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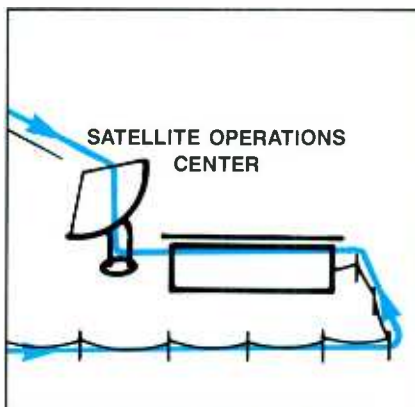
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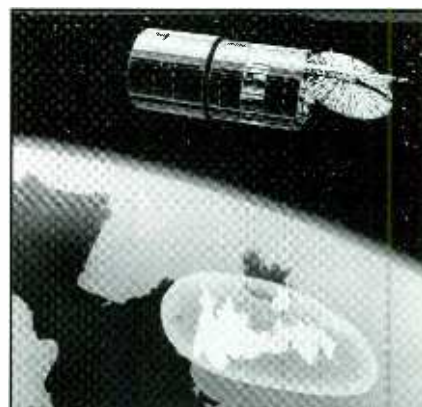
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BROADCASTING FROM THE FIELD:

As today's broadcasters search for avenues to additional revenue, remote broadcasts continue to be a common practice. Remotes have always been a headache and a challenge to broadcast engineers. However, with today's new technology, remote broadcasts are easier and of far higher quality than they used to be. This month's features look at how you can relay your program and communication circuits back to the station with studio-like quality and efficiency.

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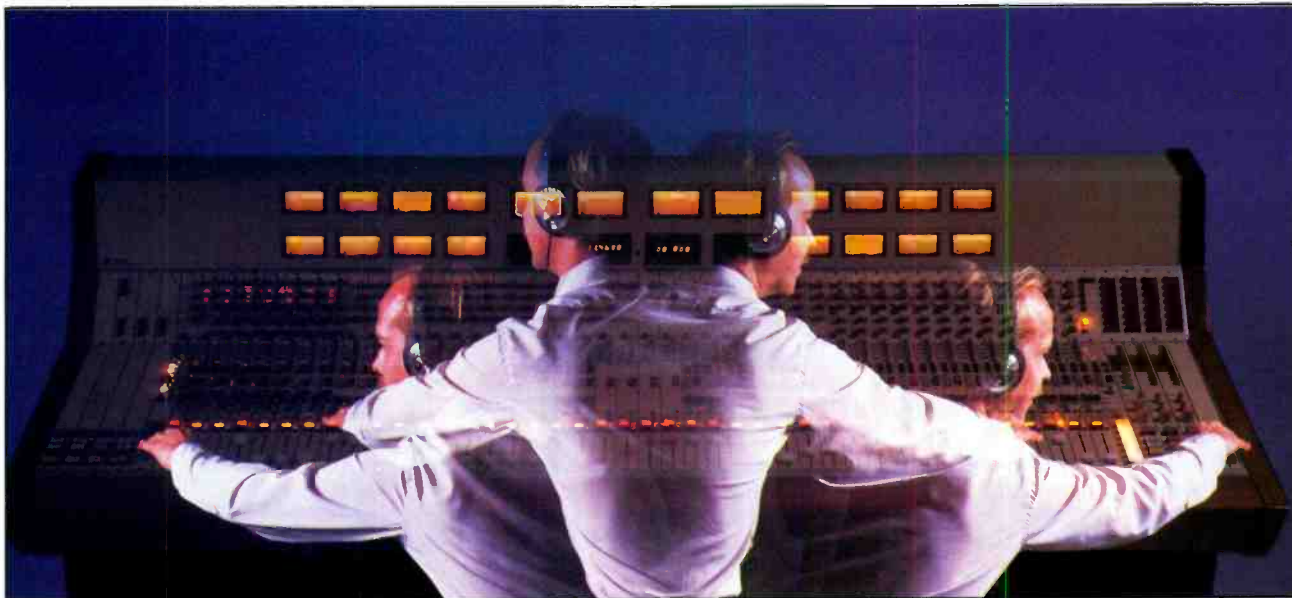
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ON THE COVER

High-tech solutions come to the assistance of broadcasters as they extend their research beyond the bounds of terrestrial communication links. Symbolized here is a satellite capable of relaying program and communication circuits between remote trucks and the studio. (Cover credit: Stephanie Chiles, BE graphic designer.)



Television audio has been changing even faster than the rest of the industry. It's time to take a fresh look at the requirements of today's television station—and to find more effective methods of meeting them.

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By Dawn Hightower,
senior associate editor

Technical Emmys awarded

The National Academy of Television Arts and Sciences awarded Emmys for eight separate technologies in a ceremony on Oct. 9. The following individuals and corporations were awarded Emmys for outstanding contributions to the advancement of TV engineering and technology during 1989 and 1990.

For achievements in the development and implementation of television for the visually impaired, the recipients were: Gregory Frazier, co-director of the Audio-Vision Institute at San Francisco State University's School of Creative Arts; Dr. Margaret R. Pfanstiehl, president of *The Washington Ear*; the Narrative Television Network; and the Public Television Network.

For achievements in the technology and implementation of still-picture technology for news, the recipients were: Colorado Video, Sony and Eastman Kodak Company.

For advancements and implementation of technology for large library robotic cassette machines, the honors went to: Odetics Broadcast, Panasonic Broadcast Systems Company, Ampex and Sony.

For achievements in the development of metal particle tape technology, which enabled its first use in broadcast video recording, the recipients were: Fuji Photo Film Company and Sony.

For advancements and implementation of technology for video workstations, the recipients were: Digital F/X and Pinnacle Systems.

Eastman Kodak Company was honored for the development of extended range (EXR) motion picture films based on T-grain emulsion technology.

The Grass Valley Group was honored for the development of E-MEM/effects memory systems for the storage and recall technology in large production switchers.

Accom was honored for the development of the Digital Image Enhancer 125, for real time component digital noise and film grain-reduction technology.

SMPTE holds 25th TV conference

The Society of Motion Picture and Television Engineers (SMPTE) is holding its 25th annual Television Conference Feb. 1 and 2 at the Westin Hotel in the Renais-

sance Center, in Detroit. The conference will focus on the evolutionary flow of TV technology from the past through the present and into the future. The theme is, "A Television Continuum — 1967 to 2017."

The AES will also host its 9th International Conference Feb. 1-3 at the Westin Hotel. SMPTE and AES registrants will be able to attend sessions offered by both groups for one fee. The theme for the AES conference is, "Television Sound Today and Tomorrow."

For information, call the SMPTE Conference Department at 914-761-1100; or fax 914-761-3115.

Call for papers for Engineering Conference

The 45th annual Broadcast Engineering Conference is scheduled for April 14-18, in Las Vegas.

The engineering program will have more than 100 presentations in 20 technical sessions. Authors of accepted presentations will receive a technical conference presenter's kit containing information on manuscript preparation. Presentations at the technical conference will be considered for publication in the conference "Proceedings." Finished manuscripts are due to NAB by Jan. 21.

Disaster preparation focus of CalCon '91

CalCon '91, the 2-day SBE technical conference set for Feb. 22 and 23 at The Sportsman's Lodge Hotel in Los Angeles, will be hosted by Los Angeles Chapter 47.

The conference will focus on disaster preparation and advanced broadcast technology.

On Feb. 22, the focus will be on disaster preparedness. The workshop will be moderated by Richard Rudman, chief engineer of KFWB-AM and former SBE president.

On Feb. 23, the focus will be on digital and advanced analog technology. There will also be an audio and video seminar and a session on how to deal with stress.

There will be no equipment exhibit at CalCon '91.

For a registration packet, contact the CalCon '91 coordinator: Sandra Woodruff, 1626 N. Wilcox Ave. No. 692, Hollywood, CA 90028; telephone 213-8710-4660; fax 213-871-4670.

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1-7-91



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A show in transition

The Society of Motion Picture and Television Engineers (SMPTE) observes its 75th birthday this year. During its long history, SMPTE has accomplished a great deal in the areas of standardization, education, and the advancement of the film and video arts.

The cornerstone of SMPTE's educational efforts is the annual fall convention. Despite steady growth during the 1980s and the concentrated efforts of many individuals within the organization, the show is facing a difficult challenge.

The 132nd technical conference and equipment exhibit, held Oct. 13-17 in New York, was a moderate success. Attendance was reported to be 12,000 — down significantly from last year. The exhibition hall was also smaller than expected.

No convention is in business to grow smaller; bigger is always better. From this standpoint, SMPTE was a bit of a disappointment. Not a surprise, however.

The problems SMPTE faced in New York were twofold. First, the professional video industry (most notably broadcasting) is currently in a slump. The boom days of the mid-1980s are gone. Facilities are still buying equipment, but not in the numbers they once did. There is a time for buying, and there is a time for paying off. This is the time for paying off.

The venue was the second and more obvious problem to the attendees and exhibitors. Now, I love New York. It's a fun place to visit. But it's also expensive. Where else could you spend \$21.50 for a breakfast consisting of coffee, orange juice and Cream of Wheat? (Gratuity not included.)

Then there was the Javits Exhibition Center. The physical plant is great, but the location is lousy and the unions are difficult to deal with. So, OK. Enough New York bashing.

The larger picture is that SMPTE is caught up in the resizing of the professional video industry, an industry facing major changes. The need for a strong organization, such

as SMPTE, in our business has never been greater. The measure of an organization's value is quantified by more than just convention floor attendees.

This year, the fall SMPTE show moves back to Los Angeles (Oct. 26-30), and will likely do well. A major move occurs in 1992 when the fall convention will be held at the Metro Toronto Convention Center. SMPTE is to be congratulated on taking the bold step out of New York and to Toronto. Early indications from exhibitors are positive. A new attendee mix should prove beneficial to exhibitors and SMPTE.

The challenges facing SMPTE, and the industry that it serves, are not insignificant. Still, few industries have shown the ability to develop and apply new technology for consumers as professional video. The only real threat from uncertain times comes from clinging to the past. The future is best assured by embracing new technologies and accepting the realities of new economic conditions.



Jerry Whitaker,
associate publisher



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FM translator standards tightened

By Harry C. Martin

The FCC has amended its rules to prohibit commercial FM stations from owning or supporting an FM translator if its 1mV/m contour extends beyond the primary station's 1mV/m contour.

Previously, FM translators could be owned and operated by commercial stations outside their service areas, as long as they were not located within the 1mV/m contour of another station. Also, under the old rules, a commercial station was permitted to financially support a distant FM translator constructed and owned by an independent party. Other changes in the FM translator rules are as follows:

- The commission will grant waivers of its primary station ownership and financial support policies and permit signal relay by any terrestrial means, where the translator would provide service to an aural service "white" area.
- Non-commercial FM translator stations will not be subject to any ownership or financial support restrictions, regardless of their location in relation to the station being rebroadcast.
- The commission retained its limitations on translator-originated programming so that only one 30-second announcement per hour is permitted to acknowledge or solicit funds.
- The commission defined "major changes" for FM translators, which are subject to competing applications and petitions to deny, as any change in output frequency or any change of more than 10% in the previously authorized 1mV/m coverage area.
- No AM/FM cross-service translators will be permitted.
- Non-commercial FM translators will be allowed to operate on any of the 80 commercial channels.
- The maximum ERP for all FM translators will be 250W.
- Translators operating beyond a primary station's 1mV/m contour will be subject to new power and height restrictions, such that the distance to the 1mV/m contour may not exceed 7km for areas east of the Mississippi River and in Southern California, and 13km elsewhere. This distance



provision may be waived upon showing that service provided at greater distances will reach only a "white" area.

- Criteria for determining interference to FM and TV Channel 6 stations have been adopted.

- Existing stations are grandfathered under the new technical rules unless they pose interference problems.

- Existing stations must comply with the new service-area limitations within three years.

The new rules are expected to become effective on March 1, 1991.

Community of license change rules clarified

In 1989, the FCC amended its rules to permit FM and TV licensees to modify their authorizations to specify a different community of license without affording interested parties the opportunity to file competing applications.

