ENGINEERING EXTRA

PERSONALIZED 'RADIO'
Poole discusses what's missing when you only listen to your own playlists. Page 22

RADIOWORLD

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NewBay Media

Fraunhofer Institute for Integrated Circuits: Developers of Audio Coding

Everyone Has Heard MP3s, But How Many Know Where They Came From?

BY MICHAEL LECLAIR

While its name may not be widely known among consumers, virtually everyone has either owned or used products developed by the Fraunhofer Institute for Integrated Circuits (IIS).

Matthias Rose

Robert Bleidt

INDUSTRY SPOTLIGHT

Developers of the MP3 audio
ec, Fraunhofer IIS is just one
of what is Europe's largest organization for applied
arch. Today, Fraunhofer comprises 60 institutes and
a total of around 17,000 employees. Its annual budget
e equivalent of about $2 billion.
raunhofer IIS focuses on audio and broadcast
nology, among other topics, and has a long his-
of innovation. It began with the idea of finding a
to send high-fidelity music over telephone lines.
nhofer was also the co-developer of the AAC
ec and the subsequent High-Efficiency AAC codec,
which is now a part of the MPEG-4 audio and video standard. Additionally, Fraunhofer has worked on many of the digital radio broadcasting platforms that exist today.

While attending the NAB Show a few weeks back, I took the opportunity to meet with Matthias Rose, head of marketing communications for Fraunhofer IIS Audio & Multimedia, and Robert Bleidt, the division general manager of Fraunhofer USA Digital Media Technologies. We talked about the history of Fraunhofer and its role in recent audio technology developments, as well as some of their new products introduced or on display at NAB.

(continued on page 4)

The Benefits of Migrating Radio Call-In Talk Shows To Wideband Audio

Consumer HD Voice Systems Offer Better Fidelity and Wide Availability

BY TOM HARTNETT

Long before the Internet and Facebook were invented, radio broadcasting filled the role of "social network" with the call-in radio talk show.

WHITEPAPER

Radio talk shows have always allowed listeners to discuss topics such as current news, sports and politics in a fast-paced, interactive environment that no online service can emulate. The radio industry has a long-standing dependency on telephones for generating on-air product, and radio pros realized early on that the quality of standard telephony for broadcast is lacking.

When both ends of the links are under a broadcaster's control (e.g. remote broadcasts), tools have been developed to enhance the poor quality of telephones. Unfortunately, call-in shows continue to sound like they always have, with host audio that is full-bandwidth and rich, and caller audio that is distinctively tinny and thin-sounding.

Several technical factors have recently converged that can help improve this situation. I will describe

(continued on page 14)

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NewBay Media

FROM THE TECH EDITOR

The Attractions of Mobile

New Telecommunications Services Offer Advantages for News Reporting

BY MICHAEL LECLAIR

Those who read my writing regularly will probably know that I am somewhat skeptical of the mobile phone revolution that has been happening around us for the last few years. For me, the mobile phone has been a welcome productivity appliance, but no more than that.

In the beginning, it was a way to stay in touch with staff while on the road. Later, mobile phones incorporated the functions of the Personal Digital Assistant, allowing us to carry a powerful business database in our pockets.

It certainly helped me to know that I had every phone number of relevance to my technical plant, including circuit IDs for broadcast lines, remote control numbers and even short instruction sheets on how to operate the various models of transmitters and their backup systems. Once this information was created, it could be copied to any number of phones so that accurate technical info could be widely distributed with ease. Finally, the widespread deployment of e-mail support to mobile was the ultimate in keeping in touch with the office.

But the trend in mobile began to cross over into the *entertainment* business as high-speed Internet surfing was offered. Apple Corp. in particular marketed its iPhones as an extension of the iPod: a portable entertainment device with tons of music storage *and* with really cool web-surfing. Oh, and it's also a phone.

Virtually overnight, a forest of little programs sprang into bloom, featuring cute little games. The intention was to create a new draw on our attention with a time-consuming entertainment device.

It's a shift in emphasis, but one that puts the mobile computer industry on a collision course with broadcasters and particularly radio. Especially music radio.

As we know, the "magic" behind all these mobile devices is fairly expensive. Some of that cost is borne by consumers in their monthly contract. But let's face it: any business model that is based on capturing the attention of consumers is really based on making money through advertising. Mobile advertising has been the last unmatched strength of the radio business and it is now being challenged.

ON THE SPOT

So it's with some irony that my column for this month is about the use of the latest mobile devices to support radio newsgathering. That's right, it turns out smartphones have a powerful business application for radio.

Scroll back just a few years, and the latest innovation was the netbook computer. Built with inexpensive and low-performance parts, netbooks were designed to be mobile computers that did 90 percent of the work of a laptop at a quarter the cost. Link up to the budding 3G mobile data networks or a WiFi hotspot and you could literally go just about anywhere and handle simple office work without a hard-wired connection.

The application to "on the spot" newsgathering was inescapable. For radio reporting, it was now possible to go to the scene of a news event, gather sound with a professional recorder and microphone, copy sound files to the netbook in a matter of seconds, edit them professionally using PC software and then upload the files with relative ease to the radio studio via FTP. All this could be done without special licenses, satellites or contracted services obtained weeks in advance. The audio quality could be as good as desired: full-fidelity when the speed was available and time wasn't critical, or compressed files to compensate for the relatively slow upload speed of the telephone networks of that time.

A device like the Samsung Infuse 4G is a candidate as a serious newsgathering tool.

PALM POWER

The latest generation of smartphones is already exceeding those early netbooks and, for some, adding the capabilities of a professional recorder and microphone.

The processor included in the latest Samsung Infuse 4G smartphone operates at 1.2 GHz and contains 16 GB of internal RAM. That compares favorably to a desktop computer running Windows XP. And it runs on a battery for several hours and fits in the palm of my hand.

Compare this with a typical Netbook from 2008, which sported a 1.6 GB processor and standard RAM of 512 MB. That wasn't so long ago.

As you might expect, a handheld device with that much computing power is a candidate to replace the netbook as a newsgathering tool. Unlike the netbook computer, a handheld device is designed from the start to handle audio file storage due to its iPod heritage. It doesn't need a complex operating system that requires an extended time to start and a nearby power supply. The smartphone can run specialty programs to edit, record and backhaul audio for news stories or spots. It already has a fairly good quality microphone built in. It replaces not only the netbook but can also replace the professional recorder.

GROWN UP

Last year at the NAB Show, iPhone applications were all over the place. Tieline uses the iPhone platform for an application known as Report-IT. The iPhone has the computing power to run what is essentially an audio streaming application that allows it to connect to a studio site decoder (such as the Bridge or Commander series) for live broadcasts at high fidelity. Comrex offers a similar product, the ARC, designed for use with smartphones based on the Android operating system.

But the current speed limitations of 3G data networks mean these are not all that reliable yet, outside of WiFi zones. In that case, reporters can use their smartphone as an audio recorder and send audio clips back to a station file server using the ftp protocol. The recording can be done simultaneously with a live feed and sent afterwards so that editors have available the higher-fidelity version of the feed if needed. Instead of having to carry a netbook, a recording device and a cell phone it is now possible to do the same work with only a smartphone.

Just recently NPR announced that it has been using 4G telephone networks for field reporting. In early April, Senator Kent Conrad of North Dakota was the

(continued on page 6)

THIS ISSUE

JUNE 8, 2011

FRAUNHOFER

(continued from page 1)

Tell me a little bit about the history of Fraunhofer Institutes and the Fraunhofer Institute for Integrated Circuits.

Rose: Fraunhofer is actually Europe's largest organization for applied research. However, in addition to our focus on research, we also have a strong dedication to bringing the technologies we develop to the market. That's why we're here at NAB. This differentiates us from other research organizations, which often do not have such a strong market focus.

For Fraunhofer IIS, the most important products we have developed in the last 20 years are in the field of audio coding and digital broadcast technologies. So when it comes to audio coding, we are the main inventors of the MP3, and we are co-developers of AAC, making us pretty much developers of the most important MPEG [Moving Picture Experts Group, formed by the International Standards Organization to develop standards for audio and video compression] standards that are nowadays used, for example, in broadcasting. They were mainly developed by us in Erlangen [Germany]. We have been doing audio codec development for more than 20 years, currently with a staff of over 120 engineers working on those technologies.

When was Fraunhofer IIS begun?

Rose: Fraunhofer began in 1949. It was founded as a research organization. Fraunhofer today consists of 60 institutes, which are like business divisions. Fraunhofer IIS is one of those business divisions, and is the biggest institute with a total of 750 employees.

Fraunhofer IIS started with microprocessor technologies when we were founded in 1985. The first thing that we concentrated on was integrated circuits and circuit design, and then we rapidly went into the audio business, and so from the very beginning we worked on audio technologies. Today, we are in the fourth generation of audio technologies, so MP3 was only the beginning.

Didn't you work on the European digital broadcasting standard, Eureka 147? That was my first introduction to MPEG and audio codecs.

Rose: Yes, that is right. Part of this work in the 1990s was also the development of audio codecs and our participation in the MPEG standardization. MPEG decided to have three different audio codecs standardized at the same time in MPEG-1. There is one codec with a very low complexity, Layer I, which nowadays is not really used any more, and then Layer II was standardized with more complexity and compression, and finally Layer III as the codec with the highest quality and also the highest complexity. We provided this Layer III together with partners like Thomson and AT&T Bell Laboratories.

We have a very extensive Web page on the MP3 history where we explain it all. The URL is *www.mp3history.com*.

Then in 1997 came AAC, and then High-Efficiency AAC [HE-AAC]. Now we are in the fourth generation of surround codecs like MPEG Surround.

So as you can see, we did quite a lot in the last 20 years, and this is just the audio part. In broadcasting, after Eureka, we at Fraunhofer helped to develop the WorldSpace system for WorldSpace Satellite Radio, including the audio codec. We were also involved in XM Satellite Radio and DAB digital broadcasting in Europe. When it comes to radio broadcasting, you hardly can find a digital broadcast system where we haven't participated in some way.

Fraunhofer IIS is the largest division within Fraunhofer Institutes.

Why was Fraunhofer IIS formed in 1985?

Rose: It was founded to advance developments in the rapidly expanding field of microelectronics. One of the first industry projects in 1985 was an intelligent running shoe.

