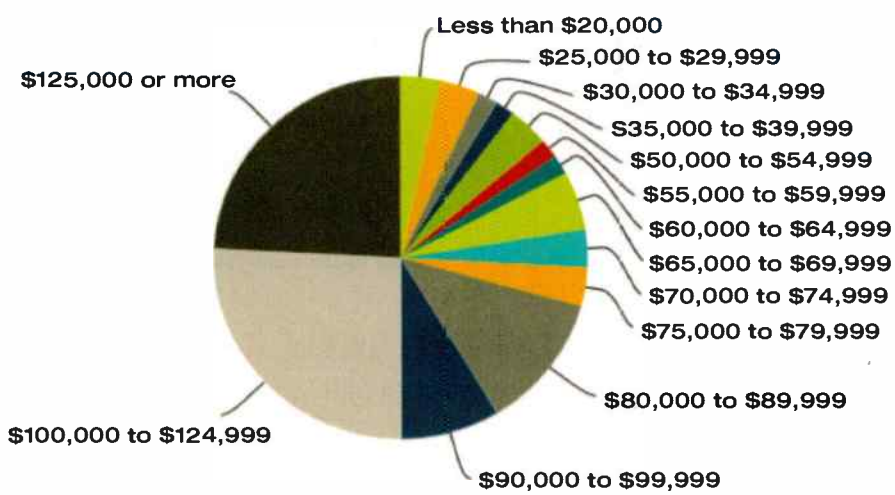
OTHER ASPECTS OF COMPENSATION

Compensation is more than just pay, of course.

Let's take a look at the results provided by all respondents, exhibited on a per-market-group basis, for the secondary aspects of compensation, such as paid medical benefits, vacation and overtime on page 20.

Many of you may not be aware that the rules regarding overtime for salaried workers are changing Dec. 1. Right now, if you're an hourly worker, you're guaranteed overtime if you work more than 40 hours per week (and in some states, more than eight hours in any particular day). However, if you're salaried, you're only guaranteed overtime pay if you make less than $23,660 per year.

After Dec. 1, when the new rule comes into effect, the cutoff for automatic overtime for salaried workers will be raised to $47,476. Most salaried workers making less than $47,476 will



Salary distribution among respondents, Top 10 Markets. Exactly half were at $100K or above.

be guaranteed overtime pay for working more than 40 hours a week.

For more details, study this Department of Labor web page, *https://www.dol.gov/whd/overtime/final2016/*.

way to make money. Those who have technical aptitude can quickly find themselves working on studio or IT projects, and those who have interest in transmission find ways to learn about it and how to deal with that aspect of the job. Eventually, management and other colleagues ask the question, implicitly at least: Can this person keep the station on the air?

Market Grouping:	YES	NO	Average Raise Amount
Markets 101 and below	32.20%	67.80%	4.56%
100 to 75	40.00%	60.00%	9.83%
74 to 50	39.13%	60.87%	4.20%
49 to 24	53.13%	46.88%	4.90%
24 to 11	35.00%	65.00%	3.40%
Top 10	68.42%	31.58%	3.56%

Respondents receiving raises in last 12 months, per market grouping.

TAKE A LOOK IN THE MIRROR

We've broken down the results in a per-market-grouping basis; now let's look at the universe of respondents.

What is the bar of entry for becoming a radio engineer? Unfortunately, we cannot say it is very high; but that is not to say that the skills necessary are minimal. In fact, that's far from the truth. In many cases, radio station staff members' job duties evolve from one aspect in to the engineering realm.

For example, many who start in programming realize later that engineering is a better

The bar of entry for radio engineers is usually a proven ability to do the job.

If you want to make more money in the business, keep raising the stakes.

Take on a larger market. Take on more stations. Take the time to learn more about technology, and use that new expertise to build your skill set. Look at it like a skills pyramid; at the bottom, you have those with the minimal skills. As you gain more expertise, you climb

NEW...

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ARC-8 Blue

Bluetooth, wireless, Cell phone interface & Stereo streaming

NO Hybrid required

long life switches,
conductive plastic faders,
Socketed ICs for fast on site repair.

- Eight channels
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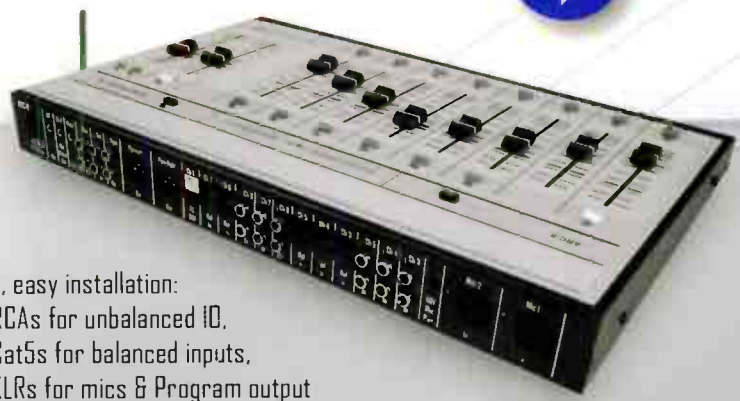
- 2 mic, 4 stereo line, PC, & Phone in
- USB interface for play and record from a PC
- Mix minus in-out for an external Telephone hybrid
- BOTH balanced and unbalanced inputs and output for flexibility

The BEST of both analog and digital. With the NEW Bluetooth built in, the ARC-8 features a wireless Cell phone interface for telephone talk shows and wireless audio streaming from any Bluetooth device such as an MP3 player. The ARC-8 Blue also features a built in USB sound card to play and record in digital directly from both Windows & Apple *PCs. With BOTH balanced and unbalanced inputs and outputs, the ARC-8 works out of the box in any Radio application.



