Radio Guide

Radio's Technology Magazine

August 1992

Station Stories
Page 43

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Radio Guide

August 1992

A Radio Press Group Publication

Volume 4, Number 8

Business & Production

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Radio Guide (ISSN 1061-7027) is published monthly, 12 times a year, by Radio Press Group Inc., 511 18th Street SE, Rochester, MN 55904.

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Radio Guide Bulletin Board — ***804-468-4957***
Equipment Guide Fax Service — ***507-280-4045***

Paging the Chief

By Ray Topp, publisher

There's a new product available that, when clipped to a person's clothing, informs a central computer system of that individual's whereabouts, wherever they are, at any time. Each "locator" device is coded with the ID of a particular employee and transmits this information and its location to a series of evenly spaced infrared receptors throughout the plant or office. Shades of Star Trek ... "Computer, locate Data please."

It seemed like a totally new concept until I realized that station engineers have been more or less tied to a similar system with their pagers for years. Of course there's a fundamental difference between the two systems. The "locator" device does just that -- provides information on the location or absence of a particular employee.

However, the pager is more insidious. It ties you to your job in ways that most other employees are not. The pager sort of comes with the territory; it is almost always assumed that the station engineer will carry one. Did you actually feel that you had a choice when you took your present job? Or was it sort of glamorous to have that pager on your belt. It's a "privilege" that has a way of becoming a pain.

The pager's utility cannot be denied; it's a useful tool to insure the availability of engineering talent when it's needed. During the first months of employment, it can actually be thrilling to be paged and come flying to the rescue.

But after a few years many engineers can come to resent that little plastic "anchor." Is it the pager that they dislike or the fact that almost no station has ever paid a salary premium for being on-call 24 hours a day.

Many of you know well what it's like to be paged in the middle of a weekend family outing, only to find that the studio monitor amp needs a fuse replacement. Yes, it's important, but is the time it takes to replace the fuse to be valued at the same rate as that of a normal workday? Of course not! But how do you attach a worth to this "off time" service?

The monetary valuation of this type of service should be determined right at the start. Even though your employer may assume that you will wear a pager and be on-call 24 hours a day, you should not do the same! At least not without appropriate compensation. What other job do you know of that does not pay a premium for on-call service?

Negotiate and determine a rate for "off hours" service in advance. That way there will be no question as to the worth of the service and its value to the station. In the real world of radio it is not always practical or possible to obtain extra compensation for extraordinary service.

Even so, the distinction between on-call and normal hours should always be maintained, and a record of those hours should be kept even if you are on a fixed salary. There may come a time when that information can help you to justify your next salary increase.

Salary review? "Computer, locate data please ..."

R.T.

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Reader Service #069

USA Digital Set To Test AM and FM DAB

By Judith Gross

Applications for two experimental stations – one for AM and one for FM – to test DAB either have been filed, or are about to be filed with the FCC by USA Digital.

USA Digital, backed by Gannett Radio, CBS and Group W, was in the process of filing the applications to do the tests in two cities: Cincinnati, OH and Champagne-Urbana, IL, where two companies providing research and development are located. Representatives of USA Digital said they would announce the names of the two companies at the NAB Radio Show in New Orleans in September.

The surprise comes with the rapid development of a system for AM DAB. The system provides a digital signal "comparable to today's FM stations," according to CBS' Tony Masiello. It provides for a stereo digital signal that fits within the mask of an AM station's allocation and may yield 15 kHz or possibly as high as 20 kHz frequency response.

The experimental application asks for an AM channel in the expanded AM band – at 1660 kHz – in Cincinnati, to test an analog AM transmitter and DAB transmitter operating in the same channel. The first tests will be done without the analog signal, however. Pending the outcome of the tests, USA Digital proponents may seek industry support on asking the FCC to allocate the expanded AM band for DAB allocations.

For FM, at press time USA Digital proponents were set to seek an experimental low-power FM authorization for the Champagne-Urbana area but were also looking for a possible high-power, or existing station frequency to test its FM DAB system. Proponents were uncertain whether or not these would include mobile tests this early.

Development of the group's FM DAB system has been boosted by a new chip – an Acoustic Charge Transport or ACT – which is owned by the company doing the FM DAB research in conjunction with USA Digital. This new ACT was funded by the U.S. military, specifically DARPA, and developed for military warfare, according to an article in the July 28 issue of Electronic Design magazine.

The new chip handles signal generation and extraction and also increases the ability to put data on a hard disk drive. It was developed for radar secure communication links and can operate seven times faster than a Cray computer. It operates at 360 MHz, is made of Gallium Arsenide and was developed by PhDs at the University of Illinois.

"Here's a device invented right here in our defense industry, with as many or more research dollars behind a single chip than has been spent on the entire Eureka 147 DAB system," noted Gannett's Paul Donahue. "Our country is trying to commercialize the defense industry, so this kind of development comes along at just the right time."

Once the experimental applications are approved, the testing will be under closed conditions. USA Digital was expecting a quick turnaround from the FCC and was hoping to provide details of the tests during the NAB Radio Show, as well.

For details on DAB demonstrations at the Radio 1992 Show, see Page 47.

EIA Committee Draws Protests

The number of votes each segment of the industry gets when it comes to picking a DAB standard drew complaints from station engineers and GMs who packed the July meeting of the EIA committee working toward a DAB standard.

At the urging of the NAB and its DAB Task Force, a wide variety of broadcasters who had not attended previous meetings showed up to protest the fact that 10,000-plus stations will receive only four of the committee's 12 votes.

Under the plan, two votes will go to radio network representatives; two will go to non-network stations; one will go to satellite interests; one to broadcast equipment manufacturers; one for software providers; one for the semiconductor industry; and four to receiver manufacturers.

Each industry segment is expected to caucus and reach an agreement on casting its vote(s), according to committee chairman Randy Brunts.

Brunts said that "nothing is etched in stone" but added that the complaints took the form of everything from protests about broadcasters being shut out if various segments decide to pool their votes, to minority broadcasters not having enough of a say, to the cries that the committee was jumping the gun before the FCC sets its DAB policy.

"It's hard to get a clear reading of specific requests from broadcasters attending the meeting," Brunts noted. But he said he welcomed the participation. Some 65 attendees were on hand in July, while the usual number of participants has been somewhere near 40.

In the end, a motion to repeal, not the number of votes but a separate item on voting procedures, did not get a consensus. The discussion on the actual number of votes was tabled with the next meeting of the committee set for September 22.

. . . continued

The NAB's DAB Task Force, however, took up the problems of the committee voting at its end-of-July meeting. Alan Box said that the group has planned some "high level" meetings with the EIA to see if the two groups could find some common ground.

Box also said the Task Force has requested an update from all DAB systems proponents by September 1 and planned to meet again in New Orleans during the Radio Show.

Satellite CD Radio Looking For FCC Nod

Satellite CD Radio, meanwhile, is optimistic that the FCC will approve its request for a conditional permit to begin constructing its satellite and also approve its petition to begin a CD-quality national audio service for car radios. The original petition was filed more than two years ago.

"We are next in the que, based on the action the Commission has taken to implement WARC agreements," said Martin Rothblatt. He pointed out that "little LEOS and big LEOS" were first and second, and the service being proposed by Satellite CD Radio is next.

Because the company is anticipating action by the FCC on its conditional and regular request, Rothblatt said it had withdrawn its request for experimental authority as being "redundant."

Satellite CD Radio has also been testing satellite-terrestrial digital signal compatibility at two earth stations put up in Washington, D.C. Currently, the tests are being done on C-band frequencies, although Satellite CD Radio says it is prepared to set up a satellite DAB service in the 2.3 gHz band allocated to the U.S. at WARC.

U.S. RBDS Draft Standard Ready

NRSC members have until the end of September to send back their comments and revisions to the RBDS (Radio Broadcast Data System) Draft Standard.

The standard incorporates ID Logic B for AM stations, which will rely on a database and station upgrades to send information on station ID and formats to RBDS radios. FM stations will control the RBDS system by their 57 kHz subcarriers.

The system also accommodates the paging method used by Cue Paging and apparently meets with both broadcaster and receiver manufacturer demands.

NAB staff engineer John Marino said that he was hoping for rapid approval of the draft standard, but said that more work may need to be done on the PTY, or program codes, decided upon in the standard.

FCC Backs Off On Ownership

Congress had its say, and the FCC decided in early August to cut back on the number of stations a single owner can have and to make a special provision for minority owners.

The original rules, which were to go in effect on August 1, would have let a single owner have 30 AM and 30 FM stations and as many as three of each in large markets.

After protests from broadcasters and threats from Congress, the FCC postponed the date the rules would take effect and then voted to allow a single owner to have 18 AMs and 18 FMs with as many as two of each in a single market.

That number will grow to 20 of each in the next two years, according to the restructuring. In addition, the Commission said it would permit attributable but non-controlling interests in an additional three stations controlled by minority group members or small businesses.

T/M Pending

Lack Of Progress on In-Band – NOT!

by Judith Gross

20 kHz, stereo DAB in the mask of an **AM** station. Yes, I said **AM**. How's that grab you for "**progress?**" Oh, you're going to be hard-nosed about it, eh?

All right. How about an **FM DAB** receiver chip with the computing capacity of **seven Cray computers**? Think carefully, now.

"Hey, Lenny! You can ditch those **seven wheelbarrows** I thought I needed for my DAB system!"

Hey, I'm not joking. In the midst of all this talk about "lack of **in-band progress**," don't the **USA Digital** folks just up and quietly put 'em all to shame?

The system developers: Gannett, CBS and Group W, along with **two research companies** (one for AM and one for FM) tied closely with the **military** (hint: the companies are located in cities where testing of each system will begin soon, according to **experimental license** requests filed) have not been wasting any time.

The applications for **experimental licenses** to test, yes, both **AM and FM DAB** were filed in August by **USA Digital**, and we'll hear all about it at the **Radio Show** in N'Awlins in a few weeks, if not before.

So it's kind of funny that the **NAB Radio Board**, **DAB Task Force**, and others from the peanut gallery have been quoted often and with vigor of late, bemoaning the slow goings. Wish we all had such **slow goings** in our work.

AT&T, meanwhile, has decided to reach out and touch us all digitally, by having their own **DAB booth** at the Radio Show. Well, it's never too late to jump on the **bandwagon**. My only question about their DAB system is: will stations get a **break in the cost** after **5 PM** and on **weekends**?

The **Radio Show** is never dull anyway. With all kinds of craziness taking shape in the industry, on DAB and elsewhere, **N'Awlins** should be a blast, and I don't mean just those nights on **Bourbon Street**, either.

But then there's lots of "funny" stuff going on with **DAB**, these days. I mean hilarious. Almost as funny as our **Presidential race** has been this year.

How about NAB making a conscious effort to "**pack the room**" at the last **EIA DAB standards committee** meeting? There are the committee's coordinators, a little puzzled but encouraged by the vast, first-time, station **engineer** and **GM** turnout, thinking "we're pleased as punch to see ya, finally" after the committee has been meeting for **almost a year.**

Always something funny in New Orleans

Now, you can't blame broadcasters for wanting **a bigger say** in the final voting on a **DAB standard**. At the risk of looking like the tail wagging the dog, why should we have the giganto **receiver companies** dictating our DAB system the way they did **AM stereo?**

The ha-ha part is that none of the faithful who showed up bothered to point out to their **esteemed trade association** that they would have played the most major of roles by now had the **NAB** not abdicated its **neutrality** by becoming a proponent of Eureka 147 so early in the game.

I mean, it would have been an **NRSC** thing by now, jointly coordinated by **NAB** and **EIA**, instead of just the EIA's big project. Now almost a year into the process, when the procedures are being **polished up**, along comes NAB crying "Foul! What about us?"

Well, broadcasters are being given **a third** of the votes. The receiver manufacturers are also getting **a third**, with the rest going to **software** folks, **equipment vendors** and **chip companies**. So what's the beef?

The lawyers (no lawyer jokes, please), who seem to be more plentiful at these meetings than **normal people**, say the courts have spoken: no one industry group can **dominate** the voting.

So let me take off my sneakers and do a quick count here: there are **12 votes**, broadcasters have **four**, they can't have six, which would be half, so maybe **five** .....

All this fuss over **ONE** measly vote? I'm gonna let youse guys in on a teensy secret here. Look at **AM NRSC**. It worked. Why did it get so far in so little time? Yep, the C-word. **Compromise**. A lot of the talking and hashing out happened behind the scenes, not in meetings or press interviews. So I'm glad to see **NAB** and **EIA** have some "informal" meetings set up together. Go for it.

And the laughs just keep coming: **Delco** tests **L-band**. Canada and Mexico keep using the **L-word**. Like the Thing from the Crypt, **L-band** hopes refuse to die gracefully. The speculation revolves around the **U.S. military** suddenly becoming a big fluffy pussycat and taking its orders from a car radio maker and two **foreign governments**. Excuse me?

Carrying this logic to absurdities: Would the NAB **revive Eureka** and its various licensing prospects IF the sun came up in the west, IF the moon was chartreuse, IF the daisies bloom in

JG's Earwaves

December and IF everybody does a complete **180-degree about face** on spectrum after the bloody battles of **WARC**, and **L-band** is allocated in the U.S. for DAB?

Wrong question! Right question: Faced with such a **turnabout**, how long would it take an organization which has had its eye on the **licensing royalties** to revive its love affair with the **only DAB system** that even hints at such a lucrative return?

Answer: **A New York minute!** You bet your bit-cruncher.

And that's about all the **DAB** hilarity I can stomach for one day.

OK, so at 12:30 **in the morning** the board op wakes up the contract guy, **Engineer Dick**, in Billings, and says he just had the strangest phone call.

Seems somebody, possibly a former disgruntled employee, called and said "Ha ha. You should check your **output**. I just got you up to **115%**. And I've been popping you **off and on** the air at whim."

Huh? Well, it turns out that the board op **dials up** the transmitter to take readings, and the **access codes** are programmed into the phone system so that when you call the transmitter they get dialed in **automatically**. That way, nobody gets to know the codes.

Only problem is, the codes are **written down** in the phone system **manual**, which is sitting there in the offices. So I guess maybe Mr. or Ms. **Just-Fired** got ahold of them and did his/her best to try to get the station in trouble with the FOB.

Engineer Dick was able to solve the mystery and change the codes, but not right away. You see the other station he works with had their accounting **computer go down** and it was billing day ... then the **network went down** and he got called on that ... Talk about your blue Mondays!

But it was all in a day's work. He's keeping those codes in a more secure place, though. Especially with the **turnover** in staff at your average station these days.

Let's see, **New Orleans** in a few weeks, then **San Jose** in October for the SBE convention, which is shaping up to be healthier than it looked at first.

And, oh, yes. I got a chance to visit **Harris-Allied** in peaceful **Richmond, Indiana**, recently. That part of the world is just like you always picture it. Blue sky, pretty porch-enveloped houses with cats in the yard and picket fences. And acres of tranquil green fields...

But what's **this**? That familiar **white turret** on the horizon? Awright! The heartland of America -- of course, a **White Castle**. Yep, reminds me of a simpler time. Two White Castles to go and you still **get change** from a dollar? Who says **lack of progress** is always bad?

Something wacky going on in your neck of the woods? Let's gossip together. Call 703-370-7943; fax 703-212-0838 or MCI mail me at #507-3038. Or write 511 18th St. SE, Rochester, MN 55904. We'll award an appropriate perk for your juicy morsels.

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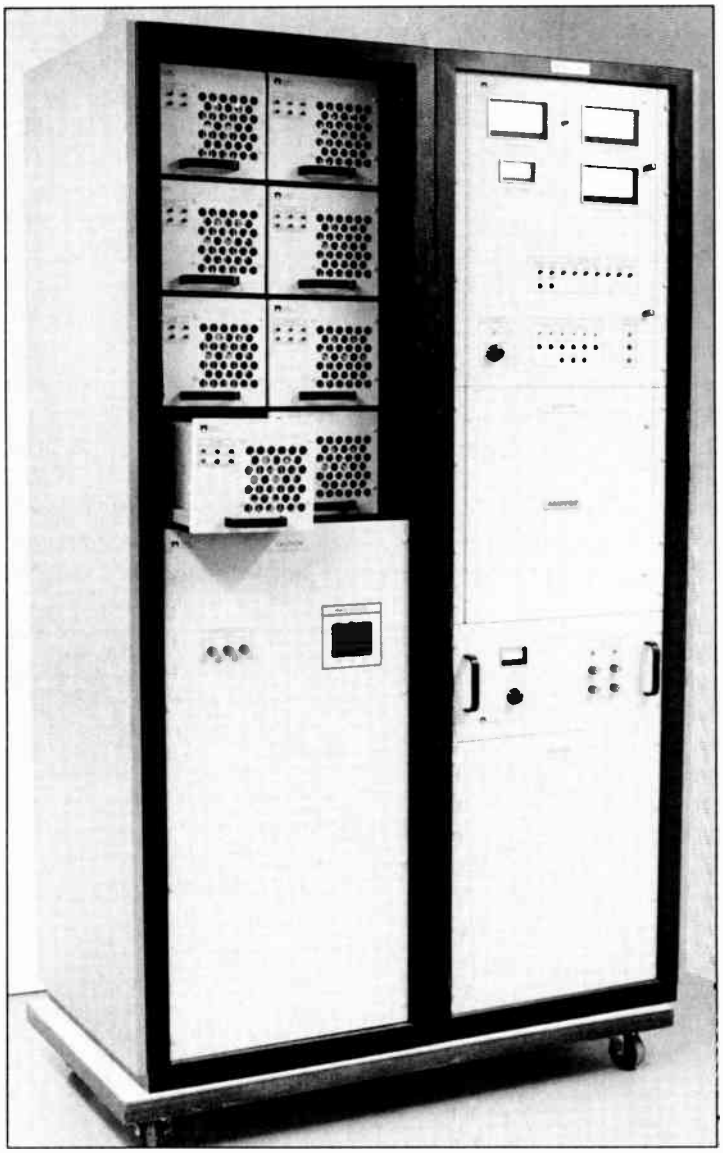

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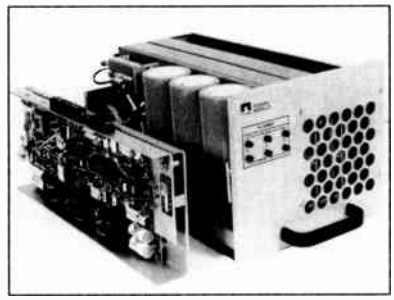

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Reader Service #072

See us at the NAB Radio Show Booth 734

Coping With Those Budget Blues

By Steve Shrader

It's late November and the GM's hair is getting gray! The time has come for that yearly ritual called Budgets. Last year you weren't even asked for an engineering budget but caught "the wrath" when you spent money for anything except emergencies.

As you can guess, this is no way for the engineering department to exist. The programmers, promoters and sales departments have budgets that they prepare, but engineering is sometimes given a budget that seems to come out of the air.