In clarifying its rules, the commission said proposals filed pursuant to the 1989 rule will be examined in light of the allotment priorities established under §307(b) of the Communications Act, which requires "a fair, efficient, and equitable distribution" of service among communities. Proposals to relocate to a larger metropolitan area may be precluded under §307(b), even if the move involves establishment of a first local transmission service for a suburban community. Removal of an existing service representing a community's sole transmission service will be permitted only if there is a sufficient showing of public interest factors to offset the public's expectation of continued service. Furthermore, the commission said it would not accept a petition for a change in community of license during the first year of station operation if the licensee had received a decisionally significant hearing preference based upon its community selection.

The commission has determined that when two licensees in a community file a petition for rulemaking that seeks to remove their station from the community, each citing the other as a remaining station, the petitions would be treated in the same manner as any set of conflicting allotment petitions. The commission also said that when AM and FM licensees in

the same community request a change in the community of license, and the public interest requires that at least one of the stations remain, the AM licensee's request to change generally would be preferred over that of the FM licensee.

Finally, the commission said it would consider the availability of all AM and FM stations, including non-commercial facilities, in making determinations whether a proposed re-allocation will deprive a community of a needed aural service.

FCC proposes children's TV rules

The commission has instituted a rulemaking to address the following requirements of the Children's Television Act of 1990:

1. *Commercialization.* The act requires that commercial TV stations and cable systems limit the amount of advertising in children's programming to no more than 10.5 minutes per hour on weekends, and no more than 12 minutes per hour on weekdays.

The commission is also seeking comments on its legal authority to hold cable operators directly liable for cable network program violations, because neither the act nor its legislative history address this issue.

2. *Programming requirements.* At renewal time, the commission is to consider whether the licensee has served the "educational and information needs" of children through its overall programming, including programming specifically designed to serve children's needs. To help evaluate licensee efforts in this area, the commission proposes to require licensees to assess the programming needs of children and to submit, with their license renewal applications, their records of children's programming.

3. *Program-length commercials.* The act requires the commission to develop a definition of "program-length commercials."

Under the commission's proposed definition, program material will be considered commercial matter for purposes of assessing compliance with the new limits on commercial time if the program is associated with a product in which commercials for that product are aired. [1:~:~)]

Martin is a partner with the legal firm of Reddy, Begley & Martin, Washington, DC.

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At the heart of Television

What does my video really look like?

By Andrew Suk

It often falls to the engineering department to perform technical training. Beginning with this issue and continuing for the next two, this column will present a series designed to help engineers teach technical fundamentals to non-technical personnel. This is important, because the easiest way to improve the quality of a TV signal is to keep it free of avoidable technical errors in the first place.

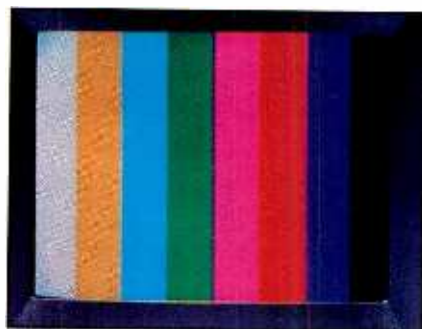
To a TV engineer, few things are as disconcerting as hearing, "This video looks rotten." When you ask the complainant to be more descriptive, the response usually is a string of even less helpful adjectives. The next logical question, "What does it look like on the scope?" often generates the frustrated reply, "It looks green." Further inspection may reveal a picture that's bleached white, with the video levels crushed at the top of the waveform monitor. Or it may be a murky picture that's as dark as the sludge at the bottom of a coffee cup, with video peaking at 30IRE. At times like this, some one-on-one instruction about what to look for on a waveform monitor and vectorscope might be in order. And it's usually up to the engineer to provide it.

The video signal

Video is an electrical signal, just like the AC power that comes out of the plug in the wall. The big difference is voltage. AC power can kill or disable, but the video signal has a low voltage — less than that used in most flashlights.

The video signal is usually specified as being 1V peak-to-peak. It is measured from the lowest tip of sync to the brightest peak white. (See Figure 1.) Examine the signal on a waveform monitor set for a 2-line sweep, also referred to as the 2H position. If the bottom of the sync is set on the line labeled -40, the top white bar touches the line labeled 100. The top of sync and the bottom of the white bar are now on the line labeled 0. This is called the *base line*.

The measurement units from -40 to 100 are called IRE units. IRE stands for Institute of Radio Engineers, the original broadcast engineering group. Saying that



a 1V signal is 140IRE provides an accurate way to measure signal levels. Instead of saying sync is three-tenths of a volt, it is said to have 40 units of sync. At first, this may sound like an insignificant difference. However, consider how much easier it is to directly measure a problem sync signal as being 38IRE, 2 units low vs. interpolating the same error as one-seventieth of a volt.

Sync signals

One word frequently mentioned by video professionals is *sync*. But what exactly is it? Sync is an abbreviated way to describe the synchronizing pulses contained in the video signal. These pulses keep everything performing together, or in sync. They ensure that video from a camera can be recorded on a VTR, played back through the transmitter and received by viewers' TV sets.

The instrument that measures these sync signals is the *waveform monitor*. If there are 40 units of sync, the video is in good shape. Significantly less than or more than 40 units indicates a problem. Although the left-to-right (timing) position of the sync pulse within the video signal is critical, most users only need to worry about keeping sync amplitude at 40.

Active video

The active video area is from 0IRE to

100IRE — well, almost. Active video should not start until 7.5IRE. (More about this later.) Images in the real world range from dark to bright. This is also true in video, which attempts to duplicate this natural range.

Any brightness above 100IRE is excessive. Although the signal may look usable on the monitor, by the time it reaches the station's transmitter, it may be severely degraded. For this reason, there is a legal limit to how bright TV scenes can be. Regardless of how bright the image, operators must adjust the aperture of the lens or the gain of the tape machine to fill the active video area up to a maximum peak white of 100IRE.

The other extreme, black, is not set at the 0 base line. The black level occurs at 7.5IRE. This is sometimes called the *setup* or *pedestal* level. If an active video component descends below the 0IRE base line, it could easily interfere with various video-processing circuits. It might be interpreted as a sync signal, and disturb the resulting image. For this reason, the legal setting for black level is 7.5IRE.

Next month, this column will address the issue of color.

Acknowledgments: Our thanks to Tektronix for providing the illustration. Readers may wish to note that Tektronix has available, at no charge, a short videotape that explains the waveform monitor display in non-technical terms.

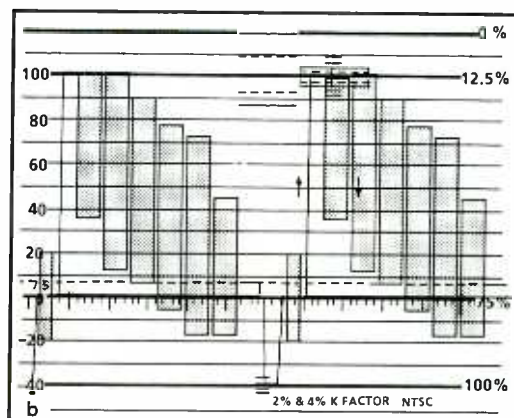


Figure 1. In a standard video waveform, the sync tip lays at -40IRE. Peak white rests at 100IRE. The black level is 7.5IRE. The entire waveform is 1V peak-to-peak.

Suk is director of engineering, Cordillera Communications, and chief engineer of KIVI-TV Nampa, ID.

If you've been putting off doing stereo field remotes for fear of risking a fragile, expensive stereo mic, Shure's new VP88 is what you've been waiting for.

The VP88 is an advanced single point stereo condenser mic that not only recreates the sonic environment with extraordinary audio fidelity, but meets Shure's legendary standards for ruggedness and reliability.

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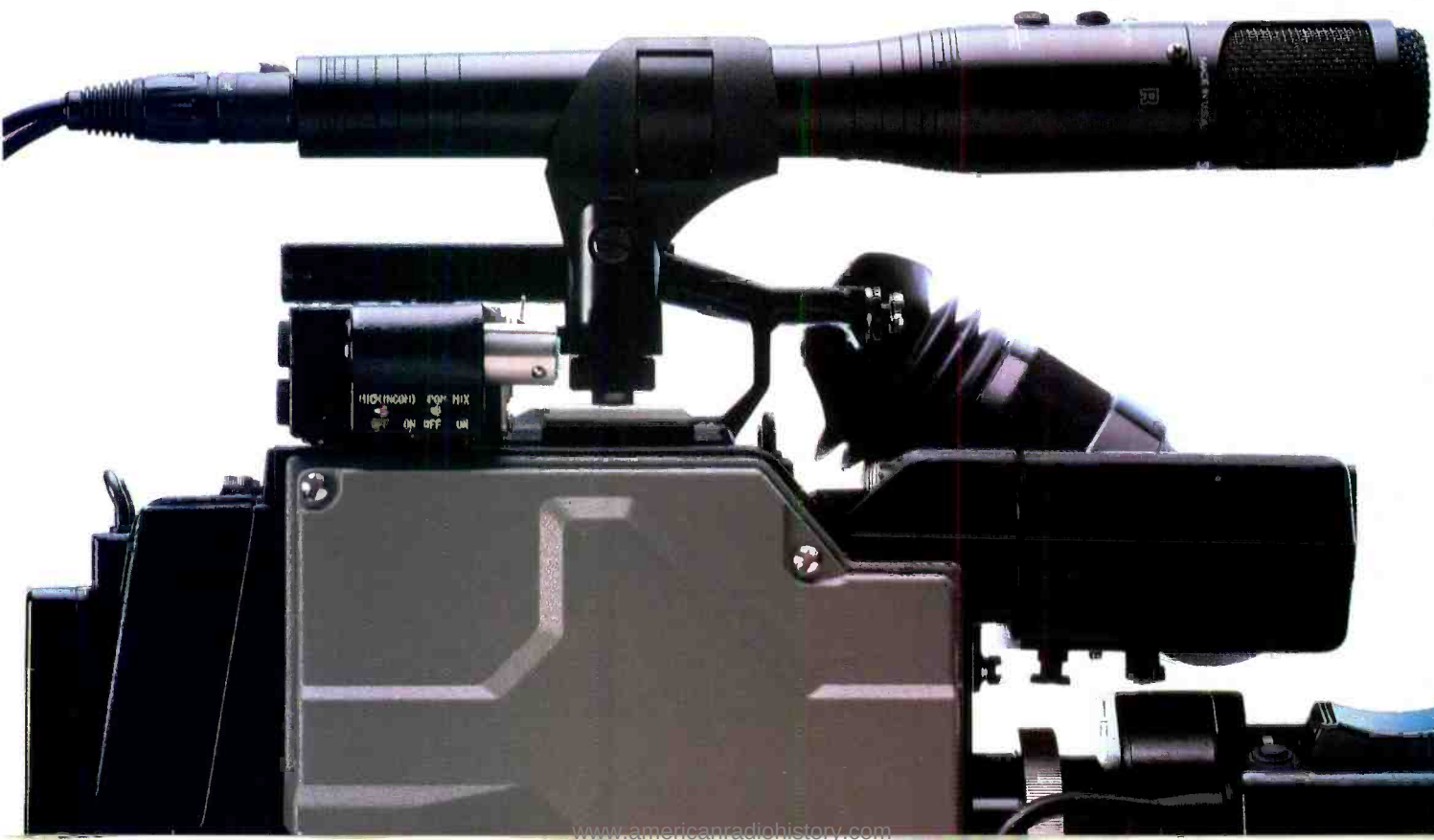
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We're legal...(Aren't we?)

By John Battison, P.E.

This is a true story, although I can hardly believe it. At a recent broadcasters' meeting, I spoke with the manager of a new FM station that had been put in under Docket 80-90. This was his first broadcasting job, although he had been active in the advertising agency field. After a brief conversation with him, I began to wonder if his ignorance — or total disregard — of FCC rules was his way of thumbing his nose at Uncle Sam's minions. Perhaps what really bothered me was the comfort he took in his deficient awareness, confidently proclaiming what he knew were the rules. In any case, he (and anyone else like him) is headed for trouble.

His first error — not one to render him liable to a forfeiture, but one for the public's memory when renewal time comes around — is his disdain for his city of license. Instead of emphasizing his city-of-license ID, there is a short one at the FCC's required times, and even this is not strictly correct, because it includes the names of the other nearby towns with which he is trying to associate the station. But every 15 minutes, an ID tying-in with the major markets nearby is broadcast. This is not illegal, but it's not too good either.