Fast, easy installation:
- RCAs for unbalanced IO,
- Cat5s for balanced inputs,
- XLRs for mics & Program output

Bluetooth enabled !!! The #1 selling ARC-8 advanced Radio console has gone 'Blue'... Bluetooth enabled that is! This means that Channel seven on the console can be paired to any Bluetooth enabled audio device such as your Cell phone, MP3 player, MP3 recorder-editor, and more. Just pair your cell phone to the ARC-8 and answer your incoming calls with the 'Call' button and drop them with the 'Drop' button, just like a standard phone hybrid. The Caller receives the console bus mix ('minus' the caller audio) so there is no feedback. OR... you can pair any Bluetooth enabled audio device such as an Ipad, Tablet device, or MP3 player and stream full bandwidth, high quality stereo (A2DP) audio to channel seven on the console. If a paired Cell phone call comes in, then the stereo stream is dropped and the call can be answered. While an external hybrid is not needed, Arrakis does all of this while still allowing an external phone hybrid to be connected if desired. Your imagination is the only limit with this amazing console !!!

list price $1,099

*USB sound card supports USB HID compatible PCs

Benefit:	Markets Below 100	Markets 100 to 75	Markets 74 to 50	Markets 49 to 25	Market 24 to 11	Top 10 Markets
Paid Vacation	96%	100%	86.36%	96.77%	95.24%	94.83%
Paid Medical Benefits	77.19%	78.57%	68.18%	70.97%	95.24%	84.48%
Company Car	42.11%	21.43%	36.36%	22.58%	9.52%	24.14%
Compensated Time-Off	52.63%	57.14%	36.36%	64.52%	28.57%	32.76%
Paid Overtime	8.77%	14.29%	18.18%	6.45%	23.81%	22.41%

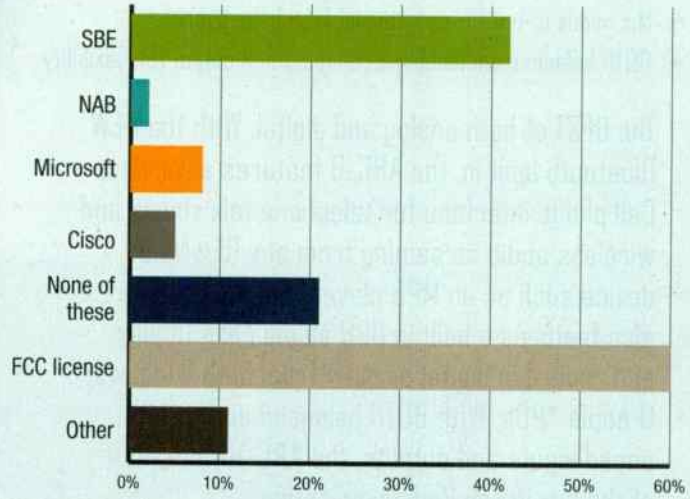
Respondents' benefits, on a per-market-grouping basis

higher. There are innumerable ways of making your way up this pyramid, and what happens is the number of people with your combination of expertise and experience shrinks. That's how you build a career and increase your compensation along the way.

Respondents to this survey have built their own skill sets in various ways. Question 17 of the survey asked whether or not the respondent has a college degree; question 18 asked those who responded "yes" if their degree was in an engineering discipline. About 64 percent answered "yes" to question 17, and about 57 percent answered "yes" to question 18. Thus, only about 36 percent of the respondents have a degree directly related to the field.

What about other licenses and certifications that pertain more closely to the business?

Perhaps the most interesting aspect of this result is that more than 20 percent of the respondents hold neither certs nor an FCC license.



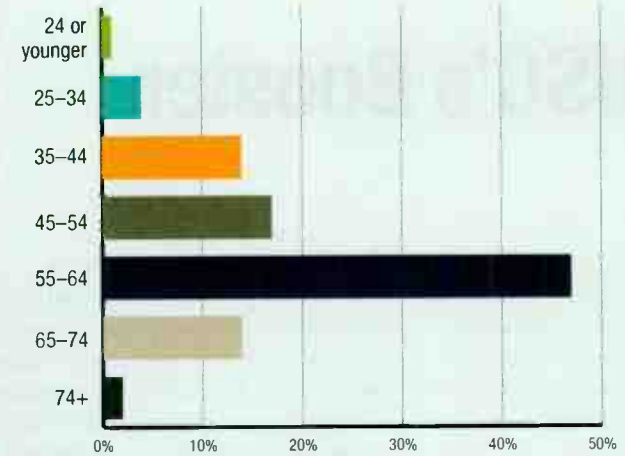
Percentage of respondents holding pertinent licenses or certifications

We asked a few questions that could be labeled as pertinent to "job satisfaction." Question 26 read: "On a scale of zero to 100, how much do you like your job? Zero would mean you hate it; 100 would mean you love it." The average answer among all respondents was 80. It seems that most of you like this work after all, despite its negative aspects.

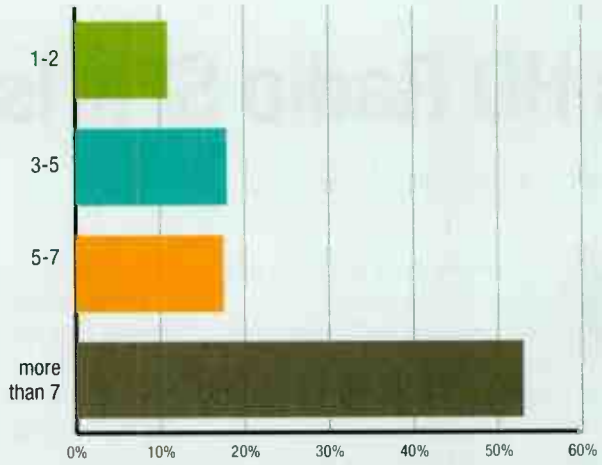
Question 27 read: "On a scale of Zero to 100, how well do you think you think your colleagues in other departments understand just what it is you do? Zero would mean not at all; 100 would mean perfect and thorough." The average answer among all respondents was 55. It seems that some education is needed around the radio station.

