ENGINEERING EXTRA

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Ground Conductivity Field Measurements

It's No Walk in the Woods to Use a Test Antenna to Determine Conductivity

BY W.C. "CRIS" ALEXANDER

Most of the time I sit behind a desk these days, shuffling paper, crunching numbers, working the e-mail and talking

A DAY IN THE LIFE

on the phone. But once in a while I get out in the field to do something interesting. I had such an opportunity in late October.

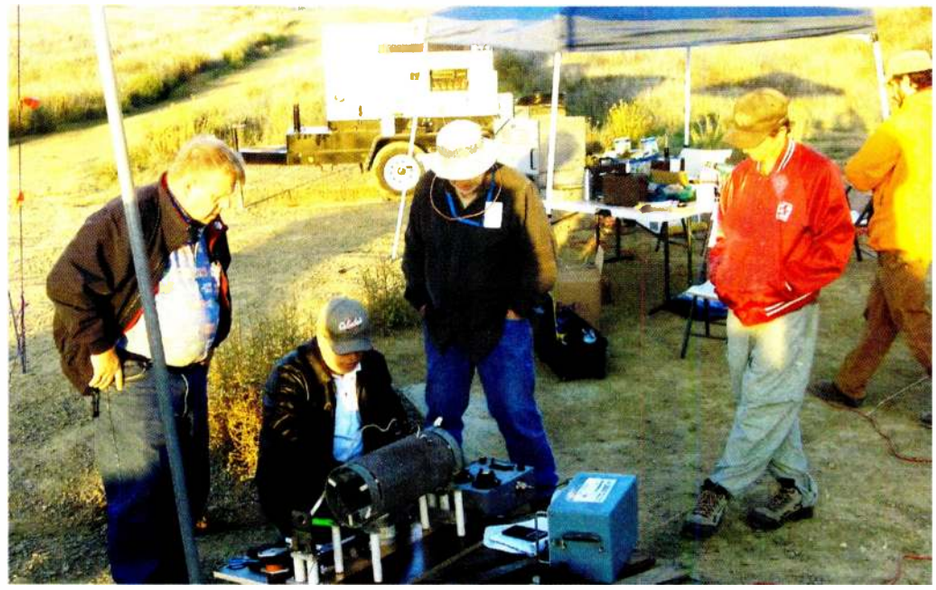
In the process of preparing an FCC application to relocate one of our AM stations to a new site, I found that I needed a span of measured conductivity data that I didn't have. In every other direction of interest I had data from an old (1990s) facility that had once occupied the Southern California site we purchased a few years ago. But in one direction, toward the contour of a nearby third-adjacent station, I had no data.

The FCC's M3 conductivity data showed a very high value that I knew was not correct. Without the measured data, I would have to roll the power of our relocated station way back. And so it was that I found myself in the position of needing to set up a test transmitter at the site and make some radial field strength measurements.

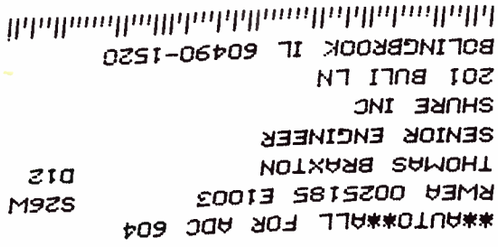
The process for doing this is fairly straightforward.

First, we had to find a frequency. That was fairly easy. I looked at the daytime allocations at the top end of the band and found that on 1690 kHz there was nothing co-channel for a long way in any direction. There were first- and second-adjacent channel stations within a few hundred miles, but nothing close enough to matter.

I filed an application for special temporary authority for 1 kW on 1690 kHz from the new site and quickly got a grant.



The author adjusts the tuning network as Joel Saxburg, Burt Weiner and Todd Stickler, from left, look on. Kyle Warner is at far right.



GATHERING THE GOODS

Next, I had to round up some materials.

Bill Agresta, our chief engineer in the market, was able to find a supplier of Rohn 1-1/4-inch steel mast sections, and he purchased 10 of those. He then found the nylon guy rope we would need, 1-inch rebar (for guy anchors) and miscellaneous hardware at Home Depot.

Since Bill is somewhat of a packrat, it was no surprise that he had in his possession a porcelain bell-shaped insulator from an old railroad telegraph pole that would work just great as a base insulator.

I had in my secret stash a couple of 2,000-foot rolls of AWG #12 bare copper radial wire, so I shipped those to California along with my recently-calibrated field intensity meter (FIM). Our friends at Nautel Ltd. have a J1000 1 kW solid-state AM transmitter that they make available for rent, so I arranged to have that tuned up on 1690 kHz and shipped.

Finally, my good friend Joel Saxburg, assisted by local engineer Burt Weiner,

(continued on page 4)

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Common Alert Protocol Timer Ticks

Broadcasters Got Their Extension, But Numerous Questions Still Remain

BY MICHAEL LECLAIR

This fall saw a flurry of activity on the Common Alert Protocol front. Rumors had been flying since April that Federal Emergency Management Agency deliberations were nearly at an end. Sure enough, on Sept. 30, FEMA announced it was officially adopting the Common Alert Protocol Standard v1.2.

This decision started the "CAP timer" or "shot clock," created by the FCC in a Report and Order released July 12, 2007. In that order, the FCC made it a requirement that all EAS participants be able to accept CAP-based alerts within 180 days of the adoption of CAP by FEMA. Thus, once FEMA acted, we all had until the end of March 2011 to purchase and install new equipment. Or so we were told at first.

Technically, some stations have already installed CAP-capable gear: for example, anyone who has purchased new equipment in the last couple of years most likely bought something with CAP capability. Many others have money set aside to purchase the equipment soon. After all, FEMA announced its intention to adopt CAP back in July 2008. It took a while for the final reviews to ensure them that CAP was the way to go for the new Integrated Public Alert and Warning System, which is supposed to operate across pretty much any media platform that you can think of, including cell phones.

The fact that we had all been told years ago that the Emergency Alert System was going to change and require new equipment didn't stop an initial round of panicked comments, even defiance, from some broadcast quarters. The argument that someone was somehow unaware of this requirement and can't afford to purchase new equipment doesn't seem to hold much water given the number of years that this has been under discussion. However, there are some legitimate reasons why the 180-day timer was a bit too hasty.

ROUND TWO

Enter the NAB and an impressive range of other supporters with a petition to delay the CAP adoption by another six-month period. National Public Radio, Society of Broadcast Engineers, Association for Maximum Service Television, the Public Broadcasting Service and no fewer than 46 state broadcasting associations all signed on to this request.

It turns out that there is a certain amount of unfinished business that the FCC was unable to complete while waiting for FEMA to act.

First, it isn't completely clear just how the new EAS system with CAP is supposed to work. While several manufacturers have built equipment that can decode CAP messages, it isn't quite that simple — equipment will have to provide the necessary features and operations that allow consistent EAS operation. The EAS CAP Industry Group recommendations are an excellent starting point but these have yet to be formally accepted. The petitioners have also requested that the FCC certify compliance of new-generation EAS equipment to make sure that broadcasters are buying what will actually be needed.

Indeed, the Communications Security Reliability and Interoperability Council, whose mission is to provide recommendations to the FCC on security and reliability of public communications and public safety, agrees that the FCC should separately certify equipment. And in a report approved in October 2010, the CSRIC makes a number of additional recommendations to the FCC regarding CAP implementation.

Key among these recommendations are the following:

- Clarification of governor's "must carry" implementation
- Requirement that EAS participants monitor multiple IP-based alert sources
- Revision of EAS Equipment Requirement Tables
- Requirement of Ethernet input to monitor for alerts

It was hard to see how manufacturers can produce compliant equipment and stations can purchase the correct complement of equipment until these recommendations are acted on. The CSRIC acknowledged this in its own recommendation to extend the compliance period for EAS participants.

WHAT ABOUT THE RULES?

Finally, as a legal matter, the FCC will need to make a number of changes to the rules regarding EAS.

While this is perfectly controllable by the FCC, the process will still require the issuance of a Notice of Proposed Rulemaking and the necessary comment periods before the new rules can be adopted. Even assuming a fairly rapid pace at the FCC, this final step probably wouldn't be complete until nearly March 2011, or right about when the CAP timer was to run out. That didn't give manufacturers and stations much time to comply, even if most stations were to go out and purchase a base system today and plan to modify it as necessary once the rules become clear.

The CSRIC report includes a thorough description of the rules changes to Part 11 of the Code of Federal Regulations that will be required in order to include CAP in the Emergency Alert System. There are too many changes for me to include them all here but it makes for interesting reading if you want to watch the cogs of government turning. The CSRIC report is publicly available at *http://tinyurl.com/rwcap*.

SECOND GUESSES

Just before our issue went to press, the FCC did indeed extend the deadline, to the end of September. That's wise. Making broadcasters purchase equipment that will not necessarily satisfy the new legal requirements would not have been good or effective government. Public safety is an important mission for broadcasters; but if we want this upgrade to work, all pieces should be in place *before* we go spend time and money.

Meanwhile, we hope for more clarity on exactly what it means to be in compliance. So keep your ears to the ground, download a copy of the ECIG to read and start to think about how you plan CAP modifications. As much as the argument today is about new equipment, in the end it is the engineer's business to spend the time and figure out exactly *how* to make the whole thing work at the station level. And there is little doubt that the requirement will be coming soon.

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CONDUCTIVITY

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came up with the materials to make an antenna tuning unit that should match just about any low-Z load. Joel and Burt cobbled the ATU together on a piece of particle board, complete with J-plugs on the input and output and a female N-connector on the input.

In the weeks leading up to the measurements, I had played with a number of antenna designs and models, and finally settled on a 50-foot vertical mast with 30 feet of guy-wire top-loading. I felt that height should be physically manageable, and the top-loading, which would consist of 30-foot lengths of the bare AWG #12 wire connected to the top of the mast and taped to the top set of nylon guy ropes, would produce a base impedance that we could work with.

We scheduled a three-day period in which to conduct the measurements. Day one was designated as setup day, and Bill arranged to have a portable generator delivered to the site that afternoon. He also had a crew of 12 on hand to assist with the assembly and raising of the antenna.

IN THE AIR ...

On the advice of a long-time friend and consulting engineer, I initially had planned to assemble the entire antenna and then raise it up by using several people along its length along with a number of others manning the guy ropes. Because the site has some slope to it, we were able to lay the assembled antenna on one of the sloped areas so we wouldn't have to pull it vertical from flat on the ground.

Like all great battle plans, that one went out the window as soon as the first shot was fired ... in this case, as soon as we tried to raise the antenna. We didn't buckle anything, but it was apparent we were headed that way. The mast material we were using must have been a lot more flexible than what my friend had used. We needed a better approach.

The new plan was to assemble 30 feet, raise it into the air (one person could do that) and have people man the guy ropes while we lifted the whole thing straight up and inserted additional sections from below.