The station runs with an STL to a remote transmitter several miles away. During the day, the station is operated by remote control. According to this manager, at night they program from satellite with local IDs inserted automatically. I asked where his night remote-control point was located. He responded vaguely, "Oh well, you know, we just use telephone line dial-up." I persisted — where is the licensed remote-control point? He told me that they don't have one.

"But the new commission rules allow us to just dial-up to check operation," he countered.

My next question concerned EBS equipment, and how the station managed to monitor the EBS receiver for alerting tones during the night from the dial-up point(s). He responded, "We don't have one. We don't have to — we don't belong to EBS, and we are not a participating station."

Battison, BE's consultant on antennas and radiation, owns John H. Battison and Associates, a consulting engineering company in Loudonville, near Columbus, OH.



Then I asked about tower lights. How did he monitor them? I was told that the tower belonged to a trucking company, that they monitored the lights, and that was that, as far as he was concerned.

By this time, I was ready to suggest that he buy a copy of CFR 47 and read it carefully, then have a long talk with a good consulting engineer and an attorney.

How long will it be before he is inspected? Who knows? The commission is so short-staffed that inspections seem to be held only when competitors complain about out-of-spec operation, or when listeners complain of interference.

A matter of conscience

What should a listening engineer do? Did I have a responsibility to "snitch" to the FCC, or merely try to point out the errors of his ways to this station manager? I chose to try to enlighten the man.

Station IDs are more a legal matter than an engineering concern, but as a long-time broadcaster, I tried to point out that even though the FCC may be satisfied with his IDs, in all probability, listeners in his city of license would not be. His lack of interest in the local high-school games was complete. I asked why he didn't carry them. He responded, "We can't afford the cost of remote equipment." Has he, or his engineer, ever heard of dial-up remotes, using some of the excellent telephone line interfacing and enhancement hardware that is available today?

On the other hand, his combination of no EBS and questionable remote operation could bring him grief in the form of a large forfeiture. The commission's rules have changed a lot, and there is still some confusion concerning dial-up remote-control requirements. But as I understand it, a notified remote-control point is still required, even though dial-up calls are permitted to check from time to time. Furthermore, possession of a working EBS receiver is a must for all stations, regardless of whether they are participants in the EBS program.

Part 73.932(a) of the FCC rules reads, "All broadcast station licensees must install equipment...capable of receiving the Attention Signal...by radio." And 73.932(b) adds, "All broadcast station licen-

sees...must install, operate and maintain equipment capable of generating the Attention Signal." Whether a station participates in the EBS program, it *must* have an EBS receiver and encoder in working order. Furthermore, the staff must be informed as to their duties in this respect. Finally, EBS tests must be conducted weekly in accordance with 73.961(c). These tests, along with received tests, must be noted in the station log. The commission has been bearing down heavily on stations failing to follow 73.961(c).

This station manager is also off-base in the matter of tower lights. Section 73.1213(c) deals with common-use towers. It states that in the absence of an agreement designating one licensee as the entity responsible for notifying the local FAA in the event of tower light failure, the responsibility falls on each licensee. I asked if he had such an agreement with the tower owner and other licensees, and he said he did not. He also had no light-monitoring device on his remote-control equipment.

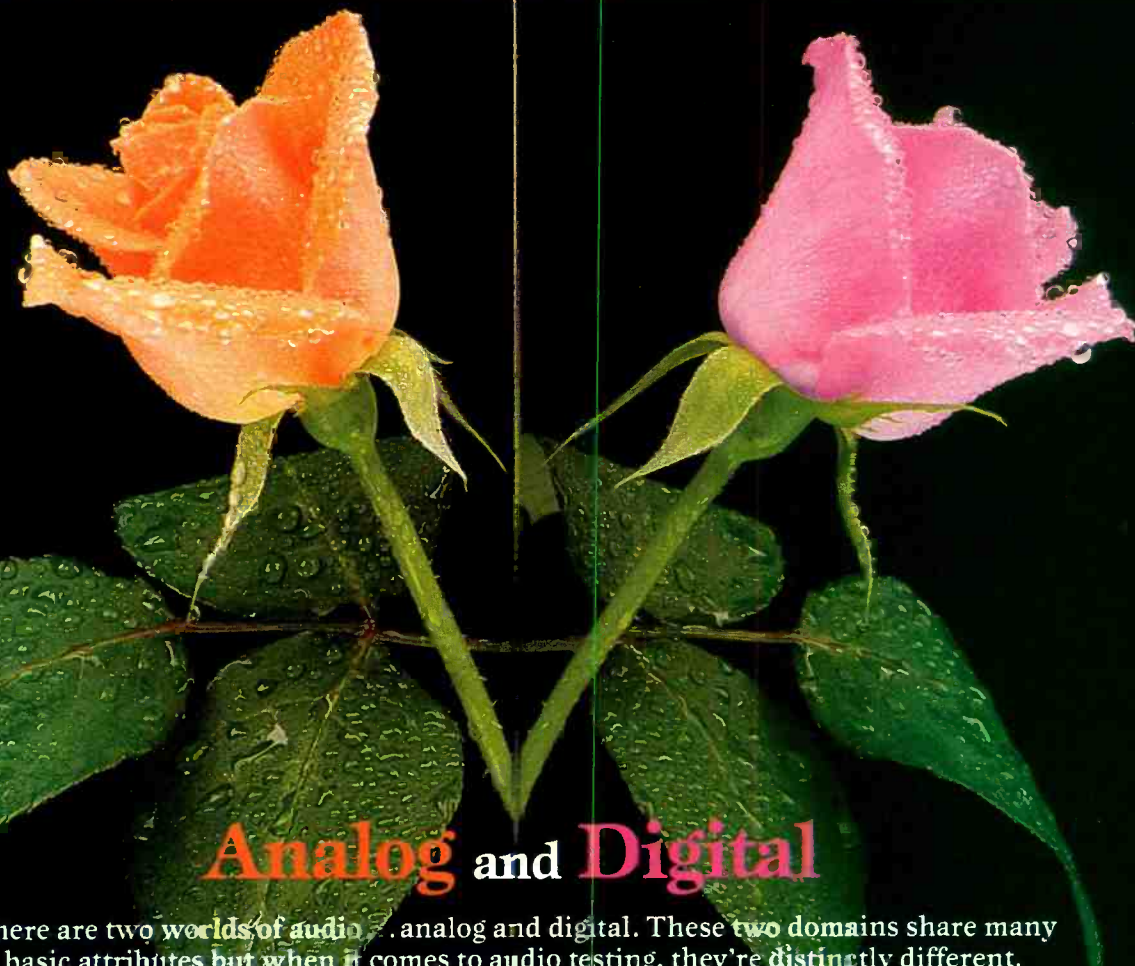
Responsibility and resources

In the "good old days," the station manager relied on the full-time chief engineer and the consulting engineer (on retainer) to interpret the rules and ensure that the station adhered to them. Today, few stations have full-time chief engineers or consulting engineers on retainer. Consequently, FCC rules are often ignored, or misinterpreted to suit the local station's requirements. In most cases, there is eventually a day of reckoning when the inspector arrives to add up the violations bill.

It is the responsibility of contract chiefs or part-time engineers to maintain an up-to-date copy of the rules. Several companies provide such a service, with regular updates. Contract engineers should be able to inform their clients accurately and intelligently about all technical requirements of their stations' operations. If engineers cannot, or do not, then they are not doing their job.

1:7:5111

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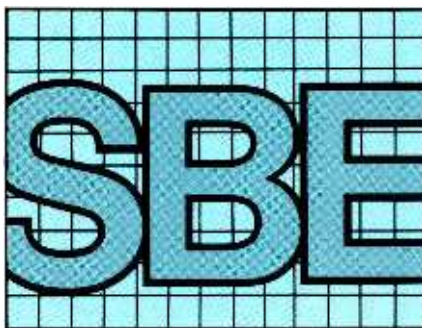
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Valuable ideas at national convention

By Bob Van Buhler

An informative and interesting part of the SBE National Convention is the annual meeting of the society's past presidents. This year's meeting was attended by SBE's first president, John Battison; SBE's current president, Brad Dick; and past presidents Bob Jones, Jim Wulliman, Roger Johnson, Jack McKain and Roger Johnson.

One idea presented at the convention was to expand the Ennes Foundation's board of directors to include high-profile broadcast industry figures outside of the traditional SBE circle. Other suggestions included an advancing need for education and job placement services as a result of the Defense Department's projected military and civilian service cuts. Operating a dark radio station as a training facility was also proposed.

The drop in the number of engineers at the average TV station captured some attention. In 1985, the median number of engineers was 19; in 1990, it was 11. Technical advances in automation were the cause of lost positions, which largely affected operating broadcast engineers.

Women in broadcast engineering

Ten people, six of them women, attended a session on women in broadcast engineering at the SBE National Convention. The SBE had never formally examined the subject.

Sandra Woodruff, of KFWB-AM, Los Angeles, was the session coordinator and indicated that the session's chief value was getting a start, letting women in broadcast engineering know that there are people interested in the subject. Woodruff noted that one of the traditions in broadcasting is networking. Networking is a valuable source of technical information and assistance, product information and employment opportunities.

During the session, it was discovered that four of the six women attending had obtained their current jobs as a result of networking. Women broadcast engineers are uncommon in a field that traditionally has attracted men. Because of this minority status, forming a network can be beneficial.

Van Buhler is manager of engineering at KNIX-FM/KCWW-AM, Phoenix.

Certification growing

An understanding has been reached with DANTES, the Defense Department's education and testing arm, whereby certification examinations can now be conducted at military education and testing centers all over the world. This will help SBE members in the military tie their advancement in the service to SBE requirements and certification. This approach may help military people obtain civilian employment, while keeping a degree of synchronization between Armed Forces

ample for broadcast industry executives who may be less attuned to technical considerations than their satellite counterparts.

Until Jan. 1, 1991, a grandfather clause existed in certification rules, whereby an uncertified, but otherwise qualified, engineer with 20 years of experience could become certified as an SBE professional broadcast engineer. As of Jan. 1, engineers seeking advancement to SBE professional broadcast engineer must be previously certified as a senior broadcast engineer.

SBE awards Fellowships

Three SBE members received recognition at the 1990 SBE National Convention. The SBE membership status of Fellow is awarded for significant contributions to the society and broadcast industry over a prolonged period of time.

Gerry Dalton, a member of the Dallas chapter, was awarded a Fellowship for his years of service in frequency coordination at the national level. Dalton was the primary developer of the software for frequency coordination and an original and continuing member of the SBE frequency coordinating committee. He has also almost single-handedly designed and supported the LAN-based computer system in the Indianapolis office.

Robert Goza, SBE's treasurer and convention chairman, was awarded a Fellowship for his convention efforts over the years. Goza has been a key player in every SBE convention to date. He is largely responsible for the growing success of the SBE convention.

Joseph Manning, SBE board member, was awarded a Fellowship for his years of hard work on the SBE sustaining membership program. Under Manning's direction, the sustaining member program has more than doubled during his tenure.

SBE awards

The annual SBE chapter awards were announced at the 1990 SBE convention. The chapters and organizations that received the awards are selected by a committee of the board of directors. See Table 1 for awards by topic.

Best Chapter Newsletter:	Madison, WI
Best Chapter Newsletter Editor:	Leonard Charles, Madison, WI
Greatest New Member Growth:	Chicago
Best Frequency Coordination Effort:	Madison, WI
Best Technical Article or Paper:	Madison, WI
Best Regional Conference:	Madison, WI
Best Regional Convention:	Syracuse, NY

Table 1. 1990 SBE chapter awards.

Radio and Television and the civilian broadcast industry's level of technology and sophistication.

IDB Communications, a satellite distribution company, recognizes the value of sound technical credentials. The company offers its engineers and technicians a 5% salary increase when they receive SBE certification. Advancement to a higher level of certification for previously certified engineers results in another 5% pay hike.

This is an unusual situation, because the satellite company is an industry entity that, unlike stations, does not sell advertising, but sells a technical service. Even so, the company still requires highly skilled people. Because IDB recognizes the value of certification, it has set a good ex-

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The Electronics

—Lighted VU meters with peak-reading LED indicators.