In 1987, the institute formed a research alliance with University of Erlangen-Nuremberg within the framework of the European Union-funded Eureka project EU147 for Digital Audio Broadcasting. This marks the beginning of audio codec development at Fraunhofer. Audio codec development was initially started at the University of Erlangen-Nuremberg in the late '70s with the idea of Professor Dieter Seitzer of transmitting audio over ISDN telephone lines.

Who owns Fraunhofer?

Rose: Fraunhofer is a non-profit organization. More than 70 percent of the Fraunhofer contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and *Länder* [state] governments in the form of base funding. This is a very unique setup. We are the largest organization like this in Europe, and I'm pretty sure also worldwide.

It's one reason our customers like to work with Fraunhofer because they can make use of our long experience. Fraunhofer is one of the most attractive employers in Germany; that means we really get the best engineers out of university.

Our customers value our services because they know they get the best possible engineering services and they also know that we really care about the quality of the products, especially the audio quality.

What type of work does Fraunhofer do on a day-to-day basis today?

Rose: We at Fraunhofer IIS Audio & Multimedia develop audio and multimedia technologies and license them to the marketplace. This includes licensing of software implementations of audio codecs to end-product manufacturers.

Our customers value our software implementations, as they know that they get the best possible quality due to our extensive listening tests. We have one of the most modern listening and acoustic labs worldwide. It is in a building that was constructed just 2–3 years ago, and it uses a room completely decoupled from the rest of the building. It was designed for the very strict standards of MUSHRA listening tests.

Can you share with us a couple of stories about the development of the MP3 audio codec?

Rose: There's a whole collection of those stories on our MP3 history website.

One early story concerns the efforts of Professor Seitzer to develop his idea of transmitting high-fidelity audio over telephone lines. His first patent application to do so was rejected because the patent lawyers said that it would never be possible to do something like that.

Our institute director, Professor Heinz Gerhäuser, tells a nice story about how they visited the BBC in their early days

(continued on page 6)

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FRAUNHOFER

(continued from page 4)

and they brought all this hardware for some listening tests. But due to a misunderstanding, the prototype audio rig was designed to operate at the wrong operating level and with inverted phase. It was late night at the BBC offices and no one was there anymore, and they were in this hardware lab with everything closed up and staring at a locked parts cabinet. The next morning they were scheduled to present their system for formal listening tests to the BBC.

One of the engineers got the idea to just get a broom and sweep around under the lockers to find any parts that may have dropped, hoping that the cleaning staff had not been all that thorough. They turned up a handful of integrated circuits and found what they needed, sitting on the floor under the cupboards, to design the proper interface and they were able to do the demonstration.

Early work by engineers also included drilling holes in a standard CD player in order to mount up an external digital interface so that high-quality source audio could be obtained for listening tests, as told by Thomas Sporer, currently head of the Department of Acoustics.

Are you working specifically on a codec that might be designed for voice channels? In my experience with low-bitrate codecs, music generally sounds very good, with little audible artifacting, but voice material does exhibit artifacting.

Bleidt: Voice signals are extremely difficult for a number of reasons having to do with the nature of the speech signal. It's really unlike most music signals in that it has a lot of impulsive transients, which you don't normally hear so frequently in music. The traditional methods that you would use in a music encoder to deal with transients don't really work that well for speech. It's almost exclusively a transient-loaded signal.

Much of the work done on voice codecs has been done by the mobile phone companies and they tend to work at very low bitrates with the goal of highest efficiency for comprehension of content only.

What are some of the latest products to come out of Fraunhofer research activities?

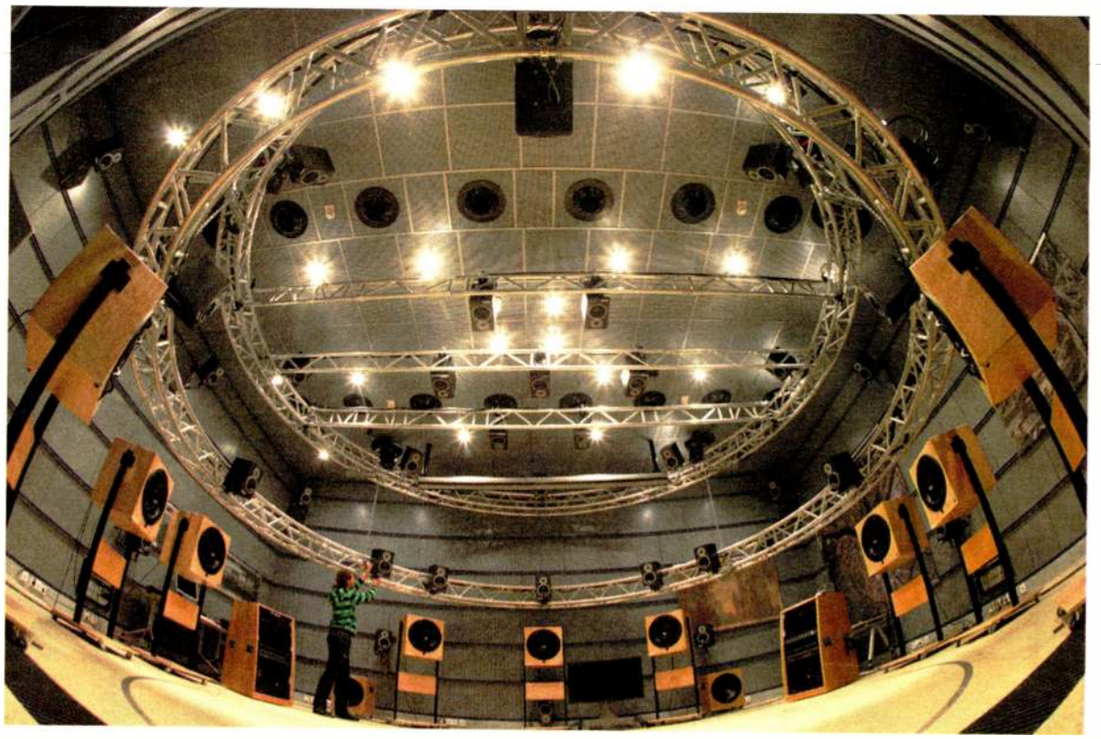
Bleidt: Well let's start with the Sonnox plug-in that we're showing at NAB. The concept behind the plug-in was to allow engineers or producers who are mixing audio to actually hear what the end product is going to sound like after the MP3 or AAC encoding is applied.

We saw that as a need in the broadcasting and music recording industries that wasn't really being addressed, and of course, we had the technology at Fraunhofer to enable this. We decided to partner with Sonnox, the former Sony Oxford digital console company, which now makes plug-ins for digital audio editing software, to bring this real-time plug-in to the marketplace.

What it offers is the ability to encode and decode in real time all of the MP3 codecs and all of the AAC codecs for anyone who is using digital audio software that uses VST plug-in, or the Audio Units plug-in, or the RTAS plug-in that ProTools uses.

That saves a lot of time in audio production because you don't have to output the finished WAV file from your audio software, encode it and then play it back and realize maybe I need to change this and have to go back. You can do all that online.

The other way it saves time is when you are making multiple types of outputs. Say you want to make different versions, with an MP3 for the archive and an AAC for a podcast, you can make all of those at once. It also supports any of the surround formats, both AAC and MP3 Surround.



The Fraunhofer IIS acoustic lab was designed for the strict standards of MUSHRA listening tests.

The Sonnox plug-in allows those who are mixing audio to hear what the end product is going to sound like after the MP3 or AAC encoding is applied.

Additionally, there are a lot of technical tools in the plug-in. We also realized that people really weren't evaluating our codecs as they should. People would do very casual listening and then say that they did or did not like a particular codec. As we mentioned earlier about testing to evaluate audio codecs, you really need double-blind testing to do a fair comparison, because we're all inherently biased. Which content we heard first, which was louder, and other factors can have an effect on our opinion. And if you know which encoder was used, that's an in-built bias you can't get around. The plug-in has a built-in tester for this so you can do double-blind listening tests yourself.

Finally, we also included some indicators that can alert you to potentially troublesome situations. One of those indicators is the noise-to-mask ratio for each of the frequency bands of the encoded signal. You can see from looking at that if there's a chance you could hear an encoding artifact.

Another new announcement that we have for NAB is the integration of MPEG Surround into Orban's products. So it's now possible for a station to use the Orban Internet radio encoding package to send out MPEG Surround. They've been doing encoding with HE-AAC v2, and that has worked out well with some broadcast properties, and now we're offering the option to do real surround broadcasting over the Internet at the same bitrate as stereo, 64 kilobits per second.

The idea there is to be able to put together a complete signal chain, and we've done some good work on that. At CES we announced a partnership with Texas Instruments to get our MPEG Surround decoder into the next generation of audio/video receivers. Most of the high-end AVR receivers today are starting to have an IP connection built in to them so they can get Internet radio services. The Texas Instruments Software Development Kit is used by many of the manufacturers of AVR equipment.

We can't name names yet, but it seems that there will be a high-end AVR receiver with MPEG Surround available in the 2012 time frame. We have a prototype here at the booth.

Interviewer Michael LeClair is technical editor of Radio World Engineering Extra and chief engineer for WBUR, Boston.

Comment on this or any other article to rwee@nbmedia.com.

MOBILE PHONES

(continued from page 4)

first person to appear live via Verizon LTE and the Comrex Access 2USB. This was a 24-minute live segment that aired on national program Talk of the Nation. According to Charlie Mayer, NPR's director of operations, they have been getting upload speeds between 2 and 5 Mbps using a USB connected modem stick — plenty of bandwidth for live, reliable and high quality audio. Advanced telephone networks are in their infancy but the prospect of combining high data speeds with a handheld device looks very promising.

For news stations these new technologies open up the ability to cover more places with greater quality. Smartphones have grown up and are now more than just a toy. For many, the iPhone or Android is the new recorder kit, and it offers greater flexibility than anything we've seen before. It promises to change the way we do news.

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BY CRIS ALEXANDER

For many years to come, people throughout the U.S., the South in particular, will remember the last week of April 2011.

It is seared into their memories as the time when an unprecedented tornado outbreak ravaged Dixie from Mississippi to Georgia.

I will be one of those who long remember the last Wednesday in April. It started with an early-morning text message from Stephen Poole, our Birmingham market chief engineer. He briefly told me that a tornado had gone through his neighborhood north of Birmingham before 6 a.m. It tore a few shingles from his roof but destroyed the homes of some of his neighbors. Stephen and his wife Sandy were shaken but okay, and they were of course thankful that they and their home had escaped unharmed.