Clearly the majority of you think colleagues in other departments lack understanding of just what it is we do. This could be a result of the loose set of standards regarding the field; the lines between what is truly technical (fixing a transmitter, as one example) and what is not (maintaining a vehicle fleet, as one example) are blurred.

Working your way up the skills pyramid is probably the most effective way to remove yourself from a situation such as this (assuming you want to do that).



Age of survey respondents



Impending respondents' retirements

One expected result of our survey is that the majority of the respondents are at least 55 years of age or older. In fact, about 64 percent of respondents fall in to that category.

While we all know of the "graying" of our industry, what do respondents say about their impending retirements? Question 24 asked, "If you are planning on retiring, how many years out?"

Over half the respondents indicated their retirements were more than 7 years in the future, and about 70 percent indicated they plan to keep working at least 5 more years. Is that a pending disaster for our industry? Or is it a natural evolution that will benefit those that are looking for long careers in a field with what will surely be a diminishing need for personnel? We feel it's more likely to be the latter.

Keep an eye out for further analysis of results from the 2016 Salary Survey on *radiomagonline.com*.

This HD Radio SFN Is KUSC's Booster

by Doug Irwin CPBE AMD DRB

One common desire for broadcasters is to extend coverage. That isn't always a practical thing to do — but having your coverage optimized within your allotted coverage area is a realistic goal.

The idea of the single-frequency network is nothing new and has been implemented in both the AM and FM bands. Interestingly, DTS' HD Radio system lends itself readily to SFN implementations.

In the November 2015 issue of Radio, we published an article entitled "iHeartMedia Gets Valley Coverage With Santa Clarita Booster." As one might expect, there are other boosters located at the same spot, serving the same purpose.

In this article, we're going to look at the booster built by the University of Southern California's KUSC. (The booster operates in hybrid mode, but in this article we're focusing on the design of the digital transmission.)

Santa Clarita is an amalgam of five smaller towns, making up a fairly large bedroom community located about 30 miles northwest of downtown Los Angeles and within L.A. County. It's an ideal location for a SFN system because, to a very large extent, signals from Mt. Wilson and Mt. Harvard, the primary FM and TV transmitter sites for L.A., are shadowed there.

RESEARCH

A considerable amount of research has been done in the implementation of SFNs with HD Radio. An important paper used in research for this article was written by Anders Mattsson and John Kean; read it online here: *http://www.nprlabs.org/media/publications/20060401_SingleFrequencyNetworks_AM-JCK.pdf.*

A second article of interest was published by NAB Fastroad, entitled "HD Radio Single Frequency Network Field Test Results WD2XAB Baltimore & WKLB Boston." Both make for great reading, should you want to learn more about the topic.

HD Radio lends itself readily to SFN implementations.

For additional research, I spoke with Philipp Schmid, research engineer at Nautel Ltd., as well as John Kean and Ron Thompson, the chief engineer of KUSC.

As I mentioned earlier, HD Radio (as well as DAB and DRM) can both be used successfully in the construction of SFNs.

According to Anders Mattsson (mentioned in the article to which I referred early), digital radio in general has a distinct advantage, not so much in the transmission mode, but in the design of the receivers: "This poor performance (of analog SFNs) is not due to any inherent limitation in SFNs. In fact, it is because of the lack of [RF] equalizers in traditional FM receivers. At the moment the receiver can handle the multipath, SFNs offer many potential advantages. Since all digital systems such as HD Radio and DRM already have equalization, the old limitations are gone."

LIMITATIONS

Even so, as one would expect, there are practical limits to what can be done with HD Radio SFNs, and they mainly relate to what is known

as the guard interval in OFDM.

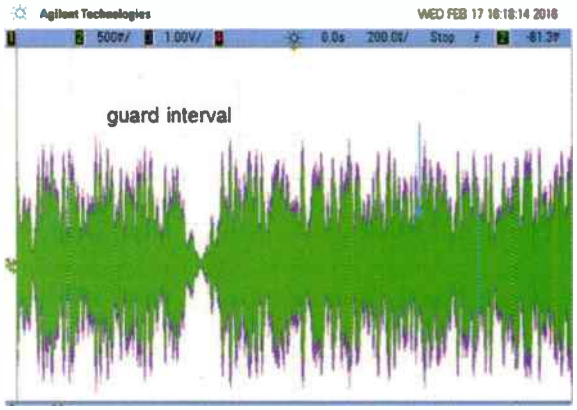
Recall that the IBOC transmission scheme uses Orthogonal Frequency Division Multiplexing, where parallel data streams are transmitted by way of multiple low-level carriers, themselves modulated in a standard fashion (such as QAM or QPSK). In the specific application of IBOC, hundreds of "subcarriers" are used; the modulation scheme is QPSK.

One of the big advantages to OFDM is its robustness, and that is in part attributable to a long symbol length. Symbol length is the amount time that the individual carriers are in a state that is detected by the receiver. Part of the symbol length, though, is called the guard interval. This is the amount of time that needs to elapse prior to the next symbol. In other words, there is not a continual flow of symbols; between changes, a certain amount of time expires — the guard interval.

This is important because of the mitigation of multipath on the receiver end. If the receiver, in the field, encounters two IBOC signals that are on the same frequency, with synchronized data, there are two characteristics that will determine whether or not there is a destructive multipath effect:

- One signal is considerably stronger than the other in which case the weaker signal doesn't have any effect on the receivers detection of the subcarrier state changes on the stronger signal, or
- Both signals are of nearly the same strength, and they are delayed by some amount of time because of different distances between the receiver and the various sources.

If the time differential between two arriving signals is within the guard interval, the receiver can correlate the symbol changes in both received signals, and essentially they "add." If the delay is outside (or longer) than the guard interval, then the picture gets blurry; the symbol changes are too far apart, and "intersymbol interference" is caused.



An example of guard interval, shown in time domain. (200 µs/div along X axis.)