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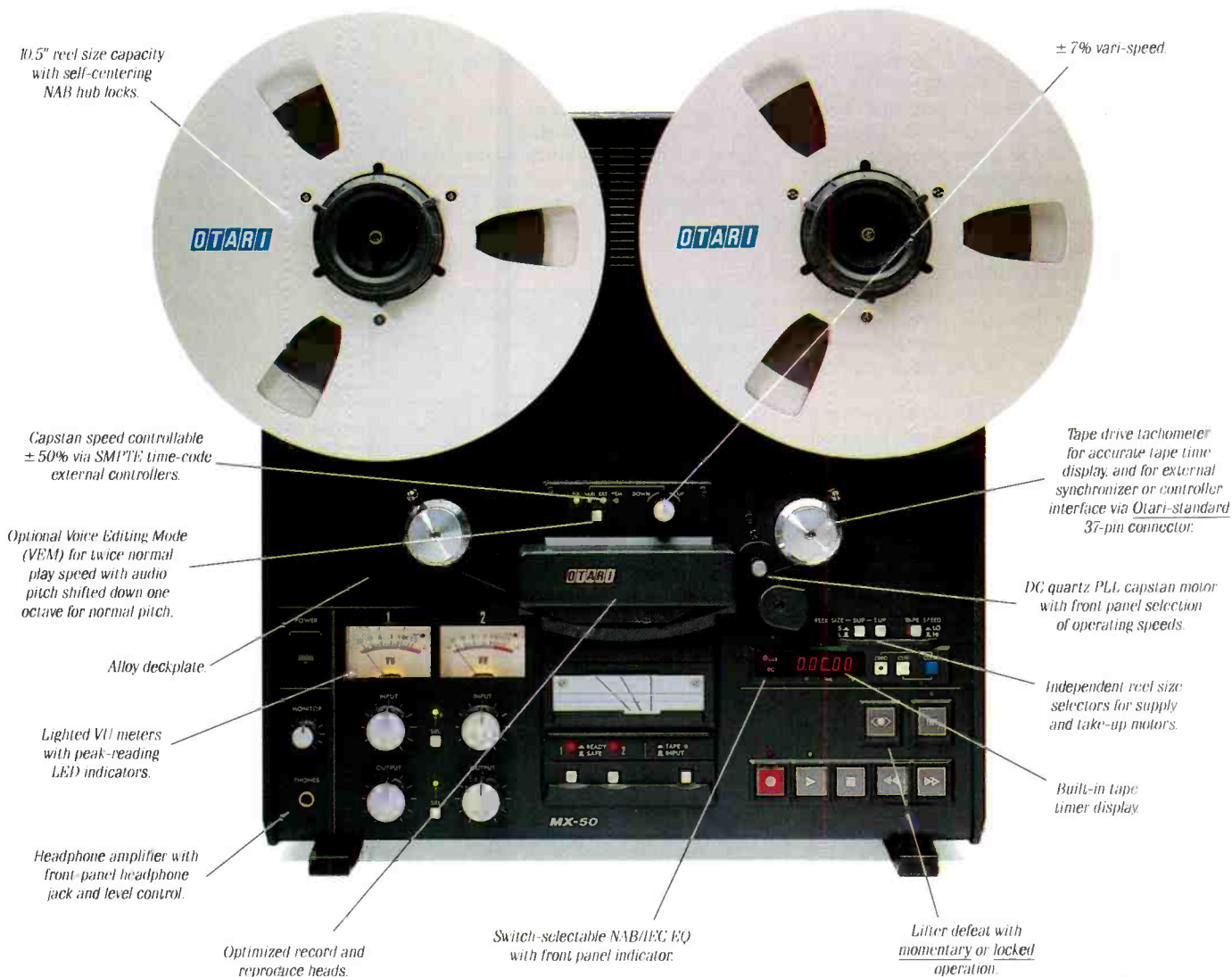


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Building with microcontrollers

By Gerry Kaufhold II

Many of the station projects you will build using the Z-8 family of microcontrollers will require the use of external memory. External memory interface can be tricky, but it is extremely important.

External-memory interface

Most practical applications require at least 2k of memory. This can be achieved by borrowing lines from adjacent ports. For the Z-8681, port 1 provides eight bits of address. Port 0 can be configured to act as an extra four or eight bits of addressing. Eight bits of addressing only accesses 256 memory locations. Twelve bits of address will access 4,096 bytes, and 16 bits can address 64kbytes.

Assuming you need to access 2k, you could supplement the address/data lines of port 1 with the lower four bits of port 0. You can use the remaining upper four bits of port 0 for other purposes, which will be described later.

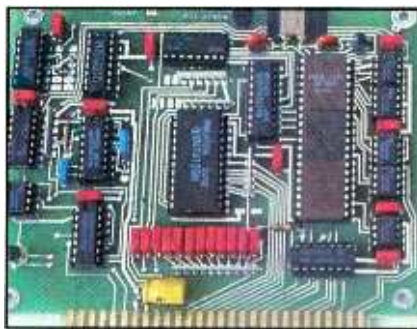
The Z-8 has three or four 8-bit I/O ports. These ports can be configured to fit the application. Because of the limited number of pins on the microcontroller chip, a port's bit lines may sometimes be forced to do double duty. This often means that the wires of a given port serve as address and data lines. This is done via multiplexing.

In this example, port 1 is multiplexed to act as data and address lines. When the eight bits of port 1 are acting as address lines, these lines are output only. They must transmit addresses to the external memory. When port 1's eight bits serve as data lines, these lines must be bidirectional, because data enters and leaves the system. *Configuration* is the process of telling a microcontroller which lines are input, output or bidirectional.

Configuring I/O ports as memory

Microcontroller I/O ports are configured by using the mode register. The mode register specifies whether flow is incoming, outgoing or bidirectional. The register also controls how many bits act as a group. Bits may be grouped into sets of one, two, four and eight.

Kaufhold is a market development engineer for SGS-Thomson Microelectronics, Phoenix.



In this example, the lower four bits of port 0 will be configured as address lines, which are output only, and all eight lines of port 1 are address and bidirectional data. (See Figure 1.)

To program the Z-8681 to use ports 0 and 1 as I/O interfaces to external memory, the first few lines of the operating program must write the hex value 077h to internal memory location 0F8h. Location 0F8h is the port 0 and port 1 MODE register. Code 077h tells the Z-8 to treat the lower four bits of I/O port 0 as external memory address interface, and to treat all eight bits of port 1 as memory and data interface. Use 074h for eight bits of addressing (port 1 only). Use 0F7h for 16-bit addressing (all of port 1 and port 0).

Timing diagram for multiplexing

Port 1 multiplexes address and data information. It cannot send addresses and receive data at the same time. The proc-

essor gets around this by employing an external latch to capture and hold the address bits. After it writes the desired address into the latch, the port is free to read or write to the external memory location just addressed. The control of this latch and other associated circuitry is the essence of external memory interface.

The memory interface is critical. If it doesn't work, you cannot program the microcontroller. However, once you have a working design, you can use it for all of your microcontroller projects. Next month, I'll discuss the timing signals for the memory interface in detail.

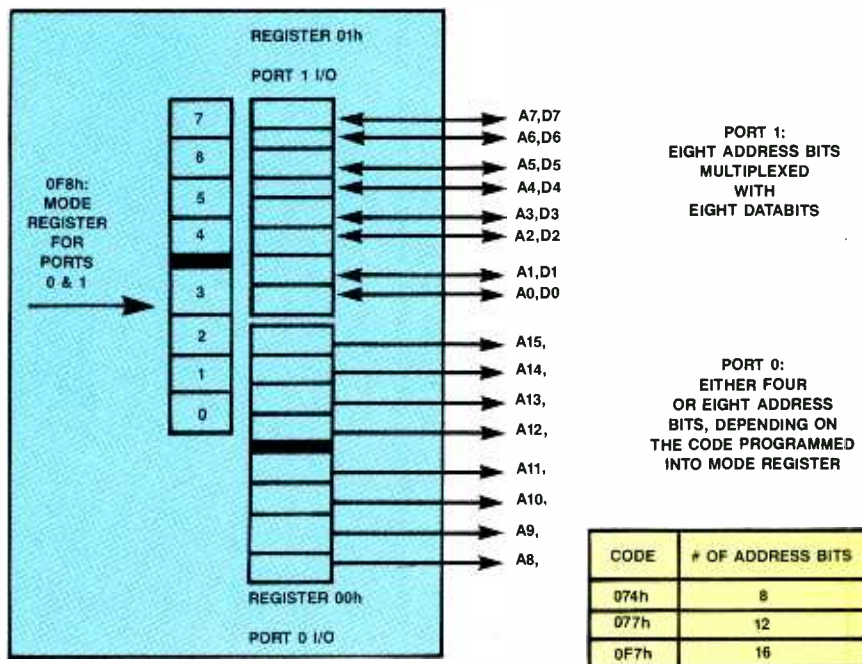
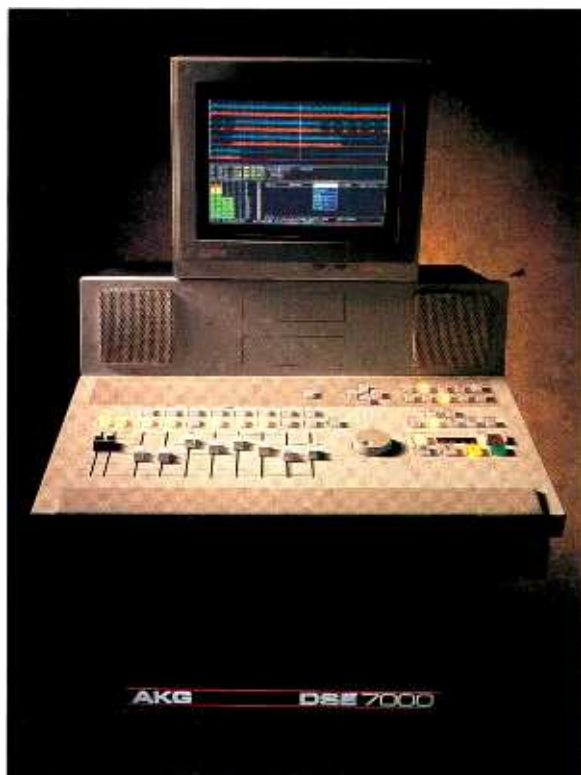


Figure 1. By loading special codes into the mode register (0F8h), users specify the function of each port. Here, port 1 is eight address bits multiplexed with eight databits. Port 0 provides either four or eight address bits, depending on the code loaded.

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and tags; then onto carts. Creativity has exploded, too. With the DSE's instant UNDO feature, the fear of trying new things is gone. You simply try another take, assemble a different edit, or test a new effect. If you don't like the results, UNDO it instantly. No wonder WZOU has designed their production facility around the DSE.  And no wonder Dan McCoy calls this machine "the most impressive thing that's ever happened to radio." His words, not ours.