That procedure worked like a charm. The hardest part was installing screws at the joints to create the good electrical bond we needed. We then lifted the entire mast and set it on the bell insulator.

AND ON THE AIR

Finally, with the antenna in the air and guyed off (and shaped like the letter "S"!), I got busy laying the ground system. I rolled out a dozen 165-foot lengths of the AWG #12 bare copper wire on top of the ground, securing the ends with spikes. Bill used a piece of 1/4-inch copper tubing as a ground ring and soldered all the radial wires to it.

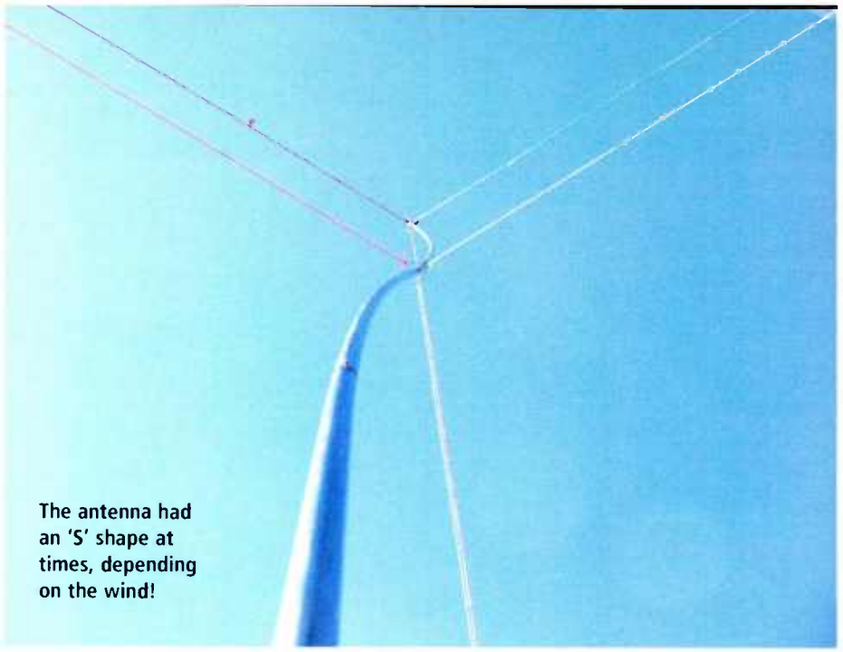
Next, we measured the base impedance of the antenna and found it to be 26.5 – j231 ohms, a value we could easily work with. We then connected the ATU network Joel had built, calculated the leg values and set them with a bridge.

Checking the input of the network we should have seen 50 ohms. What we saw was anything but! We spent an hour trying to get that network to match the antenna in both tee- and L-network configurations without success. With the sun rapidly going down we packed up and headed down the mountain for the night.

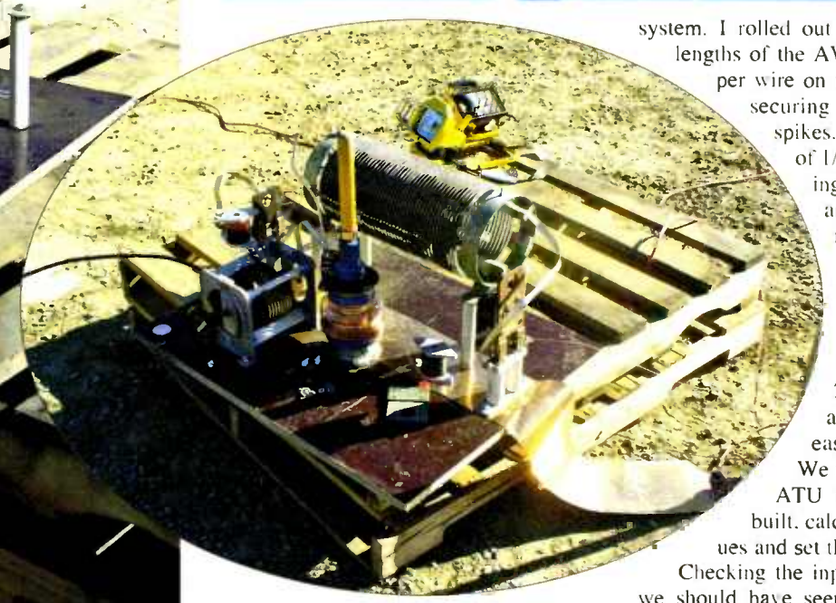
The next morning we attacked the tuning network again. Like the night before, nothing was making sense. The laws of physics and electronic theory should apply, but in this case they appeared not to.

We had just about run out of altitude, airspeed and ideas when the light bulb came on. To give us lots of adjustment range, Joel had employed a large (several hundred microhenry) coil on the output of the network. We were using only about a third of it, and the remaining turns were left open. Our problem was that the unused turns of that coil had a lot of distributed capacitance to the 6-inch copper ground strap running beneath the coil and it was acting like a large capacitor to ground across the base of the antenna!

(continued on page 6)



The antenna had an 'S' shape at times, depending on the wind!



Left: Antenna base, bell insulator, ground ring/radials and tuning network.

Above: Detail picture of homemade ATU. Note the large coil mounted over the ground strap, which added unexpected capacitance.

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CONDUCTIVITY

(continued from page 4)

A few circuit modifications and we quickly had a 50-ohm non-reactive load for our transmitter. We connected the J1000, fired it up at 1 kW and were off to the races.

We had a little generator trouble, something with the governor; but that eventually straightened itself out. We used a 360 Systems Instant Replay to loop a 1 kHz tone and voice ID into the transmitter at about 50 percent modulation so that we could identify the signal in the field, particularly at the far end of the radial where the signal would be weak.

A WALK IN THE WOODS

There are two components to any set of AM field intensity measurements for determining ground conductivity: close-in measurements to establish the inverse distance field (IDF) of the antenna, and far-field measurements to determine conductivity. The FCC wants to see at least seven measurements inside 3 km, but more measurements make it easier to analyze the data.

I, along with my daughter Amanda (chief engineer of our Denver market) and our local operations manager Todd, started off on foot for the close-ins. We used a handheld Differential GPS/Wide-Area Augmentation System-equipped GPS unit to keep us on the radial and determine the exact distance back to the antenna. Starting at 50 meters we made measurements every 50 meters or so out to 400 and then every 100 meters out to 1 km. Beyond that distance we got what we could.

Most of the area is located in the Cleveland National Forest. The name evokes images of stately lodgepole pines and aspens. Picture instead scrub oak 10–12 feet tall and so close together that we couldn't squeeze between them. We had to follow game trails through the dense brush in many locations, pushing back into the scrub to get the measurements.

We finally reached a point where there was a sheer drop-off of several hundred feet lined with more of the same dense brush. It became clear that this was the end of our close-in measurements. We climbed back out, hiked to the nearest trail and began working our way back to "base camp" where we spent hours digging the tree "stuff" out of our pockets, collars and waistbands.

While Amanda, Todd and I were having fun in the woods, Joel and Burt were out on the road taking far-field measurements. It didn't take too long to go as far as they could — they hit land's end just north of Ranchos Palos Verdes and called it a day.

It was with some sadness that I signed off our one-day test station. We took the antenna down and packed up all our stuff, leaving the site as pristine as we found it. Back in Denver I was able to analyze the data and prepare a showing for the FCC. It was a lot of trouble to determine the conductivity over a 70 km path on a single radial, but in the end it will be well worth it. And for about five hours on that one day in October there was a signal in the L.A. area on 1690 kHz.

Cris Alexander is the director of engineering at Crawford Broadcasting and a past recipient of SBE's Broadcast Engineer of the Year award.

READER'SFORUM

ORBAN: 'AN EXCELLENT PROJECT FOR THE NRSC'

Regarding Frank Foti's SSB FM proposal as described in "A Method to Improve Conventional FM Stereo" (Radio World Engineering Extra, Oct. 13):

The main computational load required to implement this system is the linear-phase FIR low-pass filters needed to realize the Weaver modulator that would generate the SSB component. The L+R would also have to be delayed by the group delay of these filters. If SSB operation is required down to 0.15 Hz (which would be required to preserve the peak level of a highly processed audio waveform), then these FIR filters would be very long (they would be required to have a transition region between pass-band and stop-band of 0.15 Hz) and would probably need to be computed by fast convolution. This implies a long coding delay, which would cause problems if talent needed to monitor off-air through headphones. (Our processors offer an "ultra-low-latency" structure that can be put on-air to address this.)

I have examined the mathematics, and it turns out that one could also do a vestigial sideband realization where the upper sideband was allowed to have frequency components up to a few hundred Hz. This would substantially ease the filter requirements and would also result in less coding delay. It is possible to arrange the VSB such that the peak modulation of the composite baseband signal is still correctly controlled; the sum of the gains of corresponding upper and lower side-

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bands must be unity and these sidebands must be in phase, which will occur in a phase-linear realization. (Conventional DSB FM stereo is a limiting case of this, where mirror-image sidebands of 0.5 gain appear throughout the stereo subchannel spectrum.)

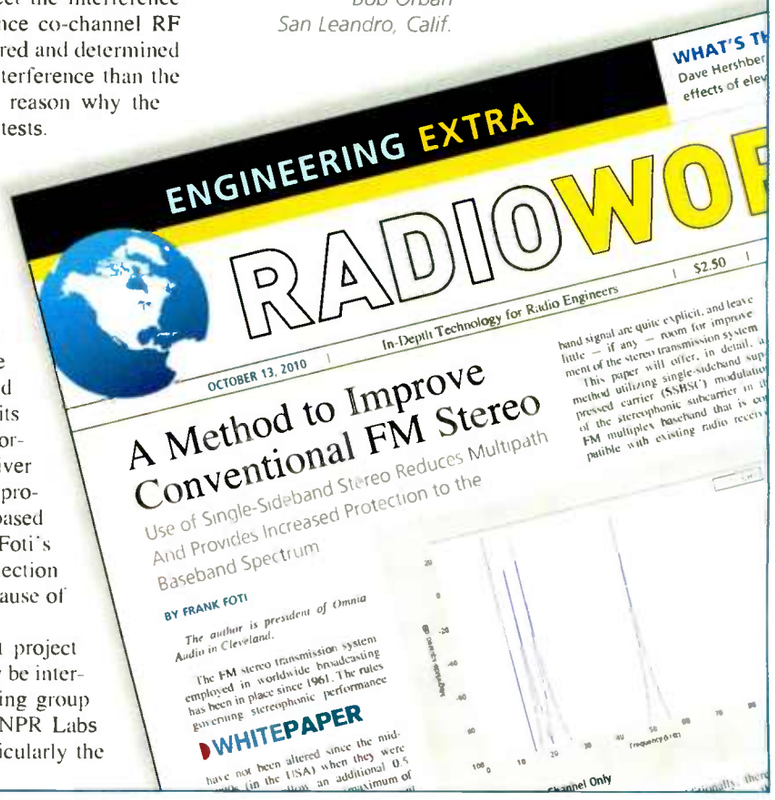
One other important thing to consider is how certain receivers might react to this waveform. I know that Sony in its most advanced receivers uses the quadrature component of the stereo subchannel to estimate channel noise. This noise estimate is used to control a variable-blend-to-mono algorithm in sub-bands. This exploits the fact that in conventional FM stereo, the quadrature component of the stereo subchannel is zero, so material appearing in quadrature can assumed to be due mainly to transmission channel degradation, including multipath and noise. I do not know if any other brands of receivers use this information, but if they do, it's important to know this because the SSB modulation will result in a quadrature component that is equal in magnitude to the in-phase component when demodulated with a conventional double-sideband synchronous detector. If the receiver misinterprets this, it could result in a premature blend to mono. Broadcasters need to know if implementing the new system will force a significant number of the listeners' radios into blending, which can also include HF rolloff.