For HD Radio the symbol length is 2.9 milliseconds and the guard interval is 150.5 microseconds. This would lead to a practical limit of about 14 miles in difference between the two IBOC sources, and considering that the

receiver could be located directly between the two, there would be a practical limit of about 28 miles between transmitter sites (based on 75 µs).

However, the current state of the art includes the addition of a flight delay in one of the RF paths so that the OFDM carriers correlate in particular geographical areas. In the case of KUSC (as we will see) a delay was added to the transmission of the booster so that the OFDM carriers would add constructively within the geographical area that presented the lowest desired to undesired (D/U) signal ratios.

One of the two signals can "slip" in time, in relation to the other, by as much as half of this amount of the guard interval, and the signals will still correlate.

So just what does the ratio of desired to undesired have to be, so that the effects of ISI are minimized?

I went to Philipp Schmid for an answer. He compiled the data, seen in Fig. 1, which shows that as the time difference between the two signals gets shorter that the D/U ratio can be less for a given BER.

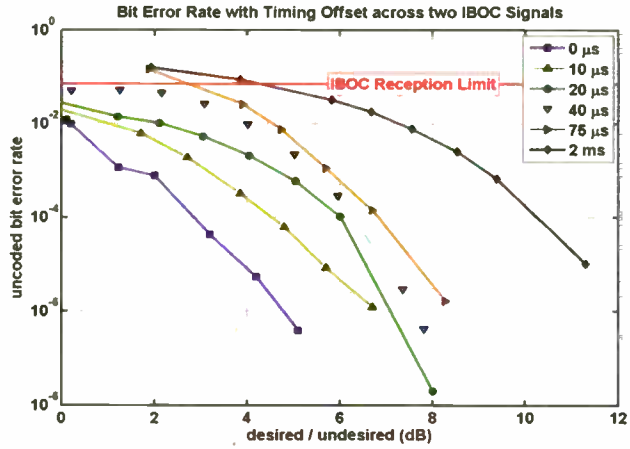


Fig. 1: Laboratory measurements of D/U ratio, delay offset and BER

Fig. 1 shows that as the time difference between the two signals gets shorter that the D/U ratio can be less for a given BER. The 2 ms delay line on the graph was an outlier I asked Schmid about.

"At 2ms offset, you essentially have an uncorrelated signal. The other signal effectively is noise to the desired signal. It works so well because IBOC is very robust," he said.

"Look at John Kean's 2008 paper, 'An Improved Coverage Prediction Method for HD Radio,' Fig. 4. You can see for steady state you only need 4 dB D/U — that matches the reception cross over point in my plot; in a mobile environment you may need 7 dB, which I did not test... you only need about 4 dB to the noise floor to have HD lock. FM needs about 20 dB for comparison."

SYNCHRONIZING THE SFN DATA

Recall earlier we spoke of the correlation

of synchronized data from two sources of OFDM carriers. These two sources are the main transmitter, and the booster transmitter. A large part of the success of the KUSC system is attributable to the technique used to ensure the data transmitted from the two sources is in sync.

Fig. 2 shows the system configuration.

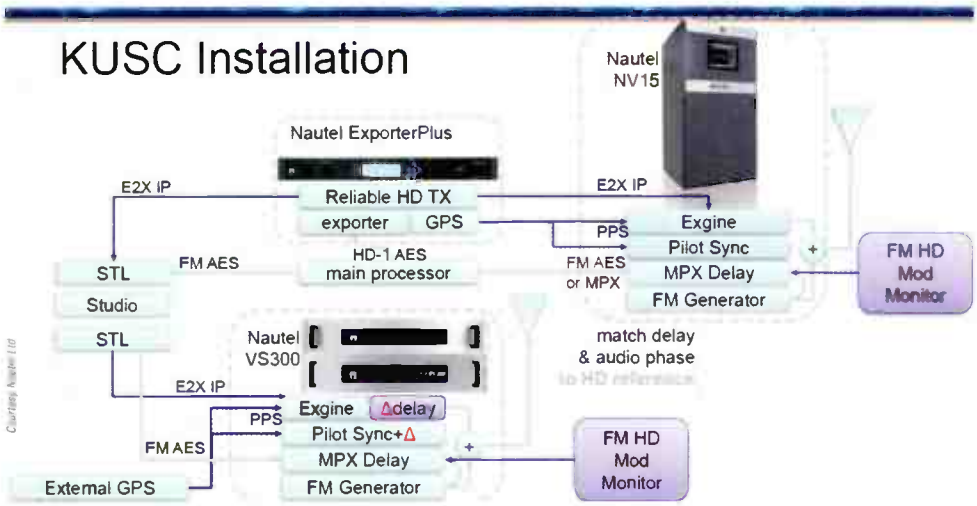


Fig. 2: Main transmitter and booster configuration for KUSC HD Radio booster system

The NV-15 is the KUSC main transmitter, located at Mt. Harvard; the VS300 is the booster transmitter, located at Oat Mountain. E2X packets are generated by the single exporter at Mt Harvard, and then sent via IP back to the KUSC studio, and thus cross-connected to the IP link that runs to Oat Mountain.

"KUSC has had the classic Intraplex T1/TDM shelves deployed for some time. In the case of this project, we just wanted to be able to continue to use what was available to us without having to revamp the whole STL system right away. [These are shown in Fig. 2 as the back-to-back STLs with the studio in between.] The shelves are a bit older, but we were able to upgrade to the PT/PR353 uncompressed audio cards and to run the Ethernet extender card [DS-64NC] sets in the same box. Seventeen time slots for audio at 32 kHz and slots 18 – 24 for the Ethernet bridge which gives 448 kbps throughput. Oat Mountain has the same Intraplex shelf units provisioned exactly the same

way," said Thompson.

Nautel's Reliable HD transport protocol is used to send the packets from Harvard to Oat.