If this has happened to you, then you need help in not one but two areas: GM education and realistic budget preparation. The hardest of these two tasks may be the educational process for the GM. A lot of managers look upon engineering as a necessary evil because they know nothing about the subject. To them it's Black Magic.

Sales performance can be analyzed easily: sell 15 spots for $100 bucks and you have $1500. Programming performance can also be easily analyzed: ARB says your station is Number 2 in adults and we can raise our spot rates. Promotions can be evaluated fairly simply: the "Weekend Bash" was a success with 3000 folks attending and the sponsor signed up for another two months at $7500 a clip.

But engineering – the station is on the air so nothing must be wrong and no money needs to be spent, right? Not likely. The GM has no analytical tool to evaluate engineering; it's usually either OK or not OK; it's on the air or off the air. There is no income or ratings, only you and expenses. Your task of educating the GM is not an easy one since there are many variables involved. Perhaps one approach is to compare the station to an automobile.

**Have any Tech Tips?
Leave Them on the BBS!**

Maintenance Is Key

Everyone knows that to keep a car running you have to have oil in the engine; that the fan belts can't be broken; that the windshield wipers have to be replaced from time to time and that the tires can't be flat. If you maintain the car properly, it will serve you well; if you don't, you'll probably be stranded out on the road.

It's the same with a broadcast station. If you don't change the tape pinch rollers the spots will "drag;" if you don't replace the fader your audio will be erratic; if you don't change the transmitter tube, you will not put out full power or even worse, the station will be off the air.

In the case of a car that malfunctions you have to pay for the wrecker. In the case of a broadcast station that malfunctions you pay in the form of lost spots.

You can bet that the GM can understand your plight if you explain your department in these terms. I'm sure there are many other comparisons, but I'll leave that up to you. Let's move on to your preparation of the engineering budget.

Spreadsheets To The Rescue

To really have a good idea of the costs of maintaining a station you must prepare a budget. Without this tool, if you are asked "What's it cost?" you are just guessing. If your answer is wrong, your credibility is shot. The easy way to do your budgeting is with the help of a computer spreadsheet program like Lotus, Supercalc, Multiplan, etc.

Start with laying out the months across the sheet, like this (and put a line at the end for Total):

Jan Feb Mar Apr May ..... Dec

After you have set up the months, start down the sheet with your different expenses. Once you are finished, have the last entry total all items.

A small budget would look like this:

Item	Jan	Feb	Mar	Apr	May	... Dec	Totals
Salary	2000	2000	2000	2000	2000	2000	24000
PT Salary	400	400	400	400	400	400	4800
Tubes	100	0	3000	0	0	800	3925
Tower	100	0	0	100	0	0	400
Parts	30	0	30	0	30	30	180
Grounds	25	25	0	0	100	0	500
Totals	2655	2425	5430	2500	2530	3230	33805

Automatic Math

After you have the basic spreadsheet set up, all you have to do is change the expense amounts and the computer handles the math. It becomes real easy to alter your budget and play "what if" with your figures on a computer.

To get a spreadsheet program to try, you can download one from the BBS. Just go into the files conference and pick the spreadsheet directory to see the many choices. One program on the system that works like Lotus is called ASEASYAS. The program includes the documentation which will tell you all the commands.

Once you get the hang of working with spreadsheets you'll probably think of other uses for them. An added plus is that your budget presentation to management will look and sound professional and well-informed. And that can't but help you get the funds you need.

Well that's it for this month. Good luck with your budgets and GM education. By the way, don't forget to budget the PD's remote disk jockey starter that he or she has been buggin' you about!

Contact Steve Shrader through the RADIO GUIDE/AVS BBS at 804-468-4957. Steve can be reached by phone at 804-468-4344.

Special Report:

By Gordon Carter

NPR ListeningTests

On July 18 and 19, National Public Radio's FISPO (Future Interconnection System Project Office) held a series of listening tests in Kansas City, MO.

The purpose of these tests was to evaluate some proposed digital audio systems – specifically, bit reduction schemes or compression algorithms – for satellite transmission. The tests were designed to evaluate each system individually against NPR's existing analog system, with no regard to the relative merits of one digital system over another.

I was privileged to be a participant in these tests. While the data from these tests has not yet been compiled, and may not be released to the public, some interesting observations can be made at this time.

Bit Crunching

Each of the digital systems proposed (all of which will remain nameless at this point) have a few things in common. In order to make effective use of the satellite spectrum available, the systems are designed to reduce the required bit rate from about 1.5 mbps to approximately 256 kbps.

Standard data compression, like that used to reduce the size of the files on your computer, cannot achieve the desired results with digitized audio. Instead, perceptual coding is used to reduce the bit rate.

The bit rate reduction techniques do not provide for a complete reconstruction of the signal, but they do give a good representation of the original audio. In other words, they remove some of the audio (supposedly only that which is inaudible) and leave the rest.

The algorithms upon which this processing is based are determined by known psycho-acoustic principles such as spectral masking and noise masking. I will not go into detail on this here, but a lot has been written on the subject. (For more detail on compression algorithms, see the interview with Larry Hinderks of Corporate Computer Systems in this issue.)

Music and Voice

The NPR testing was done using typical program material, much of it submitted by the members of the listening panel. A variety of musical selections was used and a variety of voices. The voice selections were done straight in a studio, as well as through a phone coupler and a switched-56 system to give a broad range of possibilities to the test.

Since this was to evaluate the various systems for network transmission, tests were done using a number of passes through the various systems to simulate multiple stages in the preparation of programs.

As the number of passes through the systems increased, the quality of the audio deteriorated rapidly. In some cases, the digital signal was worse than the analog signal. This can be explained by the fact that each pass was removing something from the signal but was not replacing it.

While you may be thinking that this does not apply to you, let's look at it a bit closer. Assume for a moment the digital radio station of the future (about five years hence). Some material is taken from a mini-disc or digital compatible cassette (DCC). Both of these systems use bit rate reduction schemes to increase the capacity of the storage medium to a usable point.

During production, the signal is recorded on a digital cart machine of some sort, using another reduction scheme. Perhaps this program is coming from a network feed, which adds another stage of coding. When the local station receives the signal, it is again recorded on a digital cart machine.

Then, for broadcast, it goes through a digital STL and finally another coding for DAB. By the time the signal gets to the listener, it has gone through six stages of coding. Depending on the program material, the signal may bear little resemblance to the original audio.

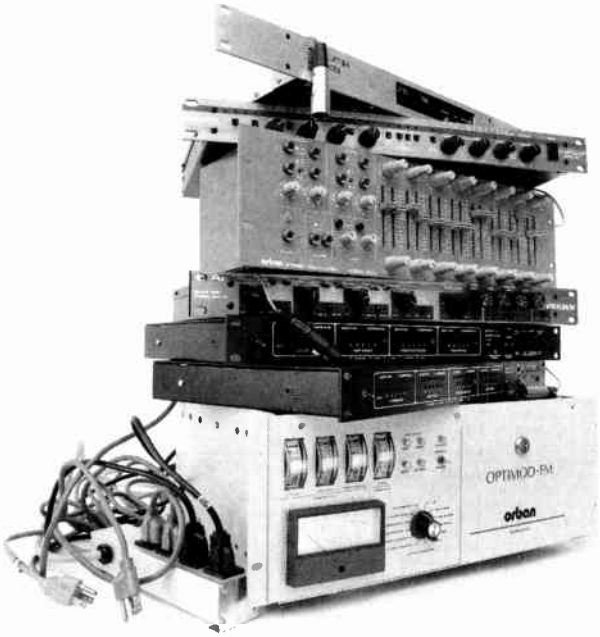
More Tests Needed

Without belittling the new technology, this is obviously an area in which we need to be cautious. There are situations where it may be impossible to avoid using a bit rate reduction scheme, such as for a satellite link. Further testing of this "tandeming" or "cascading" of compression algorithms is sorely needed before broadcasters will be willing to embrace the new systems with any enthusiasm.

Some tests, such as NPR's and the CCIR's application-sensitive tests earlier this year, pave the way for further investigations, but they are far from conclusive as far as many broadcast needs are concerned.

Therefore, it behooves the forward-looking radio station to be aware of the potential pitfalls. We need to monitor carefully the results of each coding. While a direct comparison of the original may be impossible or unnecessary, we should at least listen to make sure nothing is happening that destroys the integrity of the signal.

*Gordon Carter owns Professional Audio Services and authors **Radio Guide**'s Studio Site column. He can be reached at 708-482-4142.*



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BRING MAGIC TO
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There has been quite a bit of confusion and, frankly, disbelief concerning Audio Wizard. We don't blame you--Audio Wizard is such a powerful system that it is hard to believe. To clarify what our system can do, we have taken this blueprint from one of our stations. Just look how Audio Wizard can bring a little high-tech magic to all parts of your station:

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Audio Wizard really shines in the control room. For instance, up to 16 control rooms can be playing the same spot at the same time! Audio Wizard makes it possible for your DJ to do production while he is playing a commercial block over the air.

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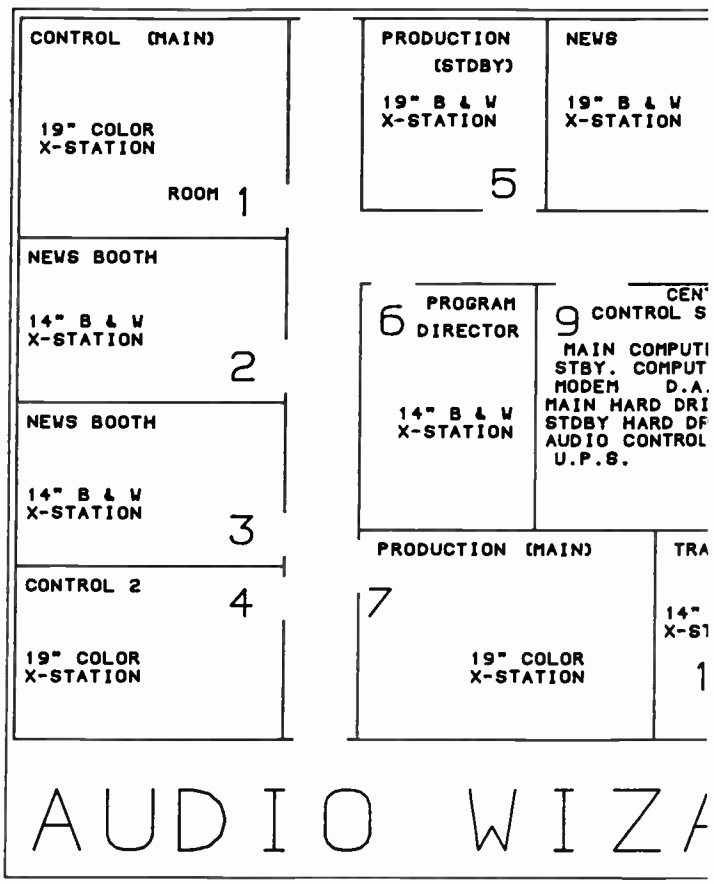
News personnel benefit from Audio Wizard because they can control their own actualities from the news booth. You don't have to tie down an engineer in the control room just to play spots. With Audio Wizard, the news person can take phone calls and record them, play commercials, and even pull up copy from the last news cast on the screen--all at the same time.

PROGRAM DIRECTOR 6

The program director can use the Audio Wizard terminal to edit the salespeople's copy, check on how each control room is doing, and even check in on the production rooms to see what is going on. Audio Wizard even lets the PD take over the control room and run the station right from that office!

PRODUCTION ROOM 5 & 7

The real time digital production capabilities of Audio Wizard make top line production a snap. And while you are recording, you can be reading from the copy that was typed in by a salesperson. Audio Wizard uses a highly acclaimed audio storage algorithm so you know that your audio will be the best in town.



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GENERAL MANAGER 14

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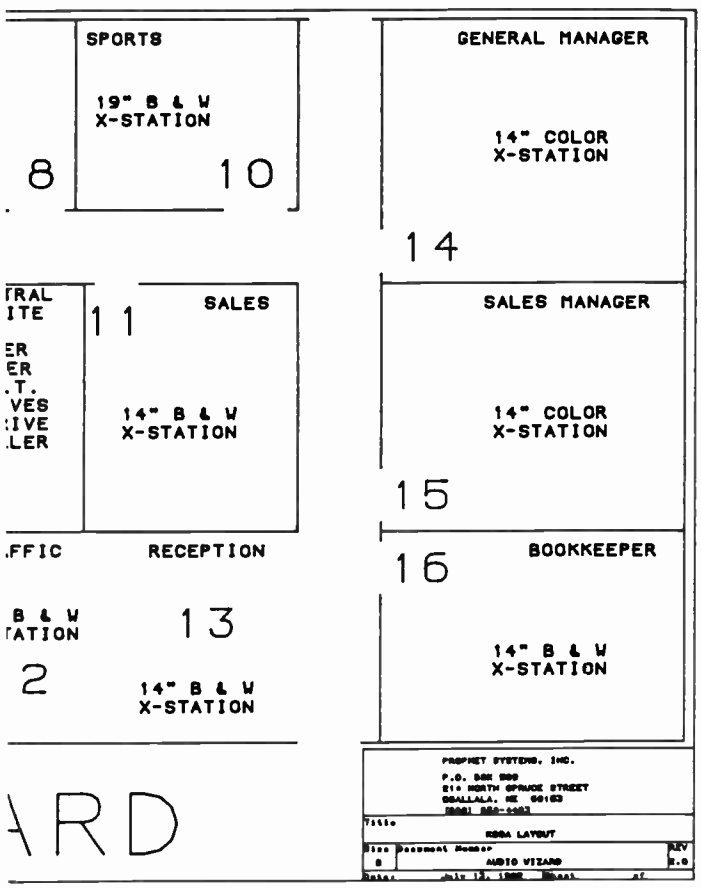

NEWS AND SPORTS 8 & 10

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Reader Service #075

Mini-Disc Has Radio Debut

by Gordon Carter

In May, 1982, WFMT in Chicago, in cooperation with Sony, became the first radio station in the world to broadcast from compact disc. Within a few short years the CD became a mainstay of radio broadcasting in the United States.

Five years later, the same radio station made the first broadcast from DAT. By now, many radio stations are using DAT daily for broadcast and production.

Then, on May 29, 1992, history was made again as WFMT and Sony aired the first-ever broadcast from mini-disc. During the mini-disc broadcast, some pre-recorded discs were played.

However, the highlight of the broadcast was live transmission of a piano recital, followed by a recording of the recital on mini-disc. The live broadcast and recording were virtually identical.

Will the mini-disc become as popular as the CD for consumers? More importantly, will it become another tool for the broadcaster, or remain a strictly-consumer product? While it is too early to predict what will happen with this new medium, let's look at what it is and how it works.

New Medium

The mini-disc, or MD as Sony prefers to call it, is an entirely new digital recording and playback medium. The disc uses a magneto-optical medium that allows it to be recorded and erased up to a million times. The disc looks something like a tiny CD, but is only 2-1/2 inches in diameter. However, it is housed in a protective caddy that only opens when inserted in the machine, something like a 3-1/2 inch floppy disc for your computer.

The discs are sold in a box similar to the CD's jewel box. Each disc is capable of holding 74 minutes of stereo audio. The first MD machines to hit the market (Sony is predicting some time before Christmas this year) will be small, portable units and possibly some units for the car.

continued from page 16

Pricing has not been specified yet, but Sony expects it to retail near the top end of its personal stereo line – putting it well within the affordable range for professional use.

When the machines hit the market, there should be plenty of blank discs available, as well as over 300 pre-recorded titles. Compare this to the only 16 titles that were available when CD players first hit the market.

Record and Play

Playback of the MD is similar to the CD in that a laser is used to read the information on the disc. However, the MD is designed to be much more resistant to mechanical shock than the CD. This is accomplished with a clever combination of improved mechanical design, a three-second data buffer and sophisticated error correction.

Access is as quick and accurate as a CD. What's more, the machine is designed to be rugged. Throw a player in the air while playing and catch it: it will still be playing. If you remove a disc from the player it will continue to play for several seconds more.

A nice extra feature is the ability to have an alpha-numeric readout of the title of the selection being played, instead of just a track number.

Recording is also done with a laser, with some help from a magnetic field. The audio that is fed to the recorder is digitized and then processed by a proprietary bit-rate reduction scheme to reduce the number of bits required to record the signal.

This allows the MD to record the same amount of time as the CD with only 1/4 to 1/5 the data storage capacity of a CD. Some very sophisticated algorithms are used to make this data reduction virtually inaudible. A recorded track can be played back immediately after recording. Also, if, at a later time, you decide to re-record track one, it does not have to be the same length as the original.

The machine will use the space of the original and then skip to wherever space is available to continue. Erasure and recording are both done at the same time with a single laser.

For Consumers Only – Not!

Sony is being very careful to position this product strictly for the consumer market, and does not like to address possible broadcast applications – at least for now. However, some obvious uses come to mind if the hardware is modified somewhat.

The possibility of using MD for ENG is in the forefront, as well as recording longer form music for editing. Of course, as material is released on MD, some radio stations may want to have players available as yet another type of program source.

Another possibility would be for the MD technology to be used as a replacement for the cart. Specially designed and ruggedized machines would probably be needed for this to happen, but the medium is capable of doing the job.

If the cost of the blank discs falls to the point where they are competitive with carts, they could be used like carts are now – one cut, or a related cycle of erasable cuts on each disc.

This would eliminate the need for a keyboard and CRT at the operator's position (which is already getting crowded in some stations) and would work just like the cart – insert the disc and press the play button when you are ready to start.

Of course, an advantage is that you could have the title of the cut displayed on the player, and possibly even checked with the station's traffic computer for verification. One of the broadcast equipment firms would most likely look at the possibility of interfacing an MD player to the console so it could be used just like a cart player.

At this point, no one knows exactly what will happen with MD. It may replace the cassette for home recording, if a protracted format war with Philips' DCC doesn't unfold. The MD may even give the CD a run for its money for the pre-recorded market.

For now, with all kinds of digital solutions to studio needs being offered, the Sony mini-disc is the industry "sleeper;" but it's certainly something station engineers as well as hardware companies should be watching closely.

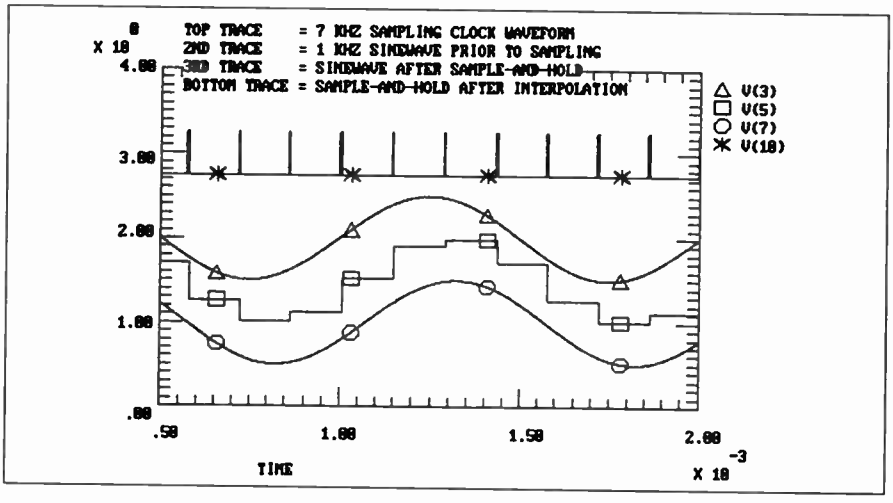
Gordon Carter owns and operates Professional Audio Services and can be reached at 708-482-4142.