In addition, I believe that before transmissions using this technique are allowed to proceed, laboratory measurements of co-channel RF protection ratios should be made both under ideal conditions and with multipath. While the results may well favor the SSB technique, it is important to know this with certainty before this proposal is placed before the regulatory authority because this would affect the interference environment in the FM band. Once co-channel RF protection ratios have been measured and determined not to create worse co-channel interference than the existing system, I don't see any reason why the system can't be put on the air for tests.

I am in favor of any changes that will in fact benefit the listener. But when one proposes changing FCC and ITU-R rules, regulations and standards, it is necessary to supply a great deal of data. The proposed system must be completely described technically (like, for example, the ATSC digital television system and not like the HD Radio system with its black-box codec) and must be thoroughly tested to determine receiver compatibility and co-channel RF protection ratios. (In my opinion, based on the RF spectra pictures in Mr. Foti's article, adjacent-channel RF protection ratios should not be a problem because of the system's lower bandwidth.)

I think that this is an excellent project for the NRSC and I would certainly be interested being involved with a working group to investigate this. I believe that NPR Labs has the necessary equipment, particularly the multipath simulator and other aspects of the RF path instrumentation.

Bob Orban
San Leandro, Calif.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A Method to Improve Conventional FM Stereo

Use of Single-Sideband Stereo Reduces Multipath And Provides Increased Protection to the Baseband Spectrum

BY FRANK FOTI

The author is president of Omnia Audio in Cleveland.

The FM stereo transmission system employed in worldwide broadcasting has been in place since 1961. The rules governing stereophonic performance

WHITEPAPER

band signal are quite explicit, and leave little — if any — room for improvement of the stereo transmission system. This paper will offer, in detail, a method utilizing single-sideband suppressed carrier (SSBSC) modulation of the stereophonic subcarrier in the FM multiplex baseband that is compatible with existing radio receiv

How to Set Up Your Own Domain

Let's Get Started on Creating That Server With a Station-Specific Name

BY STEPHEN M. POOLE

In the Aug. 18 issue of Radio World Engineering Extra, I discussed Network Address Translation, in which your router looks at the port numbers on incoming packets and "steers" them toward different IP addresses on your network. We also set up a simple VNC (Virtual Network Computing) server so that you could access your PC from home.

This time, we're going to start laying the groundwork for other, higher-traffic, publicly exposed servers with useful domain names such as "www.wxyz.com" and "mail.mybroadcasting.com."

For now, the type of server doesn't matter; this information will apply regardless of what you're trying to make available over the Internet.

In this article, we take care of the preliminaries: We'll obtain a static IP address and high-speed service from a local Internet service provider, and register a domain name for that IP address with the Domain Name System (DNS).

STEP ONE: THE INTERNET SERVICE PROVIDER (ISP)

To save time, energy, headaches and wasted effort, I *strongly* recommend that you use a good, small local ISP for both the static IP address and the domain name registration.

When you call, tell them you want them to act as the "authority" for that DNS record and that you will also need the reverse DNS set up for your domain name. If they can't handle all of that, find someone else. Even if you have to pay a bit more, it's worth it.

For example, we use HiWAAY Information Services here in Birmingham. They're a local, Alabama-based ISP that will both lease the static IPs that we need and set up all of the DNS stuff for us. In fact, we're on a first-name basis with Derrick, Ches and William at the local office, and their help has been invaluable over the years. Ask your local geek community for recommendations. If you can find your own local "hiwaay," half your headaches are solved before you get started.

Here's a tip: "www.mydomain.com" and "mydomain.com" actually are two separate domain names (or to be technically correct, the first one is a *subdomain* of "mydomain.com"). When you register your domain name, be sure to register all common variants that might be used to get to your server. For a Web server, the bare minimum might be "www.mydomain.com" and "mydomain.com." We will discuss adding other domains in a later article.

WHAT'S REVERSE DNS?

You already know how DNS works: When you enter "somesite.com" in your Web browser, a DNS server is queried and the IP address for "somesite.com" is returned. What most people don't know is that it's possible to go the other way; you can look up the domain name from the IP address. This is a *reverse DNS lookup* (or "rDNS," if you're a geek).

You've probably already seen this at work. If you've ever gone to a website that guessed your location and targeted local advertising to you, reverse DNS is probably how they figured out where you were.

As the Internet continues to fill with spammers and scammers, rDNS is one of many tools that are used by filtering software. A great deal of spam comes from computers that have been infected by viruses or other malware, which has turned them into so-called "spambots." This usually occurs without the owner even realizing that his/her computer has been compromised. But using rDNS is a valid technique against this.

For example, the IP address on the incoming mail message on one of these spambots will almost certainly not match "mail.mycheapviagra.com" with a reverse DNS lookup!

Reverse DNS creates more work for those of us who want to set up a legitimate mail or Web server, however. It's critically important for a mail server, but rDNS also is used now to check for obvious scam websites. You may find that you'll need the reverse DNS to work for an e-commerce site (i.e., if you're selling anything).

Just to provide an example, Fig. 1 shows a "host" lookup on our company's mail server, followed by a reverse DNS on the returned IP address. (Windows doesn't have a "host" command, but you can get similar results online; try dnsstuff.com, for example.)

```
stephen@linux-edxs:~> host mail.crawfordbroadcasting.com
mail.crawfordbroadcasting.com has address 216.180.115.25
stephen@linux-edxs:~> host 216.180.115.25
25.115.180.216. in-addr.arpa domain name pointer mail.crawfordbroadcasting.com.
```

Fig. 1: DNS and rDNS lookup for the author's mail server

The bottom line is that you want the reverse DNS for your static IP to map correctly, especially for a mail server (speaking from personal experience) and possibly for other types of servers in the future.

STEP TWO: GET THE PROVISIONING INFORMATION

Once you sign the contract for the high-speed Internet service and the static IP address, your ISP should send you what's called a "provisioning sheet." This will have your assigned IP address, the netmask, their DNS servers' IP addresses and other pertinent information.

Make sure your ISP understands what you're trying to do (another reason for choosing a small, helpful local provider; you will be talking to technicians instead of people who are simply reading from a script). You don't want the modem to do any routing or NAT; you will be directly connecting to the Internet.

The numbers on the provisioning sheet will look a little different from the usual "192.168.x.x" values used with a local network, but they'll work the same way. Here's the key: You can imagine that the DSL (or other) modem is simply providing a long-distance link into your ISP's network. *It's the same as if you were to take a very long Cat-5 cable and literally plug your PC into a network switch at your ISP's office.*

Assuming you've entered the information from the provisioning sheet correctly, you can test it with your Web browser. If you can hit Google on that PC, you're online and ready to go.

STEP THREE: WHAT ABOUT MULTIPLE STATIC IPs?

Some ISPs will no longer lease a single static IP; instead, you'll be given a small block of addresses — for example, from 216.180.100.121 to 216.180.100.127. If that's the case and you're only setting up a single server, simply use the first IP address and tell the ISP to assign your domain name to that one. The others will be available for future expansion.

You can again imagine that you're using a very long Cat-5 between your offices and the ISP's location, but now, you'll need a small network switch to "break out" (or "split," if you prefer) those additional IP addresses. This is shown in Fig. 2.

In the future, you could expand and add other servers by simply using the other available IP addresses.

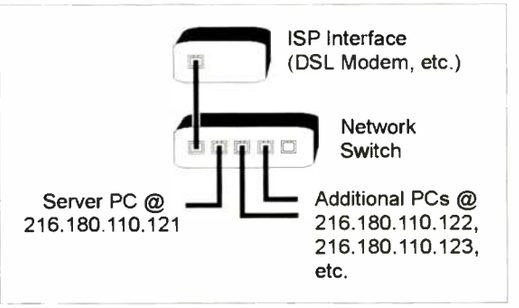

Fig. 2: Using a network switch to break out multiple static IPs

For example, you could plug a second PC into that small network switch, using the second available IP address from the provisioning sheet. A third PC could be added with the third available IP address, and so on.

What's really neat about being on the Internet is that ... well, you're on the Internet! Now, instead of just exposing your computers to the other PCs on your office network, the whole world can see them.

At this point, we'll finish up with the usual (and painfully obvious) caveats about security: Don't ever, *ever* do this with a machine that doesn't have an active firewall. If you expose an unprotected PC directly to the Internet, it could be attacked and compromised within a matter of minutes.

For now, go ahead and order that static IP address and high-speed service. Set up a PC on that connection (enable the firewall!) and test everything. Even though we introduced NAT last time, you really don't want to use NAT on your office network for a high-traffic, public-exposed server; spend the money for separate, independent service. You'll be glad you did.

Next time, I'll show you how to use that new connection and static IP to set up a SSH server. Your clients can use that to directly upload audio files to your station. This is one of those things that you'll wish you'd had years ago, once you try it.

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

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The SNMP Protocol and Its Integration As a Broadcast Monitoring Tool

IT Industry Software Tool Unlocks Equipment Diagnostics

BY TONY PETERLE

The author is technical support manager at Worldcast Systems Inc. in Miami.

I. INTRODUCTION

Today's broadcast engineers are facing challenges that seem to be ever-increasing in complexity. While systems in some areas have become more reliable and require less attention from technical personnel, new responsibilities have been delegated to the engineering department. Systems that did not even exist 20 or even 10 years ago — IBOC signals, PPM systems, streaming websites, distribution of data via RDS and IBOC data services — have maintained or even increased the overall workload and demands on the engineering staff. And frequently, that staff is smaller than it was in past decades.

Information technology systems of a broadcast facility are part of those relatively new responsibilities. Many of us can remember when the "network" of a radio station consisted of only the traffic and billing computer, the storage server for that terminal and a dot matrix printer for the logs. Of course, today's stations have large and complex data networks; many times there are even multiple independent networks in the same facility. Even if a separate department has been created to oversee these systems, the increasing integration of IT into primary broadcast systems such as audio delivery and remote equipment management requires that engineering personnel have at least a basic knowledge of networking and how the IT structure impacts their responsibilities.