"The packets are time stamped so that each exciter's firmware can buffer properly to transmit the packets simultaneously and

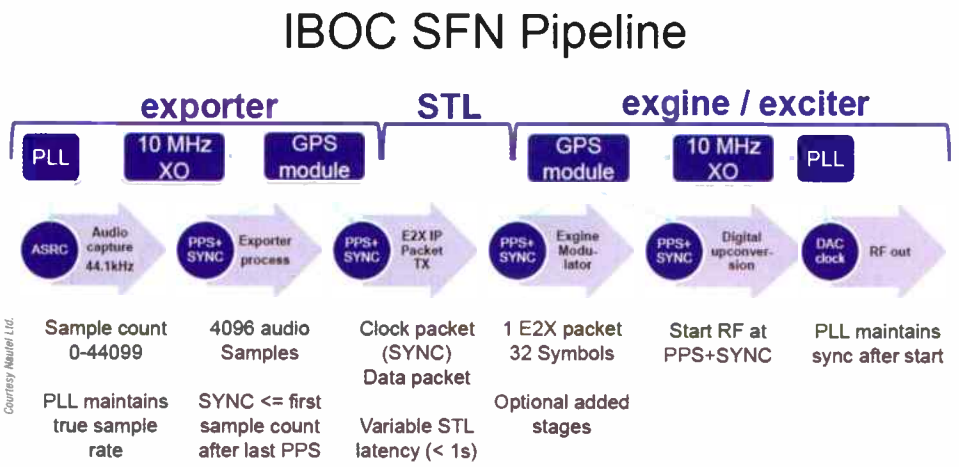


Fig. 3: Shows the means by which transmitted data packets are synchronized with one another.

either exciter over a return UDP management channel back to the exporter."

I spoke with Schmid again to gain understanding of the synchronized nature of the data path between KUSC's main transmitter at Mt. Harvard and the booster site at Oat Mountain.

against the calculated propagation delay. [More on that follows.] Also, it allows the exporter to send the packets to two IP destinations, i.e., the main and booster exgine cards via UDP to the broadcast address 10.10.15.255 in this case since you can't send via TCP/IP directed paths to multiple addresses. The protocol allows error correction resend requests to be initiated by

"One way to ensure time synchronous arrival of signals over the air is to fix the throughput delay of the entire signal chain from the common point at the single exporter at the studio or main transmitter [as is done in this particular case] to the RF output on each transmitter in the network," said Schmid. "This could involve any number link configurations in between that could all have different delay characteristics."

Looking at Fig. 3: Note that the first three steps occur in the exporter at Mt Harvard. The E2X packets are forwarded back to Oat (through the process described earlier) one second after the audio within the E2X packets had been sampled and a SYNC time tag (counting the number of 10 MHz cycles after the last 1 PPS) is inserted. The exporter literally waits and holds the packet before sending it across the STL. Packets can then take up to an entire second to traverse whatever STL combination is in use. At the transmitter site, the exgine modulator holds on to any received packets until 1 second from when it was sent by the exporter based on the 'SYNC' time tag in the E2X packet itself. The exgine modulator is then allowed 1 second to turn the E2X packet into modulated symbols that are then precisely released on the next second, 3 seconds after the audio has been sampled at the exporter based on the embedded SYNC timetag. Use of the GPS receivers 1 PPS signal allows both ends to work in lock-step with one another.

Using this method "... we can ensure two geographically separated transmitters can produce IBOC within 1-2 us of each other," said Schmid.

FLIGHT DELAYS

Let's participate in a small thought experiment here. Imagine yourself standing on the

Fig. 4: Santa Clarita is located in the "V" formed by highways 5 and 14. Highway 5 between the 14 intersection, and that of highway 118, is a primary design consideration since any radio can hear both the booster and the main from Mt. Harvard. Interference was mitigated in this area.

ground, straddling a line between the KUSC main transmitter and the KUSC booster at Oat Mountain. Recall that I wrote the OFDM carriers would correlate assuming the delay between the two, as perceived by a receiver that you are carrying, was less than the guard interval between symbols. In the case of KUSC, it turns out the interference zone is physically closer to the Oat Mountain site than it is to the Mt. Harvard site.

It's in this interference zone that the difference in time between reception of the main, and the booster, must be manipulated. (Refer back to Fig. 1 as needed.)

Since the zone is closer to Oat, some amount of flight delay is introduced there, so that the symbols as detected by your receiver match up in time; in other words, if you are standing in the interference zone, this allows signals from Mt Harvard to essentially "catch up."

"A per-transmitter delay can be introduced such as to account for the signal flight time into the interference zone," said Schmid. "With the help of John Kean, who prepared coverage simulations for us, we added 176µs delay to the KUSC booster transmission, such that the two wave fronts met 20µs or about 6 km ahead of the booster. From lab experiments, we found that any time differential less than 40µs will guarantee HD signal lock no matter what the d/u ratios and is expected to hold in mobile environments. This provided a safe zone of up to 12 km out from the booster and a cone behind it with where this requirement could be guaranteed. Outside of this zone, momentary HD drops could be expected but receivers can quickly re-acquire lock until a time differential of about 75µs."

RESULTS

Fig. 4 gives you somewhat of an idea of the challenges for FM reception in the Santa Clarita area, situated mainly in the "V" between highways 5 and 14. Oat Mountain is just west of the highways 5 and 14 interchange. Mt Harvard

is located south and east of this area, shadowed from Santa Clarita by the Verdugos as well as the ridge just north of Sylmar.

Reception testing carried out by KUSC staff found that the HD booster provides solid coverage of the Santa Clarita valley and along highway 14.

"HD is locked even with severe FM impairments. Intermittent drops only with expected terrain shield in canyons."

It should be noted that KUSC's HD ERP along this bearing is about 2 watts.

Sylmar is a town south and west of the mountains that impede coverage in to Santa Clarita, and has some visibility of Mt. Harvard as well. "Only short intermittent drops in the Sylmar region only with clear obstructions like underpasses, with little signal from either transmitter."