Some Concerns About Digital:
Conversion Of Analog Signals to Digital

by Daniel Talbot

All music and speech starts out as analog information. The violinist drags a bow across a string in a continuous motion. He does not "stutter" in this motion unless he is trying to create a special effect. Furthermore, the stuttering is slower than the rate of the string's vibration. The analog nature of most source material makes it a "continuous-time" signal.

If any continuous-time signal is intermittently observed ("sampled"), its character changes. The process of observing the waveform at intermittent or periodic discrete intervals in time is equivalent to taking "snapshots" of the signal. The result is called a "discrete-time" signal. The process is called "time quantization.



Because the character of the original signal has changed (even if the snapshots were performed with 24-bit or higher precision), there are both detrimental and beneficial consequences. The beneficial result is a series of "frozen" voltages which can be represented by a series of "frozen" numbers. This permits Amplitude Quantization of these numbers by a digital device (AD converter) and subsequent handling and manipulating by other digital devices.

This benefit can be tremendous, permitting the transfiguration of analog signals into a format compatible with lasers and other devices which operate well as "on-off" switches, but which would yield only lackluster performance if they were used directly as analog components.

Some Trade-Offs

On the other hand, the detrimental consequences are numerous. First, the discrete-time signal obtained from sampling a continuous-time signal is just an approximation of the original. For example, if the original signal changes drastically between sampling "snapshots," these changes will not be represented in the output of the sampler. In other words, the information content of the original analog signal has been altered.

Fast changes (high analog frequencies) are poorly represented and rolloff and aliasing occur. And low frequencies are distorted by amplitude quantization. At this point, we should point out that amplitude quantization can exist without time quantization and vice-versa. For example, an analog sample-and-hold (or "boxcar") circuit time quantizes but does not amplitude

. . . continued

quantize. A simple analog comparator amplitude quantizes (albeit poorly, with only one bit of resolution), but does not time-quantize.

Second, the "snapshot" observation of the original analog signal creates new signals, or "artifacts." Because the sampler is a form of signal multiplier (the original signal is multiplied by an "on-off" waveform), problems arise which plague all practical multiplying components, such as RF mixers.

Some of these include intermodulation cross-products between harmonics of the analog signal (all analog components, including the front end of the A/D converter itself, generate low-level harmonic distortion) and harmonics of the sampling frequency. These cross products can occur in any permutation, such as the 12th analog harmonic beating with the 5th sampling harmonic.

This is termed the "N-cross-M" problem, so named because the Nth harmonic of signal A beats with the Mth harmonic of signal B to generate a "whistle," or beat frequency, that can appear back inside the audio passband. There are thousands of combinations of N and M, resulting in thousands of different whistles that exist simultaneously and in some cases are so numerous that they look like part of the noise floor. Some A/D converter manufacturers describe the freedom from this effect as "spur-free-dynamic-range," or "SPDR."

Duration and Frequency Response

Third, the duration of the "snapshot" affects frequency response. Normally, the snapshot lasts until a new snapshot is taken. This is called "holding," and is best described by the word "hold" in the term "sample and hold." The waveforms in the graph illustrate the sample and hold process.

In the graph, the top trace is the sampling pulse waveform; the next trace is the analog signal before sampling. The third trace down from the top is the same signal after time-sampling and perfect "droopless" (zero-order) holding. The term zero-order is used to describe the mathematics of the sample-hold's Z-transform.

The effect of the perfect hold action is to "smear" the signal in time by protracting it, and thereby results in a high frequency rolloff. In Part 2 of this series, we will examine this rolloff, called the "sine-X-over-X" frequency response, named for the mathematics involved.

Fourth, the reconstruction of the original analog signal after it has been time-quantized must be performed by an interpolation (low-pass) filter. This creates a time delay whose theoretical minimum value is that of an ideal interpolation which is a delay equal to one-half the time between samples (see bottom trace of illustrating waveforms).

The reconstruction delay is actually much greater than this, because practical brick-wall filtering is employed. Outrageous delays are encountered if, in addition to time-quantization, digital code compression is employed.

Dan Talbot is President, T-Tech Corp., Hudson, MA. He can be reached at 508-562-5820.

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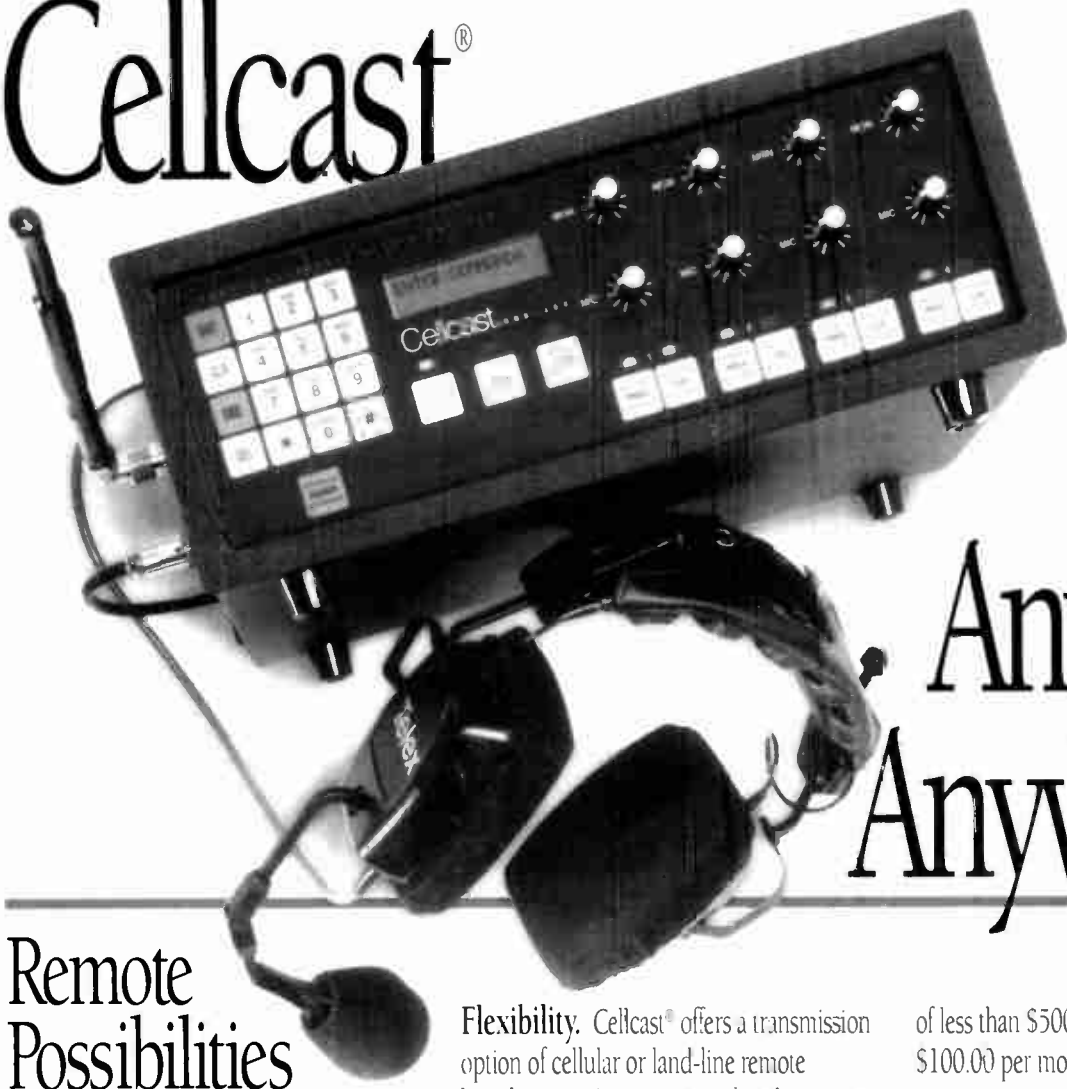

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Audio Compression Algorithms: Where We Are Now

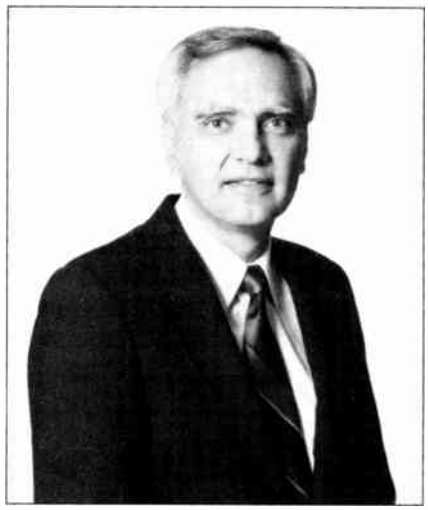
By Judith Gross

Dr. L. W. Hinderks – Larry to his friends – has become a valuable source of information on a state-of-the-art issue in audio transmission: digital compression, or bit reduction algorithms. His tutorials have been the high point of many recent industry gatherings; his presentations are laced with wit, humor and valuable insight.

Behind his user-friendly approach to this complex subject is a prestigious background of education and research. He has a PhD in physics, has worked with Bell Telephone Labs on, among other things, microwave propagation. In 1977 he co-founded Corporate Computer Systems and in 1987 he turned his attention to digital audio. CCS is a MUSICAM licensee and Hinderks' work on applications for digital compression is pioneering. **Radio Guide** got him to take time out from a hectic schedule for an update on digital compression for audio.

RG: *Why are we hearing so much about compression algorithms now and why are there so many new ones that have sprung up in the last few years?*

Hinderks: Until recently, AT&T-Bell Labs were the only people doing research and their emphasis was only on speech. The source was a human and the "receiver" was a human and the human vocal track only has certain characteristics. They did elaborate research into speech compression and today they can go as low as a kilobit per second. Back then, no one else really needed audio compression except the phone company. The original telephone lines were analog and when the time came to convert to digital they found that digital audio needed too much bandwidth. They didn't want to add new copper wire, so they were trying to squeeze down 100 kbps to 64 kbps (for 4 kHz audio) this is 30 or 40 years ago.



Larry Hinderks

RG: *Why does digital take up more bandwidth than analog?*

Hinderks: We don't know how to represent the audio in a good form. We're sending much more information than we need to for the receiver to receive the same information. When we compress it, we decide to send only the information we need to send. Digital audio should take up the same bandwidth as analog, but we're only just beginning to understand how to do that mathematically.

RG: *Then it's all really just a question of mathematics?*

Hinderks: Exactly. The most you can send over a telephone line is 24 kbps. Now you have to figure out how to send as much as you want over that. Today we can send voice in about 16 kbps and have the same quality as we're used to. But the price we pay in the digital domain is that we need more complex equipment to do it.

Today we have digital signal processors that can perform the mathematics. Ten years ago we didn't – that's why it's happening now. The calculations couldn't be done quickly enough before.

RG: *When did the desire to compress music and other types of audio come into the picture?*

Hinderks: Audio became an interest for DAB. CD audio needs a megabit-and-a-half per second. A CD provides nearly infinite storage, but when it comes to broadcasting we have a problem with bandwidth. A megahertz-and-a-half is the whole AM band. Think of it in terms of how many megahertz of bandwidth does it takes for one megabit. Today, they put a bit per second in one Hz of bandwidth. The FM channel is 200 kHz, so we need 200 kbps transmission.

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The Eureka researchers said, "Let's come up with a digital audio system," and they figured out how much they would need to squeeze down the audio to do it.

RG: *Do all compression algorithms encompass the same basic techniques?*

Hinderks: Yes, they do encompass the same basic technology: numeric compression and psychoacoustics. Numeric is just squeezing down the numbers and throwing away blanks and repetitive numbers. It's lossless compression. But the other trick is the psychoacoustics, and that's much more interesting.

RG: *How do they work?*

Hinderks: All the psychoacoustics use the same basic trick: masking. Loud sounds hide quiet sounds. When you digitize audio, you use an A/D converter. The more bits you use in A/D conversion, the more bits per second it takes, so we cut back on the number of bits and that raises the noise level. We look at the audio and see how loud it is, then let the A/D converter noise rise to just below it. What's being masked is not the soft sounds in the audio. What's being masked is the sound of the noise we're adding, being masked by the audio. The algorithms differ in how they do this. Other types of masking include frequency masking and temporal masking.

RG: *What are the differences, in general approaches, between: MUSICAM, ASPEC, Dolby AC-2, APT-X, and G.722 compression algorithms?*

Hinderks: G.722 is 20 years old. Basically, it says that there are louder sounds in low frequencies and not so loud in high. This algorithm splits the band into two: 0-4 kHz and 4-8 kHz. It can hide more sounds in the low frequency, throw more bits away. This makes it perfect for voice. In fact, it's the model for voice.

Along came APT and said, gee that's interesting, but it only goes up to 8 kHz. Let's add two more bands: 8-12 kHz and 12-16 kHz and do the same thing with four bands instead of two. They can shape the noise of the A/D converter more precisely. This makes it possible to use apt-x for FM music.

But when you only have four subbands, they are pretty grossly spaced. The human ear doesn't like to divide things up like that. MUSICAM said, let's take 20 kHz and divide it into 32 bands (each 750 Hz). They were able to look at each narrow band and adjust the A/D noise accordingly: How far can we push it before the human ear can hear it? That's where the psychoacoustic model the IRT (Institut fur Rundfunktechnik) had came in, allowing them to push up the noise even more and throw away more bits. The algorithm determines where the noise level is.

Dolby and ASPEC took a different tack. They decided to look at audio in the frequency domain. They put only 100 Hz in each band, to get finer resolution. But the problem with that is that the human ear can't perceive that fine a resolution at the high end ... so these are better at the low end but overkill at the high end.

MUSICAM is a mathematical compromise between resolution and complexity. But it's more than mathematics; you have to know where to put the A/D converter. Also, complexity of implementing the algorithm becomes a factor, because we don't want to wait for it indefinitely.

RG: *How far can you crunch the audio, down to what bit rates, and still keep the sound intact?*

Hinderks: You should be able to do as well as you do in analog. So, 15 kHz should only need 15 kbps, somehow. We're not there yet, but look at how far we've come. We're down to 256 kbps for CD quality. With stereo we can get near CD quality with 128 kbps by getting rid of the redundancy stereo affords. At 156 kbps per second, nobody can tell the difference. At 128 kbps some can. We say 192 kbps is CD quality. The critical question is: What if you find one person who can hear it? Where do you compromise? The marketplace has to decide.

RG: *There's still some debate over the ISO tests; do we have a standard, and is it MUSICAM or a combination of MUSICAM and ASPEC? How important is that standard for U.S. broadcasters?*

Hinderks: ISO recently issued a draft international standard in June. Now there's a period of six months where the world can review it. If there are no objections at the end of six months, it will be a standard. There are really three parts: Layer I, Layer II and Layer III.

Layer II is MUSICAM exactly. Layer I is a less compressed MUSICAM. Layer III is a combination of ASPEC and MUSICAM; it uses MUSICAM's 32 subbands and further splits them the way ASPEC does. If the draft standard becomes the standard, anyone can implement it how they want, whatever layer they desire. Every detail is specified, so multiple manufacturers can implement it. We now have a benchmark.

For U.S. broadcasters it gives us a reference to compare to. Broadcasters can insure quality of their transmission if they are using ISO standard equipment. And there is a whole body of listening tests to draw on.

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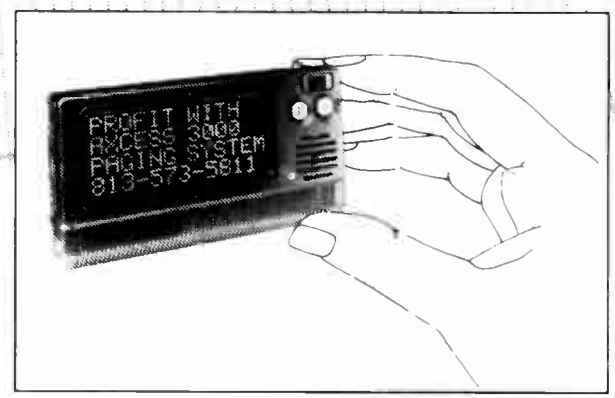

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Continued from page 22

RG: *Of more importance to radio broadcasters is the idea of "cascading," or using algorithms in various types of digital equipment in tandem, say, through digital record-and-play, processing, digital STLs and eventually a DAB transmission system. What happens to the audio at the end of this cascade of multiple algorithms?*

Hinderks: That's the world's most complex question. The only way to resolve it is to do more research on that. There are at least six major algorithms -- no one has enough time or money to do these tests. So we have to test it in the use of them. CCIR has done some tests, looked at various algorithms to see if they met their requirements for different applications.

At commentary (64 kbps), ISO Layer III met their requirements -- and that's all. For emissions (192 kbps), Layer II MUSICAM and Layer III met their requirements. At distribution (256 kbps), Dolby, Layer II and Layer III were acceptable.

RG: *How much delay is added when you compress the audio and how big a problem is it? Are DJs going to have to give up the notion of monitoring off-air?*

Hinderks: Digital processing is going to add more delay to the chain. So we have to come to grips with more delay. We aren't going to be able to get the delay down. We don't like it, but what we need to do is just say we can't do it the way we used to. But look at the incredible quality at low cost these techniques have given us. This is one of the trade-offs we have to make if we want the benefits that digital has given us. Cost and quality. Digital has made quality affordable for the masses.

RG: *You work mostly with MUSICAM. What are some of the current broadcast applications using MUSICAM?*

Hinderks: Corporate Computer Systems is a MUSICAM licensee and we can sub-license it. We've been involved in it for four years. We've done a lot of research and we have implementations we're offering. People can come here for one-stop compression shopping, including circuit diagrams, licensing and products. We license Layer I and Layer II.

What's exciting is not only have we been a champion for audio compression technology, but we've made it a reality for broadcasters. BBC sends a program to France every day via ISDN with our CDQ-2000. A CBS affiliate simulcasts its morning show from Tampa to Orlando six hours every day with CDQ Switched 56. A very interesting application is a service called Digital Patch provided by Waves, a California company. They use a special CDQ-2000 for professional recording studios to trade audio. For NCAA football starting this fall, audio will be sent to a bridge on Switched 56 or ISDN and anyone call pull it out. You can transmit 20 kHz audio from 64 to 384 kbps.