While IT requires some additional skill sets in broadcast technicians, it also offers great capabilities to help manage the overall technical workload. Being able to communicate with and control remote equipment over a high-speed network connection enables engineers to troubleshoot, correct problems and, in some cases, even perform maintenance on the most inaccessible sites from their office or home. Beyond that, the IT infrastructure brings with it certain capabilities and standards that, like HTTP or telnet, can be used to the advantage of today's broadcast engineer.

This brings us to the topic of the Simple Network Management Protocol. The SNMP standard is a set of rules that defines a way to identify certain data points, or objects, in a piece of equipment that is connected to a data network. The protocol establishes a standard syntax that allows users to query that equipment via the network and receive the real-time values of those data objects. And in certain cases, the user can even change those values using SNMP, which can allow them to control the functions or settings of that equipment.

This paper will attempt to explain at least the basics of the SNMP structure and capabilities, and how broadcast technical personnel could benefit by integrating the SNMP protocol into their overall facility control and management systems.

HISTORY AND DEFINITIONS

The Simple Network Management Protocol was developed during the late 1980s by the Internet Engineering Task Force (IETF). SNMP primarily was a way to facilitate communications with and control of distant networked computers as the Internet was being expanded into the worldwide data network that we now know and use on a daily basis. At the time, there were many protocols, some proprietary, which IT administrators used to communicate with and control their routers and other network infrastructure. After much discussion and debate, the protocol we know as SNMP was chosen.

While the "S" in SNMP stands for Simple, that word is used in the context of computers and processors. In other words, it is simple for the machines to understand and use, but perhaps not so simple for human users of the systems.

The earliest version of SNMP was called V1. Currently, the most commonly used versions are V2c, which added some new commands, and V3, which applies a somewhat more secure process to send the SNMP data back and forth across the network.

SNMP DEVICES

All SNMP communications happen between two, and only two, devices. One device is designated the Manager. In almost every case, a Manager initiates the SNMP communication with the target device, which is designated the Agent. While a single Manager — commonly called a Network Management System, or NMS — can manage and control hundreds of Agent devices, each of those communications are discrete, point-to-point connections (see Fig. 1).

To clear a semantic point, the terms "Manager" and "Agent" refer specifically to the software modules running in each device that enable and support the transfer of data using SNMP, but for the purposes of this paper, the terms are applied equally to the hardware and software on each end of an SNMP message. Also keep in mind that the device running the Manager application can also itself be an Agent, managed either by its own internal NMS software or perhaps by another Manager system elsewhere on the network. A Manager will normally send SNMP requests to the Agent on IP port 161.

OBJECT IDENTIFIERS (OIDs)

At its heart, SNMP is simply a way to retrieve and set data points in a remote system. These data points, called Objects, are defined by the maker of that system, usually at the time of manufacture. The value of an SNMP object is very flexible — it could be an integer, a floating point number, even a text/numeric string. Each Object has a unique identifying number, which is used by the Manager and Agent systems to locate and deliver the requested data to the user. These numbers are called Object Identifiers, or OIDs. A Manager will use the OID to request data from an Agent, and the

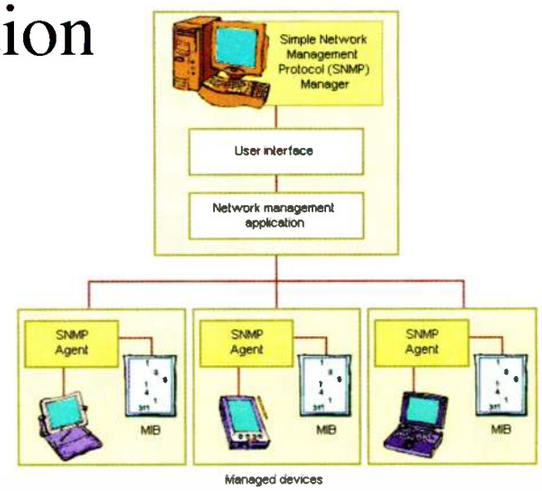

Fig. 1: SNMP Manager and Agent Devices

Agent, in its response to the request, will send that same number along with its current value. The OID is also used when the Manager device sends a SET command to change the value of a data point in the Agent, and also on those rare occasions when the Agent device is the one to initiate communications.

Object Identifiers are written with a specific (and rather old) syntax called Abstract Syntax Notation One, or ASN-1. A typical OID might look like this:

1.3.6.1.4.1.186.1.19.2.1.2.4.0

MANAGEMENT INFORMATION BASES (MIBs)

When an Agent device is manufactured, the designers will usually organize all of the OIDs for that device into a structured text file, called the Management Information Base, or MIB (see Fig. 2 on page 14). The MIB can be viewed as a "menu" that a user of NMS software can use to browse to and identify the OIDs necessary to access the desired data points on that Agent device. There are many software applications, called MIB Browsers, that will allow a user to examine these files, and most browsers display the MIB as a directory-tree type structure.

Unfortunately, it's not quite as simple as it might sound. As we will see, some OIDs cannot be completely defined at the time of manufacture, and other makers of Agent equipment publish only "truncated" MIBs that refer to other industry standard files (other MIBs or RFC files) to define their own structure and OIDs.

SNMP COMMANDS

The commands and messages that pass between the Manager and Agent devices can be divided into three categories: GET commands, SET commands and TRAP messages.

SET commands are perhaps the simplest. They are messages sent from the Manager device to the Agent, containing the OID for a particular data point, and the desired value to be set for that point. This is the way a Manager can command the remote device to enable or disable functions or change a value, such as the frequency of an N+1 transmitter. No matter if the value of that particular object is an integer, a floating point

(continued on page 14)

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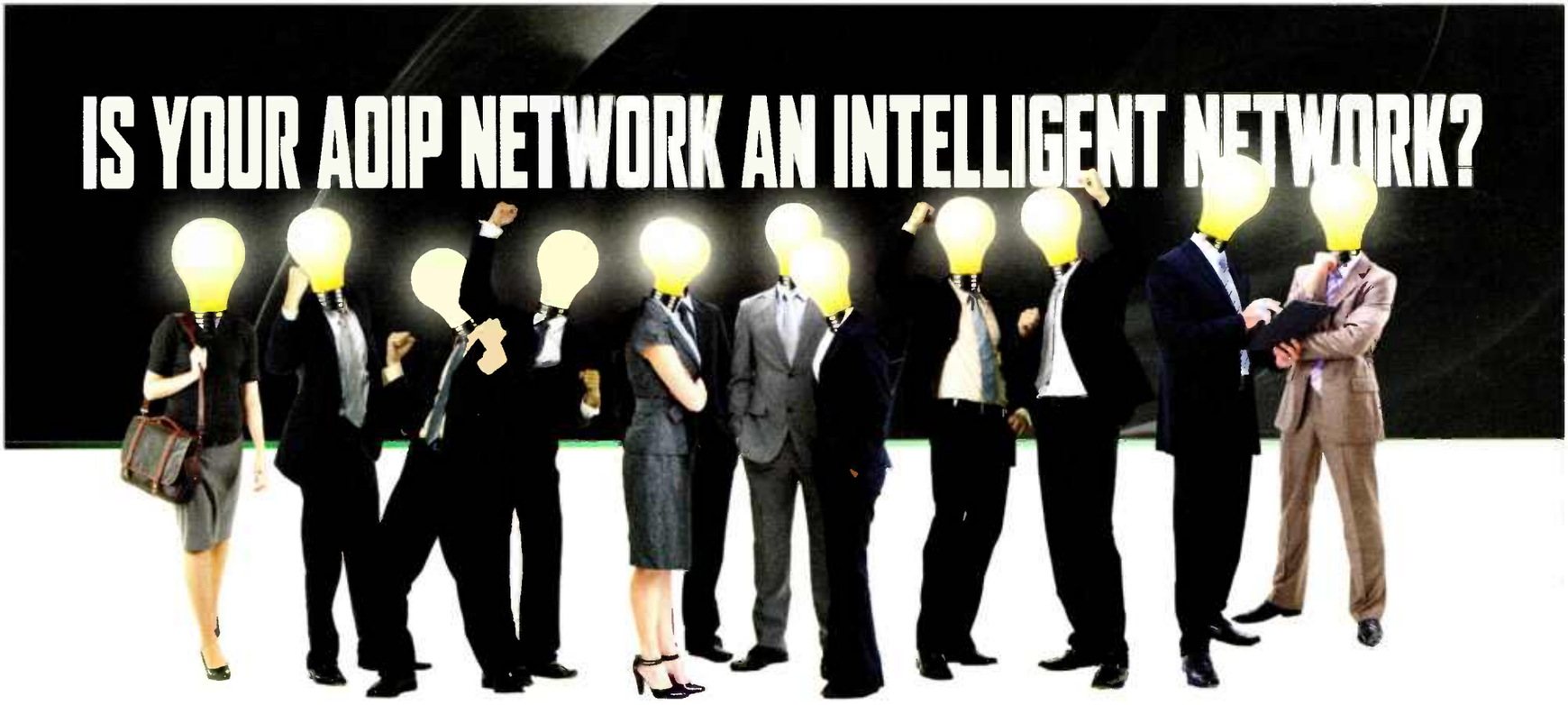