The HD Radio SFN network built by KUSC is successful, and "it all started with just the simple thought of replacing our booster and then it grew from there when Nautel reached out with the idea of participating in the R&D project," said Thompson.

"A digital-only booster is far more workable than a hybrid booster, but a design issue is the potential for interference to the analog FM reception at locations nearer to the booster. This effect will vary with different receivers and with each field case, of course," said Kean.

> ***"I can see HD SFNs taking off for all-digital."***
>
> — Philipp Schmid

"I can see HD SFNs taking off for all-digital when we can leave the shackles of FM transmission behind or perhaps delegate the FM to true fallback status. Statewide or perhaps nationwide SFNs could be a possibility. Cover roadways with a string of small scale HD SFN transmitters. I can see micro HD boosters in downtown cores, tunnels and buildings (underground parking). This would be a radical shift in RF planning but may provide better spectral efficiency and better signals for the listener," said Schmid.

The difficulties in building successful analog FM boosters are numerous and well documented. I find it interesting, and hopeful, that as the importance of digital transmission increases over time, SFNs can play a part in maximizing our reach and overcoming reception issues that are inherent with analog FM.

I would like to thank Philipp Schmid of Nautel, Ron Thompson of KUSC and John Kean for their assistance in the preparation of this article.

Those interested in learning even more about HD Radio SFNs should consider attending the IEEE Broadcast Symposium, to be held in Hartford, Conn., Oct. 12–14. Philipp Schmid will present "IBOC Single-Frequency Network Implementation" at 11:15 a.m. on Oct. 13.

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TECHTIPS

Measure These Voltages

by Doug Irwin, CPBE DRB AMD

Upon occasion, we want to measure voltages at a remote site that pose a problem for the remote control there.

Let me give you some examples:

- Battery voltage on a generator that is wired up with a positive ground
- Voltage developed across a resistor that is floating above system ground
- An antenna monitor output that is negative because the tower operates with a negative phase

The real issue is that many remote control analog inputs are unbalanced, with their common leads meant to be the negative return for voltage samples.

Regarding the generator being wired up as a positive ground: this can be problematic because you don't really want to connect the "+" lead of the battery to the common lead for the remote control. A very large current surge could find its way through the wires you connect, burning them up and making of smoke. (Don't just assume your generator battery is wired up for negative ground.) An isolation amplifier can be used to safely separate the battery system from your other system (probably wired up as 100 percent negative ground).

Another warning: If you need isolation between the device being measured and the remote control used to measure it, physically place the isolation amplifier as close to the device to be measured as you can.

A floating resistor could be used to measure current flowing through some device. An example: Some directional antenna arrays use vacuum relays for RF switching. If you have such a system you probably noticed that said vacuum relays don't have auxiliary contacts that give you status as to their position. One way to determine if current is at least flowing through them is to put small-value resistor in series with their power supply, and use the voltage developed across that resistor to indicate current flow. Depending upon where you locate this, you may want to use an isolation amplifier to sample the voltage and send it off.

Automation Direct FC-33 signal conditioner

At least one current-model antenna monitor has a positive or negative voltage output that corresponds to positive or negative phase angle for a tower in a directional AM antenna array. One way to handle a negative tower sample voltage is to use an isolation amplifier to take the negative voltage output and turn it into a positive one compatible with your remote control.

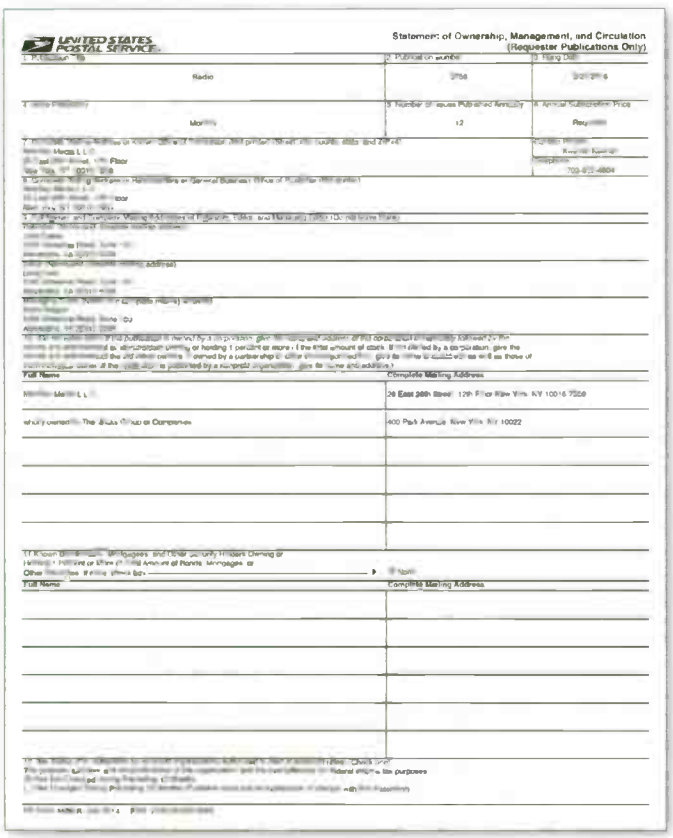
Many years ago, Moseley manufactured an isolation amplifier used in similar situations. Today there are a few companies that make similar devices, but they're known in the industrial world as "signal conditioners."

Let's take a look at the Automation Direct FC33. It's meant to be mounted on a DIN rail and has input and output voltage ranges of either 0-5 VDC or 0-10 VDC. It has 1500 VDC of isolation between input and output, and 1500 VDC of isolation between the power supply input (24 VDC) and either the input or output. Since the input is floating, you can wire the input polarity as you see fit, without worrying about how it interacts with the output side.