I see the ability to transmit high quality digital audio worldwide on a regular basis for the cost of a regular phone call. With new FCC ownership rules, the possibilities are expanding.

A future phone service planned is Switched 384. You could use that for CD mastering quality audio. Just dream ... now, all of a sudden, it makes no sense to have satellite transmission for point-to-point. Broadcasters are the trail blazers by using MUSICAM and they will be the origination points.

Our new product, Micro56, has G.722 (mono). This new unit will automatically sense G.722 or MUSICAM. We're also working with USA Digital DAB on the MUSICAM part of their system. It's our way of bringing MUSICAM to broadcasters. We're not hung up on any particular modulation scheme for DAB. Basically, we've adapted IRT's technology for U.S.

RG: *There are still some companies proudly saying that they use no compression whatsoever and still audio purists who dislike the idea of compressing audio. Given the current spectrum demands, is compression inevitable for radio broadcasters? What do you say to engineers who don't like "messing up the audio in that way?"*

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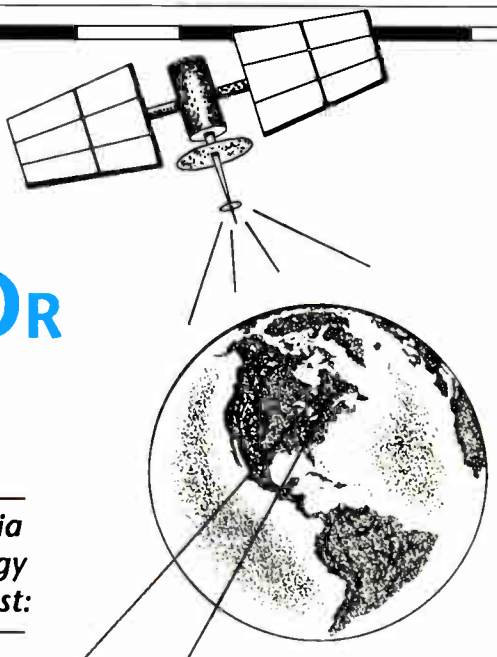

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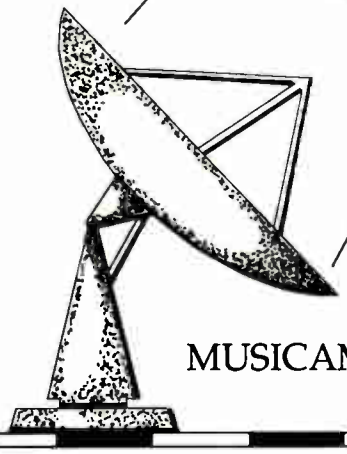

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W I T H

TECHNOLOGY

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Repair & Maintenance at the Transmitter

What To Do When Intermod Intrudes

by John Bredesen, P.E.

Intermodulation is a problem for many stations with antennas in close proximity to another transmitting antenna, such as might exist on a shared or nearby tower. Intermodulation products can result when the transmitted signal from Station B's antenna is picked up by the (transmitting) antenna of Station A, and the received RF is mixed in the final cavity of that transmitter and re-radiated along with the desired signal.

The results of this mixing are one or more spurious frequencies which, at first glance, may not seem related to the original frequencies. The FCC Rules are quite specific on the maximum allowable level of these spurious signals. For stations operating with a power of 5 kW ERP and above, the requirement is that any emissions more than 600 kHz away from the carrier be attenuated by 80 dB (see section 73.317d of the FCC Rules and Regulations).

Tracking down the mathematics of an intermod problem can be tedious, if not difficult, especially when more than two or three stations are involved. (The RF Specialties' freeware program disk, one of the two featured in last month's Transmitter Site, has a program for calculating the possible spurs from several input frequencies.) Harmonics of a station's frequency can mix with the fundamental of another to produce a third frequency. Or the second harmonic of one may interact with the third harmonic of another.

Adding and Subtracting

Probably the most common mix occurs when the second harmonic of a station mixes with the fundamental of another. This takes the form of:

2F1 – F2 = F3 or 2F2 – F1 = F3

For example, if Station A (F1) is 101.3 MHz and Station B (F2) is 98.7 MHz, then 3rd order intermodulation products may exist at 103.9 MHz and 96.1 MHz, as follows:

2(101.3) – 98.7 = 103.9
or 2(98.7) – 101.3 = 96.1

The process of mixing produces the two original frequencies, the sum of the two and the difference of the two. We're concerned with the latter mix (the difference), because the sum of any two frequencies, even fundamentals, places the resultant mix frequency far above the FM band where it's severely attenuated by both the transmitter low pass and/or harmonic filter, and by the bandpass characteristics of the transmitting antenna.

The characteristics of a tuned output cavity are such that there will be a drop in level between the incoming "undesired" frequency and the resultant spurious frequencies. This loss is quite often referred to as "turn-around-loss" or "mixing loss," and results because of the bandpass attenuation in the cavity acting on the undesired frequencies, as well as the loss in the conversion process itself. This turn-around-loss is added to the level of the incoming undesired signal.

If, for example, an out-of-band signal is coupled into a station's transmitter at a level 58 dB below the desired carrier, and the turn-around-loss is 13 dB, then the spurious frequency will be returned to the antenna system 71 dB below the desired carrier. Some additional attenuation will be gained because of the bandpass characteristics of the antenna, but in all likelihood, not enough to meet the -80 dB attenuation requirement.

It's interesting to note that little help is realized from the station's harmonic/bandpass filter in combating the problem. Once the undesired fundamental is introduced into the station's transmitter, the culprit harmonics are generated in the cavity. When the mixing and generation of the spurious frequency has occurred, we're faced with a frequency which is inband and therefore passes through the filtering as easily as the desired frequency.

The transmitter output tuning can have an effect on the turn-around-loss because the degree of loading affects the "Q" of the cavity, and therefore the bandpass characteristics. However, there is just so much which can be done by this method.

Measuring Spurious Signals

Using directional coupler ports in the transmission line with a spectrum analyzer will allow you to measure the presence and level of spurious signals going into and out of the station's transmitter. Be cautioned, however, that many spectrum analyzers can overload quite easily and will generate intermodulation products of their own.

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Transmitter Site

Continued from page 27

While these spurious signals are internal to the analyzer, they can be very misleading to say the least.

A tunable, high-Q filter inserted between the directional coupler port and the analyzer to minimize the station's carrier may be helpful. Adjust the calibration of the analyzer relative to the station's carrier without the filter. Once the calibration has been established, insertion and very careful tuning of the filter to reduce the station's carrier (but not the signals to be measured!) will allow easier measurement of the spurs.

I've found it vitally important to use double shielded coax, such as Belden 9222, for these interconnections. Without the additional shielding so provided, stray signals can be introduced into the analyzer, making meaningful measurements difficult.

So now you've found that the new station in the vicinity is producing a spur, and it's coming out of your transmitter. You've determined to your satisfaction that the new station's frequency is entering your transmitter and one or more spurious frequencies are leaving. Beyond the problem of who's responsible for the cost of any changes or modifications necessary, what are your options?

The way to avoid the generation of these spurs is to prevent other carriers from getting into your transmitter in the first place. There exist two types of filters to prevent this intrusion: band stop and band pass, or a combination of the two.

Band Stop Filters

Band stop filters, depending upon design, are generally smaller and less expensive than band pass filters. They provide a notch with steep shoulders, are tuned to the frequency of the offending carrier and function to prevent that one frequency from passing. Because of the steep shoulders and depth of the notch, often only one or perhaps two sections are needed depending upon how strong the offending signal is.

Because of the high Q of these filters, modern design incorporates temperature compensation as an integral part of the design. Some older band stop filters without this compensation were notorious for producing a high VSWR at sign-on when they were at room temperature. This would either trip the transmitter off the air or induce power foldback until the filter warmed to it's operating temperature!

One disadvantage to a band stop filter is that if another station should appear in the vicinity, it may be necessary to install another filter in series with the first to deal with the new station.

Band Pass Filters

Band pass filters provide a more general protection for a station because the filter sections are tuned to pass only the desired carrier. Any offending carriers outside the bandpass are rejected. The big advantage, therefore, is that they provide protection against any new stations, regardless of frequency, as long as they are outside the passband.

But because these band pass filters must pass the entire spectrum of sidebands from a transmitter without introducing unnecessary group delay and carrier amplitude variations, they of necessity are quite wide in their passband characteristics and don't discriminate well against an offending transmitter only a few channels away. If that kind of situation affects your station, it may be necessary to combine both a band pass and band stop filter.

The subject is complex with many factors to be considered in making a decision as to which is correct for your particular installation. I would recommend strongly that you contact one or more of the several manufacturers or vendors of such filters for advice with your particular situation.

John Bredesen has been involved in both radio and TV engineering for more than 30 years. He is a P.E. and currently CE of KLCC/KLCO in Eugene, Oregon. He can be reached at 503-747-4501, Ext. 2478.

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Reader Service #089

Tech Tips From the Field

Practical Solutions to Practical Problems

1. Dim Lights
2. CD Remote Start
3. Motor Bearings
4. Makeshift RPU
5. Cathodic Action Fix

by George Whitaker

Don't you just hate it when someone walks in and says, "If you plug it in, it might work," and they're right? We've all had that happen at one time or another. We have some days when we're absolutely brilliant and then we have those days when we couldn't be a proofreader in an M&M factory.

What causes me to be thinking about all this is that I recently did something similar to a very good engineer in Florida. I was down there on a consulting job, went to the transmitter with the owner and found that the lights in the building were dimming with regularity.

The local engineer, whom I know by reputation and from seeing his work, is a very competent and really above average engineer. But he had convinced himself at the moment that the power company was doing something weird.

There are two things that I have found to cause these symptoms. One is when an air conditioner compressor locks up and the lights will dim as the unit tries to start the compressor. Then the thermal overload will take the compressor off-line and the lights will return to normal.

The other is when the tower lights get into the RF and vice versa. The tipoff is the frequency with which the events are occurring. The air conditioner will cycle every 30 seconds to a minute; the tower lights will cycle several times per minute.

In the case in question it became obvious to me within a few minutes of observation that it was the tower lights. We turned off the breaker to the lights and the dimming ceased. The lighting choke had probably been damaged by a lightning hit and was no longer providing isolation for the circuit.

I know that the local engineer knew these symptoms and the information was stored away in the back of his mind. It just didn't come forward at the moment. That's why I thought that dropping them in here might help refresh some memories.

And, yes, I have many stories of this type of thing happening to me ... more than I care to admit in public.

Stu Englke of WWDJ in New York has discovered an added benefit of:

Remote-Starting A Radio Shack CD Player

At our sister station we use consumer model CD players on the air with good results. The idea is that if one breaks, they are cheap enough to throw out and get a new one.

The problem was how to remote-start them. We use a Radio Shack model and, upon investigation of the Play button, I found that one side was at ground. So, all that was necessary was to connect the other side of the button to the console remote start logic.

Our console is an Autogram and supplies an open collector ground with an option for a start pulse or a continuous ground until the channel is turned off.

With the Radio Shack CD players, I found that if I held my finger on the Play button and tried to operate other functions of the unit, they were locked out.

This meant that if I used the continuous ground from the channel on the console to start the player, the DJ could not accidentally open the CD drawer, change tracks or stop the player until the console channel was turned off.

As an old skateboarder (I used to outdo my kids), I found the next item absolutely fascinating. J.D. Kimple of WMCD in New Concord, OH found out that:

(continued on page 32)

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Tips From the Field

continued from page 30

Skateboard Shops Have Motor Bearings

While working on several cart machines, I noticed that the bearings in many motors were stamped with 608Z. These bearings are the same size as – believe it or not – the bearings used in skateboard wheels. In fact, they are the same thing. The good part is that these bearings are available from any shop that sells skateboards and parts for about $1.50 to $2 each.

Yes, I did start tapering off skateboarding several years ago and have not been on one now for over three months. But I can hardly wait to teach my granddaughter in a few years.

This next shortie I must consider a Tech Tip, and it certainly qualifies as a "slapper." At any rate, R. Michael King of King Mt. Services, Ltd., of Frisco, Colorado adds the following to Bill Jones' "Solder-Wik Container as a Solder Dispenser" idea. He says,

Keep Your Desoldering Act Together

By snapping your new solder dispenser on top of a spool with Wik still in it, you now have a one-handed desoldering and re-soldering device ready at your fingertips. Pay attention to how you wind the solder. It must be in the same direction as the Wik or you will fight it.

I have to admit that I have gotten lazy in my old age and have subscribed to the theory, "Who needs brains when you've got software?" But sometimes necessity does bring out the best in thinking, and I have to hand it to Maynerd Meyer of KLQP-FM of Madison, Minnesota for coming up with a:

Makeshift RPU

When a local church decided to have an outdoor service in the park a couple of blocks away, they asked if I had an idea how they could still broadcast their service on their local radio station. Normally, they just throw a switch, which puts a PA amp output into the telco system.

After examining the situation, I suggested that they take the transmitter from their wireless hearing aid system over to the park (on 72 mHz) and feed it with a tap into the portable PA system they were using in the park.

I whipped up the proper cable to connect a hearing aid receiver into the PA system back at the church so they could use the regular telco hookup to the radio station.

It worked great and they were impressed; however, I'm not sure the "Big GM" upstairs gave me any extra points for helping them out or not. I hope so, I need 'em!

It is surprising how far you can go with a good wireless mic. We have used ours from as far away as two city blocks by putting a Yagi on the receiver.

Clif Glasgow of KROP/KSIQ-FM in Brawley, CA has a "scratcher" for us dealing in how:

Cathodic Action Might Be Corrosion Culprit

When I first arrived at KROP/KSIQ-FM, the uproar of the moment was over "corrosion" on the base piers of the self-supporting AM tower. The piers has been dug back and exposed, plus the concrete caps jack-hammered off one when I first got to look them over.

My initial reaction was that the problem wasn't severe enough to justify replacing the supports, even though they'd been in the ground since 1946. My "gut" reaction was backed up by the report of a structural engineering consultant. Second, I did not believe that in an area with an annual rainfall of less than 2-1/2 inches and sandy soil that this was a "rust" problem.

After checking with the local irrigation and power company, I confirmed a local problem with "cathodic action." I even managed to locate the consulting firm that handled problems for the irrigation district. They confirmed that the high alkalinity of the soil contributed to the problem. The engineer explained to me that the problem is especially severe at the interface of soil, concrete and steel.

Essentially, what you create is a battery, with the steel acting as the cathode, sacrificing to the anode (earth). Over time, depending on the efficiency of the battery and "leads," the steel will give up enough iron molecules to become pitted and weaken.

Where structures are completely buried, such as guy anchors, this can happen quite rapidly. One tower in our area collapsed a couple of years ago and cathodic action was contributory to the failure. If your soil is moist or if your tower is in an irrigated field, this can seriously exacerbate the process.

When you know what you're looking for, it may be easy to spot this problem by eye. Most towers, guy anchors, etc. are galvanized. In this case, the zinc will sacrifice to copper ground wires or the earth.

You might find dark spots or flaking wire where the zinc has completely eroded away and exposed the steel. In damp climates, the steel will quickly begin to oxidize and you might find rust. Look especially close where steel meets concrete at, or under, ground. If you have to, dig down to the top of base or anchor piers.

In my case, I had a ground strap break loose from one of the base piers. When I put a meter on it to the pier, I could actually see, with the tower cold, a difference of better than 0.75 V and current flow of some 20 microamps without anything more sophisticated than a hand-held VOM and test leads.

Another handy indication of the propensity for your soil to conduct this way is if your chain link fences rust out quickly – in less than 10 years.

So how do you deal with it? The engineer who first brought this phenomenon to my attention, Dennis Silver, PE, of Salt Lake City, has successfully used back-bias. He uses a simple battery or one of the cheap, little DC power supplies available almost anywhere to balance out the cathodic flow.

I opted to use the same method the irrigation and gas companies all over the world use – a sacrificial anode. These are commercially available, are relatively inexpensive (almost any-

. . . continued

thing is, compared to the cost of replacing a tower), and simple to install.

The anode is a magnesium slug in a sack of electrolyte and backfill and comes with several feet of #12 wire for attachment. You can check with a local natural gas company or contact International Metal Company in Sapulpa, OK at 918-224-4746. IMC has at least one eastern outlet as well.

The anodes come in standard sizes of 5, 10-12, 17 pounds and much larger sizes as well. The five-pounders handled all four legs of my AM tower and I bought four more for the tower and three guy anchors of our FM.

For more info on this last one, you can contact Cliff at 619-344-1300.

Those of you who attended the technical paper that I delivered on "Common-Frequency Broadcasting in the Medium Wave Bands" (that was the formal title) at the Houston SBE convention will probably remember the slide of the young lady in the bikini that somehow found its way into my slide show of charts and graphs.

I, of course, never allow levity to emanate from my person and, if I do get to deliver the paper which I am now planning for next year's convention I hereby promise that it will be as serious as everything else I do.

Now that SBE conventions have been mentioned, I want to take the opportunity to urge every one of you to head for San Jose this October. I always learn a tremendous amount from the bull sessions as well as from the papers presented. I know that you've got some information I could use, so, I hope to see you there.

Send Your Tech Tips to:

George Whitaker
3505 Daniel Dr.
Arlington, TX 76014

Dealing With the "M" Word

by Mike Patton

This month we are continuing our discussion of the business end of contract engineering, with emphasis on the word "business." Obviously, the bottom line on my business and yours is that we all must make a living. I find it very easy to end up running a non-profit organization (not by choice!), and I lose a lot of sleep worrying about earning enough money.

This is a very complex issue, with pressures from all sides. I've been in business for twelve years. My wife and I have three children, all in public schools, with another on the way. So far, my wife has been able to stay home with the kids. After driving the same vehicle for 14 years, I was recently able to purchase a used, mid-priced American car.

Being a contract engineer, and having a wife who doesn't work (with my blessing and encouragement) puts us considerably "closer to the edge" than I would like (my cousin, also in business for himself, brags of having six months' expenses in the bank–envy, envy). Nevertheless, so far, we have managed.

How Do You Bill?

For me, the hardest thing is to face up to the reality of how many hours I can bill each week, and how much I have to charge per hour to make enough money. Of course, there is a limit on each of these. I can only work about 80 hours in a given week and only about 60 on a continuing basis.

If I work more than this, I can't maintain my sanity, much less my family life. Try as I might, I can bill only about half of the hours I actually work, between office work, workbench, supplies (spare parts) and test gear maintenance, travel, shipping and receiving.

On the other hand, there are limits to how much I can charge per hour, influenced by the changing (usually not for the better) economic conditions of my clients and the rates of other engineers in the area. The major pressure here is from the younger, less experienced guys, the ones without families (and car notes, house notes, doctor bills and...).

These engineers are able to charge significantly less and still have beer and pool money. Most of them are fair engineers, but everyone gets in over his or her head sooner or later. When he does, esteemed GM, who ya gonna call? Not me, if I have had to go to work for the phone company or an industrial plant to support my family comfortably far from the edge.