Later in the day, I got another text from Stephen telling me that the skies were starting to get ugly again and that they were hunkering down for another round of severe storms. That was the line of storms that produced the big tornado outbreak, including the mile-wide monster that stayed on the ground for 200 miles, destroying Tuscaloosa and the north part of Birmingham.

I watched the Weather Channel in awe as its cameras followed that huge, black wedge. The primary camera was on top of Red Mountain, just a mile or so northeast of our studio site, looking north. I prayed as I watched the wedge slowly creep from left to right on the screen, noting visible landmarks and thinking about what was in the path … our 850 site with its five towers at Tarrant, our 1260 site northeast of downtown …

Another tornado was moving from west to east about 60 miles north, cutting a path through Cullman and destroying the town. We have a 1,380-foot tower just a couple of miles south of Cullman.

Our chief engineer's house sustained only minor damage, but this neighbor was not so fortunate.

Refueling the generator at the Cullman site from a 55-gallon drum was part of the daily grind until the power came back on.

This satellite view from the National Weather Service shows the track of a major tornado that passed through the Birmingham area. The gray area near center bottom is Crawford Broadcasting's five-tower directional array on 850 kHz.

As the storms moved off to the east, I started trying to get in touch with Stephen to no avail. I did get in touch with Todd Dixon, one of our other engineers, and he told me that all the signals were on the air. That was a huge relief! At least I knew that we hadn't sustained a direct hit on any of the sites.

I did finally get in touch with Stephen that evening. The tornado that had plowed through his neighborhood earlier in the day had evidently taken out power to the Verizon site in that area, leaving him with very spotty service. Landlines and power were all down in his neighborhood.

THE AFTERMATH

As the sun rose the following day, we started getting a look at the damage the storm had left. Amazingly, the three of our sites without emergency generators were up and operating on commercial power. The two 100 kW FMs that had generators were operating on generator power with the commercial mains out.

We were okay for the moment, but we realized that the clock was definitely ticking on both the fuel and the longevity of those engines running continuously.

Alabama Power was telling us that it would take days to get the power back on at the Ishkooda mountaintop site, and there was no estimate on restoration at the Cullman site, where the electrical generating plant reportedly had been heavily damaged. We knew we were going to be on our own for quite awhile.

Our people quickly found that with all the tornado damage in the area, fuel delivery was not going to happen anytime soon. Fuel jobbers were being tasked with priority and public service applications. Radio stations were a long way down the list.

In the case of the Ishkooda site, it was a moot point anyway — the road up to the site was completely blocked by fallen trees: big ones, many of which were also tangled in overhead power distribution wires.

I asked Stephen about taking a chain saw and cutting some of those trees. He understandably was hesitant. The overhead power lines evidently were dead but they could come to life at any moment. So he had to haul fuel in five-gallon cans about two-tenths of a mile up that steep road, stepping over and around the tangle of fallen trees, to keep the generator fueled.

The road was relatively clear up at the Cullman site. Once the authorities opened the interstate up that way, our engineers were able to borrow a farm truck, drive it some distance south of Birmingham, fill its 100-gallon tank with diesel and drive it up to the Cullman site to fuel the generator. Those 100 gallons would hold us for less than 24 hours.

The decision was quickly made to shut

(continued on page 10)

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Broadband Internet is everywhere. Which makes it ideal for live remotes.

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TORNADO

(continued from page 8)

the Cullman station down between 10 p.m. and 6 a.m. to save on fuel and wear and tear on the generator. The FAA was notified that the tower lights would be out for a few days. Every evening at 10, one of our engineers would drive the 60 miles to the Cullman site to shut down the transmitter and generator. Every morning at 6, someone else would make the drive, fire up the generator and turn on the transmitter. And so began the long grind.

Stephen found a fuel jobber that would sell us diesel in 55-gallon drums, and they would sell us a hand pump and hose. Three different times, Stephen drove his pickup to the oil terminal and had them load two drums of fuel. He would then make the long drive, pump the fuel into the generator tank and make the drive back with the empties.

ESSENTIAL MAINTENANCE

At one point during the week following the tornados, we made the decision to shut the generator down during daylight hours and change the oil. Not surprisingly, it was black and gritty. The typical standby generator at a radio transmitter site is not meant to run continuously for days on end, and the manufacturers have told us that should they be pressed into that kind of service, special attention must be paid to the oil and coolant.

Our friends at Clear Channel share the access road up to the Ishkooda site with us, and their generator ran completely out of fuel on the Saturday after the tornados. Bob Newberry, no doubt exhausted after several days of dealing with storm damage in both Tuscaloosa and Birmingham, decided that if he didn't clear a path through the fallen trees, it wasn't going to happen. He wore out two chain saws making a hole wide enough to drive a pickup through. Bob got his generator fueled, primed and running again, and we got some fuel into ours as well (we were down to just a few gallons in the tank but had not yet run out).

Stephen's neighbor is a Birmingham city police officer. Talking to him one day in the aftermath of the storms, Stephen told him that the city's trunking system is located on our Ishkooda tower and that if the generator runs out of fuel, the city and county will have no radio communications for its police, fire, sheriff, EMS, meter maids and dog catcher.

The neighbor called his boss, who in turn called someone else. That evidently got power restoration at the Ishkooda site moved up the priority list. By Sunday afternoon, four days after the outbreak, the trees were cleared and power was restored.

Even though we had been told it might be more than a week more before power would be restored at the Cullman site, the juice came back on the following Tuesday. Six days after the worst tornado outbreak on record, all sites were up and running on commercial power.

We had one additional casualty to deal with. The plate contactor in the BE FM-30T main transmitter at the Ishkooda site was damaged and closing only two phases. This probably occurred when the power first went down and phase wires got crossed as trees fell across them. That contactor was replaced after the power was back up at all the sites, returning that station to full-power operation and marking the return of our market operations to "normal."

WHAT WE LEARNED

So what did we learn from this experience?

First, our disaster plans had always assumed that only one of the sites would be impacted. Tornados tend to be localized; it's very unusual — almost unprecedented — for a tornado to stay on the ground for 200+ miles and be more than a mile wide. It's also very unusual to have such a huge outbreak of tornados over such a large area.

But the bottom line is that we had two sites seriously affected, and we could have had more. Our contingency plans must, from here on, provide for multiple site involvement.

Another lesson is to keep the generator tanks full during storm season.

From normal exercising and periodic power-out operation, we were probably down to half a tank at the Cullman site when the storm hit. That had us playing catch-up from the first pitch.

We also learned that we need to keep oil, filters and coolant on hand at the sites. Changing the oil during prolonged operation is a must, and normal supply lines may be severed (as they were in this instance).

Finally, I relearned what I already knew: Our engineers are rock stars, the heroes of the story in the aftermath of any disaster.

Stephen and his crew set aside their personal lives for a week and focused all their energies on keeping the stations on the air. Without them and their superhuman efforts, two of our five stations would have been dead in the water for days.

Hopefully, we will never again face such wide destruction, but forewarned is forearmed. We'll be better prepared next time.

W.C. "Cris" Alexander is director of engineering at Crawford Broadcasting Company and a past recipient of the SBE's Broadcast Engineer of the Year Award.

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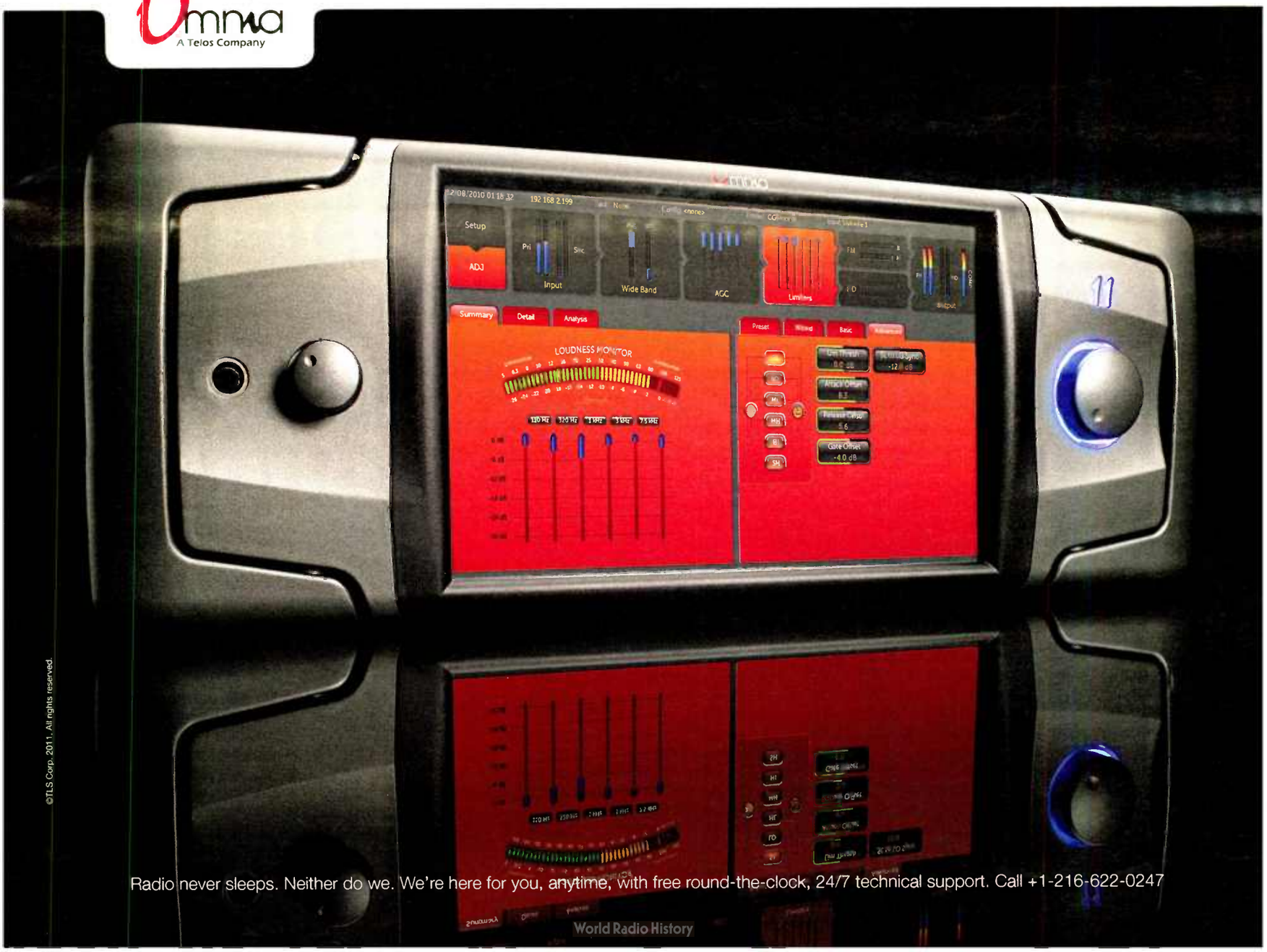