Another option would be the Omega DRG-SC series, which is also meant to be mounted on DIN rail and features 1800 VDC of input/output/power supply isolation. 0-5 VDC and 0-10 VDC are its expected working voltages on the input and outputs sides.

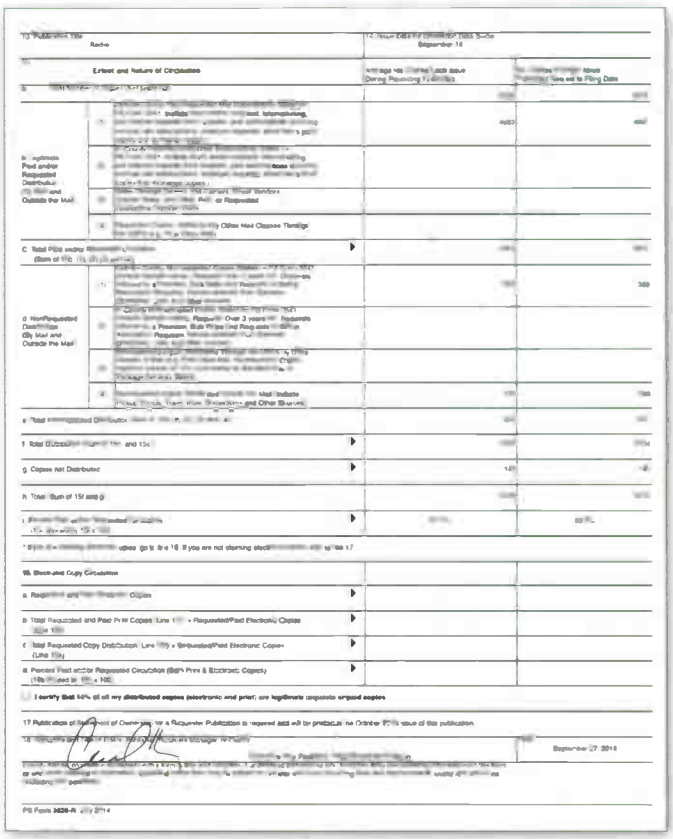
Typical remote controls can be used to sample and measure all types of things at a transmitter or other remote site. Use caution any time the signal to be measured is "above" ground. Failure to do so can lead to equipment damage or unsafe conditions.

Statement of Ownership, Management, and Circulation



Statement of Ownership, Management, and Circulation (Requester Publications Only)

Radio



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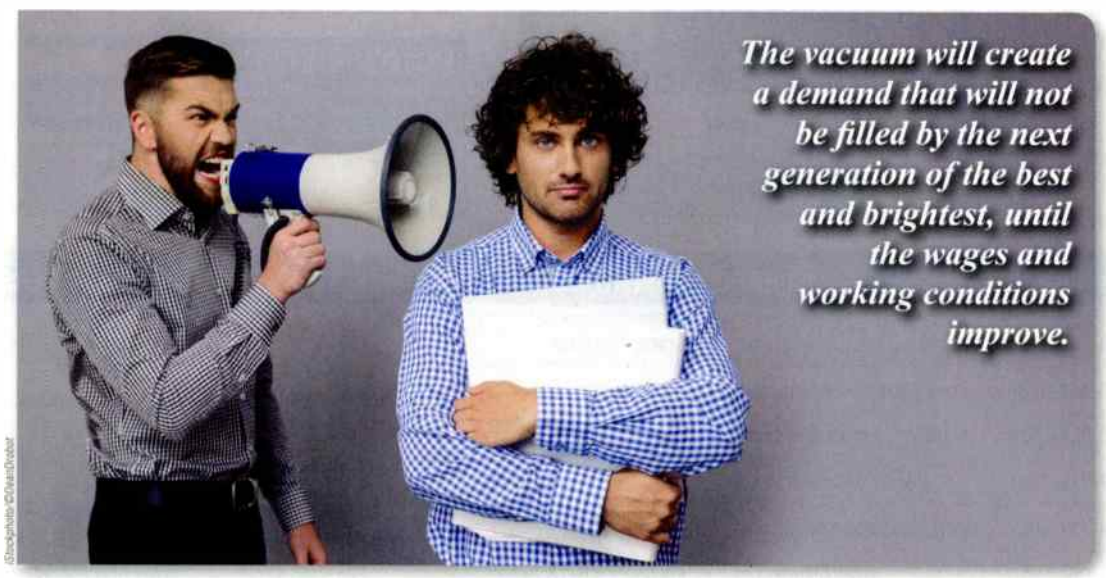
From Trade to Profession

by The Wandering Engineer

There was a recent article in another radio broadcast publication that has garnered some commentaries. The basic observation is that broadcast engineering, as we know it, will come to an end in a giant train wreck because of inaction.

I actually think that through action and selflessness broadcast engineers have documented and preserved our skill set to an extraordinary degree (think Society of Broadcast Engineers and the online engineer).



We've made this knowledge readily available to the next generation and many of us will remain available to mentor until we can't do it any longer. As our generation backs away from our burdens (and retires), the vacuum will create a demand that will not be filled by the next generation of the best and brightest, until the wages and working conditions improve. I believe they will improve, or the crank will fall off of the broadcast money machine. That will not happen in any intelligent universe.

In the future, this will be a better profession than it currently is.

MARKET FORCES

Broadcasting has not been immune to forces that have driven down wages, reduced the number of jobs and forced those that have work to work more hours for less, just to tread water.

If you have a great gig, and you love it, you may have the luxury of only worrying about the lack of the next generation of engineers.

We all admit that radio has drifted into unhealthy working conditions in the form of long hours, overwork, always being on-call and low pay — unless, of course, you live in a place where the shortage of qualified broadcast engineers or the quality of our art allows us to demand big dollars and control of our hours.

If you're honest with yourself, you'd admit that electronic media has presented ever growing opportunities. Radio, once the sum total of all electronic media, has had to split that pie with each wave of new technology in electronic media.