Factoring It In

Since we are in a business, there are some things we can't ignore – at least without great peril. How do you factor occupational license business (liability) insurance, office supplies, a high phone bill, the cost of tools and test gear, and travel expenses into your rates? Add employees, and then we must deal with withholding and unemployment taxes and workers' compensation.

Taking all of these things into account, if we set our rates so low that we can pay all the bills only in a good month, what happens when the car breaks down, a kid breaks an arm and grandma in Canada dies and we have to buy air fare to her funeral for the whole family – all in one month? The rates we charge define the distance between the fire and the frying pan.

Planning, as in most cases, is your key ingredient when calculating rates. Don't forget the obvious costs and then add the less obvious ones (like insurance and general supplies) to the list. Don't forget expenses that are reimbursable, either. Then, when you've got that all tallied up, add that something extra for a cushion to make sure you still have a business in the future.

You're Worth It

Sure, there are stations who gripe about paying our "high rates," yet they pay more per hour for almost any other professional they hire. Ask a station owner how much the lawyer, CPA or even the copy machine repairman charges, and I'll bet you that your rate is less than half of most of these.

We may not have as much formal training as a CPA or a lawyer, but I guarantee you that we have to have as much or more ability to deal with the "real world" than any of these.

Here's the moral of this story: count the cost of being a contract engineer, and charge accordingly. Don't be afraid to charge what you need or what you know you are worth. What you lose in the way of marginal business you will assuredly gain in respect and self-respect. Just be sure that you give your clients their money's worth.

Next month we will look at dealing with manufacturers and vendors.

Mike Patton owns and operates Mike Patton and Associates and is becoming an old hand at being a daddy and driving a used car. He can be reached at 504-292-4189.

Coming Next Month

S.B.E. Convention Preview

Equipment Report:
FM Transmitters
Exciters, SCA, RDS

Building An Engineer's Library

by Eric Small

With the premise that engineers can never have too many good sources of information, there are a few "good reads" that I have found invaluable and would like to share.

Building a good reference library means, in addition to expanding your base of knowledge, that you'll always have somewhere to turn when that perplexing problem crops up, even at four in the morning.

Reference Data for Engineers: Radio, Electronics, Computers, and Communications, 7th edition
by Edward C. Jordan
Published by Howard W. Sams

This book and its predecessor, **Reference Data for Radio Engineers**, are the most used technical books that I own. It's the first place to turn for almost any kind of technical information you might need. And it's not just a book for designers; there is a lot of information useful for operations and troubleshooting.

Some chapters, like "Scattering Matrices" and "Lasers," you may never need (but might find interesting); but others, like: "Attenuators," "Units, Constants, and Conversion Factors," "Broadcasting, Cable Television, and Recording Systems Standards," and "Transmission Lines" will get frequent use.

For example, recently I wanted to test a 12 volt car battery under a load of about 30 amps. I didn't have one of those fancy testers that mechanics use, but I did have a good digital multimeter. I calculated the resistor that I needed was 0.4 ohms at about 400 watts. Not exactly a Radio Shack item, but I did have a lot of 14 gauge wire around.

Checking the wire table in Reference Data, I found that 14 gauge has a resistance of 2.525 ohms per 1000 feet. That worked out to 160 feet of wire and I had my load resistor.

The chapter on attenuators covers audio pads thoroughly (many references ignore audio) as well as RF attenuators. The power supply chapter is nice because it provides the ripple frequency for all of the popular polyphase power supply designs. That's useful information when you're trying to figure out where that 360 Hz hum in your audio is coming from. The section on transmission lines has a very complete table describing all the RG style coax cables that you will ever encounter, and many that you will never see.

My favorite chart in the book relates distance to the radio-horizon to transmitter and receiver antenna heights. That answers the often-asked question, "given a good antenna, how far away can I reliably receive the station?"

The chapter on broadcasting is OK because it has a lot of information in one place, but don't expect to find anything here that you don't already know. The math chapter has all those area and volume formulas that no one ever remembers. In the miscellaneous data chapter I found the formulas for determining the sag and tension on any cable hung between two supports.

All in all, if I could have only one technical book, it would be **Reference Data.**

Two Amateur Radio Books

Many broadcast engineers got their start in ham radio, but sometimes we ignore the high quality technical publications that come from this still technically active community. Here are two recent publications.

Reflections: Transmission Lines and Antennas
by M. Walter Maxwell
American Radio Relay League, 1990

Anyone dealing in the generation and transmission of radio frequency energy must also deal with transmission lines. Few things appear as simple on the surface but are as complex in practice as transmission lines. Whether your work keeps you at the low end of the AM broadcast band, or if you are involved in Ku band satellite links, transmission lines are an essential component.

More misconceptions and hype surround transmission lines than any other field, except maybe acoustics. The author's motivation in writing this book was to debunk the topic. In the process he created a first rate text on transmission lines and antennas that does not need any fancy math to follow.

Where math is needed to follow a discussion, it is buried inside a BASIC computer program. The book is full of short, useful programs. All of the code is available on floppy disc from the publisher.

The chapters on how to use a Smith Chart and what it means are the best explanation that I've ever read. There is no tool more powerful than the Smith Chart for designing, maintaining and documenting any RF transmission system, AM or FM.

I would especially recommend this book to any of the "new breed" of broadcast engineers who learned the business in FM radio, then got plunged into an AM facility. The sections on antenna impedance matching will take the mystery out of those endless coils and capacitors in the antenna tuning units.

Spread Spectrum Sourcebook
by Andre Kesteloot and Charles L. Hutchinson
American Radio Relay League, 1991

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Radio Basics

Continued from page 35

A few years ago, if you said "spread spectrum" to anyone who knew what it was, the immediate response would be "That's spy stuff, why would anyone else be interested in it?"

Then DAB came along. Although the various system proponents sometimes don't point it out, spread spectrum technology is part of nearly every proposal for DAB. Spread spectrum and data compression are the "black magic" that makes DAB practical.

Trying to learn about spread spectrum can be frustrating. There is no shortage of textbooks about it, but they are written for communications engineers aspiring to jobs with the CIA. No "nuts and bolts" and lots of discussion about security, along with pages of math. Oh yes, buried in there is some discussion of how robust SS can be, but you've got to dig for it.

How the hams got into spread spectrum is a story worth buying the book for. The best feature of this book, and its most unique one, is that it includes actual design data on practical spread spectrum systems: real schematics, actual parts values and waveforms. You may not want to build an SS system, but for me at least, things don't entirely make sense until I can understand how a real system goes together.

For anyone interested in the unifying concepts of DAB, this book includes both the practical and conceptual information needed to understand spread spectrum.

DSP Basics

Digital Audio Signal Processing: An Anthology
by John Straw
William Kaufmann, Inc., 1985

The concept of digital audio processing seems almost a contradiction in terms. How can something as clumsy as a digital computer manipulate something as smooth and subtle as high quality audio? The idea of a computer doing filtering and equalizing has always been hard for me to accept.

If, in an attempt to understand how digital filters work, you happen to have picked up an engineering text about digital filters, you know that we mere mortals don't stand a chance. The math of digital processing is menacing.

Fortunately, there are others who need to understand digital audio processing who don't have credentials in math. Among them are music composers who use computers.

"Digital Audio Signal Processing" was written for computer music composers who need to use and understand digital processing. It is not an "easy" book, but rather one that teaches a complex topic without making any demands that the reader have any more prior math background beyond basic arithmetic.

The first section, "An Introduction to the Mathematics of Digital Signal Processing," starts at the beginning and ends with a clear explanation of the Z transform. It does this without resorting to cryptic mathematical notation or pages of formula. Every step is explained in clear English.

(cont. on pg 45)

Computerize Your Newsroom On A Budget

by Scot Witt

The boss wanted something simple: a quality local news product –and to save a few bucks while I was at it. What news director hasn't heard those words? Do more with less. Even though WDCB is a professionally run public radio station, we're no different than any other radio station.

And we aren't one of those "pampered" public radio station newsrooms. Both our full time news managers made the jump to this locally driven and mostly unaffiliated FM operation from commercial radio news. I've got 20 years of commercial experience, my assistant, seven.

The boss-induced stomach curdling turned out to be unnecessary. With a little searching around and some evaluation of the newest products on the market, we found a way to get the newsroom organized from the reams of wire copy down to the editing for the next newscast, and even add some automation capability. I decided to look into a product called WireReady, a software-based computerized system for the newsroom.

All Wires in One

WireReady gathers as many wires as you want, sorts stories any way you want, offers powerful word processing, archives thousands of items, has split screen editing, allows wire re-writes without damaging the original copy and offers a series of standard and optional modules that will automate your news operation. We bought it 18 months ago and found it to be cost effective, feature for feature.

The basic WireReady package works on any IBM-compatible computer. The installation is simple; the software installs itself and wire service subscribers simply connect the wire service to any open serial port on the computer.

When everything arrived, we ran the menu-driven Setup program to copy files and set aside hard drive space for the wire service library, as well as an

(continued on page 38)

Continued from page 37

archive file for our locally produced copy. The software was ready to go within 15 minutes.

WireReady places all wire service products in a common "Wire Browser." Each user then sets up his or her own "searches" to separate stories and read them (split according to wire service category codes, key words, key phrases, priority codes, according to state/national/international – whichever way you want it, WireReady delivers it).

Or you can set up general searches for everyone (state news, national/international, sports, etc). You get all the matched stories within seconds. In fact, when the system is searching for stories, you can still write copy and cut and paste found stories, while it looks for more at the same time.

Setting Up the System

We wanted four terminals with easy and cheap upgrades as we could afford them. We already had three XT computers. We added 20 Mb hard drives to them, bought a 286 and traded for a 386. While WireReady also runs on industry standard networks like Novell and Lantastic, we decided on its SNAP system because each workstation runs independently on its own hard drive, making the package fault tolerant. Each machine maintains its own copy of the wire and locally produced stories. Even if several machines go down, we can restore it easily from another workstation in minutes.

Everyone on line has access to all copy within seconds. We use this feature for e-mail, assignments, archiving, phone lists, emergency scripts, procedures, formats, pronunciation guides and research material. The massive archive (which works just like the Main Browser to reduce the novice and non-computer person's learning curve) grabs properly coded items from the data stream and stores it at a permanent hard disk address.

I'm told that upgrades planned for the upcoming year include a pop-up calculator, auto-dial, remote access, enhanced e-mail, security groupings, spell-checking, thesaurus and more. The company also sells modules for school/business closings, election results, newscast/producer run-downs and electronic teleprompting.

Revamped Operation

We rewrite all wire copy now; vocal flubs from mangled copy are things of the past, and easy rewrites help our newsies to write well. We figure we broke even 12 months after installation, hardware included. And we own the system.

Our newsies have every phone number, wire story, operating procedure, memo, message, assignment, local story, research copy and pronunciation guide up to 20 seconds and a macro stroke away. Newsies search wire stories or the archive ... while writing stories or reading the wires. They rewrite wire copy without destroying the original. They get more done in less time. That improves writing, anchoring and story counts.

Installation was easy. Cables are simple 4-conductor with ground, and I did all the soldering (not hard at all). There's also an inexpensive, 24-hour, toll-free support number for problems.

I've recently learned that WireReady will soon be offering a digital audio board and software module for less than $1800. This system operates from within WireReady and will act as a cart or reel-to-reel machine. I'm looking forward to writing my stories, editing my actualities, writing my newscast and running all my newscast audio from the news studio WireReady terminal.

You can tell I'm pretty satisfied that we were finally able to bring our newsroom into the computer age. The boss is happy, too. He didn't have to sign a requisition for $25,000 to $35,000 and he hasn't seen a tenth of the paperwork I used to send him for paper, ribbons or service contracts.

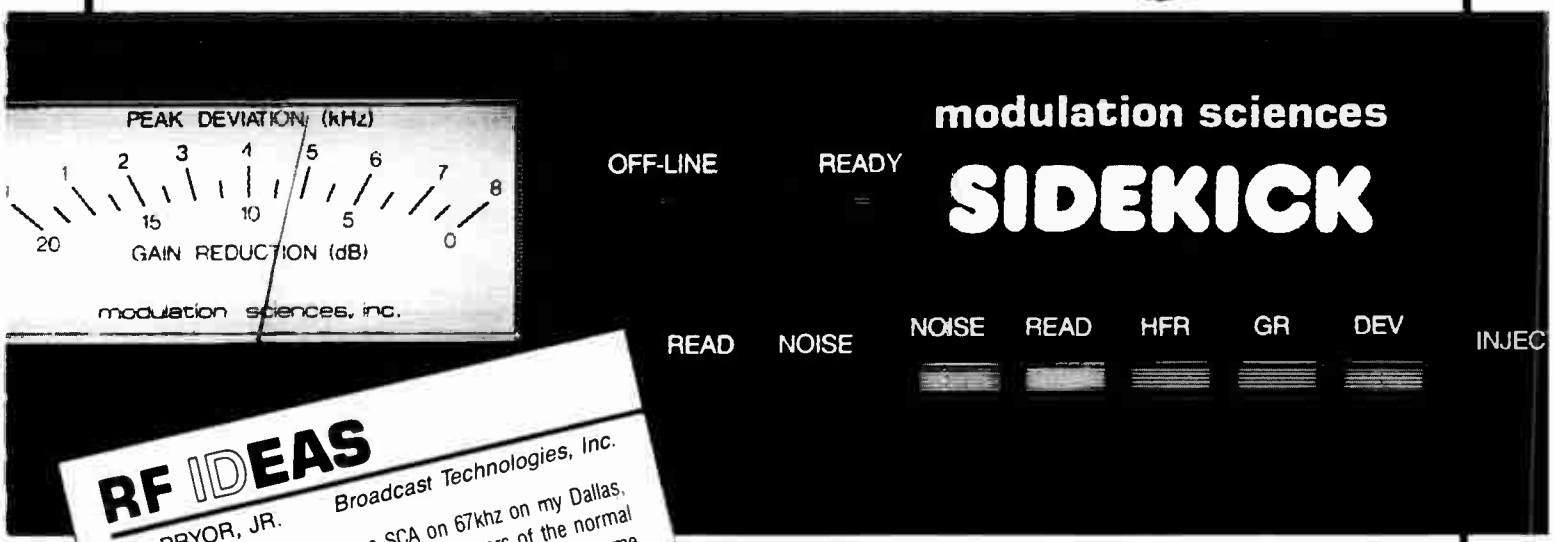
About the only criticism we've had has been that the documentation has been sparse in some areas. After calling in with enough suggestions to fill an entire three-ring, the company contracted me to rewrite several parts of the 1992-93 manual revision.

But, saving money and getting work done efficiently in less time ... hey, I'm not really complaining.

Scott Witt is News Director of WDCB Radio in Glen Ellyn, IL.

Need a Hybrid? Find Yours in the Equipment Report. Pages 50-53

THE ONE BOX SOLUTION THAT MADE SCA WORK



RF IDEAS

E.J. PRYOR, JR. *Broadcast Technologies, Inc.*

"I have been operating one SCA on 67khz on my Dallas, TX station for some years. After many years of the normal problems of crosstalk, noise, etc., Modulation Sciences came forward with the 'Sidekick' SCA generator. I have never spoken out for a particular device in this column before, but I found that virtually every problem I had been experiencing, disappeared when I finally got one of these units and installed it at the studio between my stereo generator and composite STL. I found that the crosstalk, main to sub and sub to main, was improved almost 20db and the system noise was markedly improved also. There is no measurable degradation to the stereo performance or loudness whatever. With the new rules allowing stations to increase their total modulation 5% for each 10% of injection, the main channel (mono) level suffers a negligible 0.5db reduction in loudness."

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30-Market Survey Results:
SIDEKICK IS THE #1 CHOICE OF MUSIC SCA OPERATORS.
From SCA: Radio Subcarrier Report
© Waters Information Services, Inc.

Here's how Sidekick® makes SCA work:

Sidekick installation is quick, easy, and problem-free:
- Install at studio or transmitter.
- Insert anywhere in chain via Sidekick's loop-through composite input/output (SCA input NOT required).
- Remote control provisions standard.

Sidekick's elegant circuit design takes the hassles out of SCA:
- Sidekick is tweak-free and drift-free.
- Crystal-locked synthesizer is stable over time/temperature.
- Excellent RF and EMI shielding.
- Performance certified by an independent P.E. (to receive a copy, just call).

Sidekick's "One Box Solution" builds in everything you need:
- Integrated audio processor for superb SCA performance.
- Noise generator and synchronous AM meter lets you tune transmitter for minimum crosstalk.
- Super-accurate peak & hold SCA deviation monitor.

Proven Performance:
Over 1000 Sidekicks already on-air.

Call our **Toll-Free** SCA Info Hotline—**(800)826-2603**

Reader Service #098

WAEB Mutipath Study: Method and Scope

by Harry Simons

Editor's note: In 1989-90, Harry Simons, then CE of WAEB in Allentown, PA, coordinated a joint effort of broadcasters and receiver manufacturers to provide a definitive study on multipath – one that was sorely needed. The study was eventually filed with the FCC. Portions of the study have been used by receiver manufacturer Delco to help in future radio design, and the ins and outs of multipath have become even more crucial in designing DAB systems.

At the time the study was initiated, I made an agreement with Harry that we would bring radio engineers the results of the study, come hell or high water. Here, at last, in the first of a multipart series, is the fulfillment of that promise.

After several weeks of procrastination and, in all honesty, a lack of desire, I begin this series. Don't misunderstand, I want to share with the world the details of the Multipath Studies and you may recall I promised to do so. I'm just reluctant to become embroiled in any more controversy as a result.

I felt like someone had put a target on my rear end and never ran out of ammunition for quite some time. Enough was enough. If you followed any of the press coverage surrounding the multipath tests you're aware that controversy played a major role.

It is that very controversy that inspired the multipath tests in the first place. Lack of knowledge, untested theories and a desire by broadcasters to reduce this annoying natural phenomenon demanded action and answers. So how did it all begin, what was done and what are the results and conclusions?

Basic Background

Early in 1989, the NRSC-FM committee was formed by the NAB and the EIA. Members of the NRSC-AM committee were asked to serve as the committee base membership along with any other interested and qualified parties. Prior to the formation of the NRSC-FM committee, the NAB conducted a letter survey to members of the NRSC-AM committee.

This poll was to determine the feasibility of the proposed FM committee, as well as create a list of major technical concerns of the FM broadcast community. This list of concerns would ultimately serve as the NRSC-FM committee's first guide in choosing areas that would be considered for involvement. The eventual goal was a major technical revision of FM rules, as had been undertaken for AM.

The issue of FM multipath appeared as the industry's greatest concern, according to the poll results provided to the committee. As I recall, the multipath issue was put aside several times in the course of the first meeting.