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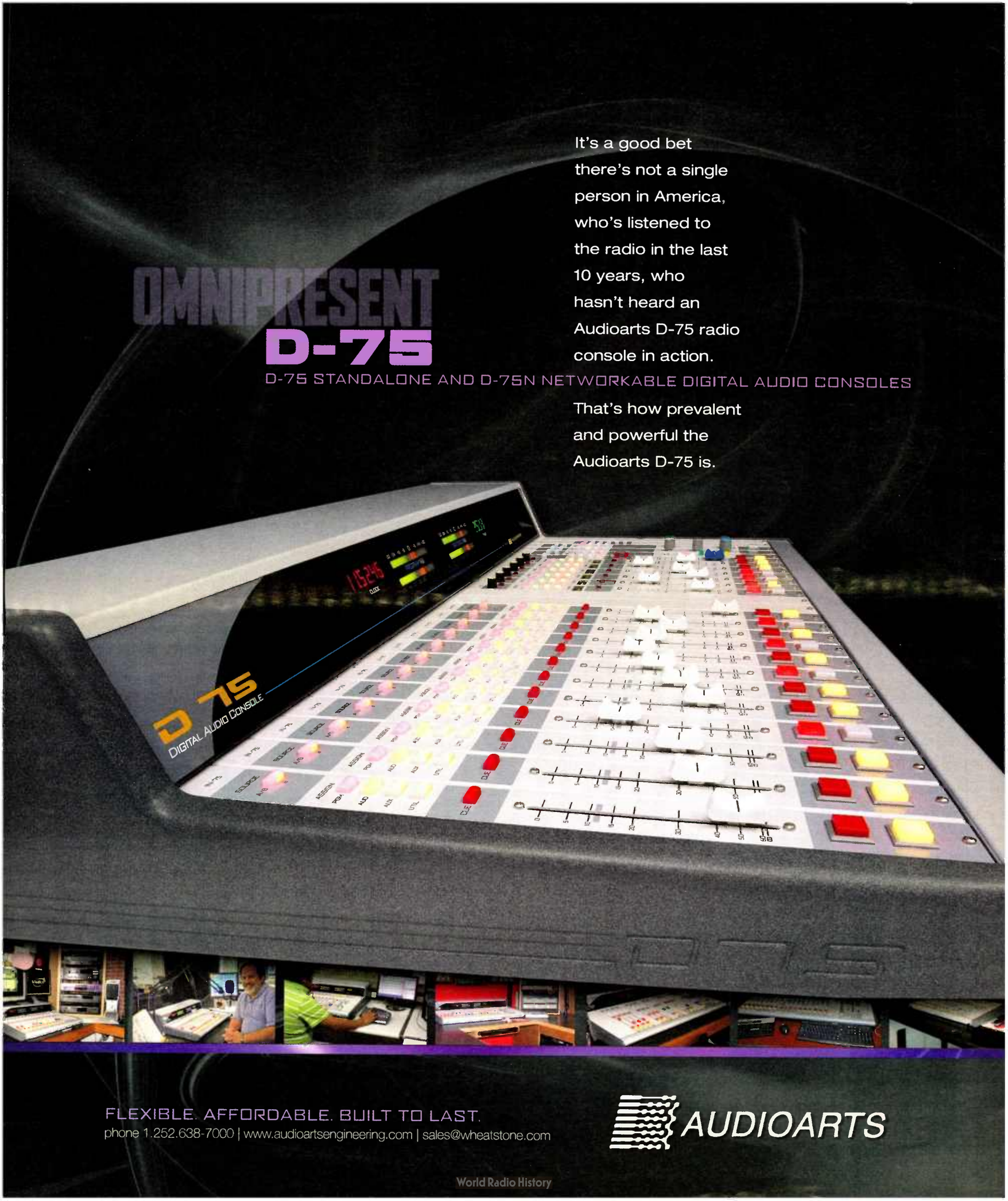

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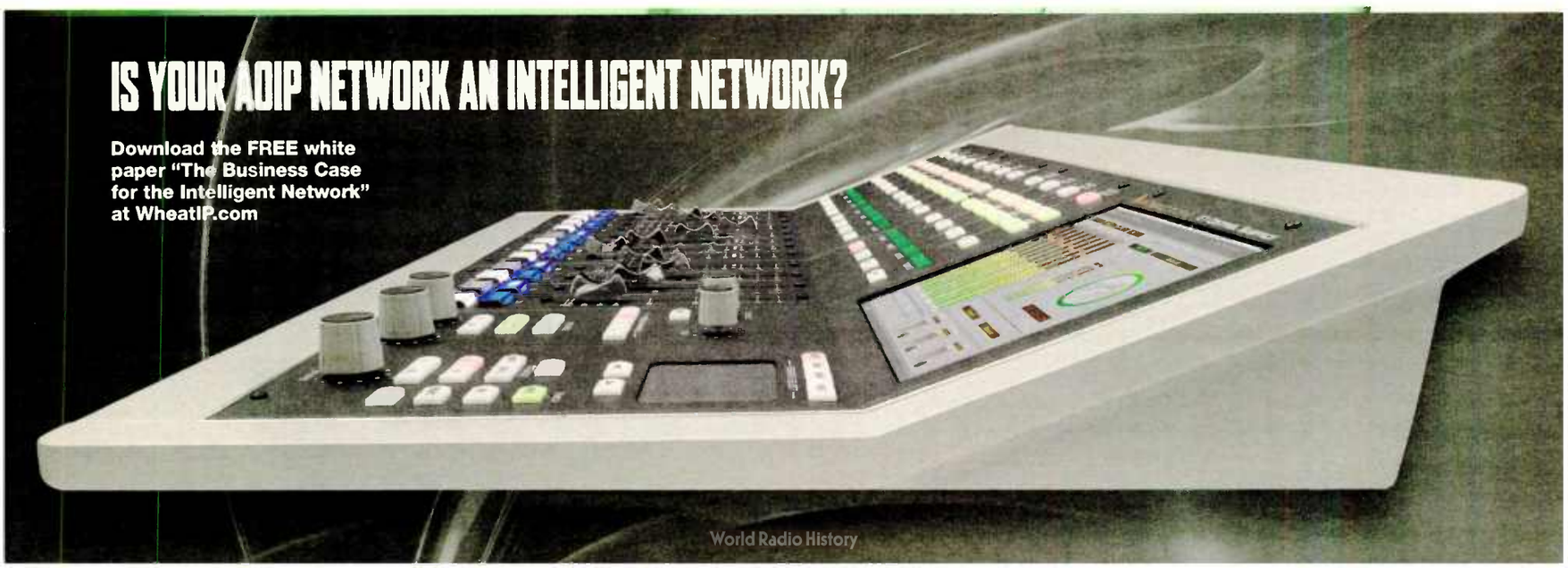


HD VOICE

(continued from page 1)

these factors and the impact they have on modern telephony, and then introduce a new type of studio telephone system that can leverage the changing telephony landscape to allow the system to present the natural, full sound of wideband callers, while still interfacing easily with legacy narrowband calls.

Stations that implement such a system and promote the new ways for callers to reach them will benefit from a much more listenable and intelligible on-air product, which will likely lead to higher ratings.

WHY PHONES SOUND BAD

The telephone network was designed by engineers for efficiency rather than audio quality. Compromises were made to the shape of the telephone frequency response curve to account for the economics of transporting uncompressed digital audio streams within limited media bandwidth, as well as to reduce noise from analog trunks running in parallel with power lines.

The universal digital sampling rate of telephone channels is 8 kHz. According to the sampling theorem, this limits the upper frequency response of telephone calls to 4 kHz.

In reality, most converters used in telephone circuits start to roll off response slightly above 3 kHz. Codecs used in some modern mobile phone systems start to roll off at an even lower frequency. Humans have an excellent ability to discern speech even under challenging circumstances, making a 3 kHz roll-off no problem for intelligibility, but in terms of subjective quality of the speaker's voice, much of the sibilant character is lost.

At the other end of the spectrum, things are even worse. To prevent audible hum from power lines bleeding into phone calls, telephone converters employ fairly harsh high-pass filters, targeting the AC frequency of 60 Hz in North America and the first and second harmonics. To make matters worse, many mobile telephone microphones, due to size necessity, have very poor frequency response on the low end.

Again, this doesn't have a dramatic impact on intelligibility, but it has the effect of filtering out quite a bit of voice energy and removing much of the character of the caller's voice.

Fig. 1 shows the frequency response of typical mobile and landline phone calls. Of course the host audio produced in a radio studio can be assumed flat (or even "sweetened") to produce a full-fidelity sound. For telephone callers, however, so much voice energy is intentionally cut off by these filters that there's very little that even aggressive equalization can do to improve things. As shown, the average fundamental frequencies of human

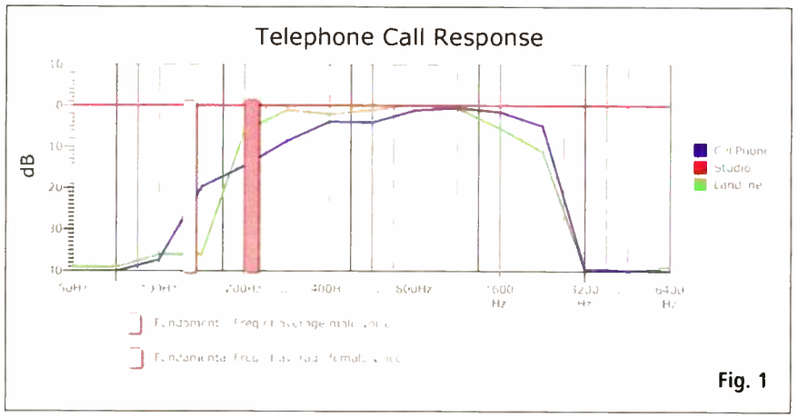


Fig. 1

voices straddle the lower end of these filters. Luckily, the ear is capable of "filling in" these gaps in the audio spectrum. But the result can be grating and fatiguing to listen to for extended periods.