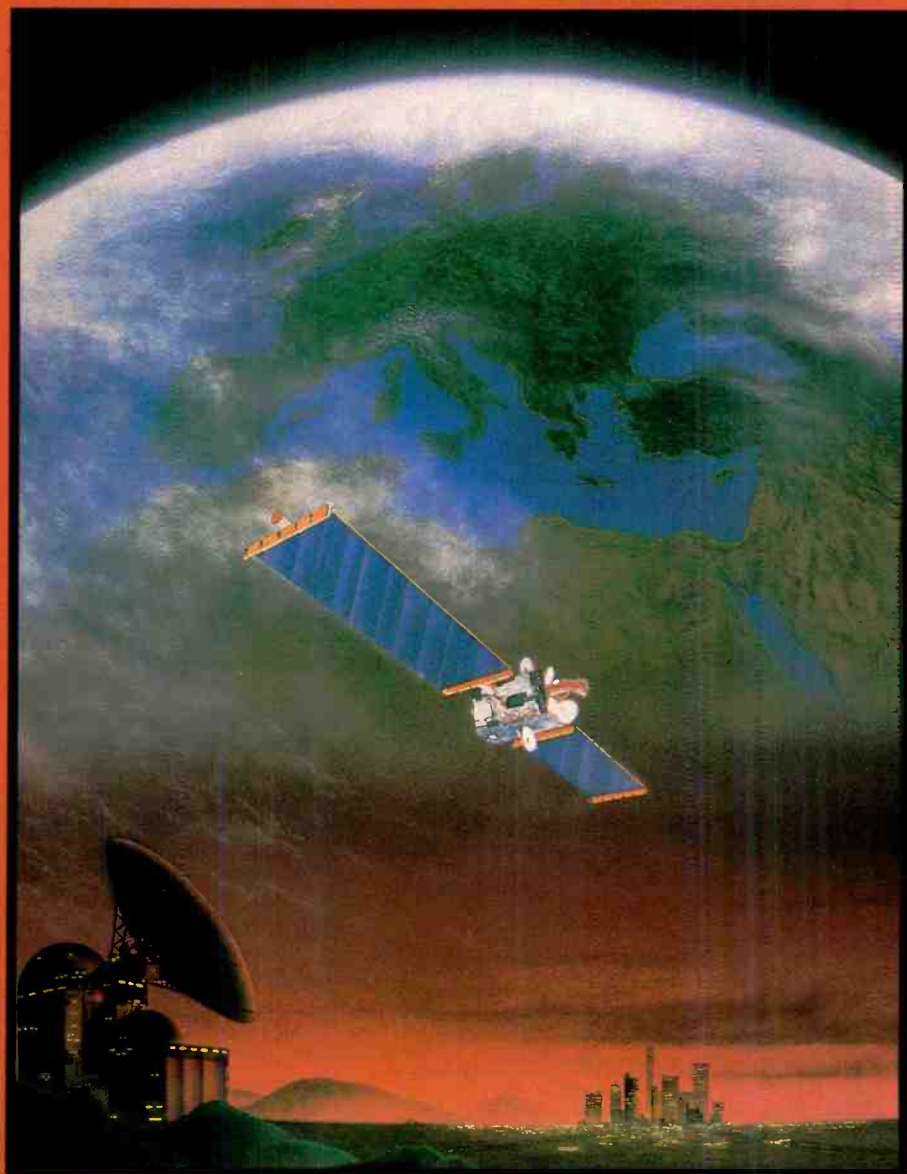


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emote broadcasts can be either a joy or a pain, depending on your perspective. Many of us cut our teeth on remotes. Football and basketball games or a broadcast from the local car dealership used to be the typical arrangement. The setups were cumbersome and required hours of advance planning and, sometimes, a lot of luck. Now, technology makes it possible for radio and TV stations to conduct remote broadcasts from almost anywhere at almost any time.

Technology has moved us forward in so many ways that we often forget how far we've come. From the heavy, tube-filled remote amplifiers, to pocket-sized amps with built-in telephone couplers, remote broadcasts are certainly easier.

I recall seeing the many satellite trucks parked in New Madrid, MO, awaiting the predicted Dec. 3 earthquake (that never materialized). One thing struck me as particularly important. If an earthquake had hit that area, those trucks would probably have become the primary link between that community and the rest of the world.

Telephone lines would likely have failed as the earth shook and crevices opened up destroying cables and their land-based circuits. At the time when

communication and information was most important, those circuits might not be there. However, even if the terrestrial communications circuits failed, the satellite links could continue to broadcast. Broadcasters now have more control over their destiny through the use of remote broadcast technology that has only recently become available.

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This month, we will examine three important aspects of remote broadcast technology:

- "Remotes Revisited" page 26
- "Communicating
With the Field" 48
- "Sharing the
Crowded Spectrum" 62

By Brad Dick, editor



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Remotes revisited

By Skip Pizzi, technical editor

New technologies are rapidly changing the world of audio and video backhaul.

Mention the word remote to a broadcast engineer, and an immediate, decidedly mixed wave of emotions will result. Remotes can provide the highest highs and the lowest lows in broadcasting for those involved. The first things the engineer wants to know are "where?" and "when?" Based on the answers to these, the engineer will determine how to get on the air from the site.

There are usually multiple methods to choose from for this signal delivery, each with its own set of advantages and disadvantages. Quality, reliability, availability, lead time and cost usually define the decision matrix, leading the engineer to a decision on the best route. But the programming for that matrix, which has remained fairly stable for some time, is about to be radically revised. New methods of signal delivery, some evolutionary and some revolutionary, are becoming available, and they each offer potential improvements in one or more of the parameters mentioned previously. Although most advances so far have involved wired applications, wireless paths are now beginning to join in.

Most of the advances involve digital transmission, but the real advantages arise not from the digital transmission itself, but from some of the ancillary technologies that digital transmission allows into the game. Data compression algorithms, which have been the subject of recent interest, really find a warm welcome in the world of transmission.

Transmission of data is, of course, nothing new. But the high data rates required for digital audio and video transmissions had previously rendered the availability

and cost of such service impractical. Data compression, or bit-rate reduction systems, have made possible broadcast applications of data transmission paths that previously were only useful for computer interconnection. Reductions from earlier data rates for digital audio and video transmissions of 8:1 or higher are now becoming commonplace.

Data compression, transmission

Although these data compression algorithms are viewed as major breakthroughs, history will likely look upon them as natural evolutions, and consider the earlier linear PCM systems as dinosaurs. Although the straightforward nature of linear PCM may have been helpful in making the transition from analog systems, especially where bandwidth was cheap and available, it is an inefficient method for encoding digital audio and video signals. The resolutions of today's linear PCM systems are overkill in terms of the actual needs of listeners and viewers. Significant reductions in actual transmitted data can be achieved by applying data compression algorithms to the datastreams that linear PCM conversion produces. At present, linear PCM of as high a resolution as economically feasible is still a good idea for the *original* conversion of analog signals to the digital domain. For signal-processing manipulations of digital audio and video signals, this linearly converted, high resolution is also desirable. But once the production phase is completed, and it comes time for final signal storage or delivery, data compression is an appropriate tool.

The recent progress in data compression

for audio and video signals owes much to a departure from earlier compression systems' purely statistical analysis of the datastream's coding redundancies; new systems acknowledge the limits of the listener/viewer's sensory perception. Study of masking effects in the auditory and visual systems has now become the starting point for algorithm design. Today's so-called perceptual coders are, therefore, based on psychoacoustic or psychovisual (rather than statistical) models, and owe their coding efficiencies to an appreciation of the audience's tolerances. Purists might consider this cheating, but in fact, it is simply an elegant implementation of the inherent attribute of a digital system, which allows such customizing of a medium to its users.

Although data compression systems that use perceptual coding exist for audio and video signals, further progress has been made in the audio realm. The services used for such backhaul are all data pipelines, and as such, are specified in terms of data rates. Broadcasters need to shift gears a bit here, and no longer think in kilohertz or megahertz of bandwidth, but in kilobits or megabits per second (kbit/s or Mbit/s) of data throughput.

A data rate must be considered first in linear PCM terms, and then in its subsequent compressed form. In the linear mode, the data rate of a given signal is simply its sampling frequency (in hertz) multiplied by its resolution (in bits/sample). For example, CD-quality audio uses 44.1kHz sampling at 16-bit/sample resolution, requiring a 705.6kbit/s data rate, per channel (stereo requires doubling that data rate to 1.411Mbit/s), before adding



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any error correction overhead. A digital audio compression algorithm capable of 4:1 data rate reduction takes that linear PCM signal and reduces its resolution to an average of 4-bit/sample (while leaving its sampling frequency alone), therefore, providing a 192kbit/s data rate. Table 1 shows some other data compression ratios for audio, and their resultant data rates, at several common sampling frequencies.

Because the sampling rate is not changed by the digital compression system, frequency response and time-domain performance retain the same excellent specifications typical of most linear PCM conversions. Delay is introduced by these codecs, however, and it is generally in direct proportion to the amount of data compression applied. (For more on this coding hardware, see, "Digital Radio: Promise or Peril," *BE*, December 1990, pg. 68.)

Audio applications

Current telephone company installations and tariffs can provide a variety of services in most domestic and some international locations, with more new services being deployed in many cities. Table 2 shows these services and their data rates. (See the related article, "Glossary of Terms," pg. 42.) Rough equivalents to each of the domestic services shown in Table 2 do exist outside the United States, but their actual data rates differ, requiring format conversions for international transmissions. Most LDSs can handle these.

Digital audio transmission on DS1 (or T1) lines has become widely available, and is often cheaper than standard analog program audio loops, for service and installation charges. (See the glossary for distinction between DS1 and T1 nomenclature.) DS1 is a 1.544Mbit/s serial data link, and like all telco data transmission (but unlike audio loops), service is provided bidirectionally. Using the calculations just mentioned, it's easy to see how DS1 can carry a linear PCM stereo audio signal, or several such compressed channels.

DS1 service is also extremely reliable. Its bit error rate (BER) of 10^{-9} (the probability of error reflected by the specification of no more than one erroneous bit in 10^9 transmitted) is the lowest of any

available. By way of reference, IEEE and CCITT have established 10^{-6} as the BER required for data customer satisfaction.

The data carried on a DS1 circuit is actually a multiplex of 24 data channels or slots of 64kbit/s each. (An additional 8kbit/s is reserved for sync data.) These individual 64kbit/s slots are called DS0 channels. For standard telco T-carrier use, each DS0 carries a voice-grade circuit. When a customer leases a DS1 circuit, it can be configured to carry any bandwidth channel that DS1 hardware is available for (3.5kHz, 5kHz, 7.5kHz, 15kHz) in any combination, up to the customer-usable data limit. When a customer leases a full DS1, a telco may take one DS0 slot for framing and other overhead, in addition to the 8kbit/s synchronization slot, leaving approximately 1.4Mbit/s for customer data. Check with your telephone company for its exact rate. A rack of coding and multiplexing hardware appears on each end of the DS1 line, usually as customer-provided equipment (CPE), and the circuit can be reconfigured simply by changing the appropriate cards in the proper slots in the racks at both ends. These reconfigurations can be performed by the customer at any time, without telco involvement or notification.

Unlike the labor-intensive installation and equalization of an analog audio loop, putting in a T-1 circuit has become as routine as a standard dial-up telephone service installation. This and the capacity gluts in some areas are lowering costs for DS1 service. Customers' use of digital compression systems on DS1 channels will only increase this economy. Whereas, in the past, a 15kHz audio channel had required six or more DS0 slots, current hardware implementing perceptual coding reduces this to two DS0 slots. Equipment for 15kHz audio on a *single* DS0 should become available this year. When comparing the old and new orders, remember to account for these digital telco services' fully bidirectional capabilities, which add further to their thrift. Although interfacing hardware for backfeed channels from the station to the remote site must still be provided, their pathways require no separate costs or orders.

In some areas, "Fractional T-1" service

SERVICE OFFERED	DATA RATES (bits/sec)
Switched 56	56k
DS0	64k
DS1	1.544M
DS2	6.312M
DS3	44.736M

Table 2. Current U.S. digital telephone data services and their data rates.

is becoming available for intraLATA (local) applications. This service allows a customer to lease only the number of DS0 slots on a DS1 circuit that are needed for a particular application. Although installation charges will be about the same as for full DS1 service, service charges may be drastically reduced for many remote audio applications. Again, all slots operate bidirectionally.

Another new telco digital offering that broadcasters have begun to use is the Switched 56 service. This facility is available in approximately 400 metropolitan areas in the United States, and from some long-distance carriers. It provides a bidirectional 56kbit/s data path for use with dial-up terminals, with service billed by the minute. A switched channel service unit (CSU) — the equivalent of a telephone instrument and data interface — is provided by the telephone company, or may be purchased by the customer. It allows voice or data interconnection, and dial-up routing of the data path to any other similarly equipped destination on the network. For broadcast use, additional codecs may be used on the circuit to feed wideband audio. (See Figure 1.) These codecs are not available from telcos, and must be purchased by the customer. They are currently available in 7.5kHz versions (using CCITT G.722 coding), with the first widebandwidth units implementing more sophisticated perceptual coding expected early this year.

Terminal hardware for this application (CSUs and codecs) is expensive, ranging from \$2,500 to \$4,000 for each end of a Switched 56 path at present. Usage cost, on the other hand, is much less than audio loops of similar bandwidth, especial-

RESOLUTION (av. bits/sample)	COMP. RATIO	OUTPUT DATA RATES (kbits/s)			
		$f_s = 48\text{kHz}$	$f_s = 44.1\text{kHz}$	$f_s = 32\text{kHz}$	$f_s = 16\text{kHz}$
16	1:1	768	705.6	512	256
4	4:1	192	176	128	64
3	5.3:1	144	132.3	96	48
2.67	6:1	128	117.7	85.4	42.7
2	8:1	96	88.2	64	32
1.45	11:1	69.6	64	46.4	23.2

Table 1. Data compression table showing range of compression ratios currently under consideration and their resultant output data rates at a variety of sampling rates (f_s). Audio bandwidth is approximately one-half of f_s . Data rates quoted are per single audio channel (mono).