Multipath was considered a problem the NRSC-FM committee could do nothing about. But, the first meeting of the NRSC-FM committee concluded that FM multipath was too big an issue to ignore. It was decided to seek out-

. . . continued

side consultation on the subject by inviting Edward A. Schober, P.E., of Radiotechniques, Haddon Heights, NJ. Ted was the author of a paper on multipath vs. AM noise, which had been well received by the broadcast engineering community.

At the next NRSC-FM meeting, at my invitation, Ted had an opportunity to briefly speak on the topic of multipath. It was quickly apparent to those attending that multipath may be influenced by a number of factors other than its most simple definition.

The NRSC-FM committee then voted to create a working group on multipath, the purpose being to study multipath and suggested areas of influence. The group would then report its findings to the full NRSC-FM committee. I was named working group chairman.

During that same NRSC-FM committee meeting a number of suggestions were made relevant to exploring and defining multipath. One of the topics discussed was AM incidental noise (ICAM) as it relates to multipath. This was of particular interest to the representatives from Delco Electronics.

The following week, Jim Gotchal of Delco contacted me and indicated his firm's interest in some of the proposed tests. He asked if I was still willing to provide WAEB-FM as a test site and if I would work with Ted Schober and Delco in performing field tests. I accepted.

NRSC: In Then Out

As chairman of the working group, it was my intention that these tests be co-developed and monitored by the group. I informed Wes Whiddon, then NRSC-FM Chairman, of the agreement between WAEB, Delco, Radiotechniques and myself and explained my intentions to have this research fall under the working group's umbrella. I was authorized to proceed.

A number of NRSC-FM working group meetings followed, with the purpose of developing a test agenda. This was the first indication of the NRSC working group's inability to agree on an agenda. It was apparent that each member of the group had a sperate area of particular concern, or had a special interest in the outcome of proposed tests to be performed.

Delco indicated to me that they were becoming frustrated with the delays and wanted to proceed as soon as possible with the tests, with or without the NRSC.

Stan Salek, then with NAB, suggested to me that WAEB conduct tests with Delco and Radiotechniques separate of any affiliation with the NRSC. His reason was that the NRSC had never managed any research projects in the past and had always accepted research data from others for consideration.

Stan felt that this disaffiliation would allow the participants of the research project much more flexibility and the opportunity to move much faster than the NRSC-FM committee could accommodate. It was agreed that I would provide a copy of the results to the committee when completed. This would suggest that the project data was for submission to the NRSC rather than researched by the NRSC.

I agreed knowing that this would be the only way the tests could proceed. The NRSC, under the influence of the NAB, was reluctant to become involved in what could turn out to be controversial and wanted out. So much for the history lesson, what about the tests?

(continued on page 46)

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Reader Service #101

New Antenna For New York FMs

By Judith Gross

It was state-of-the-art when it was installed in 1965. Since that time, the number of Class Bs on the Alford antenna, several stories above the 86th floor observation deck of New York's Empire State Building, has grown to 11.

The new design was the first FM antenna constructed for multiple antennas, and became the subject of engineering papers. The elliptical polarization of a double layer of tilted dipoles gave the desired horizontal and vertical pattern. Then, in 1984, the antenna was rebuilt.

Now, it's in the process of being replaced.

The 28-year old Alford antenna sits above the building's observation deck.

Part of the Eighth Wonder

Probably few, if any, of the millions of tourists who visit or photograph what New Yorkers like to call "the eighth wonder of the world" are even aware of its existence. The original antenna's design fit in so well with the building's famous silhouette, that most probably just regard it as part of the building.

All that will change, however, when the new ERI antenna is installed late this year or early in '93, 160 feet above where the Alford now resides.

"We did have to file with the Landmarks Commission," notes Bob Tarsio, CE of WLTW and chairman of the antenna project. The Empire State Building will own the antenna and lease it back to its users.

Alex Smirnoff, who oversees telecommunications operations in the famous building, said those concerned about changing the silhouette "had to weigh the benefits of broadcast service" against those concerns.

Eleven Users

The stations currently using the Alford antenna are WBLS, WLTW, WMXV, WNCN, WNEW, WHTZ, WBAI, WRKS, WSKQ, WQXR and WXRX. Three other stations, WQHT, WCBS and WPLG broadcast from the building, but separately.

Tarsio says there is room on the new ERI 1084-2CP panel antenna for 15 stations in all. WNCN is staying on the Alford antenna until 1996 and WQCD is moving onto the new antenna, leaving the current total at 11 stations. Once the new antenna is in place, the Alford will remain as a standby.

The new system is the largest antenna of its kind. Several antenna manufacturers bid on the job, but the committee went with ERI, because of the "comfort level," Tarsio says.

"ERI has maintained the Alford antenna since 1983," says Tarsio. "They also built the filters for the Alford rebuild in 1984. We wanted whomever builds the antenna to also build the combiner; we went with loop coupling for the combiner and ERI fit our requirements."

Tarsio and some colleagues recently traveled to ERI's test range in Indiana for acceptance testing (see cover photo). There they witnessed pattern measurements on the new antenna.

"The circularity spec between horizontal and vertical was 2 dB. It met all our other specs; it looked good," says Tarsio. The antenna is being developed by ERI just for this project. It's a two-bay "swept-back cog" according to Tarsio.

Completion Next Spring

ERI is the general contractor as well as the antenna and combiner manufacturer. Installation will begin soon, and Tarsio said plans are to have the new antenna on-air by next spring.

The antenna will go up first, then the combiner, which is the most time-consuming part of the job. Smirnoff has an interesting tale about how the transmission lines are to be accommodated.

Currently, the combiner and Alford antenna are in close proximity. But the new antenna will sit well above the 103 stories of the building while the combiner is slated for installation in a large room on the 85th floor next to a room with one of the TV installations.

Smirnoff noted that the first idea was to cut conduits in the stairwells to run transmission line. But then he made a discovery. Back in the old days, there used to be a restaurant on the 21st floor of the building. Huge air ducts went from the kitchen up, up, up all the way to the outside of the top story. Now, the restaurant is empty, the ducts are not used for anything and remain tucked behind hallways out of view.

Will the new antenna disturb the famous silhouette?

Smirnoff reasoned that these cavernous ducts would be perfect for running transmission lines, so they will be put to good use. ***(cont. page 44)***

Station Stories

Continued from page 43

The combiner system itself is made up of 11 modules each with an 8-pole filter and constant impedance. Each station owns its own module.

The project is budgeted in excess of three million dollars, according to Tarsio. He says all stations are contributing equal shares and for new stations, the final cost will be redivided, with the current 11 getting a rebate as the new ones are added.

Expected Benefits

What exactly will be gained by replacing Dr. Alford's creation? Well, obviously, going up 160 feet in height can't hurt. Then there's the null fill.

While the 32 Alford dipoles represented the best horizontal-vertical pattern at a time when side-mount antennas were the norm, a look at the actual radiation pattern reveals a daisy-wheel. To be fair, the nulls are not as severe as they appear.

But employing the latest state-of-the-art FM antenna technology will be a definite plus, and the benefits in circular polarization should help reduce multipath.

New York City engineers visit the ERI test range to view antenna specs.

"We won't see increased coverage," Tarsio notes, "but we should experience better quality signals. A lot of the problems due to scalloping should go away."

The reach of the 6 kW Class B's on the Empire State Building is substantial, with the 1 mV contour 32 miles away.

Listeners might notice better reception in areas where the signal was marginal due to the daisy-wheel effect. And Tarsio also points out that since the Alford antenna is 27 or 28 years old, there will be the added comfort of having a brand new antenna to rely on.

As for the tourists and photographers? Well, they might notice a change, especially in those dramatic sunset shots of the well-known silhouette.

It will be interesting to see who is more vocal: observers noticing a change in the look, or listeners enjoying the improved reception.

This autumn in New York should prove interesting for Tarsio and his engineering colleagues. And later, even more interesting for the ERI tower installers who get to experience the breath-taking views of Manhattan from 1380 feet up. King Kong would understand.

Continued from page 36

The second section, "Digital Filter Theory," builds on the math introduced in the earlier chapters and leaves the reader with a through understanding of how digital filters work.

The remaining half of the book is more specific to the needs of composers and delves into various computer techniques for sound synthesis and modification. It makes interesting reading, but is not directly relevant to broadcast engineering.

Digital Audio Signal Processing won't help you to fix a DAT machine any faster, but it will teach you how digital audio filters work. If you put some effort into this book, you will be rewarded with enough understanding to be able to read a signal processing computer program and maybe write some of your own.

OP-AMP Circuits and Principles
by Howard M. Berlin
SAMS, 1991

Op-amps are the building blocks of all modern analog circuits. A through understanding of op-amps is needed to understand, repair, or design almost any analog circuit. **OP-AMP Circuits and Principles** takes the reader from an elementary introduction to the ideal operational amplifier all the way to practical filter and waveform generator design.

All of the important aspects of op-amp theory and application are discussed. The first two chapters are general: "What is an Operational Amplifier?" and "Practical Performance Considerations."

After that it's on to applications with chapters dealing with "Single Supply Operation," "The Norton Amplifier," "Voltage and Current Regulators," "Waveform Generators," and "Active Filters." One especially useful chapter, "Nonlinear Signal Processing Circuits" goes into detail about the design and application of precision rectifiers, peak detectors, comparators, sample and hold amps, and log and antilog amps.

The last part of the book is devoted to a series of 14 experiments intended to give the a reader a "feel" for op-amp applications. Real op-amps and real component values are specified. Using parts that are all available at any Radio Shack, and test equipment common to any radio station, the reader can become proficient with op-amps at little expense.

If you are not completely comfortable with charging in to repair a circuit full of op-amps, or want to learn more about these ubiquitous ICs so that you can design with them, then **OP-AMP Circuits and Principles** is a good addition to your library.

Eric Small is president of Modulation Sciences. Call him at 800-826-2603.

Continued from page 41

Scope of the Tests

The purpose of this research was to provide a logical beginning of the investigation, including areas of concern that are thought to have an effect on the severity of multipath, or what is perceived to be multipath.

We hoped to achieve a level of knowledge and understanding that would provide broadcasters and receiver manufactures the ability to improve the quality of the signal transmitted and the product delivered to, and by, an FM receiver. Now that the tests had been separated from the confusion and political bureaucracy of the NRSC and the NAB, a test agenda was developed. Initial suggestions for test categories, goals and methods were by Delco, Radiotechniques, myself and Ford.

Yes, Ford Audio. Rick Zerod of Ford called me shortly after the disaffiliation from the NRSC asking for an opportunity to observe. Ford was provided every opportunity to participate yet choose to remain only an observer in the first round of tests.

Methodology

Test objectives included some 135 suggested areas of consideration that had to be condensed to a mere few. It was decided that the group would:

(1) Characterize multipath interference within each of several specific predetermined geographic areas which consistently produce severe FM multipath reception

(2) Investigate the effects of transmitter incidental AM modulation, as a function of its level, on multipath reception in the same areas and locations

(3) Investigate the effects of adding 67 kHz subcarrier (SCA), with and without modulation, on multipath in the same areas and locations.

The test methods employed would include but not be limited to obtaining an RF spectrum analysis of the multipath interference composite signal from the receiving antenna including:

(a) Fixed locations

(b) Utilizing tone and programming modulation conditions

(c) Record the spectrum analyzer output display's peak hold

(d) Perform a pattern analysis with respect to null frequency(s), depth and spacings

(e) and attempt to correlate results with reception location and the environment.

A propagation path analysis using pulsed output from the transmitter in a fixed location utilizing the vehicle antenna would attempt to:

(a) Record the received RF output from an oscilloscope

(b) Analyze scope patterns to determine time delay and relative strengths of contributing paths

(c) Attempt to correlate the results with reception location and environment

The tests would also observe the effects of transmitter incidental AM (synchronous AM), with respect to its level, on multipath reception as well as:

(a) Record receiver left and right audio output, and perform an A/B listening comparison test as ICAM level is adjusted

(b) Record distortion and separation data as ICAM level is adjusted

(c) Analyze the RF spectrum under tone and programming conditions

(d) Record analyzer output displays with low and high ICAM

(e) Compare spectral components.

Further tests were designed to study the effects of 67 kHz SCA, with and without modulation, on multipath reception and evaluate receiver audio output under tone and programming modulation conditions by:

(a) Recording receiver left and right audio output, without SCA and with SCA (with and without modulation)

(b) Taking distortion and separation data under tone modulation conditions, without SCA and with SCA (with and without modulation)

(c) And while recording and analyzing the RF spectrum under tone and programming modulation.

And finally, we sought to determine the effects of overmodulation with the transmitter tuned for -50 dB ICAM, a primarily fundamental component, and measure the multipath effects for 90%, 100%, 110% and 120% modulation.

These would be done under tone and programming modulation conditions at all fixed test locations with and without 67 kHz SCA, modulated and un-modulated with program material and data, utilizing 8% and 10% injection at a level of 75% and 98% deviation.

Only the Beginning

This most unusual project was near a beginning, but first more preparation and leg work was needed to insure smooth implementation.

If you think that all was smooth from this point on, hold on to your chair.

There has never been a study with as much last minute coordination and (thankfully) cooperation among contributors. These tests brought together different companies, industries, individuals and even competitors, all striving for a common goal that may help to improve FM reception.

If nothing else positive was to come from these tests, a new level of understanding and camaraderie existed.

Next: Work in sun and snow.

Special Section:

NAB Radio Show

DAB Hot at Radio 92

By Judith Gross

There will be two companies taking advantage of the NAB's offer to provide exhibit space to DAB proponents, but at least one of them is a surprise entrant.

USA Digital and AT&T have announced plans for DAB demonstrations, but Ron Strother, backing the Strother-Lincom in-band adjacent channel system, said he will not have a booth at the show.

USA Digital is waiting until the outcome of its experimental tests (see Page 8) before firming up its demonstration plans. But CBS' Tony Masiello noted the group intends to show over-the-air AM and FM working DAB systems.

For AM, the plan is to generate both a digital and analog signal on an AM frequency to show that the AM DAB signal will fall within the mask of an AM allocation. The demo would also include a receiver to demonstrate non-interference.

For FM, USA Digital hopes to show analog and digital signals originating from a single source, either a low-power FM signal generated by the proponents, or possibly an existing FM station, pending the outcome of the experimental tests.

Strother noted that funding for continued development of his system is a concern and said that "given the EIA's aggressive timeline we had to make a decision whether to devote time and dollars to the show or to developing the system. We chose to develop the system."

Strother said that the system is undergoing some technical changes and that he still has plans to do over-the-air tests in Los Angeles. But he also said that the company is "rethinking" its positions in light of overwhelming broadcaster support for an in-band on-channel system.

AT&T, which has told the EIA it will submit a DAB system for testing next year, will be at the show demonstrating a digital audio codec that goes "a step beyond ASPEC" source coding, according to Nikil Jayant, the head of the Signal Processing Research Dept. for AT&T/Bell Labs.

The improved compression algorithm is called PAC -- Perceptual Audio Coder -- Jayant said. Beyond that, he noted that AT&T has not yet committed to the RF part of the system, but intends to develop an in-band DAB system. He said it was too early to say whether it would be in-band on-channel or not.

Stay tuned ...

Special Section:

NAB Radio Show

Engineering Sessions Sizzle at Radio 1992

By Andy Butler

We're all living with the stagnation of radio revenues. The NAB's financial reports have shown most stations struggling for profits if not survival for at least the last two years. When you're operating on the ragged edge, making the right technical choices is often the difference between remaining financially viable and sinking slowly beneath the load.

Unfortunately, increased revenue pressures leave radio managers with even less time to keep current with the latest changes in technology and the opportunities those changes present. The Technology Management Sessions at NAB Radio '92 are designed to relieve that pressure. Over 75 experts will offer proven practical advice to help you avoid wasting time and money while being certain your station's technical needs are met.

EBS Starts It Off

The series begins on Wednesday, September 9 at 1:30 PM in room 25 of the New Orleans Convention Center with "The Station Level Impact of the Proposed EBS Rules Changes." The FCC has upgraded the office responsible for overseeing EBS and initiated a major rules update.

The results are still being determined, but a number of the proposals being considered could have a major impact on station operations and costs. Larry Eads, Chief of the FCC's Audio Services Bureau and Helena Mitchell, Assistant Bureau Chief for Emergency Broadcast Systems of the Field Operations Bureau will bring you the latest on this ongoing revision.

Find out what impact the changes may have on your responsibilities as a licensee. Will they permit more flexibility in unattended operation? How will local access requirements be affected? Will state and regional operations be effectively coordinated with the new Primary Entry Point System at the federal level? How much will the proposed changes cost stations? Get some answers from the people who are guiding the process.

(continued on page 54)

OVER 5 MINUTES OF 15kHz STEREO AUDIO ON EACH 13MB FLOPPY DISC

Digital Made Simple

The New Dynamax DCR1000

Digital Cartridge Recorder

The Recorder

- Selectable sampling rates
- Secondary and Tertiary cues
- Extended scale peak metering
- AES/EBU digital input
- Start on audio
- Direct digital dubbing from CD
- PC keyboard for titling

The Reproducer

- Simple cart-like operation
- No on-air personality training
- Just three front panel buttons
- Instant start and cue
- Maintenance-free design
- No head cleaning or alignment
- Awesome audio quality

The Media

- 13MB stores over 5 minutes stereo audio with 15kHz bandwidth and 15 minutes mono with 10kHz
- Standard low-cost 2MB floppy disk holds 60-second commercials

The new Dynamax DCR1000 is available now, and it's priced like an analog cart machine. You will be amazed by its versatility. Call Fidelipac for more details.

DYNAMAX™
BROADCAST PRODUCTS BY FIDELIPAC®

"At the NAB Radio Show, join us for lunch and a demo in our suite at the New Orleans Hilton."

Reader Service #135

Fidelipac Corporation ☐ P.O. Box 808 ☐ Moorestown, NJ 08057 U.S.A. ☐ TEL 609-235-3900 ☐ FAX 609-235-7779

Equipment Report: Telephone & Phone Hybrids

Equipment Report: Genter Digital Hybrid I

Reader Service #107

Digital Hybrid I: Low-Cost Solution

by Elaine Jones, Gentner Electronics

Today's radio listener is much more demanding than in the past. High quality audio and increased listener interaction are mandatory to stations wanting to build and maintain leadership. For more than ten years, Gentner telephone products have been helping broadcasters fulfill this need.

Gentner's newest telephone product, the Digital Hybrid I, was designed for broadcasters who want the high quality of digitally processed telephone audio, but have limited budgets. The Digital Hybrid I, which lists for $995, can be used for most broadcast telephone applications.

The Digital Hybrid I, like all broadcast telephone hybrids, requires either a "Tip-Ring" circuit directly from the telephone company (a C.O. line), or an analog audio pair from a PBX or other telephone switching system.

Connection to the telephone line is made using an RJ-11C jack on the unit's rear panel. This connector feeds the telephone line to a hybrid coil, which performs basic 2-to-4 wire conversion, then to the DSP circuitry to analyze and further adapt the line. A one-time setup procedure is required at installation to establish the basic analog hybrid null.