There are stations that have slipped below the profitability line with more approaching that point. Some are kept alive by special means, including sheer love and outright charity. Many of these stations once supported a significant staff and families. Now the power bill is often in arrears. As a business, a radio station often is simply not viable.

Electricians, hairdressers and plumbers all perform a skilled trade. But broadcast engineers, like painters and dry-wallers are a low-skill, non-essential trade. There is no longer a requirement for a certification or license; you don't need to be a member of the SBE, nor have an SBE certification; you don't have to enjoy continuing education, or to even read any of the trade magazines.

Being a broadcast engineer has the same bar of entry as any 12-step program — simply admit that you are one and you're in the club. It's harder to become a hairdresser.

If you love the business, it's in your DNA to keep the station on the air; but when that DNA causes us to undervalue our profession and treat it as a low-skill occupation, we insult ourselves and kill off the next generation.

If I were starting out today, there would be only one barrier to overcome: the lack of opportunity for rewarding employment.

The real problem is allowing a low-barrier-of-entry, rather than treating our careers as a profession. Yes, there is an art and often a higher purpose to the work we do, but when we're ready to get off the cross, there will be a generation of broadcast engineers whose lives will have better balance and be treated with greater worth.

The Wandering Engineer is an industry stalwart who has been in broadcasting since the days of Marconi and Tesla. He gives his thoughts on the current state of broadcast engineering and the broadcast engineer.

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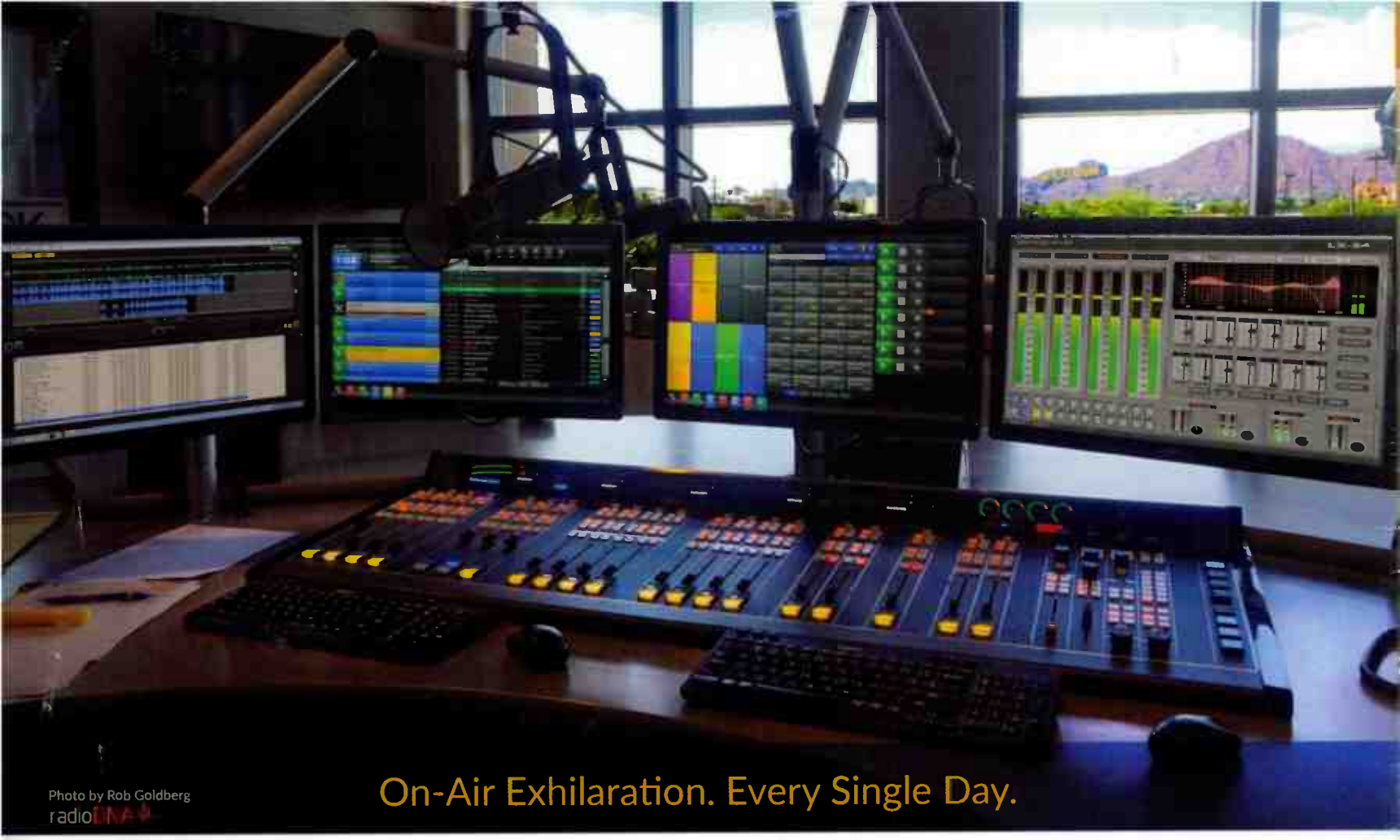

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What does all that get YOU? Absolutely spoiled...

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Exceptional console at every level, fully loaded and completely customizable.

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Outstanding companion to the LX-24. perfectly sized for newsrooms, etc.

IP-12/IP-16 Control Surfaces
Precisely designed and engineered for peak performance at mid-size stations.

The IP Network is IN the BLADE...Like DNA

Each powerful BLADE-3 (point-of-use interface) contains the entire WheatNet-IP Intelligent Network to route I/O, access sources, add processing, mix to/from any device. Plus routable logic, silence sensing, gain control, automated mixing, discovery/control, and much more. Format agile: AES67, MADI, AES/EBU, TDM, Analog, and AoIP.

*Includes on-site commissioning, in-factory total-system proof-of-performance testing, installation support, and real 24/7/365 service. We don't mess around.

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