Since the mid-1970s, Comrex has been marketing systems to restore the lower 2-1/2 octaves lost by low-end telephone filters. Unfortunately, by their nature, these systems must exist at both ends of the call, and it certainly isn't practical for callers to use this equipment for a call-in show situation.

ENTER VOIP

The past 10 years has seen a migration in the business community away from traditional telephone systems toward PBXs that utilize Voice-over-IP (VoIP) technology. The incentives are many: No special wiring networks are required, better standards have been established to allow VoIP equipment from different vendors to interoperate, and configuration and management has become simpler. Interconnection between these "VoIP islands" can be handled by traditional telephone trunks, or by more VoIP connections.

Consumers have also been reaping the cost savings of VoIP for several years. With the proliferation of broadband Internet to the home, it's now common for households to utilize a VoIP telephone instead of a traditional telephone line. Often this service is provided by a company other than the local traditional phone company (e.g., Vonage), but it will gateway the customer's VoIP service on to the public telephone network as part of the service. It is also possible for two consumers provisioned by the same VoIP provider to experience pure VoIP calls between them, never touching the traditional phone network. If the customer utilizes a PC-based "softphone" rather than a traditional handset, he can often establish free calls to other VoIP users by "dialing" an alpha-numeric address rather than a phone number.

Providers are able to offer this service for free because the majority of their costs involve paying traditional telephone companies for the right to gateway, and on pure VoIP types of calls no gateways are involved.

SMARTPHONES PROLIFERATE

With the huge uptick in popularity of the iPhone and Android-based smart phones, VoIP apps have become popular as a means to conserve airtime minutes. These apps are generally based on the VoIP SIP protocol and can interwork with each other. Many VoIP providers deliver free apps for these platforms that enable free VoIP-to-VoIP calling, along with access to the provider's paid

Fig. 2

gateway services. Mobile phone apps can often communicate with each other directly via the use of a free Session Initiation Protocol (SIP) service like iptel or Sip2Sip.

One important element of incoming SIP-provider-based telephone lines is they can often be dialed (using the SIP address) without the caller having been registered to any provider at all. This means an "app" can be developed that will make a free call to a SIP line from any Internet-based location without any configuration or cost. This will become a powerful tool and provide an incentive for talk radio to make the VoIP migration.

While not based on the SIP protocol, the VoIP Skype service is now available for iPhone and the Android platform as well. This popular service provides free Skype-to-Skype calls using a proprietary protocol, including video and enhanced audio performance.

THE VOIP INDUSTRY TAKES NOTICE

With a significant (and growing) number of users placing telephone calls that don't touch the public switched network, the VoIP industry has rightfully noticed that it is no longer necessary to utilize old-fashioned telephony techniques on these calls. This has led to a movement dubbed by industry pros as "HD Voice." To achieve the status of HD Voice-compatible, a VoIP product must be able to process phone calls at better than toll quality.

The foremost ingredient in this formula is the audio "codec" used to encode and decode audio for packetization and network transmission. Traditional telephony utilizes a standard called G.711, but this protocol is rather dated and requires a lot of network bandwidth by modern standards, and provides only toll quality. Other standards exist to achieve comparable quality in less bandwidth (e.g. G.729, G.726 and GSM), but of special interest are codecs that allow higher fidelity to pass between callers. Freed of the shackles of the public switched network, these calls can be placed between users with codecs that encode a much broader spectrum of voice, including all that energy and nuance that is lost outside of the traditional telephony filters.

Popular wideband VoIP codecs include:

- G.722 — Familiar to broadcasters, this codec utilizes the same bandwidth as a traditional call, but doubles the audio spectrum
- Speex — A product of the open source movement, this is a free codec with many options for fidelity and network bandwidth, and is unencumbered by patent and copyright
- iSAC — An algorithm from Global IP Sound (recently purchased by Google) that is used in several Google-based offerings
- G.722.1, G.722.2 — Modern standardized wideband codecs delivering equivalent or better fidelity than G.722 at lower network bandwidth
- G.711.1, G.729.1 — Less widely implemented wideband offerings

These algorithms are being widely deployed in new VoIP hardware, as having the "HD Voice" label is seen as appealing to consumers and businesses. These codecs are also now being imple-

(continued on page 16)

MINSTRUMENT MATRIX

Sophisticated Minstruments from NTI give you comprehensive test capability... and these flexible audio instruments fit in the palm of your hand

DL1 Digilyzer
Digital Audio Analyzer

A handheld digital audio analyzer with the measurement power & functions of more expensive instruments, the DL1 Digilyzer analyzes and measures both the digital carrier signal (AES/EBU, SPDIF or ADAT) as well as embedded digital audio. In addition, the DL1 functions as a smart monitor and digital level meter for tracking down signals around the studio. Plugged into either an analog or digital signal line, it automatically detects and measures digital signals or informs if you connect to an analog line. In addition to customary audio, carrier and status bit measurements, the DL1 also includes a comprehensive event logging capability.

- AES/EBU, SPDIF, ADAT signals
- 32k to 96k digital sample rates
- Measure digital carrier level, frequency
- Status/User bits
- Event logging
- Bit statistics
- VU + PPM level meter for the embedded audio
- Monitor DA converter and headphone/speaker amp
- Audio scope mode

DR2 Digirator
Digital Audio Generator

The DR2 Digirator not only generates digital audio in stereo & surround, it is a channel transparency and delay tester as well, all condensed into a handheld package. Delivering performance & functionality challenging any digital audio generator made today, it produces all common audio test signals with sampling frequencies up to 192 kHz and resolution up to 24 bit. The Digirator features a multi-format sync-input allowing the instrument to be synchronized to video and audio signals. In addition to standard two-channel digital audio, the DR2 can source a comprehensive set of surround signals.

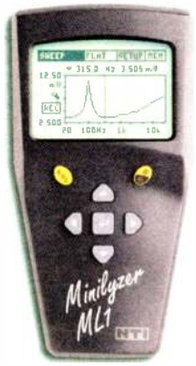
- AES3, SPDIF, TOSLink, ADAT outputs
- 24 bit 2 channel digital audio up to 192 kHz SR
- Sine wave with stepped & continuous sweeps; White & Pink Noise; Polarity & Delay test signals
- Dolby D, D+, E, Pro-Logic II, DTS and DTS-HR surround signals
- Channel Transparency measurement
- I/O Delay Measurement
- Sync to AES3, DARS, word clock & video black burst
- User-generated test signal files

AL1 Acoustilyzer
Acoustics, Audio & Intelligibility Analyzer

The AL1 Acoustilyzer features extensive acoustical measurement capabilities as well as analog audio electrical measurements such as level, frequency and THD+N. With both true RTA and high resolution FFT capability, the AL1 also measures delay and reverberation times.
With the optional STI-PA Speech Intelligibility function, rapid and convenient standardized "one-number" intelligibility measurements may be made on all types of sound systems, from venue sound reinforcement to regulated "life and safety" audio systems.

- Real Time Analyzer
- Reverb Time (RT60)
- Delay measurements
- High resolution FFT with zoom
- Optional STI-PA Speech Intelligibility function
- Automatic Distortion analyzer (THD+N)
- Frequency, RMS Level, Polarity measurements
- Requires optional MiniSPL microphone
- Includes MiniLINK USB interface & Windows PC software for storing tests and PC transfer

ML1 Minilyzer
Analog Audio Analyzer



The ML1 Minilyzer is a full function high performance audio analyzer and signal monitor that fits in the palm of your hand.
The comprehensive feature set includes standard measurements of level, frequency and THD+N, plus VU+PPM meter mode, scope mode, a 1/3 octave analyzer and the ability to acquire, measure and display external response sweeps generated by a Minirator or other external generator.

Add the optional MiniLINK USB computer interface and Windows-based software and you may store all tests on the instrument for download to your PC, as well as send commands and display real time results to and from the analyzer.


MiniLINK

- Measure Level, Frequency, Polarity
- Automatic THD+N and individual harmonic distortion measurements k2 ➡ k5
- VU + PPM meter/monitor
- 1/3 octave analyzer
- Requires optional MiniSPL microphone for SPL & acoustic RTA measurements
- Frequency/time sweeps
- Scope mode
- Measure signal balance error
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Analog Audio Generator +
Impedance/Phantom/Cable measurements

The MR-PRO Minirator is the senior partner to the MR2 below, with added features and higher performance. Both generators feature an ergonomic instrument package & operation, balanced and unbalanced outputs, and a full range of signals.

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- Sine waves & programmable swept (chirp) and stepped sweeps
- Pink & white noise
- Polarity & delay test signals
- User-generated custom test signals & generator setups
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- Phantom power voltage measurement
- Cable tester and signal balance measurement
- Protective shock jacket

MR2 Minirator
Analog Audio Generator

The MR2 pocket-sized analog audio generator is the successor to the legendary MR1 Minirator. It is the behind-the-scenes star of thousands of live performances, recordings and remote feeds.

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- Programmable Swept (chirp) and Stepped sweeps
- Sine waves
- Pink & White noise
- Polarity & Delay test signals
- Illuminated Mute button

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HD VOICE

(continued from page 14)

mented in many software phones available for computer as well as smartphone platforms. Examples are Media5Phone for iPhone and SipDroid for Android, both capable of G.722 wideband coding via the SIP protocol.

As mentioned, the popular Skype program also provides for enhanced audio quality. Using a codec called SILK, Skype calls can deliver up to 10 kHz audio fidelity if network bandwidth permits. But Skype only offers this enhanced quality between Skype software clients; as with other VoIP calls, once the call touches the public switched network, all enhancements are lost. Wideband-capable Skype clients are now available for Android-based mobile phones as well as the iPhone.

With wideband codec-capable hardware and software in the hands of consumers, the next logical step is to figure out how the radio industry can leverage this to create compelling programming.

SYSTEM REQUIREMENTS

Some basic requirements exist for delivering any calls in a radio talk show environment.

The system must have the ability to make and receive calls, separate the caller and host audio completely and conference at least two callers on-air (allowing them to hear each other clearly). It is desirable to have signal processing to normalize caller audio levels and provide for host domination. The phone system must have the ability to screen calls before placing them on air to provide useful information about the caller to the talent. For operational reliability, a simplified interface is required to allow talent to put calls on-air and disconnect them.

Other specific requirements exist for many users. These may include display of caller ID, blacklist functionality, audio and metadata archiving and auto-priority functions.