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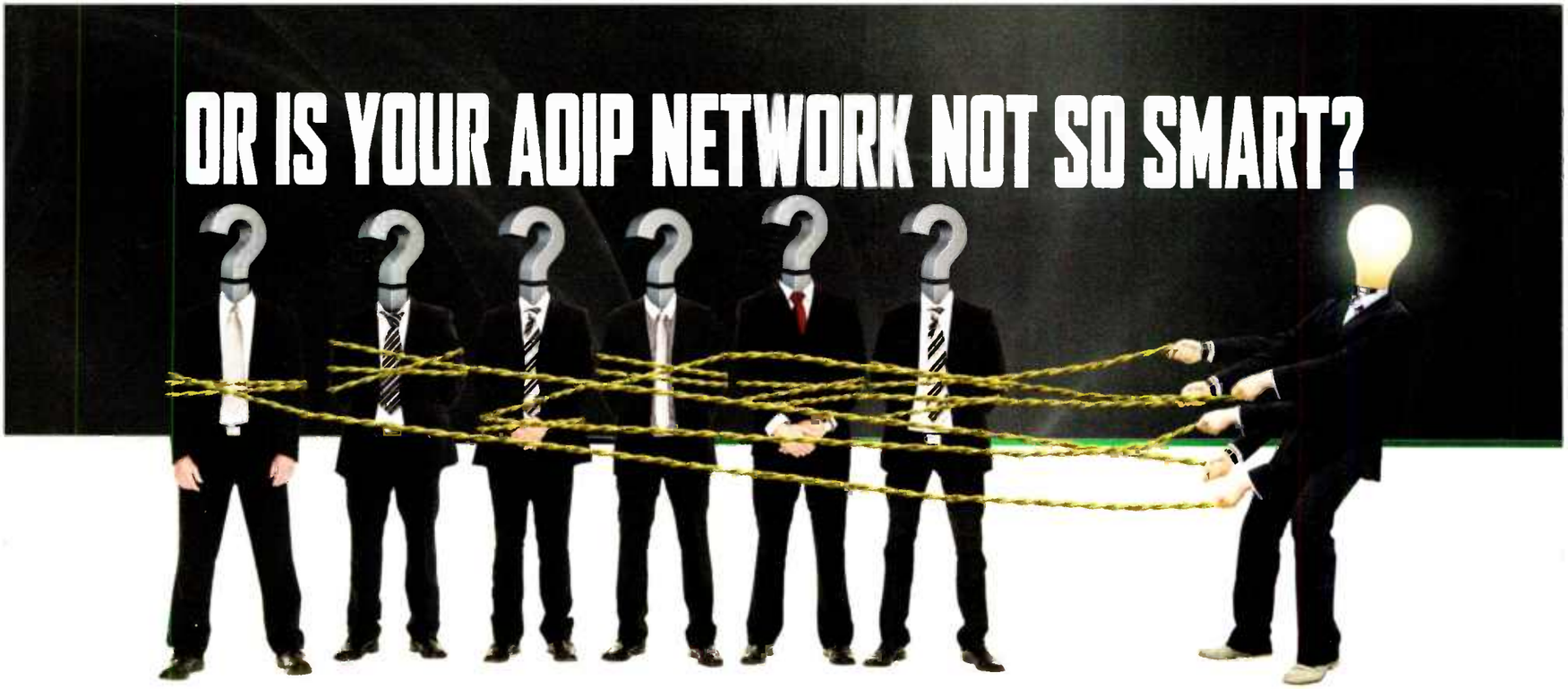
OR IS YOUR AOIP NETWORK NOT SO SMART?



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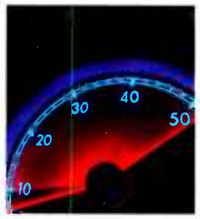

You may not think you need the speed, but think of it this way... remember when a 10 meg hard drive seemed like it was all you'd ever need? Or when a 56K modem seemed like overkill? Audio needs as much bandwidth as you can throw at it, and WheatNet-IP Intelligent Network gives you 10 times the bandwidth of the other major system. Think of it as money in the bank.

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SNMP

(continued from page 10)

number, even a text/numeric string; in any case, the SET command is used in the same way.

The TRAP messages also are simple. They are unique in that they are the only SNMP messages that are generated autonomously by the Agent and sent to the Manager. As you might guess from this characteristic, they generally are used to alert the Manager (and its users) to abnormal conditions in the Agent that could negatively impact the performance or stability of the system. Put simply, they are alarms. High CPU temperature, a router port that has stopped responding, a hard drive approaching full status — these are examples of some of the conditions for which SNMP Agents might send a TRAP message to a Manager.

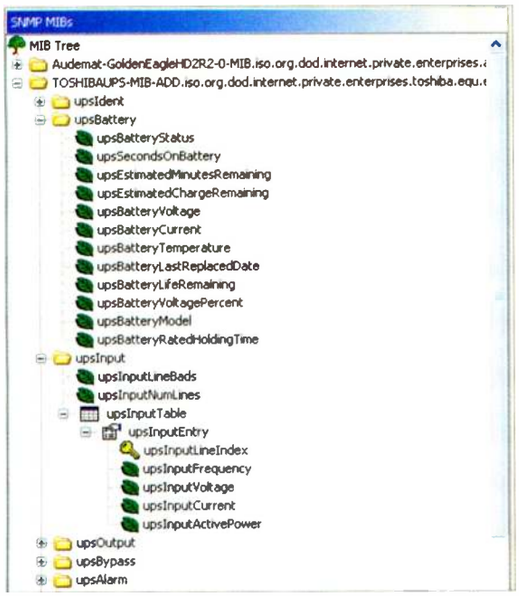

Fig. 2: SNMP MIB Structure

SNMP Version	Commands Supported
SNMP V1	GET, GETNEXT, SET, GETRESPONSE, TRAP
SNMP V2c	GET, GETNEXT, GETBULK, GETRESPONSE, TRAP, INFORM, NOTIFICATION, REPORT
SNMP V3	All of the above commands; adds encryption and password protection

Table 1

Since SNMP was designed in the early days of connectivity, minimizing bandwidth usage was a high priority, which is why there is no default automatic acknowledgement for SNMP messages. However, the critical nature of TRAP messages has led many designers of SNMP Agent software to include optional settings that will cause the Agent to resend the TRAP message until acknowledgement has been received from the Manager that the message has been received and understood. It is important to know that this acknowledgement handshake must also be supported by the NMS software, but most common Manager systems do support this function. The standard port on which a Manager will "listen" for traps is IP port 162.

The GET command is certainly the most-used in SNMP systems. A Manager will send a GET command containing a specific OID to an Agent, and the Agent will use that number to "look up" the current value for that data point. It will then send that value in a message called a GETRESPONSE that also repeats the OID.

All versions of SNMP support these message types, as well as the GETNEXT command. GETNEXT is a command that, when repeated, will cause the Agent to methodically research and deliver data on each and every object that it has defined within its MIB (see Table 1). In some Agent systems, data is defined in tables — for example, the connection status and speed of each port on a router. For these types of systems, the GETNEXT command is an easy way to retrieve a large number of data points without having to write multiple GET commands, each with the specific OID of a single object in the Agent. When the Agent returns a response to the Manager, the Manager issues another GETNEXT, which causes the Agent to look up and deliver data on the next OID in its MIB.

An additional GET command, GETBULK, was introduced in SNMP V2c and is also supported by version 3. The GETBULK command allows an NMS to request from the agent a large portion of a data table with one command. Again, this is done to minimize the need to send GET commands for each data point and so minimize the demands on programmers and network bandwidth.

For each GET command received from a Manager system, the Agent device will return a GETRESPONSE. Or in cases where the structure of the GET command is improper, the Agent might return an error message.

There are several other types of SNMP messages that were defined in the V2c and V3 standards, including INFORM, NOTIFICATION and REPORT.

INFORM is the mechanism by which an NMS can acknowledge SNMP Traps sent by an Agent. A NOTIFICATION is a variation on the SNMP TRAP message, created to share the same data structure as the GET and SET commands (the original TRAP messages as defined in V1 had a different structure). And the REPORT message is designed to allow different NMS systems on a network to communicate easily with one another about the status of the devices and network segments each is monitoring. INFORM V2c messages are the most common alarm messages used today, and although they don't have the same data structure of the original V1 alarm messages, they are still commonly called TRAPS.

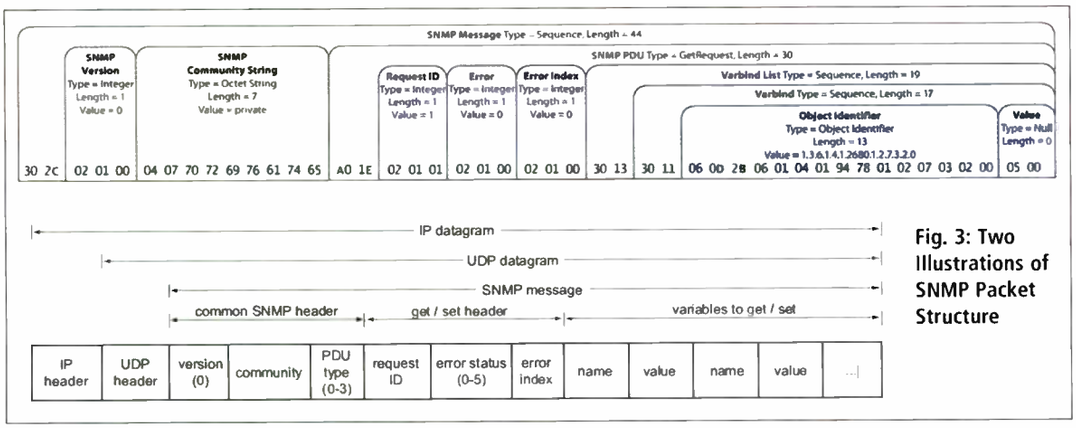

Fig. 3: Two Illustrations of SNMP Packet Structure

SNMP TRANSPORT AND PACKET STRUCTURE

SNMP communications can be carried out via a number of different transport protocols, but typically employ the User Datagram Protocol, or UDP. Because this is a simplex protocol, there is no built-in acknowledgement of messages traveling in either direction. UDP is a Transport protocol, operating in Layer 4 of the OSI model. SNMP itself operates in the Application layer 7. UDP allows systems to communicate with each other without having to first establish communications ports and protocols.

Since an SNMP message (particularly the GETRESPONSE) can contain different amounts of data, they cannot be a fixed length. Instead, the data are defined as variable bindings. An SNMP message packet follows the basic encoding rules, and the data contained in the variable bindings can be divided into three parts: Type, Length and Data.

Type is a single byte that specifies the type of data being transported — Octet, Integer, String, etc. Length delineates the size or amount of data, in bytes; and Data is of course the data itself. It is noteworthy that the data can span multiple bytes (see Fig. 3). In such cases, the highest order bit is used as a flag to indicate that the data is being spread into two or more bytes, and only the lower 7 bits are actual data.

A message in SNMP will contain three elements — the SNMP version being used (V1, V2c or V3), the Community string, (or username and password for V3 messages) and finally the SNMP function itself — be it a SET request, a GET Response, TRAP, etc. This central part of the message is called the Protocol Data Unit, or PDU. The Community string is like a password that must be used to retrieve or set data points using SNMP (from V2c on). This is absolutely no guarantee of security, as the strings are sent using open text on the network, so it would be comically easy for someone to intercept and read that information. SNMP version 3 offers some more robust security, with data encryption and stronger passwords.

II. PRACTICAL ASPECTS OF SNMP MANAGEMENT

UNDERSTANDING AN OID

When we look at an OID, we're really seeing an address — a way to work our way down a MIB tree until we arrive at the specific data point in which we are interested. But the OID starts from a much broader viewpoint. To understand this perspective, we should

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SNMP

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examine the meaning of each of the numbers in a typical OID, for example:

1.3.6.1.4.1.186.1.19.2.1.2.4.0

The first six numbers in the OID will be the same for most OIDs in nearly every commonly encountered object. They are intended to allow traceability of the OID, as follows:

1 – Identifies the International Standards Organization, or ISO
3 – Specifies that this OID belongs to an ISO recognized organization
6 – Indicates the Department of Defense, creator of the Internet
1 – Confirms that this is an Internet OID
4 – Shows that this OID belongs to a private organization
1 – Tells us that this organization is a business enterprise

The next number identifies the manufacturer of the equipment to which this OID refers. In this instance, the 186 refers to Toshiba; this OID comes from a Toshiba UPS power system (see Fig. 4).