The Digital Hybrid I provides an internal test tone generator and jacks for connection of test equipment to simplify this setup. After this short setup procedure is complete, the unit's digital nulling will ensure accurate adaptation to line conditions on each connection.

The Digital Hybrid I uses 16-bit, 10 kHz digital sampling, which provides good quality audio with very low noise and distortion characteristics. Upon connection to the telephone line, caller output audio is muted and a brief burst of white noise is applied to the hybrid's Send (telephone line transmit) circuit.

The DSP then compares the white noise with audio appearing on the Receive circuit and "builds" a digital adaptive filter to subtract unwanted audio from the receive circuit. After the nulling process is complete, the caller audio output is unmuted. This entire process is accomplished in 300 milliseconds, about the time required to press and release the On button.

Balanced line level audio from the studio console (typically mix-minus) is applied to the Send input XLR or the hybrid. Receive audio, also balanced line level, appears on the Caller XLR. A third XLR on the rear panel provides a balanced mix of Send and Receive audio for feeding other equipment such as a tape recorder.

A DB-37 connector provides remote on/off control as well as access to send and receive audio for feeding other equipment or cross-feeding dual hybrids. A variable "caller control" adjustment, available behind a front access panel, provides a range of 0-40 dB of caller override when the talent is speaking.

The Digital Hybrid I is housed in a rugged steel chassis. It is designed for mounting in a standard 19" rack and utilizes one rack space. A built-in power entry module provides operation on any voltage worldwide.

Applications for the Digital Hybrid I include on-air telephone calls, talk shows, news interviews and contests. Note: users who typically record telephone calls in advance of airing may prefer Gentner's Digital Hybrid II because of its "record" and "cue" functions, not available on Digital Hybrid I.

The Digital Hybrid I is available through authorized Gentner distributors. For further information, contact Gentner at 801-975-7200, fax 801-977-0087, or **circle 107** on the reader service card.

Equipment Report: *Audio Processing Technology DSM100*

Reader Service #108

CD-Audio Over Switched Networks

by Hamish Eassie,
Audio Processing Technology

Question: How can you send CD-quality audio from New York to Los Angeles in real time, whenever you want? **Answer**: Use the telephone!

Audio Processing Technology has developed the DSM100, a full duplex digital audio transceiver. The DSM100 allows CD-quality audio to be transmitted in real time anywhere in the world, over standard switched (dial-up) digital lines such as ISDN or Switched 56 (SW-56).

The DSM100 incorporates apt-X100 digital audio data reduction and inverse multiplexing technology in a single portable unit. The apt-X100 algorithm is a proprietary 16-bit to 4-bit subband adaptive differential PCM codec (ADPCM) that has won widespread acceptance in the professional broadcast marketplace. It offers CD-quality compressed audio, a low coding delay of 3.8 msec and audible resilience to transmission-induced random bit errors.

Audio input/output is mono or stereo, analog or digital, at sampling rates from 14.7 kHz to 48 kHz. The input/output compressed audio bit rates range from 56 to 384 kbps, in multiples of 56 or 64 kbps. These match the international ISDN and North American SW-56 standards.

The basic implementation of ISDN has two 64 kbps data channels, while SW-56 offers a single 56 kbps data channel. Compressed stereo FM music (15 kHz audio bandwidth) requires 224 or 256 kbps for transmission.

The simplest approach would be to sequentially divide the bit stream into the four channels. However, each independent channel may take a different physical route to the destination, resulting in variable transmission-induced delay times. In order to accurately reassemble the compressed audio bit stream at the receiver, these delays must be buffered out.

The DSM100 can aggregate up to six 56 kbps or 64 kbps digital channels (N x 56/64). These connect via X.21 interfaces to ISDN or SW-56 terminal adapters (TAs), which in turn interface via network terminating units (NT-1s) using RJ-45 jacks to the digital network. It is the TAs which do the dialing of each line.

A full duplex audio link has a DSM100 and one or more terminal adapters plus network terminating units at each end, depending on the audio bandwidth sought. Individual data paths are established by dialing between pairs of TAs, while the inverse multiplexers buffer out any differential delay between the data paths. Once a stable wideband data path has been established, full duplex audio may be transmitted between the two sites.

For more information, **circle number 108** on the reader service card or call APT at 213-463-2963.

Equipment Report: *AT&T ACCUNET Switched Digital Services*

Reader Service #109

AT&T Offers Dial-Up Digital Phone Service

By Rick Wallerstein, AT&T

Remote broadcasting became significantly less expensive in June when AT&T lowered the price of its ACCUNET (R) Switched Digital Service.

The new lower prices, far less expensive than private line connections or satellite links, are causing many radio stations to rethink how they transmit remote broadcasts.

This service can be used to provide in-studio quality for remote news reports, weather reports, sports, interviews, station-to-station connections or program syndication.

Using AT&T ACCUNET Switched Digital Services, audio signals at 7.5 kHz can be transmitted and received digitally almost anywhere in the U.S. and between the U.S. and 19 countries. More countries continue to be added. Stereo transmission is available using equipment that transmits simultaneously over two ACCUNET Switched Digital lines.

The service provides full-duplex, end-to-end digital data transmission, point-to-point or multi-point at 56 kbps. By using only terrestrial facilities, even for international links, ACCUNET Switched Digital Services eliminates the delays associated with satellite transmission.

The service is available 24 hours a day. Because the service is full-duplex, people at the station can communicate with the remote broadcaster throughout the feed. For other needs, AT&T also offers dial-up digital connections at speeds ranging up to 1.5 million bits per second.

With the new price schedule, the cost of a standard day rate call will not exceed 20.6 cents for the initial 30 seconds or 25.2 cents for each additional minute. International prices range from 22.5 cents to $2.70 for the initial 30 seconds and 23 cents to $2.50 for each minute thereafter.

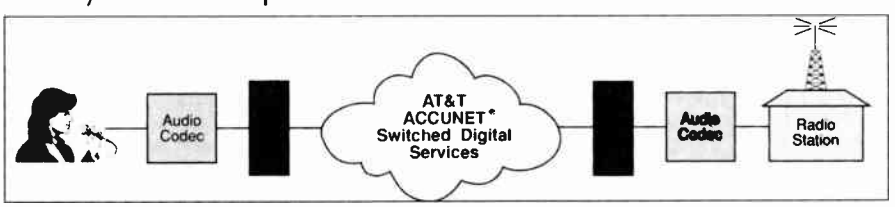
AT&T also offers a Switched 56 bridge that allows a remote feed to be sent to up to 12 locations. For example, a remote broadcast from a baseball stadium could be simultaneously connected to up to 12 stations (domestic and overseas) in a broadcast network just as easily as connecting a conference call.

Digital audio codecs for these uses are made by companies such as Comrex and Corporate Computer Systems.

ACCUNET Switched Digital Services is rapidly gaining in popularity because its clarity and price make it useful for radio broadcasts as well as video calling, computer aided design, high speed facsimile, and data transmission.

A special center at AT&T can provide assistance with all aspects of ACCUNET Switched Digital Services including information about pricing, availability, provisioning and support. Specialists at the center can also assist in obtaining access through local telephone companies.

For more information about using ACCUNET Switched Digital Services, call 1-800-222-SW56 or **circle number 109** on the reader service card.



Equipment Report: Comrex TCB-2

Reader Service #110

Couplers For Network Distribution

by Tom Hartnett Comrex Corporation

The Comrex TCB-2 Auto Answer coupler opens opportunities for broadcasters in new uses of the public telephone network. The coupler was designed specifically for broadcasters who need a convenient, inexpensive means of sending audio to, or receiving audio from, a remote source in an unmanned operation.

The TCB-2 detects when a phone line is ringing and answers it much like an answering machine. It then couples audio on or off the phone line using an FCC-registered protective voice coupling circuit. When the calling party hangs up the line, the TCB-2 detects a DC signal sent from your phone company central office, and automatically hangs up the line, ready to take another call.

Most, but not all phone companies provide this signal, so the TCB-2 can be retrofitted with an optional card which will detect the presence of dial tones in order to disconnect. The most common applications for these couplers are for IFB type listen lines and for use in conjunction with frequency extenders.

For small to medium markets, however, these devices become an attractive alternative for program distribution. This was done by WSJS-AM, flagship for the Wake Forest University Sports Network.

WSJS has 30 Comrex couplers on 30 phone lines. The phone lines all "hunt" to a single "800" number. All the affiliates need to do is dial the "800" number and they are automatically routed to a coupler, which will feed them the program audio. The audio is fed to the coupler network via a distribution amplifier.

In a similar application, Great Basin Network in Carson City feeds their news and information programming to a bank of six TCB-2s. Because some of their affiliates prefer to use frequency extenders, Great Basin encodes the audio using a single line frequency extender encoder.

Using a stereo distribution amplifier, half of the couplers feed the raw audio and the other half feed encoded audio. In this case, two "800" numbers are used, one hunting to the encoded and the other to the non-encoded audio sources. The affiliate simply dials the assigned number to automatically start a tape machine which feeds the daily newscast.

With the alternative being expensive satellite delivery of audio programming, many smaller networks are finding telephone lines to be an inexpensive, reliable form of audio distribution. The Comrex TCB-2 can be used as a building block in a versatile and expandable audio delivery system.

For more information circle reader service card **number 110** or call 508-263-1800.

Equipment Report: Henry Engineering Digistor

Reader Service #111

Information Lines Without Carts

by Hank Landsberg, Henry Engineering

A few months ago, Henry Engineering introduced "DigiStor," a digital audio storage device made specifically for radio station "information lines." For years, broadcasters have used (usually worn out) cart machines for this application, giving out information on concerts, weather, school closings and similar events. It was time to replace the cart machine with newer technology.

DigiStor is a digital audio recorder. It stores an audio message in digital solid-state memory. Since there is no tape (or any other moving part), there is nothing to break, jam or wear out. The message sounds as good after 10,000 plays as it did on the first play.

At the "heart" of DigiStor are the A/D and D/A converters. These units convert the analog audio signal to digital form for storage, then back to analog for playback. The system used is a 4-bit converter, which provides quality that is ideally matched to this application.

Adaptive Delta Modulation is used to maximize the amount of audio that can be stored in RAM memory. The key factor is the sample rate. A high sample rate produces the best audio, but reduces the maximum memory time; conversely, a lower rate increases memory capacity but with lower fidelity.

DigiStor has two user-selectable sample rates. The "fast" rate (32 kHz) provides good audio quality (suitable for music or voice) with a memory capacity of slightly over two minutes. This is what most broadcasters use, as two minutes is usually sufficient time for most messages. The "slow" sample rate (16 kHz) doubles this storage time, but with reduced (voice-only) audio quality.

Using DigiStor is quick and easy. There are both Mic and Line input jacks on the front panel. Just feed your audio into the appropriate input, flip the switch to "Record" and start recording.

Once the message is in DigiStor's digital memory, the unit is ready for use. A modular cord connects DigiStor to any modular phone jack. When the line rings, DigiStor will answer the line and play the message to the caller. The unit can be set to play the message once only, or continuously until the caller hangs up.

Since DigiStor was introduced, we have developed two important enhancements. Some applications require more memory time; we can now quadruple DigiStor's memory, so it provides over eight minutes of record time with good audio quality.

Some other applications required even better audio quality, such as news services that distribute actualities via dial-up phone line. For these users, we are able to increase the sample rate to improve the bandwidth and lower the noise and distortion. This version of the DigiStor really does sound as good as a cart machine playing back over a phone line.

For applications other than phone-line use, DigiStor can be controlled with simple contact closures to activate the Play, Stop and Record functions.

Broadcasters have always liked the PR and "community service" aspect of providing information service lines, but haven't liked the expense, unreliability and difficulty that goes with using old and tired cart machines. DigiStor makes information line service easy and reliable with digital technology.

For more information, please call Henry Engineering at 818-355-3656, fax 818-355-0077 or **circle number 111** on the reader service card.

Equipment Report: Telos 100 Delta

Reader Service #112

Solution Fits the Big Picture

by Kevin Nosé, Telos Systems

Digital signal processing (DSP) technology can accomplish tasks that were previously impossible with solely analog components. One example is the digital adaptive telephone hybrid pioneered by Telos in the mid 1980s. Adaptive hybrids achieve exceptional performance in extracting send (studio) audio from receive (caller) audio on a standard telephone line, resulting in full-duplex conversation.

The first problem is to obtain consistent output level and tonal quality from the telephone line. Nominal levels can vary as much as 30 dB between calls due to telephone line conditions. The 100 Delta utilizes a digital, logarithmic (dB linear) compressor that uses a feed-forward topology to normalize call-to-call levels.

This type of compressor provides level-independent operation, which is critical for telephone-related applications. The "smart" response of the compressor in the 100 Delta imparts the least amount of processing required so that the natural dynamics of the caller's voice are retained.

Since the bandwidth of a telephone line is about 3.5 kHz, it is narrow enough for three frequency bands to do a good "correcting" job. The 100 Delta takes advantage of DSP to dynamically vary the high and low bands so that overall tonal quality more closely resembles the natural characteristics of speech.

The second problem encountered in the radio context is feedback. The telephone interface is often monitored through loudspeakers, and open microphones in the studio can create a feedback path. The 100 Delta deals with this issue in two different ways: pitch shifting and acoustic ducking.

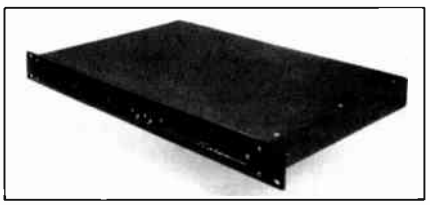
Digital pitch shifting of a few Hertz, placed on the send-to-phone line path, prevents feedback from occurring while still allowing full-duplex operation.

The acoustic ducking helps prevent feedback by reducing the audio level in either the send or receive direction, thus reducing the overall loop gain. The 100 Delta's digital ducking has been refined to minimize its noticeable effects on the audio signals.

Both send and receive audio paths have the equivalent of high quality noise gates with user adjustable depth and with attack, hold and release times refined for speech. The triggering mechanism that controls both gates is intelligent enough to sense which direction should be active and appropriately gates the other direction.

All of the above components are tightly integrated onto a single DSP chip and the parameters of each have been optimized for broadcast applications. Though most of the adjustments come "pre-tweaked" in software, the most important controls are extended to the user so that the 100 Delta can be custom-tailored to suit the sound of any station.

For more information, contact Telos Systems at 216-241-7225, fax 216-241-4103 or **circle reader service number 112.**



Equipment Report: Racom 1700X Tele-Vote

Reader Service #113

Racom 1700X Tele-Vote

by Dave Williams, Racom Products. Inc.

The Tele-Vote is a new automatic telephone polling system developed to make telephone polling more convenient, flexible, accurate and cost effective.

The 1700X is a unique system which provides the user with the ability to poll up to six callers simultaneously, provide a digital, user-recorded greeting message, provide each caller with up to five different touch tone responses, tally each vote on an LCD display and provide a thank-you message.

Installing the Tele-Vote is very simple. For each line ordered (up to six) a modular phone cord is provided that can plug directly into any existing RJ11 jack. Each line has ring-detect circuitry which allows the Tele-Vote to answer the phone on the first ring. Each line is also capable of detecting CPC which allows the Tele-Vote to disconnect even when a caller doesn't vote.

The Tele-Vote is a completely solid state device; there is no tape and no moving parts to wear out. The greeting and thank-you messages are recorded via microphone or an optional tape input. Incoming audio is digitally sampled and stored in a semi-conductor memory, allowing callers to hear a clear, natural-sounding voice prompting them to vote.

Callers vote by simply pressing keys on their touch-tone pad. For example: Let's say you are taking a poll on how your callers think the President is doing. First, they call your polling number, which Tele-Vote answers. The unit plays your custom greeting and asks for the vote. It might go something like this: "Welcome to WWWW's telepoll, brought to you by Wally's Widgets. If you think the President is doing great, press 1; good, press 2; okay, press 3; poor, press 4; and terrible, press 5." The caller would select a response and then hear the thank-you message.

Once entered, the votes are automatically tallied on the unit's LCD display, showing how many times each number has been pressed. This way, the results are shown in real time, as they happen, and the final tally is obtained by simply looking at the display.

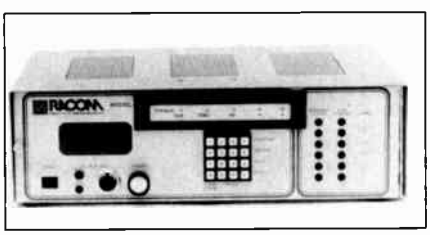
The Tele-Vote comes standard with one line and 1.5 minutes of storage time. Up to five additional lines and 48 minutes of storage time are available for larger applications. Other options include: battery back-up, counters for tallying the total number of calls received, 19-inch rack mount and a back-lit LCD display.

The greeting and thanks messages may be turned off and there are safeguarding features available which prevent callers from "stuffing the ballot box."

Racom also manufactures a large line of custom digital message repeaters for use as information lines and sports score services that are capable of handling up to six phone lines and 48 minutes of storage time.

All lines operate independently and plug into RJ11 jacks for easy installation. A full array of custom software packages are also available to fit almost any broadcast need.

For more information call 800-722-6664 or **circle number 113** on the reader service card.



NAB Sessions

Continued from page 48

Help From Consultants

Financial pressures have encouraged many stations to use Contract or Consulting Engineers instead of maintaining their own technical departments. This has reduced the financial burdens on stations but greatly increased the responsibilities of local management. Managers must now decide what engineering services are needed and plan their budgets accordingly.

How do you decide what must be done to keep your facility operational and legal? What could be done to improve your facility's competitiveness and what can be left undone without seriously threatening your station? You can't possibly keep track of all of these technical issues and also run a station. You must seek reliable technical advice. Choosing the right person can be tricky.

Establishing the right relationship with your contract and consulting engineers makes a major difference in the cost and effectiveness of the service you receive. The panelists for the session "Practical Suggestions for Dealing with a Contract or Consulting Engineer" will cover all aspects of this challenge.

Moderator Paul Montoya spent years working as a station engineer. When the market changed he formed his own firm to provide a full range of engineering services to broadcasters in Colorado. He is joined by Gary Cavell of Lahm, Suffa and Cavell who also worked at the station level, then moved into a consulting position.

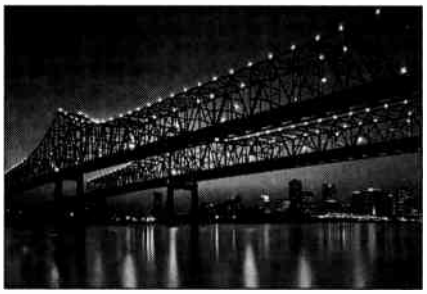
Barry Victor of the Victor Group not only provides construction and ongoing maintenance for a group of stations in California but assists several broadcast equipment manufacturers in research and development. John Bissett, who operates Multiphase Consulting, also logged a great deal of industrial experience with Delta Electronics before offering his services directly to broadcasters.