These functions can be handled by available products designed for the task. But when we consider handling callers and hosts digitally at varying degrees of quality, many of these tasks become much more complex. A successful wideband talk show system must be equipped to handle not only legacy 3 kHz bandwidth calls, but the entire range of possible wideband options. It must be able to mix and balance all these sources seamlessly, and create proper feeds back to each caller at the appropriate bandwidth and protocol.

COMPATIBILITY WITH LEGACY TELEPHONE TRUNKS

It is likely that not all users will be ready to make the leap immediately to a complete VoIP solution for their telephone trunks, so it will be necessary to interface with analog POTS, ISDN and T1/E1-based phone lines.

The wideband talk show system interface is purely IP-based, and in order to interface to other types of trunks, "gateway" devices are available at reasonable prices from a variety of vendors. Such a device is shown in Fig. 2, the AudioCodes MP-114 VoIP Gateway. Note that when using these devices, most calls will be translated to narrowband G.711 unless the device specifies support for wideband protocols. Of course when interfacing to POTS lines, there are never any wideband options due to the limitations previously discussed. The VoIP side of these gateways will convert the telephone trunk to a SIP-compatible VoIP trunk for connection to the talk show system.

SIP BASICS

VoIP calls generally are placed and received via the SIP (RFC 3261) protocol. SIP standardizes how calls are negotiated between the caller and called parties. Part of that standard is the codec negotiation process, wherein the two endpoints deliver each other a list of compatible codecs, and the best mutually compatible option is chosen. In this process, the wideband talk show system will prefer wideband codecs over narrowband codecs, though either type is supported for any given call.

Once negotiated, the selected codec is set for the duration of that call and all communications between the caller and the system are handled at the chosen fidelity.

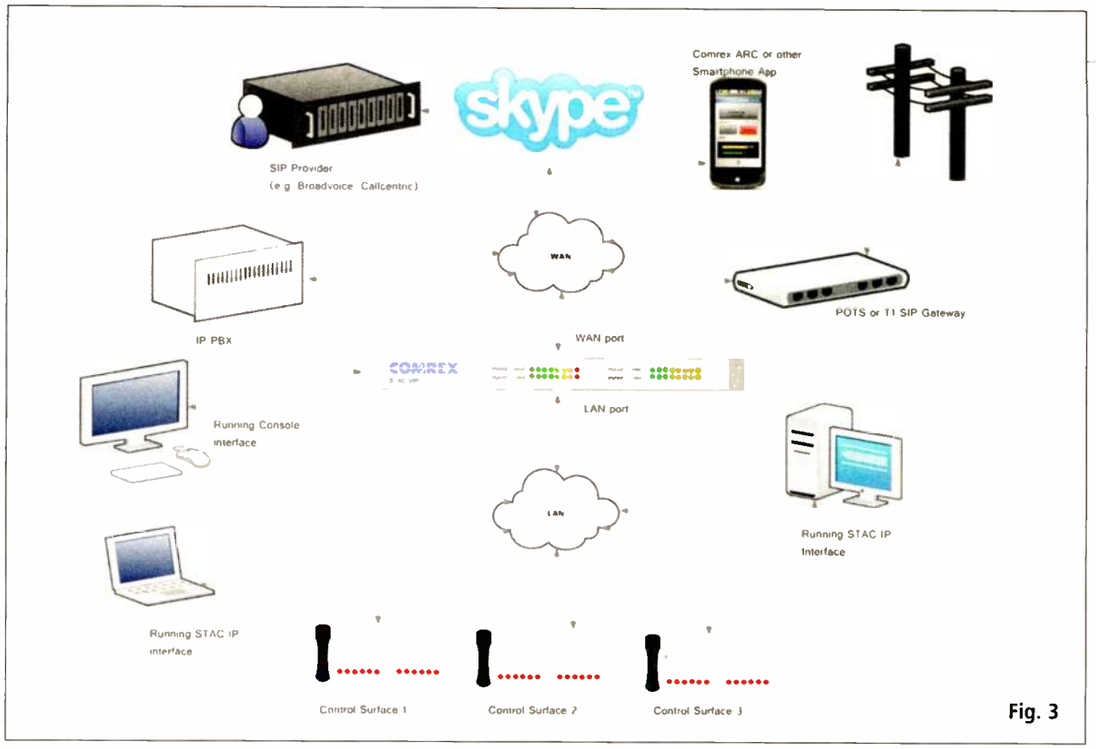

Fig. 3

SKYPE INTEGRATION

A key element of the wideband talk show system is integration with Skype. This presents a special challenge because the Skype client software is a proprietary, closed system available only from Skype Ltd.

Skype has openly published the SILK codec specification; all other aspects of the system including call negotiation and the protocols for Skype data transfer remain secret. Recently Skype Ltd. has been allowing manufacturers to integrate a specially designed software package with the necessary "hooks" to allow Skype to be embedded into specific targeted products. This allows the studio Skype client to be placed into dedicated hardware suitable for specific tasks, rather than relying on generic-purpose computers.

The wideband talk show system uses this Skype software integration, and can simply treat the Skype caller as another telephone connection. This includes the ability to answer, screen and air the Skype call along with non-Skype calls. As long as the connection comes from another Skype user and the call was placed to the station's Skype address, the system will negotiate a SILK-based wideband call. This creates an opportunity for stations to promote the wideband talk show aspect, advertising on air that priority will be given to callers who dial their Skype address to call in.

CONTROL SURFACES

In many ways, a talk show system can be considered a PBX, with "outside world" phone lines entering one side, and the extensions — which are a combination of control surfaces and audio I/O ports — on the other side. Control surfaces act like PBX extensions, with the ability to make and receive calls and transfer them to "on-air," which can be considered just another extension.

When using the SIP protocol, there is little difference technically between the connection of the talk show system to its "outside world" lines and the connection of a control surface to the talk show system. Both use a SIP client-server architecture with similar setup protocols and rules.

TRANSCODING

In many cases, the talk show mainframe can simply transfer incoming calls to control surface extensions with no processing. However, cases will exist where the control surface doesn't have the complexity to decode all formats supported by the mainframe. In these cases, the mainframe must transcode the incoming call audio in each direction to a codec supported by the control surface. One example of this is for Skype calls, where the control surface does not have all the Skype protocols built in and must rely on the mainframe to transcode dynamically to G.711 while the call is being screened on the extension. Once the call is sent on-air, however, it must be transcoded to linear digital audio to be mixed with the other sources.

The mainframe can have many transcoding functions all happening simultaneously. These include encoding the program audio to each caller in the "on-hold" queue based on their specific negotiated codec, transcoding all calls currently "on air" to linear PCM for mixing and processing purposes, and transcoding each call active on each control surface to a codec compatible with the surfaces.

Since many of the supported codecs require significant CPU capability to encode and decode, the processor in the mainframe must be extremely capable. Computational power is never unlimited, however, and an upper bound exists for the number of simultaneous transcodes that may occur in the mainframe.

ASSEMBLED TOGETHER

Fig. 3 shows the wideband talk show product, STAC-VIP, with all possible connections. The system is divided into those connected to the device's WAN port, dedicated to telephone trunks to the outside world, and the LAN port, primarily dedicated to control surfaces. In addition, the system acts as a web server for graphical user interfaces, available to screeners and on-air talent via a standard web browser. On the WAN side, a combination of telephone line sources is possible, with some lines connected through a gateway to legacy telephone

(continued on page 21)

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HD Radio: Is It Worth the Effort?

Despite Lingering Questions, Guy Wire Says the Answer Is Still 'Yes'

BY GUY WIRE

It's been several years since your masked rebel of radio reflection discussed the painfully slow HD Radio rollout and adoption as our digital platform for the future.

Lingering questions about the long-term viability of HD continue to dog our business. The larger markets have mostly all converted, but the total is only about 14 percent of all stations. Most uncommitted station owners are still reluctant to spend the money and the resources to add HD, uncertain that their investment will ever pay off.

Let's break down the uncertainty and shed some clarity on how far HD has come and where it's heading.

Stations started transmitting HD for evaluation and testing over a dozen years ago. The HD transmission standard was formally adopted by the FCC in October 2002. Since then, according to iBiquity, about 2,100 stations have added HD, including around 1,800 FMs, with 1,300 separate HD2 and HD3 channels.

By comparison, the latest FCC data indicates there are a total of 14,600 AM and FM stations in the country, not counting LPFMs.

The major stakeholders in this technology, including the early-adopting members of the HD Radio Alliance and the committed car companies, have hunkered down and stayed the course. A lot of us have not been happy with the proprietary standard aspect of the adopted iBiquity platform or the high licensing and royalty fees both broadcasters and radio manufacturers are being charged.

Unfortunately that's the price we had to pay to play digital radio in an era when a private company develops a mission-critical product that corners the market. We need to realize the general model of adopting a technology innovation as a standardized platform is not all that different from most other industries.

GOOD NEWS AND NOT SO GOOD NEWS

FM-HD continues to grow, but it's no secret AM-HD is struggling, with many of the 250+ converted stations choosing not to operate HD at night.

Limited data capacity with few feature enhancements of real value plus irresolvable interference issues have seemingly killed the promise of a technically rejuvenated digital AM service.

At least those stations that have added AM-HD got the added benefits of new transmitters and optimized antenna systems. The stations that have persevered and made AM-HD work as a valued addition to their product will be along for the ride as long as AM-HD decoding remains in the FCC adopted standard receiver chipsets.

The additional channel bandwidth and adjacent channel guard bands for FM have allowed FM-HD to offer a much richer feature set than AM-HD and escape most of the dreaded interference problems. The early promises made for FM-HD suggested that our primary coverage contours would be served with the improved quality of digital using only 1 percent, or –20 dBc, of the total transmitted power. Car radios in unobstructed terrain almost delivered that promise, but we've since learned that effective digital coverage at –20 dBc in most markets achieves only about 60 to 70 percent of the analog.

Early versions of portable and tabletop HD radios came up especially short. It wasn't that long ago when many pioneering engineers who installed HD systems on their stations had a difficult time finding HD Radio models that would reliably play their new signals inside a home or office without the aid of an external antenna. Many of the HD receiver makers have stepped up to attack this problem by improving their front-end designs, including better filtering and shielding to keep internally generated digital noise from de-sensing the radios.

Large-screen media display shows HD Radio will soon be available in the 2012 Ford Focus.

SOLVING THE PUZZLE

Thanks to those ongoing receiver improvements and the excellent work of NPR Labs, which pushed the supplemental HD2/3 channels and increased HD power initiatives, a lot of the initial disappointment over HD performance has abated.