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ly for occasional service. For long-distance applications, relative savings are even higher. Several radio networks already use this system for audio backhaul, and expect full amortization of their terminal hardware to occur within the first year of operation. For strictly local or less frequent use, this cost-recovery period will be longer, but still may warrant exploration. Hardware costs are also expected to drop as sales and service availability increase.

CSUs may also be leased from some telcos, keeping up-front outlay lower. CSUs are available in 2-wire or 4-wire versions, with 2-wire types costing less (as low as

\$500 currently, while 4-wire CSUs may exceed \$2,000). Unfortunately, the choice between 2- and 4-wire operation is not up to the customer, but to the local telco serving the area. (See Table 3.)

Switched 56 charges are levied by the month for the access line (and leased CSUs), with intraLATA call-time billed at a flat per minute rate. InterLATA service is also billed by the minute, but on a distance-sensitive basis. Access fees around the United States currently run from \$30 to \$200 a month, with most areas on the lower end of that range and dropping steadily. IntraLATA connect time

costs approximately 10 cents a minute, and interLATA domestic calls average less than 50 cents a minute. Installation fees vary widely, but seem to average around \$200-\$500.

Switched 56 is available to Europe and Japan, as well, although it is a 64kbit/s service in most overseas locations. Conversion hardware is available for such an application. Like the higher-speed channels previously mentioned, no international standards exist for these switched services today, although they are currently under development. Among their goals is a framing standard for byte synchroniza-

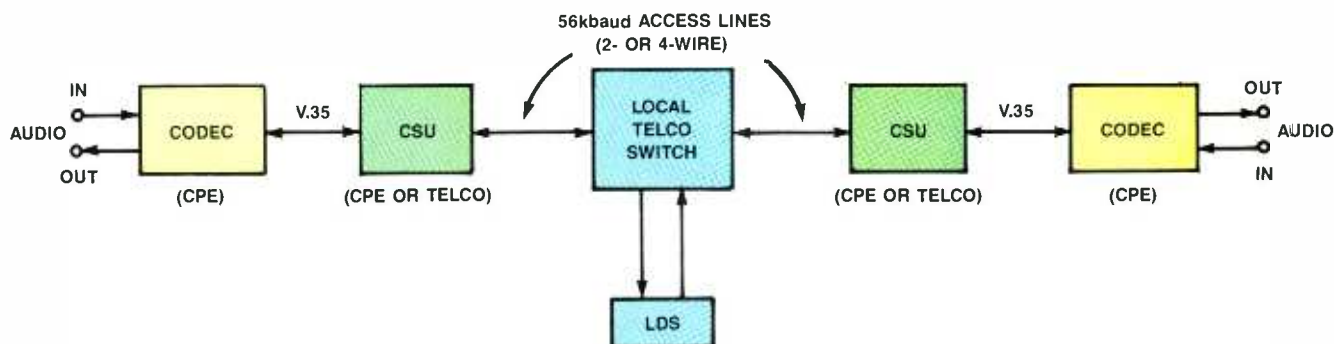


Figure 1. Block diagram of Switched 56 circuit path.

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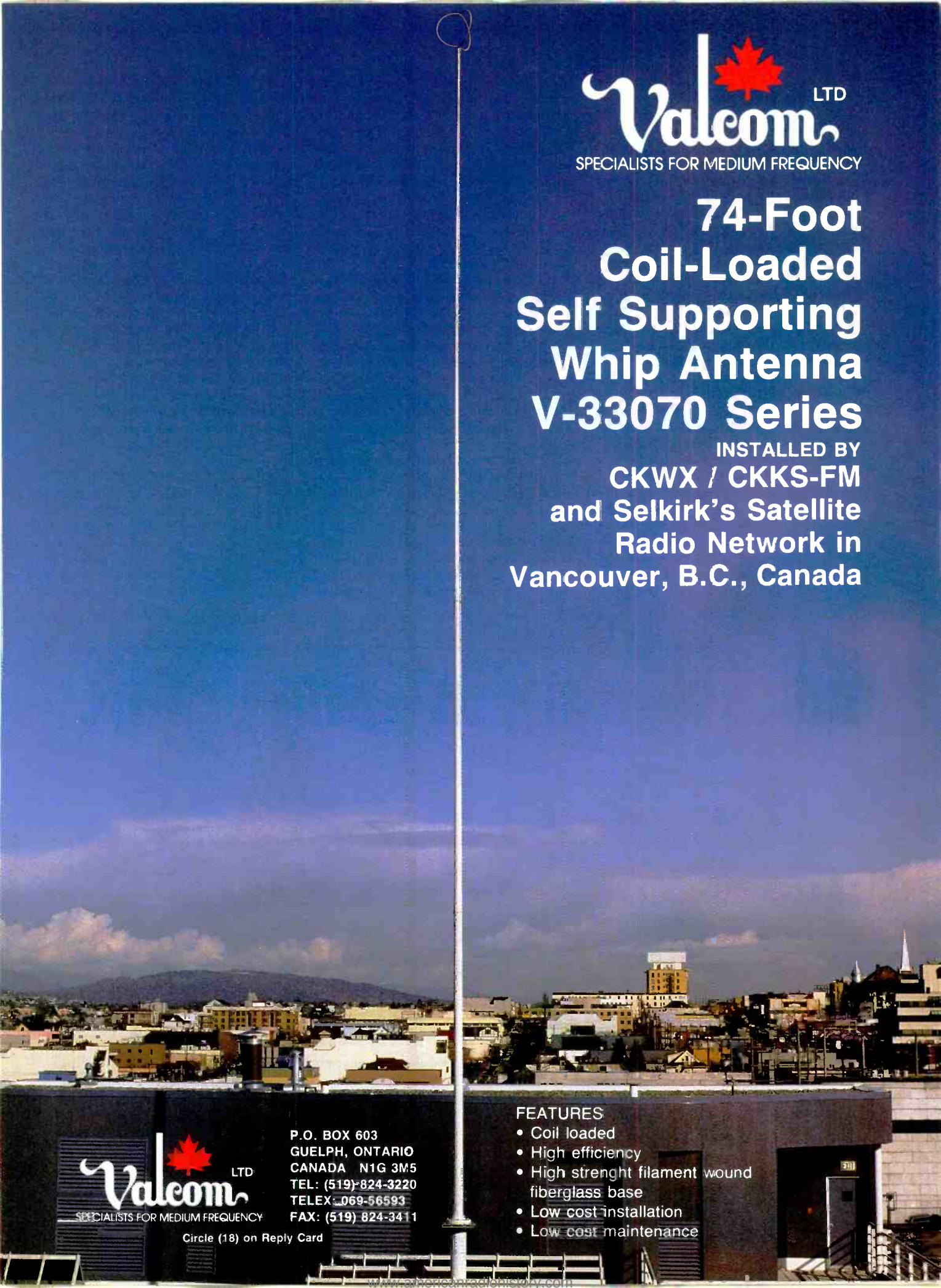
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tion, so that full interoperability between codecs from all manufacturers worldwide will be assured.

Some telcos offer a similar unswitched service, in which a single DS0 channel can be leased on a monthly basis. For heavy point-to-point users, this may be cheaper than a switched approach. It is also available in some areas where switched service is not yet operating. As single DS0s, these operate at 64kbit/s, and their terminal hardware is less expensive because it need not accommodate switch signalling.

Data network broker services can arrange for a Switched 56 (or other digital service) circuit or network to be established, at no charge to the customer. Like travel agents, these companies operate on commissions paid to them by the telcos whose circuits they book. This service can provide great convenience to the broadcast user, especially for long-distance applications where multiple and distant telephone companies are involved.

The next level of service that U.S. telephone companies will be providing is the Integrated Services Digital Network (ISDN). Already available in a few locations, basic rate ISDN provides two 64kbit/s paths (B channels) and one 16kbit/s circuit (D channel). This service

is also referred to as *2B+D*. Primary rate ISDN service will provide 23 64kbit/s B channels, and one 64kbit/s D channel (23B+D); this is roughly equivalent to a full DS1 circuit (1.536Mbit/s). The distinction between B and D channels incorporates an important change from current switched networks (including most Switched 56 technology). With ISDN, data paths are separated from the signalling paths used for all the logistics of call-directing and other switch control. This technique is referred to as *out-of-band signalling*, and is contrasted to the *in-band signalling* in use with today's switched systems, wherein the switching is controlled by pulses or tones on the same path and within the bandwidth of the audio or data being transmitted. For data transmission, the datastream interruptions that in-band signalling demands will be eliminated with ISDN.

ISDN will be a bidirectional, customer-switched service, operating as a dial-up, billed-by-the-minute data network, allowing circuit-switched and packet-switched operations. Its multichannel nature will allow simultaneous voice and data or other combinational applications. ISDN is eventually intended to replace the current dial-up telephone system, but it is consid-

ered a far future possibility. In fact, ISDN is characterized more as a concept than as an actual single service, because it is, in effect, the mating of several other separate services — some already available individually — with higher-capacity switching hardware and new system architectures. Although new fiber paths are being laid for more and faster intra- and intercity carriers, ISDN can continue to use existing network copper to the end-user.

At present, some telcos offer ISDN service only to large, data-intensive businesses who order hundreds of lines to a single location, but acceptance of orders for single stations is on the horizon. When this ultimate stage is reached, and service is widespread, 2B+D ISDN may be the delivery method of choice for stereo 15kHz broadcast audio plus communications to and from a remote site. Universal domestic deployment of ISDN is expected by the late 1990s.

Meanwhile, back in the land of POTS (plain old telephone service), frequency-shifting equipment for standard dial-up lines has also seen some advances. The original single line units (50-2,750Hz) that appeared in the 1970s were followed by 2-line (50-5,000Hz) devices in the early

Continued on page 38

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'80s. In the last year or two, 3-line systems (50-7,500Hz) have been introduced. Different manufacturers use different techniques to accomplish the frequency division and shifting, some employing analog circuitry, some digital. Throughput delay, therefore, varies between systems. Additionally, some hardware implements complementary multiband noise reduction, which can help in long-distance applications. Auto-dial, automatic delay compensation and other smart setup features are also available on some of these newer units.

For non-real time applications, half-speed transmission can be used with any frequency-shifting system, thereby gaining an additional octave at the high-end, while losing one at the bottom. Three-line systems are, therefore, capable of full 15kHz response at half-speed. Transmission time is, of course, doubled with this technique, and line noise may become more of a problem than at normal speed on some long-distance calls.

In the non-wired audio world, digital compression algorithms are also beginning to be applied to remote satellite applications, with several companies combining perceptual source coders with satellite modems. The narrow bandwidth and robust coding of these transmissions make them ideal for very small aperture terminal (VSAT) applications. This, in turn, allows stations to operate a cost-effective remote vehicle or flyaway package using a dish as small as 1.2m. Because these systems use the Ku-band, satellite time is cheaper, and terrestrial interference is reduced when compared to C-band operation, although rain-fade may be a greater problem with Ku. Satellite feeds may also originate from practically anywhere — across town or across the country — within the satellite's footprint. If transponder space and hardware is available, and budgets permit, the satellite link can be made 2-way, allowing high-quality audio backfeeding to the remote site, and full voice and data communications. This is especially helpful when the remote site is beyond the broadcast signal range of the station. When comparing VSAT operation to short-haul alternatives, however, remember that each hop of the satellite introduces about 1/4-second of delay.

Video applications

A great deal of work is currently under way on digital video compression. The most notable for broadcasters puts compressed NTSC video on DS3 (45Mbit/s) telco service, with high-quality video and two to four digital audio channels. In contrast to traditional analog telco video circuits, DS3 service is provided bidirectionally. DS3 is becoming available from some RBOCs and LDSs; video services based on this technology are also being offered by

some private operators equipped with their own DS3/fiber networks. Although DS3 currently operates mostly as a leased-line service, with monthly-rate billing, and switching orders called in with at least one hour's notice, this year will see the widespread introduction of customer-switched services, with per-minute, mileage-sensitive billing. Vendors of these services point out their improved security and reliability over satellite delivery, although for remote backhaul, the portable uplink retains its edge in quick access from practically anywhere. But as fiber networks expand, this latter point will require frequent re-evaluation, along with comparisons of cost and quality between the fiber and satellite backhaul options.