After the manufacturer number, the remaining numbers delineate a path down the MIB tree. Each branch of that tree has a number assigned to it and by following the numbers down the MIB we come to the object specified by this OID. The 1 says it belongs to a piece of Toshiba equipment, the 19 indicates a Toshiba UPS system, the 2 specifies the Toshiba Industrial line of said systems, and the 1 identifies the particular software. This same software (and thus the same MIB) could be in use on any number of different models.

The official name of the data object is upsEstimatedChargeRemaining, and from the description in the MIB browser software we can see that it is an Integer type data point, from 0 to 100. In raw text form, the OID definition in the MIB would look like this:

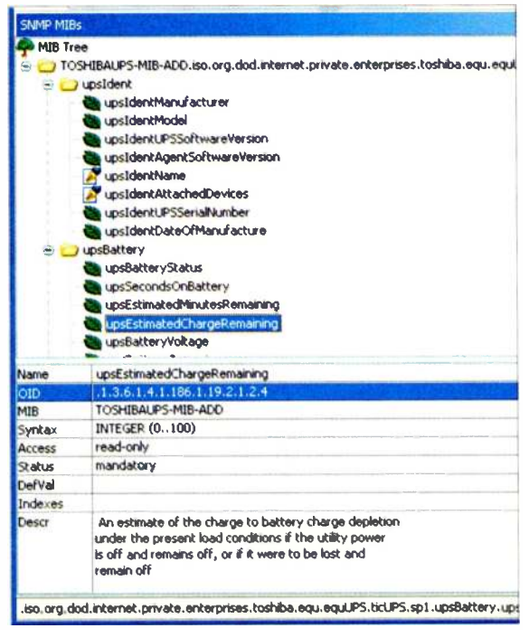

Fig. 4: MIB Tree for Toshiba UPS

```
upsEstimatedChargeRemaining OBJECT-TYPE
  SYNTAX INTEGER(0..100)
  UNITS "percentage"
  ACCESS read-only
  STATUS mandatory
  DESCRIPTION
     "An estimate of the charge to battery
      charge depletion under the present
      load conditions if the utility power is
      off and remains off, or if it were to be
      lost and remain off"
  ::= { upsBattery 4 }
```

Note that the actual definition of the object in the MIB file does not mention the full OID. As mentioned earlier, this is an example of a "Truncated" MIB. Truncating is a typical and tremendously confusing method used by manufacturers to avoid having to write complete MIB files for each piece of equipment with the resultant costs in man hours and possible errors. By examining the text at the beginning of the Toshiba MIB, we can see that a number of 'imports' are described:

```
IMPORTS
DisplayString, TimeStamp, TimeInterval,
TestAndIncr, AutonomousType
  FROM SNMPv2-TC
enterprises
  FROM RFC1155-SMI
OBJECT-TYPE
  FROM RFC-1212
TRAP-TYPE
  FROM RFC-1215;
```

SNMPv2-TC, RFC1155-SMI, RFC-1212 and RFC-1215 form the backbone of SNMP; they are "standard" MIBs published by the IETP and ISO that organize basic structural elements and methods such as data types, table structures, definitions, etc. By incorporating these standard files into their own MIB structures, manufacturers help ensure compliance with the standards while also saving themselves from having to write the full syntax of each OID in the MIB files for their equipment. As long as your browser or NMS software can import and integrate these standard MIBs, it should remain relatively easy to locate and use the OIDs you need.

An example of an OID from a different MIB (this one from an APT Horizon audio codec), looks like this:

```
-- 1.3.6.1.4.1.22425.2.1.4
    alarmTrap NOTIFICATION-TYPE
       OBJECTS { sequenceNo, name, status }
       STATUS current
       DESCRIPTION
          "This trap is sent when an alarm is
           either set or cleared on the unit.
           The variable bindings which are
           sent are:-
          Sequence No
          Alarm Name
          Status of alarm.
          "
       ::= { horizonalarm 4 }
```

Note that while this MIB is also truncated, the designers have included the full OID as a comment line before the object description, preceded by the double dash --. This method saves some time and also helps make the MIB more legible to the human readers.

Regardless of structure, the MIB file serves only to indicate the correct OIDs for each data point. If there is another way to obtain accurate OIDs, the MIB file itself may be unnecessary.

SPECIAL CASES

In most instances, the OIDs for a particular system can be defined and the MIB file published at the time of manufacture.

There are notable exceptions to this rule, however, such as systems where data objects can be created by the user after the equipment is delivered. One example set are facility control systems, where inputs, controls and analog information can all be integrated, polled and controlled by remote equipment using SNMP. Since the inputs and controls are software based, they can be created and altered as needed by the user, so their OIDs cannot be completely defined when the equipment is built.

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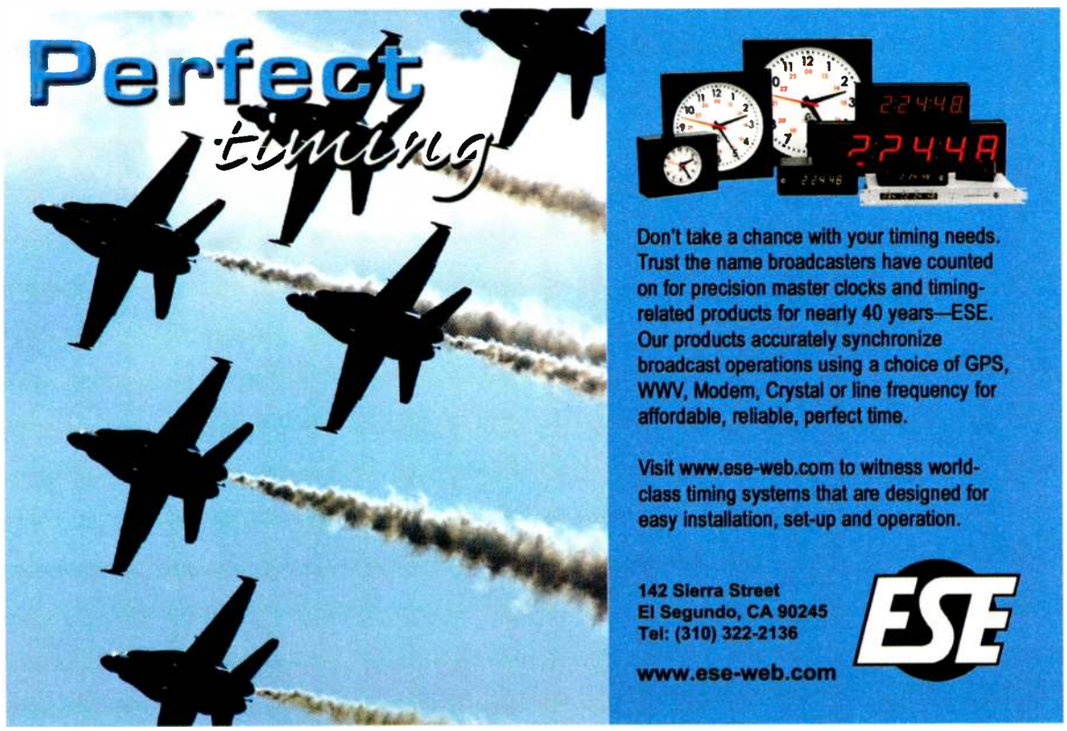

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- Channel Transparency measurement
- I/O Delay Measurement
- Sync to AES3, DARS, word clock & video black burst
- User-generated test signal files

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MR-PRO Minirator
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Analog Audio Generator +
Impedance/Phantom/Cable measurements

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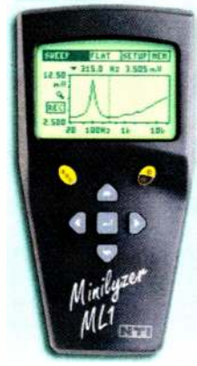
- Impedance measurement of the connected device
- Phantom power voltage measurement
- Cable tester and signal balance measurement
- Protective shock jacket

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.
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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.

- Measure Level, Frequency, Polarity
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For these types of data objects, two things are defined, the first being a "base" OID, which identifies a class of object (say, an analog reading) in the software. Second, a table is built into that definition in the MIB that will allow the user to add something called an Index value to the base OID. Together, the base + Index value can identify a specific object in the Agent, even one that was created only moments ago.

As an example, here is the "base" definition of a user created button in Audemat's Scripteasy software:

```
-- 1.3.6.1.4.1.5299.15.42.1.10.3.4.1.3 :
   scripteasyActionsState
scripteasyActionsState OBJECT-TYPE
  SYNTAX INTEGER
  ACCESS read-write
  STATUS mandatory
  DESCRIPTION
     "No description"
  ::= { scripteasyActionsEntry 3 }
```

Just above that definition of the base OID, the MIB file defines the Index table:

```
-- 1.3.6.1.4.1.5299.15.42.1.10.3.4.1.1 :
   scripteasyActionsidScriptObject [index]
scripteasyActionsidScriptObject OBJECT-TYPE
  SYNTAX INTEGER (0..2147483647)
  ACCESS read-only
  STATUS mandatory
  DESCRIPTION
     "Scripteasy action button identifierr"
  ::= { scripteasyActionsEntry 1 }
```

As each button is created in the software, a specific Index number is assigned to it and made visible to the user. So while the base OID for 'a' button in the software would look like this:

```
1.3.6.1.4.1.5299.15.42.1.10.3.4.1.3
```

The OID for a *specific* button would incorporate an index value at the end:

```
1.3.6.1.4.1.5299.15.42.1.10.3.4.1.3.361
```

INTEGRATING SNMP MANAGEMENT WITH OTHER INPUTS

When we begin to formulate a plan to incorporate SNMP monitoring and control within a broadcast facility, we must remember that this protocol comes from the world of computers and IT, and thus the information we get may be somewhat confusing when interpreted from other perspectives.

One example might be sending an SNMP GET request to determine the usage level of a hard drive in a remote system. From a normal human perspective, we would expect the result to be an integer from 0 to 100, indicating the percentage of hard drive space that is currently occupied with data. However, from an IT perspective, it might be simpler for the Agent software to deliver a number from 0 to 255, indicating the percentage of use. Or they might have chosen to indicate the number of megabytes remaining, or cylinders occupied, or some other metric that is a natural choice in that world, but might be counterintuitive for a broadcast engineer.

In short, when dealing with numeric results of an SNMP GET request, it usually is advisable to have some information on exactly what form that data will take. In most cases, the object description in the MIB will give some indication. In other instances a user might have to perform multiple GET commands and look at the raw values in order to understand the format. And depending on the data returned, it is frequently necessary to perform some mathematical operation in order to provide data that can be easily interpreted by the users of the system.

The 'S' in SNMP stands for Simple, but that word is used in the context of computers and processors. It is simple for the machines to understand and use, but perhaps not so simple for human users.