Jim Stanley and Chip Morgan both head highly successful multi-engineer firms that specialize in continuing maintenance contracts for radio facilities. The final panelist is attorney Chris Imlay. As general counsel for the Society of Broadcast Engineers, Imlay has devoted a great deal of time to defining the responsibilities of the engineers who provide contract services and the broadcasters who hire them. Don't guess about getting your money's worth. Get some realistic guidance from people who deal with the questions successfully every day.

Yes, It's SuperTuner!

Knowing how your station sounds is important, but sometimes it's difficult to decide if it's right or wrong. It's discouraging to keep your radio station sounding good knowing that your clients can't really appreciate that sound on the radios they usually use. Several years ago the NAB began seeking a solution to the problem. It's finally ready!

On Thursday, September 10 at 9:00 AM you can see "The NAB SuperRadio – featuring AMAX: A Technical Description and Demonstration." Moderator Stan Salek from Hammett and Edison was the chief architect of this radical radio as a member of the NAB Office of Science & Technology. He will be joined by Robert Heiblum of Denon USA, the company chosen to make the final production version of the tuner.



Other panelists will include Glynn Walden, Director of Engineering for Group W and Ted Snider, President of the Snider Corporation. As members of NAB's AM Improvement Committee, they were major forces behind the push for the dramatically upgraded radios that comply with the AMAX standard.

Also on the panel is consultant Almon Clegg, who contributed design support for the receiver. Hear a truly outstanding radio and learn how to use it to evaluate your station. Whether you use it as a test instrument or a perk to impress your best clients, the NAB SuperRadio is a powerful addition to your equipment compliment.

Digital For Remotes

Recent advances in digital technology are dramatically improving the quality of remote broadcasts. Implementing these new technologies without breaking your budget requires a whole new range of understanding. Where are digital facilities available?

Who can supply the necessary hardware? Which of the several available delivery methods is the most cost effective and reliable for my operation?

These are just some of the questions that session moderator Tom Corelli will pose to a panel of experts in "New Backhaul Alternatives for Remote Broadcasts." In his job as Media Services Coordinator for the National Basketball Association, Corelli is answering these very questions every day.

His panelists will include Dave Anderson, VP for Operations at IDB, Inc., suppliers of a wide variety of satellite and fiber based communications services. He will be joined by Bob McCarthy from AT&T who specializes in providing Digital Switched 56 service to broadcasters.

By using newly developed encoders and decoders, this service provides two-way 15 kHz audio over dial-up data lines. Daniel Joffe is a product engineer for Integrated Network Corporation, one of the companies offering encoders and decoders for Switched 56 Services. Another equipment provider is Comrex. Chief Engineer Tom Hartnet developed their Switched 56 codecs, then traveled around the world to test them on a variety of phone lines.

To discuss wider ranging services, Paul Manuele, a broadcast services specialist from GE Americom and Evette Fulton of Comsat Communications

. . . continued

Center will join the panel. The new services are powerful tools, but you need good advice from experts like these to use them without wasting scarce cash.

Behind the LMAs

The LMA rage is sweeping the country. Broadcasters from small markets to the largest cities are considering ways to increase their sales effectiveness by combining efforts with others. These agreements can take forms ranging from simple programs to combined sales efforts for stations that serve divergent audiences, to full scale simulcasting using a single resource to provide programming service to a series of communities.

These agreements are attractive because of the economies they offer, but making an LMA work requires careful technical planning. Making a wrong decision can turn the potential revenue source into a costly nightmare. As President of WZNF Radio, moderator Mark Rollings operates a successful multi-station/ multi-market LMA in west central Illinois.

Rollings will discuss the secrets of his success Thursday at 2:00 PM in "Gearing Up for An LMA." He will be joined by Dan Rau from Marti Electronics, Mike Shott from WHIS radio and Norma Lyda from WHKP Radio. Don't leap into an LMA unprepared. Find out the right questions to ask from people who have had to answer them first hand!

RDS Possibilities

Radio Broadcast Data System, known as RBDS or RDS, is a technology that allows broadcasters to transmit text information as well as their regular programming. The U.S. is struggling to adopt a standard that will carry this technology into the mainstream of consumer products. Find out what impact this capability may have on your station operation.

Milford Smith, DE for Greater Media, will lead the discussion. He will be assisted by David Benjamin from Community Pacific Broadcasting; Mark Kady from Delco Electronics; Charles Morgan from Susquehanna Broadcasting; Greg Skall from Pepper and Corazzini; Jerry Lebow from Sage Alerting, John Casey from RE America, and Matthew Straub from Axcess USA.

Questions to be considered include the scope of RBDS service. Is it simply a "smart tuner" that displays station format information on the front of the radio or is it more? Can information broadcasting via RBDS provide a new and distinct income source for broadcasters? How would such a service be structured and what impact would it have on existing bandwidth and interference limits? The answers to these questions are being decided now and your station's profitability could be hanging in the balance. Be sure you know what's happening.

(continued on page 56)

NAB Sessions

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Processing in the '90s

The sound of your radio station is your only product. Most stations use some form of audio processing to control and tailor that product. How good is your processing? If you are still using the same processor, adjusted the same way as you did five years ago you are penalizing yourself and your audience.

Generally, the sound of today's CDs is better than vinyl but their robust high energy content, wider dynamic range and reduced noise require substantially different audio treatment to achieve a satisfactory product. Manufacturers have redesigned and upgraded their processors to meet this need.

Find out what has changed as moderator Dennis Ciapura from Noble Broadcast Group leads Frank Foti from Cutting Edge Technology, Bill Ammons from CRL, Steve Hnat from Hnat/Hindes, Bob Orban from Orban Division-AKG Acoustics, Paul Anderson from Gentner and Vick Sherrill from Audio Animation through a tour of the latest tools of audio "Processorcery." You can't afford to be the last one in your market to learn how to bring your sound up to date!

Digital, the Right Way

You don't have a lot of money to spend for equipment, but the equipment you have just won't last forever. What do you do? The digital revolution is presenting a whole rash of exciting new possibilities for broadcasters but how do you decide what to buy? Nobody wants to buy the very last analog cart machine ever made, but the road to bankruptcy is paved with purchase orders for the "newest, most advanced, cutting edge widget" that was eclipsed by the "right machine" that was introduced six months later.

How do you tell the "right machine" from a concept that can barely stagger out of the research lab? There is no absolute answer but Al Kirschner, Director of Engineering for Westwood One, has gathered a panel of DEs and equipment vendors to offer some practical guidelines for making the best possible decisions.

The experts will include Tom Harle from Harris Allied, Bert Goldman from Shamrock Broadcasting, Art Reed from Bradley Broadcast Sales, Tom McGinley from Cook Inlet Radio Partners, Tim Schweiger from Broadcast Supply West and Candy Clark from Broadcasters General Store. Bring your toughest purchasing decision and challenge the experts. Even a glimmer of insight is better than buying blind.

All New Digital Seminar

The highlight of Radio 1992's technology management series is the Digital Radio Seminar on Saturday. This day-long program will give you the knowledge you need to guide your station successfully into the digital age. Whether you're trying to choose the right studio equipment or preparing to expand your service, digital is in your future. Seize this chance to understand the technology and ask your questions. Don't miss the perfect opportunity to insure your digital future.

NAB Sessions

Continued from page 56

Since the technology has developed at breakneck speed, it has spawned its own terminology and created a whole new set of criteria for judging equipment performance. If you don't know the language you can't flourish in the culture.

Professor Ken Pohlmann has given thousands of people the tools they need to understand digital audio through his music engineering classes at the University of Miami in South Florida, his articles for audio magazines, and his books, including the standard reference "Principles of Digital Audio." Pohlmann opens the Radio 1992 Digital Seminar with a "Technology Tutorial -- Defining the Basics" on Saturday morning.

Whether you have followed the growth of digital for years or just decided that you need to find out what's going on, you'll want to get up and get to this session at 9:00 AM. Pohlmann's clear, concise style and in-depth understanding of the subject will prepare you to understand the rest of the day's material as well as for the decisions you need to make for the rest of this digital decade.

Making the Transition

Digital technology has permeated every aspect of radio station operation. From network distribution to audio signal storage to studio/transmitter links, the digital age is here. This has dramatically improved audio quality, but most stations don't have the money or the opportunity to build an entire new facility. The challenge is mapping a solid strategy for transitioning your facilities into digital.

What equipment should be replaced first? Which digital technologies are compatible and which aren't? How difficult will it be to intermix digital and analog equipment? What are the practical results of repeated digital-to-analog transformation? How can you choose equipment that won't be rendered obsolete by future developments?

At 10:30 AM, Don Lockett from National Public Radio will lead a group of industry experts considering these questions in "Building the Digital Radio Facility – Managing the Transition." Their answers may surprise you and their advice can save you thousands of dollars and hours of frustration.

Digital – Right Now

In addition to improving the quality of traditional programming, digital technology offers broadcasters substantial opportunities to expand their busi-

nesses. In the third part of the Digital Radio Seminar, at 1:30 PM, a group of visionaries offer practical suggestions on possibilities you can pursue today!

Doug Talley from Digital Planet Radio tells broadcasters how they can add their signals to digital pay radio selections on cable. Ken Malinowski from Scientific Atlanta Broadcast Radio and Data Systems will explore the expanded services available using Spectrum Efficient Digital Audio Transmission (SEDAT) equipment. Albert Stem from SpaceCom Systems offers details of enhanced broadcast services using FM cubed digital satellite technology.

Linda Donahue completes the panel from a unique viewpoint. Donahue began her career as a customer service representative for a telephone company selling traditional leased lines to broadcasters. She now heads California Digital, a company that offers broadcasters services ranging from Switched 56 transmission through small aperture transportable Ku band uplink packages. You can make more money by serving new audiences. Let these examples fire your imagination.

Finally...DAB

Digital Radio Broadcasting is comi

We will conclude the NAB Digital Radio Seminar at 3:00 on Saturday with a careful study of the proposed standardization process. Randy Brunts of Delco, the chairman of the EIA Digital Audio Radio committee, will chair the session. Tom Keller of EIA's engineering department will present details of the proposed testing program.

Each of the eight registered DAB systems proponents will then be allowed time to present whatever details or demonstrations of their equipment they wish to reveal. This is your chance to become part of determining the future.

It's not too late to take advantage of the NAB Radio 1992 Technology Management Sessions. For full registration information, call toll free 800-342-2460 or fax 202-775-2146. For further details on Technology Management Sessions call the NAB Office of Science & Technology at 202-429-5345.

Andy Butler is an engineer with NAB's Office of Science & Technology and coordinates engineering programs for NAB-sponsored conventions.

Equipment & Technical Services Exhibitors at NAB Radio Show
(As released by NAB – subject to change; check show program)

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A.F.C.C.E. 948
AKG Acoustics 440
Arrakis Systems 141
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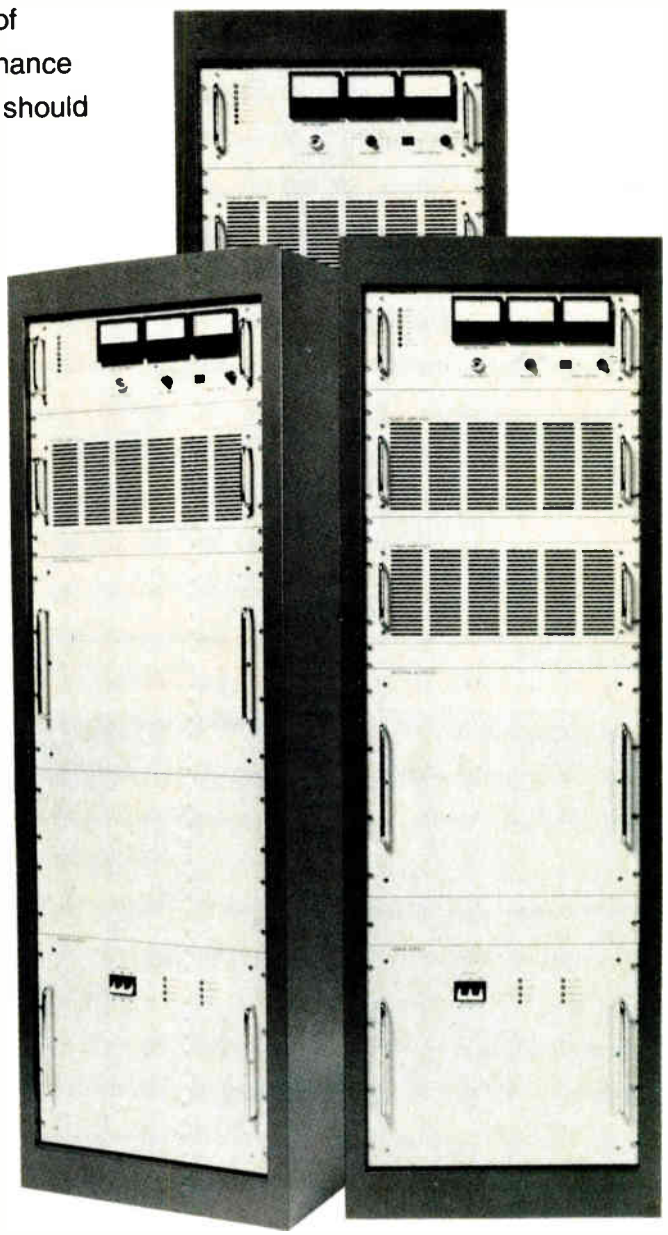
Exhibit Hall Hours:
Thursday, September 10: 10:00 AM - 7:00 PM
Friday, September 11: 10:00 AM - 7:00 PM
Saturday, September 12: 10:00 AM - 2:00 PM

INTRODUCING

The "T" Line

These highly efficient solid - state AM transmitters yield the broadcaster superb audio performance whether operating in stereo or mono. The economic pay back can be realized quickly due to the very low power consumption and no routine replacement of vacuum tubes. Modular construction for easy maintenance and each transmitter will automatically reduce power should a failure occur.



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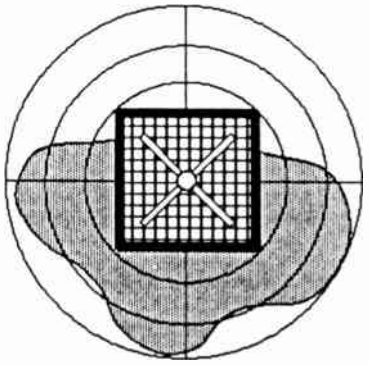

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Reader Service #130

On The Road

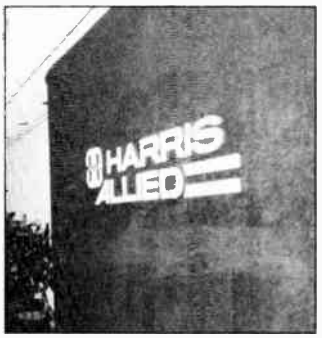
Harris Allied
Richmond, Indiana

By Judith Gross

Richmond headquarters, about to be endowed with a new Harris Allied logo.

Founded in 1974 as an outgrowth of a 1960's theatrical lighting business started by Richmond, Indiana native Roy Ridge, Allied Broadcast Equipment grew over a decade and a half to become the largest supplier of broadcast equipment in the U.S.

In 1988, Harris Corp., the then 66-year-old offshoot of the Gates Radio Company, acquired Allied Broadcast Equipment and Harris Allied was formed. Herewith, some scenes from a recent visit to Richmond.



An elegant welcome.

Roy Ridge, former DJ, theatrical buff, and Allied's founder.

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How to Submit Articles to Radio Guide

Radio Guide welcomes your comments, letters, articles and Tech-Tips. We prefer electronic submissions.

1. MCI Mail to Judith Gross, at MCI Mail #507-3038.

2. Modem: Call 703-370-7943 and request an XMODEM transfer.

3. Mail a 3.5" or 5-1/4" double or high density floppy disk (Wordperfect 5.0 or ASCII) to: Judith Gross at 101 S. Reynolds St., Suite H-405, Alexandria, VA 22304.

4. Or post to the Radio Guide/AVS BBS by calling (804) 468-4957. Please send as a private message to Judith Gross or Ray Topp.

We also accept clean, typewritten or printed manuscripts mailed to Judith Gross at the above address. Photos and clean, camera-ready art with articles and Tech-Tips appreciated.

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015	040	065	090	115	140
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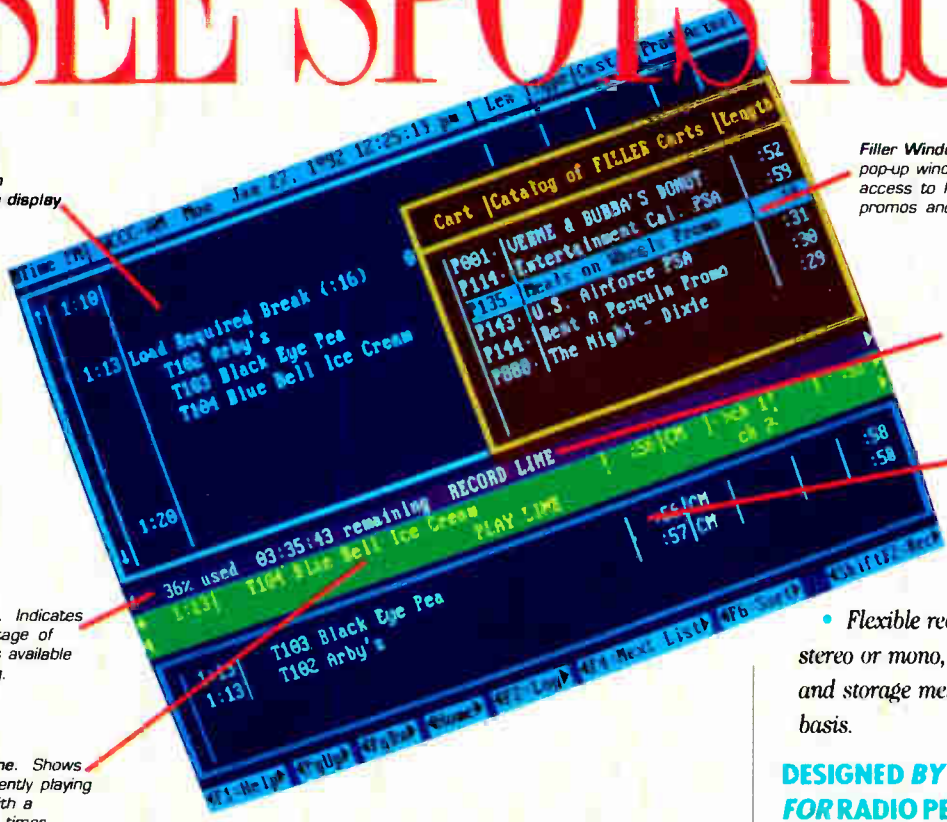

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