Telco DS3 trials for NTSC transmission have been conducted during 1990, and are continuing into 1991. The trials connected eight cities on a customer-switched network, using a standard PC for switch control. Video is compressed using discrete cosine transform (DCT) coding on a frame-at-a-time (intraframe) basis, thereby avoiding the motion artifacts introduced by earlier interfield/frame differential PCM systems. A perceptual approach to the coding algorithm has produced successful results. This compressed video signal requires about 40Mbit/s, while 14-11 coding (CCITT J.41) is used for audio, allowing four 15kHz channels to be carried in the 1.5Mbit/s allotted to audio. (The current trials are only equipped for two audio channels, however.) For network control, 131kbit/s is used with 65kbit/s used for a quiet voice-grade communications channel, and a 7% overhead is retained for forward error correction. The tests have been considered largely successful, and have provided much useful experience for all involved. The tests have taken place at ABC and CBS Television, and are currently under way at NBC-TV.

Later steps in the trial (early-mid '91 at PBS) will introduce an HDTV system us-

ing two DS3 channels, with compressed high-definition video replacing the NTSC signal, but the rest of the format will remain the same. This is designed to provide a graceful evolution to HDTV distribution, because during the transitional years, it is expected that some programs will remain NTSC while others move to high-definition (just as in the B&W-to-color transition). A sensible backhaul and distribution system will be easily able to accommodate both.

Other digitally compressed HDTV transmissions are also under development. Several medical applications using three DS3 channels (one for each RGB component) have been established, linking hospitals and other medical facilities. At the prototype stage right now are codecs that put a full composite HDTV signal into a single DS3, albeit with some loss of resolution.

Unlike T-1, DS3 typically does not use copper for any of its paths, but requires end-to-end fiber or wideband radio links. A long-haul fiber link carries 12, 24 or 36 DS3 channels, while first- and last-mile fibers generally carry only three DS3s. Radio links put a single DS3 on an 18GHz or 23GHz channel, but as many broadcasters know, these have limited path lengths, and are often affected by rain fade. (DS3 can also travel up to 450 feet on coax, but this is rarely implemented in telco operations.)

On the other end of the resolution spectrum, low-resolution video transmissions are also becoming available, aimed primarily at the teleconferencing market. One LDS has begun to offer a switched 384kbit/s service for teleconferences; its video quality is limited-motion monochrome. A similar application will be available in the future with primary rate ISDN, using three 384kbit/s "H0" channels and one 64kbit/s D channel.

Still-frame video technology has also

Continued on page 42

TELCO	SERVICE NAME	WIRE MODE
Ameritech ¹	Switched Digital Svc. (SDS)	2 or 4 wire ²
Bell Atlantic	Switched 56	4 wire
Bell South	Accupulse	2 wire
NYNEX	Switchway	2 or 4 wire ²
Pacific Telesis	Centrex IS ³	2 wire
Southwestern Bell	MicroLink I	2 wire
USWest	Switchnet 56	4 wire
AT&T	Accunet 56	
US Sprint	VPN 56 ⁴	
NOTES:		
¹ Service varies from widely available (Illinois) to nonexistent (Ohio).		
² Wire mode varies within service area, depending on local switch hardware.		
³ Actually an ISDN service, providing two basic rate lines (four B channels).		
⁴ Interfaces only with Bell South or PacTel, and incompatible with AT&T.		

Table 3. Brand names under which Switched 56 service is marketed by RBOCs and LDSs. (Most are registered trademarks.) Wire mode of switch operation at RBOCs is also shown.



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benefited from digital compression developments. Currently available hardware allows still video images to be transmitted over standard dial-up phone lines in 30 to 90 seconds per frame. Using Switched 56, DS0 or ISDN, the transmission time is reduced to as little as 10s/frame. Any standard video device can feed these systems.

On the RF side of video backhaul, one satellite company has begun testing a video compression system that places two 55dB signal-to-noise (S/N) video signals (or three at 46dB S/N), each with its own pair of 15kHz audio channels, on a single 36MHz transponder. The system performs its claimed 22% baseband reduction with time-division multiplexing of component NTSC signals, using a type of perceptual coding for digital compression of the video signals' diagonal resolution. Meanwhile, a DBS vendor recently announced a digital compression system that squeezes eight NTSC video signals on a single 36MHz transponder, available by mid-1991.

The rate of change in point-to-point transmission technology is sometimes enough to make a person yearn for the old tin can and string. But these new serv-

ices are providing broadcasters with better quality, easier access and lower costs for their remotes. In that kind of win-win situation, it's well worth the effort to bring a broadcast operation up to data speed.

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Glossary of data transmission terms

By Skip Pizzi, technical editor

ADPCM—Adaptive differential pulse-code modulation. A form of digital coding more efficient than linear PCM because it only codes the difference between one sample and the next, instead

of assigning a fully discrete value to each sample. It also adapts its coding to the signal values currently under process. Considered a form of statistical data compression.

AMI—Alternate mark inversion. The binary modulation code used by the telephone company for data and digital voice transmission. It uses RZ coding in an alternate bipolar scheme, with logical 0s corresponding to 0V, and logical 1s alternating between +3V and -3V. (The first logical 1 produces a +3V output, the next 1 produces -3V, the next +3V, and so on.) Self-synchronization is possible with this approach, but the number of continuous 0s must be limited.

Baud—Bits per second.

B channel—In ISDN service, a channel designated for customer data transmission, uninterrupted by any signalling data.

Bellcore—Bell Communications Research. The R&D company that feeds technology and standards to the RBOCs,



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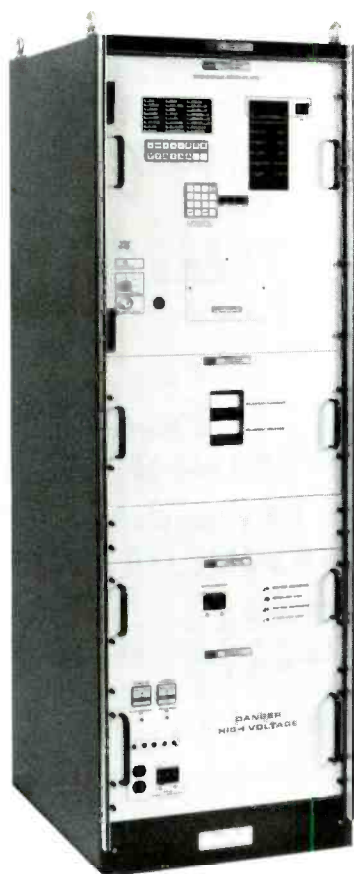
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Carrier—In telco parlance, refers to a multiplexed digital interoffice signal, containing many individual calls or signals in a single cable or fiber.

CCITT—Consultative Committee of International Telephone and Telegraphy. The international standards-setting organization for telephone systems, established by the United Nations. Its T1/D1 committee is currently at work on developing standard digital audio and video compression systems.

Codec—Coder/decoder. Any device that includes digital transmission/encoding and reception/decoding circuitry in the same chassis.

CPE—Customer premise equipment. Refers to any network interface hardware not provided by telco.

CSU—Channel service unit. Terminal hardware for a telco data line, either CPE or telco-provided. Also referred to as CSU/DSU (DSU = data service unit) in T1 applications. Interfaces unipolar NRZ computer-style datastreams to the RZ bipolar (AMI) telco data format. A

switched CSU includes a keypad for call direction and other switch control.

D channel—In ISDN service, a channel designated for signalling data only.

DDS—Dataphone Digital Service. The first telco data service in the United States, originated in the mid-70s by AT&T.

DSO—Digital service 0. A 64,000 baud data channel.

DS1—Digital service 1. A 1.544kbit/s data service usually configured as 24 DSO channels plus an 8kbit/s sync.

DS2—Digital service 2. Four DS1 channels multiplexed together.

DS3—Digital service 3. Twenty-eight DS1 channels multiplexed together with additional control data, providing a data rate of 44.736.Mbit/s (45Mbit/s).

First-mile—Refers to the signal path between a program's origination site and its entry point to a common-carrier's network or a private satellite uplink.

InterLATA—Refers to telco service or

rates between LATAs, or long-distance service.

IntraLATA—Refers to telco service or rates within a LATA, or local service.

G.722—A CCITT standard for audio data compression. It uses two subband ADPCM coding to put 7.5kHz audio into 64kbit/s.

ISDN—Integrated Services Digital Network. A new telco service designed to eventually replace POTS with flexible digital service.

J.41—A CCITT standard for digital audio encoding. Using 14-11 PCM encoding (14 bits for lower level signals, 11 bits for higher level signals), it places 15kHz audio on 384kbit/s.

Last-mile—Refers to the short-haul signal path between a long-distance network terminal point (or private satellite downlink) and the customer's receive point. Usually a local telco loop.

LATA—Local access and transport area. The service area of a local exchange company (LEC).

LDS—Long-distance service. A carrier



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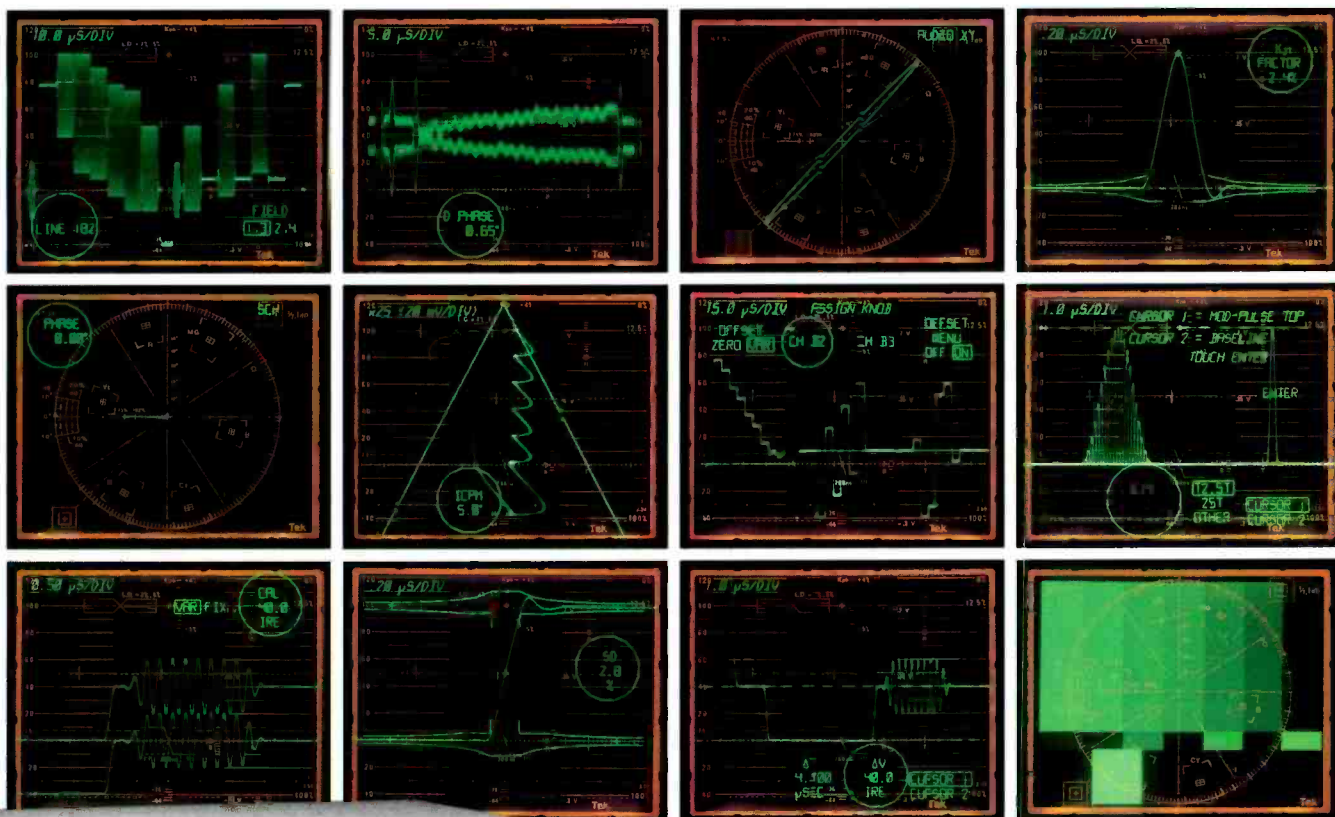
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of long-distance (interLATA) telecommunications, such as AT&T, MCI, US Sprint and others.