Increasing digital power from –20 dBc up to a maximum –10 dBc or 10 percent of total power has been demonstrated to improve digital coverage significantly. That factor by itself may be the missing piece that will make HD stick long-term.

About 300 U.S. stations are running increased HD power levels, mostly in the –14 dBc or 4 percent power range. That level appears to give digital coverage parity with analog. Even at –10 dBc, very few reported incidents of noticeable analog self-interference have emerged. The HD power boost is proving to be a welcome enhancement for the reliability of HD2 and HD3 channel reception.

Quite a few station clusters are now leveraging some commercial success with these additional program services. Many of those include extended coverage, especially at night, for their AM news, talk and sports stations. But it also provides minor league and extended major league sports franchise deals and various foreign-language services in major population centers. Even music-branded stations are developing unique niche formats that can super-serve targeted audiences that become very loyal and supportive when they discover them on an HD Radio.

LOTS OF FLAVORS AND COLORS

HD naysayers and opponents have warned from the beginning that if new HD receivers didn't catch on quickly and sell in big quantities, the manufacturers would stop making them and abandon the technology. That has not happened.

A few of the early models have disappeared, but receiver and car radio companies continue to build and introduce new HD models in increasing quantities and at lower price points.

There are now more than 15 automakers building the technology into more than 85 different vehicle lines, and more than 100 HD Radio receiver models are available at more than 12,000 retail outlets nationwide.

According to iBiquity, 12 million HD Radio devices will be part of the national radioscape by the end of 2012, with many of these sporting larger color displays. It seemed like it took forever to cross the 1 million mark reached less than three years ago.

The multimedia color displays now appearing in many new car dashboards not only include navigation packages, but also a host of new glitzy features that offer Internet resources along with the enhanced visual features of HD Radio driven by PAD and other data. The HD Radio Artist Experience is one of those.

This summer, we'll begin to see digital radios with large color touch screens showing up even in economy models of cars, with the Volkswagen Jetta being the first, and a number of others in early 2012. The new Ford Edge was previewed at the NAB Show in April with an awesome HD Radio system built in with Sync and a large color display, all standard. These next -en HD radios will display album and commercial artwork as well as station logos.

The Artist Experience along with other HD visual features like real-time traffic maps and iTunes tagging allow radio to look and feel more like many of the new Internet destinations folks will be dialing up on their car dashboards. We simply need to provide the same level of eye-popping content variety and excellence to stay competitive in that space.

THE BATTLE FOR THE OASHBOARD

Most car radio companies don't want to build old technology into new cars or additional radio chipsets just to support legacy products that will be going out of style. It's no secret that radio is being squeezed by other interactive multimedia resources consumers want to see available on their car dashboards. The simple reality is that radio needs to keep justifying its right to claim a big chunk of this incredibly valuable ergonomic real estate in cars.

HD Radio as a consumer experience, for those who aren't aware of it or haven't been seeking it out, will be much like discovering RDS. They buy a new car and *voilà*, the RDS scrolling text and the HD radio with all its extra features are just there. Once they get turned on to the enhanced features of HD in the car, they'll want to buy portable and table radios with those same features.

Public awareness of HD Radio admittedly has been disappointing and slow to pick up. But the increase has been accelerating in recent years.

The 2010 Edison Research study shows it in the 40–50 percent range, although many still confuse HD with satellite. Four years ago, it was only 10 percent.

In 2007, according to a *Bridgeratings.com* report, only 1 percent of consumers polled said they were interested in buying an HD radio. Edison shows 7 percent are now "very interested" in HD Radio, although this has remained about the same for the last three years. See *www.edisonresearch.com/The_Infinite_Dial_2010.pdf*.

Clearly, we still have a lot of work to do.

Sirius XM eventually will raise its monthly rates now that the three-year deal with the FCC to allow their merger

(continued on page 22)

In the middle of your busy day...
take a break and install an iQ.

With all that's on your plate, time is precious. Here's a way to get some time back: iQ, the powerful new AoIP console from Axia. So fast and easy, you can unpack it at 11:00 and have audio running by noon. No switch to set up - it's built-in and preconfigured. In fact, everything's built in. Audio. Logic. DSP engine. Power supply. Just plug in power and audio, and you're ready for air. Smart and intuitive, so your jocks will love it. Cost-effective, so your boss will love you. A 16-fader iQ starts at just $9,985.00; 8-faders are only $7,990.00.

iQ. It's about time.

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AM Coverage: Frequency vs. Conductivity

More Power Isn't Always Better Than the Right Frequency, Location

BY RICHARD J. FRY

It is common knowledge and experience that the groundwave coverage areas of AM broadcast stations can vary significantly, even for identical transmitter powers and antenna system parameters.

AM stations at the lower end of the AM broadcast band have greater coverage areas than those at the upper end, all other things being equal.

This variation in groundwave coverage area with frequency is related to the conductivity of the earth along the propagation path, and the differing loss that this conductivity produces for different AM broadcast frequencies.

Earth conductivity along a groundwave path is dependent on the basic composition, moisture and mineral content present at, and below, the surface of the earth. Groundwave radiation in the AM broadcast band travels along the surface of the earth, and also penetrates the earth to a depth of several tens of meters.

The portion of the radiated groundwave that penetrates the earth encounters losses, causing the wavefront to tip forward slightly in the direction of its travel, which is useful in providing coverage beyond the radio horizon. Both poorer earth conductivities and higher broadcast frequencies result in greater losses.

The table below lists the descriptions, dielectric constants and conductivities for various land types common in the United States, in descending order. For reference, sea water has a dielectric constant of 80, and conductivity of 5,000 mS/m.

WHAT'S THE BEST FOR COVERAGE?

The amount of AM broadcast coverage difference that results from earth conductivity and frequency can be difficult to appreciate fully, without a detailed analysis. For this reason, a set of graphs is included as

Type of Terrain	Dielectric Constant	Conductivity mS/m
Pastoral low hills, rich soil, typical of Dallas or Lincoln, Neb.	20	30
Pastoral low hills, rich soil, typical of Ohio and Illinois	14	10
Flat country, marshy, densely wooded, typical of Louisiana near Mississippi River	12	7.5
Pastoral, medium hills and forestation, typical of Maryland, Pennsylvania and New York State, except mountainous territory and seacoasts	13	6
Pastoral, medium hills and forestation, heavy clay soil typical of central Virginia	13	4
Rocky soil, steep hills typical of New England	14	2
City, industrial areas, average	5	1
City, industrial areas, maximum attenuation	3	0.1

Source: Federal Register, July 1939

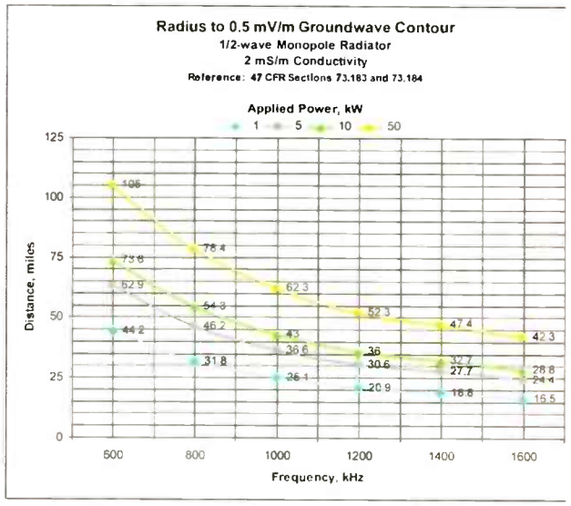


Fig. 1

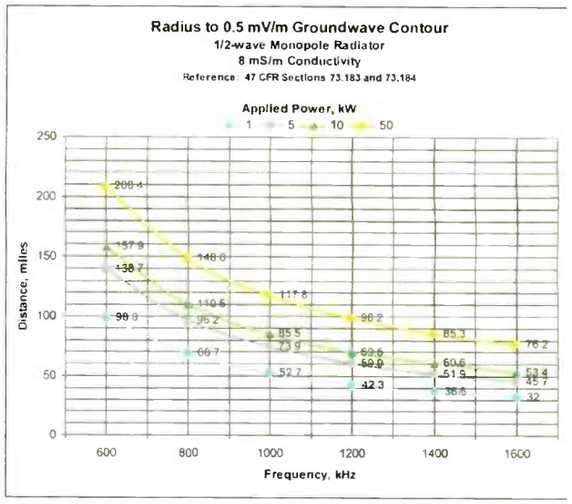


Fig. 2

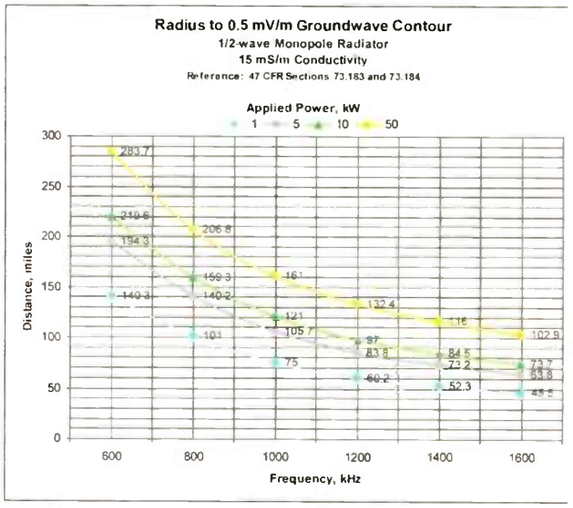


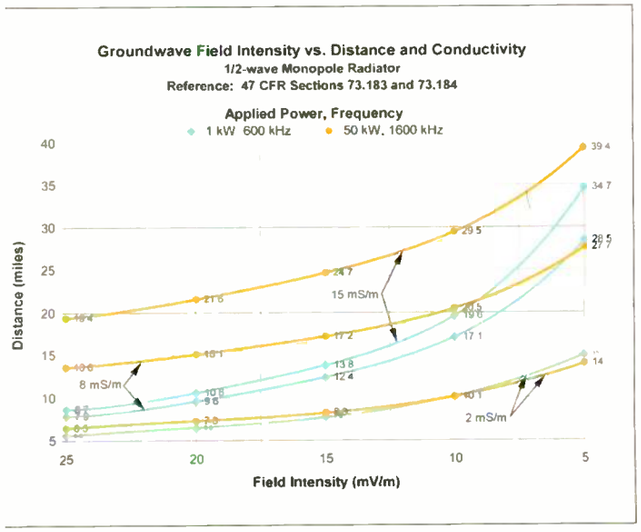
Fig. 3

Figs. 1–4 to show these effects visually.