This also brings an enormous challenge when attempting to integrate SNMP monitoring alongside more traditional I/O connections and typical data formats. NMS systems do not normally have any capabilities for connecting with normal analog and status inputs, nor do they generally have any kind of relay outputs or control functions outside the SET command. For broadcast operations, users expect these functions plus robust monitoring and alerting, and even the capability to preform automatic actions based on the information received. So to "bridge" the functions of an SNMP Manager with the more traditional capabilities of a facility control system can require a unique combination of software and hardware.

SUMMARY AND CONCLUSION

Just as IBOC, ATSC, AES and basic IP structure and languages were once little understood by broadcast engineers, SNMP has only recently entered our consciousness as a useful tool. More and more manufacturers of transmitters and other broadcast equipment are including support for SNMP operations within their systems, and that is a trend that is not likely to change soon.

It is a powerful option, since it expands the user's capabilities in two important ways. First, SNMP provides the ability to control and monitor more different types of equipment. Since SNMP is a standardized system, not only broadcast gear, but IT devices such as routers, servers, printers, etc. can be incorporated into the overall facility control plan. And second, the concept that the equipment being monitored can be remotely located from the facility control device, whatever it may be. This allows great possibilities for inter-site communications and being able to monitor a large network of sites and equipment that may be spread over great distances. With SNMP, anything you can reach over a network connection can be controlled.

That presents great potential to ease engineering workloads and reduce downtime for broadcasters and anyone who is willing and able to include the Simple Network Management Protocol as a part of their facility monitoring and control toolkit.

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

MARKETPLACE

BEXT+ELENOS: Bext Inc., supplier of RF equipment, now has exclusive distributorship of Elenos broadcast transmitters in the United States and Canada. The companies emphasized the energy efficiency and compact size of Elenos solid-state transmitters. Bext is observing its 25th anniversary this year. Elenos is made in Italy; equipment stock and customer service for U.S. customers are at Bext headquarters in San Diego.
Info: www.bext.com.

STRINGERS CALL: Matching stringers to employers in need has always been a catch-as-catch-can operation. The folks behind the VeriCorder iPhone apps are trying to bring some organization to the chaos with site FindStringers.com.

It is designed to bring stringers looking for work together with media companies (radio or TV or whatever else) in need of temporary or regular help. VeriCorder says it will be more than merely a listing service, providing tools and server space to enable mutually beneficial transactions.

Gary Symons, VeriCorder founder said: "FindStringers gives both parties the tools they need to work together easily. We provide accelerated transport for large media files. We protect the security of the media company's networks and we make it extremely easy to find, hire and work with qualified journalists, anywhere in the world."

FindStringers uses VeriCorder's audio and video recording and editing apps. Media companies participating are "always free," according to VeriCorder. The site allows for storage of work, résumé/qualifications listing and story pitching, and it covers copyright issues.
Info: www.findstringers.com.

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Dynamic Delay Control in Synchronous FM Broadcast Systems

Precise and Controllable Delay Is the Key to Best Performance

BY BOB BAND

The author is Intraplex product line manager at Harris Broadcast Communications.

Synchronous FM broadcasting is also known as simulcasting. Everybody's heard about it. Lots of people are doing it. But not everyone understands the subtleties involved in getting it right.

Let's look at an important but oft-neglected aspect of effective simulcasting: dynamic delay control.

In this context, simulcasting is the use of multiple transmitters with overlapping coverage, operating on the same frequency, to cover a single market.

There are a number of reasons we might want to do this. One is to fill in coverage gaps caused by natural or man-made obstructions such as hills or clusters of high-rise buildings. Another reason is to saturate an urban market without the expense of a high-powered downtown transmitter. Some broadcasters have done well by purchasing relatively inexpensive suburban stations surrounding a city and directing their antennas to cover the metropolis in the center. Multiple simulcast transmitters are used in some places to cover travel corridors such as highways. In general, U.S. FM broadcasters are allowed to license boosters that operate at up to 20 percent of their main transmitters' ERP levels for whatever purposes they deem appropriate.

THE CHALLENGE

Simulcasting clearly offers functional and financial benefits, but getting a simulcast system to work at its best presents a number of technical challenges. This is because of the way that the listener's radio receiver responds in areas with multiple signals on the same frequency.

The receiver captures a signal cleanly when the listener is close enough to one transmitter or the other. However, the receiver may alternate between the two signals in the overlap area, and any variation between the two in frequency, phase, amplitude or arrival time can cause interference. This renders the receive signal unpleasantly noisy or even unlistenable (Fig. 1).

Frequency and phase alignment can be handled by using GPS clocks to synchronize the inputs to the various transmitters in the system. Amplitude variation can be controlled by using an all-digital air chain. Controlling arrival time can be addressed by using precisely adjustable digital delays, but determining the correct arrival time at each transmitter is much trickier, and is a crucial aspect of simulcasting. To understand why, let's look at what it takes to optimize a simulcast installation.

No FM simulcast system can provide 100 percent perfect coverage over the entire region between two adjacent transmitters. But a well-designed system can minimize the amount of undesirable interference and also allow the engineers to maximize the performance of the system in the most important coverage areas (busy highways, crowded residential areas) and move the areas of remaining interference to less populated regions.

Fig. 2 shows the area where we need to be concerned about interference between two overlapping transmitters of equal ERP on relatively flat and simple terrain. If we precisely equalize the delay from the studio to each of the two towers, we optimize coverage in the overlap area.

What if the area we're mainly interested in covering is not dead center between the two transmitters? Fig. 3 shows this scenario, and in this case we would want to delay the signal arriving at transmitter #2 more than that arriving at transmitter #1. This allows both signals to arrive at the same time in the metro area we're trying to cover.

Another scenario is that which occurs when we're using transmitters of differing ERP, as is typical when using one transmitter as the main and another as a booster or gap filler (Fig 4). The challenges increase in this situation as the line of equal delay between the two transmitters cannot be made to match that of equal signal level precisely. Add to this the fact that most real-world simulcast projects involve terrain issues as well, and we can see that deciding on the correct amount of delay on each STL to optimize the overall performance of the system is a complex skill — essentially, a combination of art and science.

The bottom line is that it is critical to maintain the exact amount of delay that the system engineers implement on each link.

DELAY DYNAMICS

In a simulcast system, engineers set the desired delay on each STL link by first measuring the actual delay inherent on the STL. The proper amount of additional delay then is added to raise the total to the desired amount.

How precise does this delay control need to be? Radio propagates at 3.33 μs per km, so a system that provides control to an accuracy of 200 ns allows the engineers to adjust coverage areas in as little as 30-meter increments. However, all the accuracy in the world doesn't help when the absolute delay changes. This is where dynamic delay control comes into play.

The actual delay on an STL circuit can change over time. T1 circuits tend

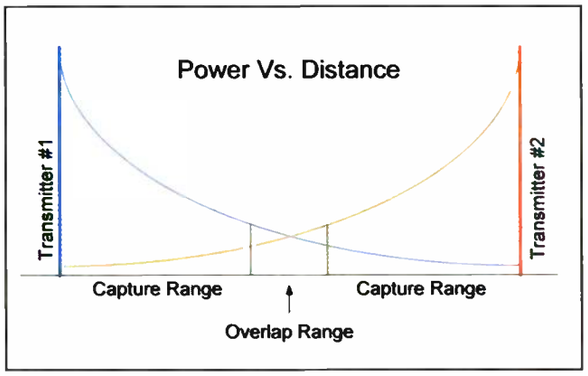

Fig. 1: Power vs. Distance

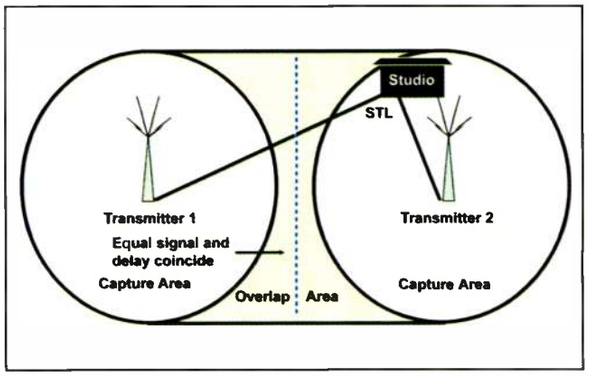

Fig. 2: Equal ERP Transmitters

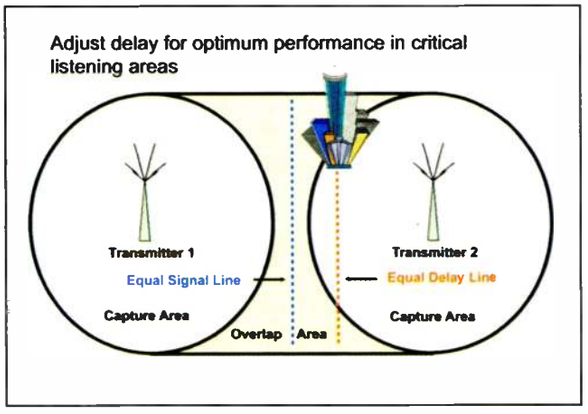

Fig. 3: Off-Center Coverage Area

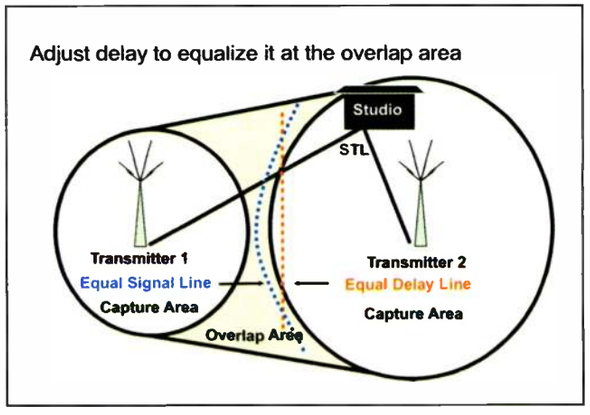

Fig. 4: Unequal ERP Transmitters

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to have fairly stable delay characteristics. Public networks, however, are subject to rerouting. This means that the phone company or service provider can shift the data to a different physical network path in the event of hardware fault or excessive congestion. Rerouting can cause a sudden and dramatic change in the overall circuit delay, and can happen as often as several times each day without warning.

IP packet networks are even more prone to delay variation than T1, in the form of jitter due to packet routing and buffering. Even point-to-point microwave links can be subject to variable delays as a result of data buffering in modems or other equipment. For example, spread spectrum and other types of radios can be designed to operate cleanly in the face of high levels of interference, but the mechanisms that allow them to do so can affect the throughput delay.

This means that one key factor in the successful operation of a simulcast system is a mechanism that provides dynamic delay control — "dynamic" referring to the fact that the system actively monitors the actual delay on the STL circuit at all times. The amount of delay being added is adjusted whenever it detects a change to maintain the desired total on each link.