The graphs lead to some interesting observations. For example, Figs. 1–3 show that a 1 kW AM station on the lowest AM frequencies can have a greater radius to its 0.5 mV/m daytime contour than a 50 kW station on the highest AM frequencies.

However this does not mean that a high-power, high-frequency AM station has *no* advantage in comparison to a low-power, low-frequency station. The high-power, high-frequency station can have significantly more field intensity, ranging to 40 or more miles from the transmit site, which serves a large portion of the city of license and surrounding area.

This effect is shown in Fig. 4, where the distances to equal field intensities for a radius of at least 26 miles and conductivities of 8 mS/m and 15 mS/m are greater for a 50 kW station on 1600 kHz than for a 1 kW station on 600 kHz.



ig. 4

Probably this advantage to high-power, higher frequency stations is more important to them and their local advertisers than the distances to their 0.5 mV/m contours.

Richard J. Fry, CPBE, was an RF systems applications engineer with Harris Broadcast. He is retired.

Comment on this or any article. E-mail rwee@nbmedia.com.

HD VOICE

(continued from page 16)

circuits, some lines for Skype access, and some for pure VoIP services from outside providers.

In addition, due to the daisy-chaining nature of the SIP protocol, it's possible for these lines on the WAN side to be extensions from an upstream PBX system — as long as it is SIP-compatible. This allows VoIP accounts to be shared between on-air and other station resources. Of course, the PBX must be wideband-friendly in order to pass wideband calls to its extensions.

In use, the specific nature of each call may vary, but the system hides these differences from the users. All calls are treated equally and have all the same management options. Any type of call can be placed on the air with any others regardless of codec, and whether narrow or wideband.

POSSIBILITIES

The platform for the STAC-VIP product lends itself to other features that will make it even more useful.

Some feature enhancements that are envisioned include the ability to record, archive to external storage and quickly edit calls and play them out through the system, all controlled from the web-based interface. Also possible is automatic archiving of call records and statistics in exportable formats and the integration of wideband capable softphones into the web-based user interface, eliminating the need for a physical control surface in many cases.

SUMMARY

The broadcast radio industry has been burdened with the sub-par quality of on-air phone calls long enough. Using a wideband-capable talk show system, stations can take the first steps to move beyond this problem.

With the proliferation of consumer-friendly "HD Voice-capable" phones, talk radio can be produced that is less fatiguing and more listenable. At first, it is likely that wideband options will be confined to prearranged guests with known compatible phones, but once stations get experience airing phones in wideband, I expect the demand both from listeners and program creators to increase, and for wideband talk to be common on broadcast radio.

Tom Hartnett is technical director at Comrex Corp. in Devens, Mass.

Can Anything Survive the Internet?

The Web Is Here, But Radio Can Still Be Saved

BY STEPHEN M. POOLE

Years ago I did some contract engineering for an FM station in the Sandhills of North Carolina.

If you like whacking little white balls with clubs, I'm sure you've heard of Pinehurst, the self-proclaimed "Golf Capital of the World." The place attracts northern retirees who enjoy the game and the warmer weather, making for a disproportionately large elderly population.

It should come as no surprise that this station was quite successful with an easy listening format. On Saturday evenings, they even did a special program of big band music. At the time (early 1980s), there were many retirees living in Pinehurst/Southern Pines who had grown up with Glenn Miller, Les Brown and Woody Herman. They absolutely loved that show.

The station later increased power to move into a larger market and changed formats. I don't think they ever made it as successful as they'd hoped. But the original owners knew the secret to good, profitable radio: Give the listeners what they want and do it well.

What brings this to mind is that we're going to kill ourselves if we're hard-headed or nearsighted. Cranial impenetrability is insisting on doing things the same way, regardless of whether it's working; myopia is refusing to see the clear trends.

WHERE ARE THE YOUNG LISTENERS?

Trends, by definition, occur slowly; things don't change overnight. But recent polls of younger Americans (say, under 25 years old) clearly show that most of these people rarely, if ever, listen to radio nowadays.

While tape and CD made it into our automobiles, these younger Americans are far more likely to take an MP3 player and connect it to the car stereo. At home and in the office, if they want music, they'll listen to that same player, or to a web "station" that allows them to set up their own playlist.

I won't get into the classic conundrum: How does one reach the younger listeners while not alienating the older, established audience? Greater minds than mine will have to figure that one out. But since Web radio looms on the near horizon as the Great Boogeyman, I can and will address that.

We remain competitive, especially in automobiles, because no one has figured out how to get truly reliable, wide-area Internet service into vehicles ... yet. What will we do when that happens?

The key words here are "yet" and "when." We have some breathing room in which to work, but we need to make wise use of it. HD Radio was implemented, at least in part, to help compete with new digital delivery methods, but if we ultimately determine that HD-R isn't doing that, we need to look to something else.

To hedge our bets, we also have to make sure that our web streams are as good as possible. The stations I work at don't treat streams as throwaway additions; in some cases, especially with our more successful formats, we even use dedicated processing just for the stream.

But I still think that the real answer is the same as what the original owners of that easy listening FM in the Sandhills figured out: Give the listeners what they want, and (aha!) what they can't get elsewhere.

Those web "stations" that allow you to set up your own playlist are a neat trick, but you know what they can't do? They can't do live, real interviews with the listeners' favorite artists. They can't easily do traffic, or warn listeners when severe weather is approaching either.

That last one is especially important to me. As Cris Alexander relates elsewhere in this issue, deadly tornados swept through Alabama where I live and work during the last week of April. Hundreds of people lost their lives.

iStockphoto/Martina Ebel

Today's young listeners are more likely to listen to music off an MP3 player or connect to a web 'station' that allows them to set up their own playlist.

But the consensus among emergency personnel is that broadcasters kept that horrible death toll much lower than it might otherwise have been. We were on it from the moment the first advisories were issued and we stayed on it for days. After the storms, we told survivors where to find basic supplies: Food, water and even ice to keep insulin chilled. My stations took calls from people all over Alabama expressing needs; other listeners would call and say, "I can help."

Web radio just can't do that. And neither can a half-hearted, lackadaisically-programmed, fully automated station that just plays the same 30 songs over and over. When a crisis occurs, people want information, not a jukebox.

The real keys to radio, of course, are personalities. People.

Look at the most successful stations, and you'll see real show hosts who talk to real listeners. They are not just egos with great voices; they are friends with the audience. You'll see salespeople who treat their clients with care and respect and who genuinely care whether the advertiser gets results. You'll see engineers who are passionate about how the station sounds, who think of new ways to tinker and get one more ounce of performance from the equipment, and who will give everything they can to keep services alive when an emergency hits.

Simply put — and I believe this with all my heart — you'll see people who love radio, who believe in radio and who want radio to continue to be a success. It will take some flexibility and an open mind, but if we really want it to happen, it will happen.

Stephen M. Poole, CBRE-AMD, CBNT, is chief engineer for Crawford Broadcasting in Birmingham, Ala.

HD RADIO

(continued from page 18)

is expiring; a recent settlement of a lawsuit by subscribers only delays an inevitable increase. Meanwhile, wireless Internet subscriptions for cars will no doubt start growing and hitting consumers' pocketbooks. It should become even easier for free over-the-air radio, including HD, to exploit our zero cost advantage.

New and creative methods for stations to justify and afford converting to HD have been introduced. In case you missed it, Citadel Media offers radio stations iBiquity licensing and HD transmission equipment from major manufacturers in trade for spot inventory. It's a partnership deal iBiquity and Citadel unveiled last fall as way for smaller and cash-strapped stations to add HD.

CHANGE IS IN THE AIR

So is HD Radio really worth the effort?

If I were a station owner committed to keeping my business viable and profitable going forward, I don't think I'd want to rely on analog-only radio to sustain me. Nor would I succumb to the hype that ubiquitous wireless Internet is right around the corner and expect my Internet stream and website to take over and replace my air signal for the entire audience.

If you're worried about the Internet completely replacing traditional over-the-air radio, it's going to be quite a while before that's likely to happen. And even when the technology and the necessary supporting infrastructure advance sufficiently across the country to make that possible, there will be an associated cost to acquire and maintain the service. Many consumers will not be willing to step up and pay the freight as long as free alternatives remain.

I'm comfortable letting future generations of station owners deal with that entire issue; technology continues to change and the market determines the time and the need to make the right decisions. For today and the immediate future, let's stay focused on providing and selling compelling content on every delivery platform we can harness, and it won't matter which one the listeners choose to receive it.

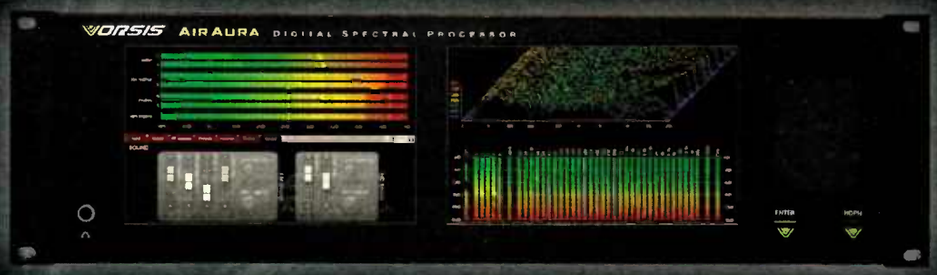
Guy Wire is a pseudonym for a veteran broadcast engineer.

SOUND:REAL

"With the AirAura, THUNDER sounds more thunderous..."

It's not often that management and engineering are in total agreement. It's even more unusual when the top dog is a CPA who is the GM AND the CFO. That's Richard T. Morena, Principal of Press Communications, LLC. He and George M. Kowal, his Assistant Chief Engineer, see eye to eye (or ear to ear) when it comes to their on-air sound. Press Communications, LLC is located in Arbitron Market #51 and broadcasts on the simulcast 106.3FM/106.5FM (THUNDER 106) from Atlantic City to NYC. That's why they've got a pair of Vorsis AirAura processors taking care of business at THUNDER 106.

"Sure, WE can hear the difference immediately. But when our LISTENERS call to tell us how great we sound, we know we're onto something big. With the AirAura, THUNDER sounds more thunderous and THAT is something that really shakes up our bottom line," says Richard Morena. "We LIKE that!"



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