Typically, this involves adding a GPS-derived time stamp to the signal leaving the studio, and then comparing this timing indication to a GPS clock at the transmitter site. The system must then have the intelligence to monitor the STL delay for changes and tweak the amount of delay being added as necessary to maintain the total with an acceptable degree of precision. Only systems capable of achieving this highly precise degree of dynamic delay control can provide the kind of reliability that makes them suitable for real-world broadcast applications.

REFERENCES:

Junius Kim, "RF Simulcasting Over IP Networks," Proceedings of the National Association of Broadcasters, Broadcast Engineering Conference, April 2008

Bill Gould and Jai Eu, "Using Synchronized Transmitters for Extended Coverage in FM Broadcasting," Harris Broadcast Communications White Paper

SWOT

(continued from page 22)

side of your current job description. You might teach in a religious school because you have good mentoring skills and a charismatic personality. You might have a good knowledge of computer networking because you maintain the computer system in your parent's assisted living facility. You may have discovered that you make a good negotiator when settling arguments in your sports club. These, too, are part of your Strength inventory.

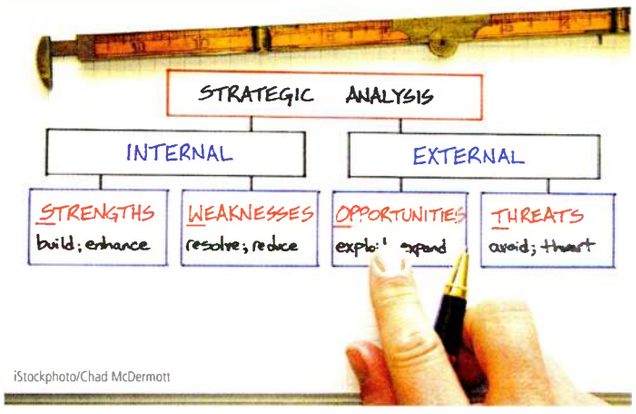
Weaknesses are those liability attributes that undermine your value. In my case, I do a terrible job on those activities that involve a large quantity of details, which I never remember. I tend to draw inferences with very little data to support conclusions. I do not like situations that have high risk even if the payoff is potentially large. Because I love diversity, I cannot focus on a single project to the exclusion of all else. I am uncomfortable in a reactive situation where I do not know what is coming next.

Often Weaknesses and Strengths come in pairs, for example concrete vs. abstract. When being concrete is a Strength, the inability to be abstract becomes a Weakness, and vice versa.

Opportunities are situations that the world presents to you. Over my career, I have noticed opportunities that completely changed my career. The most dramatic example happened when I was a junior professor at the age of 27. I was playing video games on our research computer at 3 a.m. when a colleague, Francis Lee, wandered into the laboratory. He was an expert on computer memories, and I was an expert on analog audio signal processing. We took the opportunity to discuss the relationship between digital and analog. As a result of this discussion, we recognized that the time was right for digital audio. We conceived of a first product, a digital audio delay, and we started down the path that led to the creation of Lexicon. We were pioneers in what became a massive industry.

These *Last Word* articles were also the result of an unexpected opportunity. I was having lunch with Michael LeClair, who had recently been offered the chance to manage Radio World Engineering Extra. We saw the opportunity for me to contribute my experience and perspectives in a column. It was an opportunity for both of us.

Threats are aspects of the world that can undermine your success. I noticed my first career threat when I became an expert specializing in transistor amplifier design. I was good! But within a few years, integrated circuits could produce a much better amplifier than I could. My early career was threatened by a new technology that dramatically reduced my value as a business.



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The Internet has already proved to be a threat to terrestrial broadcasting. Online purchasing has threatened local bookstores. The popularization of reality TV using volunteer performers is a threat to those who make their living as actors. Globalization is a threat to those who are part of the manufacturing sector. Free "want ad" listings on the Internet, such as Craigslist, are a threat to the revenues of traditional daily newspapers. A new piece of legislation can threaten a stable industry. Something can be both Threat and Opportunity. For some, the new health care legislation is a threat, for others, an opportunity.

MANAGE, ADAPT AND SUCCEED

The goal of this article is twofold. First, I want to convince you that you are a one-person business, and you should manage our career on that basis. You can borrow a large body of knowledge that businesses use in being successful. Individuals do not have to invent the wheel.

Second, I introduced the SWOT analysis technique as an example of one such tool that can be used by individuals. Since this is only an introduction, I suggest that you search the Web using such keywords as "SWOT analysis" to get more information about this technique. There are many other aspects of running a business that are just as relevant to planning a career.

There is a more general conclusion: Become proactive in your strategic planning rather than feeling like a helpless victim who depends on luck and dreams. All of us must adapt to the paradigm shifts that are happening. Many years ago, 19th century farmers discovered that ma-and-pa farms would no longer be economically viable. Periodically, the world experiences major paradigm transformations in which the old order decays and a new order replaces it. We are simply in the middle of one such paradigm shift. We do not choose our decade, but we can wisely adapt to it. New paradigms are both threats and opportunities.

Barry Blesser is director of engineering for 25-Seven Systems. Opinions are his own.

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SWOT: Old Business Idea for 21st Century Careers

Analyze Your Value as an Employee to Better Manage Your Future

BY BARRY BLESSER

Great ideas do not have to be new in order to be useful — novelty is not important unless you are in the advertising business.

In fact, good ideas take time to mature. Musical instruments took centuries to refine, and composers took generations to learn how to use these new instruments. If an idea has been around for decades, it has passed the test of time. Some novel concepts are actually repackaged versions of old trusted veterans.

One of my favorite business tools has been around for more than half a century. It is a business analysis technique with the acronym of SWOT, which stands for Strengths, Weaknesses, Opportunities and Threats.

I am introducing the tool now because it also has value when used by an individual to manage a career. In the current world of economic uncertainty and shifting paradigms, all of us are concerned with our careers in order to pay the mortgage and to send our kids to college.

I will return to a discussion of SWOT after I have argued that all of us have become one-person businesses. Borrowing business tools for managing individual careers is a cheap way to gain an advantage.

YOU'RE ON YOUR OWN

Every employee actually is running a business.

To appreciate this conclusion, let's take a quick review of employment history beginning in the mid 20th century. At that time, employees were viewed as loyal servants and companies as paternalistic feudal rulers.

When I received my college degree in 1964, the conventional wisdom was that one should get a general education with good grades. The company that hired you would then invest two years in training you to be productive. Employees were expected to stay with their sponsoring company for decades, and companies expected to keep employees until they retired. Twenty-year-old students were told about generous pensions that would be provided 50 years later.

These students and employers were getting married.

In the ensuing half-century, employees have become functional objects to be hired and fired based on their contribution to the bottom line. People, like computers, are used and discarded unless they retain their value. Companies now are routinely merged, reorganized, downsized, restructured; business models shift like sands in a hurricane. Having been an active professional for some 40 years, I am acutely aware that our relationship to organizations now is very different.

At one time, the distinction between employee and contractor was large and apparent to all. That distinction now remains only in regard to a few components of the legal system. The difference shows up mostly in the taxation system and default laws, which serve as a hidden contract.

Companies are now less concerned with whether you are a W2 (employee) or 1099 (contractor/consultant). At one time, the implied distinction was permanent or temporary, but the distinction disappeared with the widespread use of temporary employees. To some degree, this describes all of us. You can quit your job or be fired with little notice because the legal default is being an employee-at-will. While companies may have rules that provide a more secure relationship to their employees, they are not legally obligated to maintain them.

Some high-powered executives write their own employment agreements with protective clauses, including buyouts in case of forced termination. Such agreements are a form of business contract. While every employee connects to his or her employer with some kind of explicit or implicit contract, most employees are oblivious to the terms.

The point of this discussion is that you are a one-person business relating to your company by virtue of a contract: You provide services and you receive payment for that which you delivered. This is not very different from buying an automobile.

THINK LIKE A BUSINESS

In my consulting business, I viewed myself both as a CEO and an employee. What task would I (the CEO) assign to myself (the employee)? Everyone should learn to think like this if they want to be proactive in managing their career. Those who have trouble finding a new job after being terminated often start their own businesses. At one time, it was the exception, but no longer.

Because we are each a one-person business, we should be using business tools to manage our careers.

I am now ready to return to the SWOT business tool as applied to each of us.

When examining the components of SWOT, we would be wise to make career decisions based on the interplay between these four. For example, Strengths and Weaknesses are properties of you, while Threats and Opportunities focus on your relationship to the world. Ultimately, the goal is look for Opportunities that draw on your Strengths while avoiding your Weaknesses and Threats. To make such choices, you must know your particular SWOT.

To illustrate the analysis process, I will take myself as an example. You should make a similar list. But be forewarned, dishonesty only serves to fool you. Sometimes a friend or colleague is useful as a dialog partner. Businesses often bring in outside consultants to help the process because they are more objective.

Strengths are those asset attributes that have value. They may be specific technical skills or broad general abilities. Anything that makes you a valuable commodity can be viewed as a Strength. In my case, I have good communications skills, a refined sense of pattern recognition, the ability to build engineering teams and good understanding of many technologies.

Do not forget to include those strengths that exist out-

(continued on page 21)

PRODUCTS & SERVICES SHOWCASE

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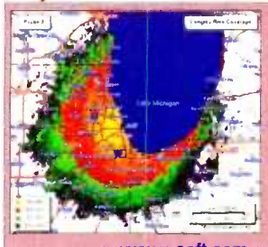

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AirAura Sweet-Spot Technology

When you think about the 'sweet-spot' you need to think about this: Every song or album (yes, a CD IS an album) is mastered differently. Record companies are having their own loudness wars. Of course, this can play havoc with your on-air processor, which essentially is 'mastering' the signal you broadcast. Sweet Spot Technology (SST) has been uniquely designed by Vorsis to manage the behavior of the multi-band AGC as program content density changes, something a typical broadband AGC simply cannot do. It effortlessly handles transitions between the hyper-compressed recordings of today and those of the past that have considerably more dynamic range. SST achieves uncannily natural-sounding consistency in both on-air loudness and spectral balance regardless of density variations in the incoming source material.

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Vorsis Smart Stereo Enhancement

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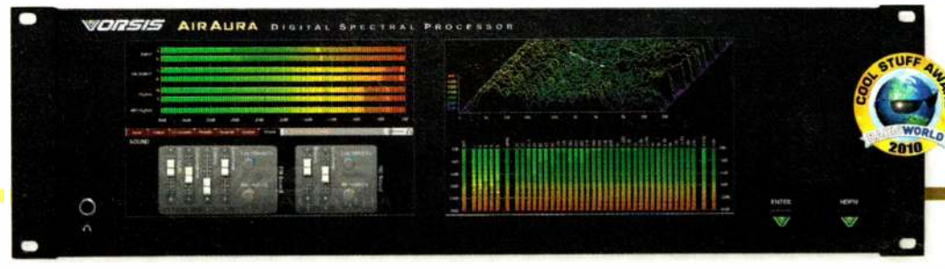

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