LEC—Local exchange company. A local telco. Each RBOC contains one or more LECs. Also refers to independent, non-Bell local telcos.

Mark—The telco term for high-level data pulse, usually corresponding to logical 1.

NRZ—Non-return-to-zero. The most basic form of binary modulation coding, in which logical 1s and 0s are directly represented by high and low levels respectively.

Packet switching—A sort of data party-line, in which data is transmitted in addressed bursts or packets, occupying its data channel only for the duration of the packet, after which the channel is free

for other packets to or from the same or other users.

PDN—Public data network. Telco data services, including switched and leased lines.

POTS—"Plain old telephone service." Refers to the public switched telephone network.

PSTN—Public Switched Telephone Network. The standard dial-up phone system.

RBOC (or BOC)—(Regional) Bell operating company. The seven "Baby Bells" created when AT&T divested itself of its local telephone operations.

RZ—Return-to-zero. A form of digital modulation coding in which logical 1s and 0s are directly represented by high and low levels respectively, but where coding output returns to low level following each high pulse.

Slot (or time-slot)—Generally refers to a DS0 channel within a DS1 signal.

SDMS—Switched Multi-Megabit Data Service. A future high-speed switched data network, operating at DS1 to DS3 rates.

SONET—Synchronous Optical Network. An upcoming telco standard for ultrafast data transmission, operating at speeds of 150Mbit/s to 2.4Gbit/s.

Space—The telco term for low-level data pulse, usually corresponding to logical 0.

Switch—Generic name for any telco call routing and connection hardware.

Switched 56—A switched digital service offering 56,000 baud data service on a dial-up network, available in an increasing number of areas.

TA—Terminal adapter. The term for a CSU in an ISDN system.

Tariff—A schedule of services and their prices that a telephone company will provide to a given service area, subject to approval by the appropriate regulatory agency.

T-carrier—See **carrier**.

T1—The copper network and hardware used to carry DS1 service.

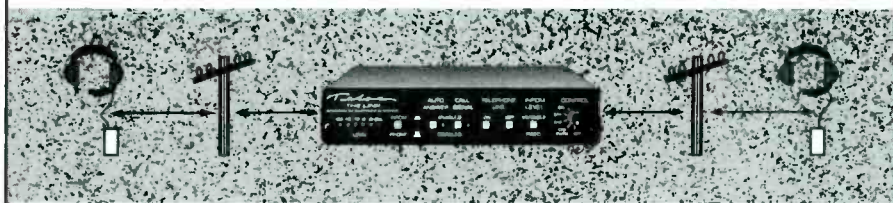
VSAT—Very small aperture terminal. Refers to Ku-band satellite earth stations for fixed or portable use with dish diameters of 1.5 meters or less.

V.35—An older (but still common in the United States) CCITT telco standard for low-speed data I/O to a CSU, with a unique multipin connector.

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Communicating with the field

By Rick Lehtinen, technical editor

Dispatch and cuing enable outside broadcasts.

A successful outside broadcast stands on the three legs of a communications troika. First, there has to be coordination communications between the remote site and the studio. Second, there has to be some way to give cues to the talent while the broadcast is under way. Third, there has to be a way to get program material from the remote site back to the studio. Remove any of these, and the broadcast will likely fall flat.

A companion article ("Remotes Revisited," pg. 26, by Skip Pizzi) discusses the options for the program signal path. The present article will address the coordination and cuing issues.

Distance vs. complexity

Figure 1 overviews the communications requirements for a simple, close-to-home satellite shot. Program audio and video travels via satellite from the satellite vehicle to the station. Coordination communication, or dispatch, might use the station 2-way system. Cuing information, or IFB, takes one of several routes from the station to the talent. More about this later.

There are several options for each leg of the troika. Generally, the complexity of the communications system required for a remote broadcast increases with the distance from the station. (See Table 1.)

In the studio, coordination is done using the studio intercom system between

the control booth and the floor director and camera operators. On instructions from the booth, the studio personnel gets

the talents' attention and coordinates their actions. The crew uses verbal commands when mics are closed, and hand signs

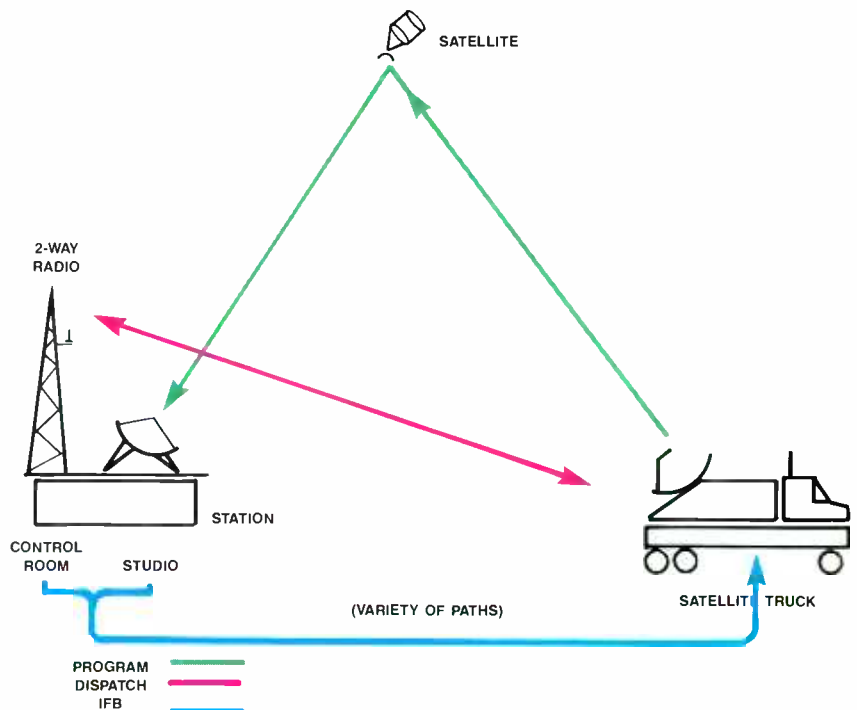


Figure 1. In this simplified satellite shot, program audio and video travel via satellite to the station. Coordination communication might use the station 2-way system. Cuing information, or IFB, can take one of several routes from the station to the talent.

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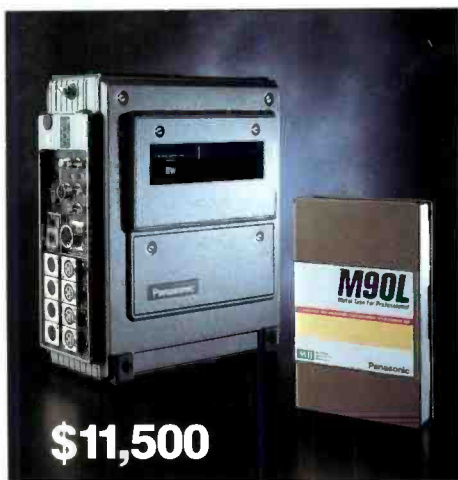
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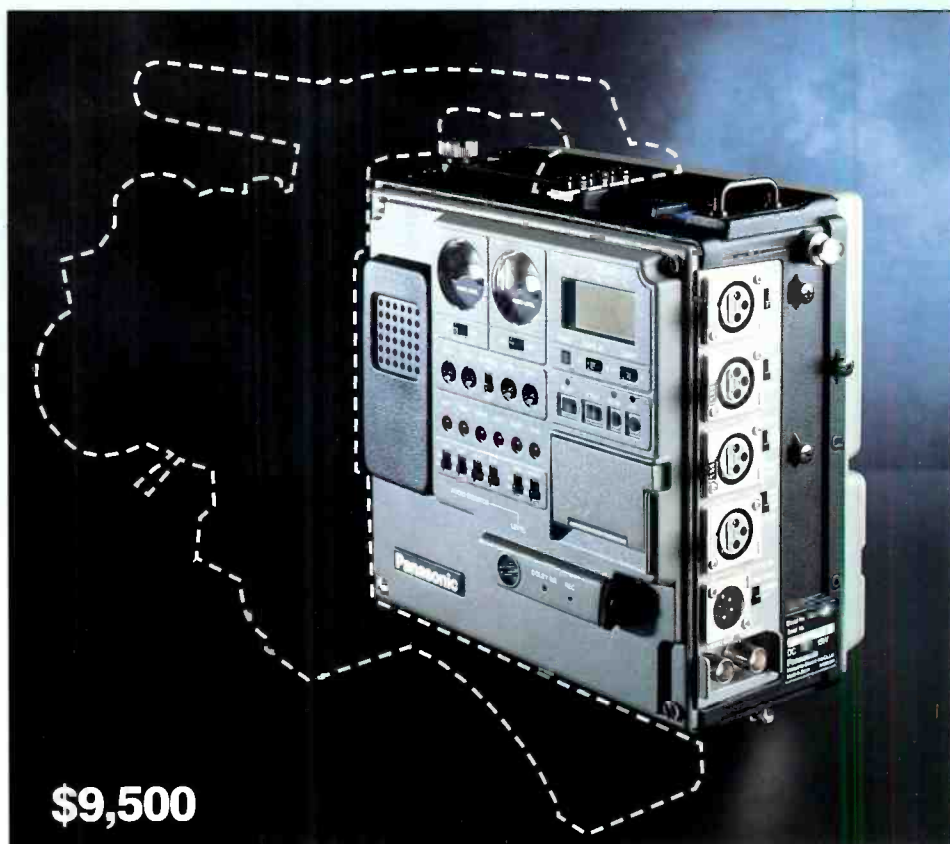
answer is the new, lower-cost, high quality 1/2-inch video-tape recording system, a family of recorders priced like 3/4-inch, but with performance and quality more like one-inch. With cassettes nearly 50% smaller than 3/4-inch (providing up to 50% more recording time), Panasonic's new MII LC not only provides much more flexibility in the field; it takes up far less archival real estate. Plus, the new MII LC's broad compatibility ends the dilemma of meeting rising quality requirements within today's lean budgets.



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simply can't get a 3/4-inch camera/recorder.

The new AU-410 Dockable Recorder can mate to virtually any video camera designed for camcorder operation. Now, your favorite camera can make pictures with quality that rivals that of one-inch VTRs. The AU-520 Field Recorder provides *all* the high-end production features required in the real world, and, unlike 3/4-inch, offers full 90-minute videocassette record capability in the field.

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To ensure reliability, all new MIIc machines feature self-cleaning heads, a drum motor confidence check during edits, a modular power supply, plus a Super Dropout Compensation* (SDOC) system, which corrects for up to one field.

For systems compatibility with almost any mix of VTRs in use today, each of the new production VTRs includes a 9-pin RS-422A serial/parallel interface, plus a 50-pin parallel input via an optional interface board.



AU-65 Studio VTR, the perfect editing platform for sourcing from MII or other formats.

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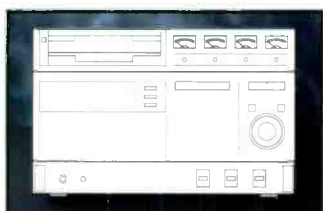
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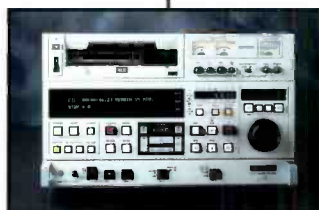
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when mics are open.

Studio cuing often relies on a mixture of IFB and hand signs. The studio IFB system, usually a subsystem of the station intercom, lets the talent listen to program and cues on headsets or earpieces. The floor crew, in touch with the booth via intercom, can give hand signs as well.

Should a related broadcast occur on an adjacent set or different studio, the procedure is essentially the same. In most modern facilities, the intercom/IFB system is stationwide.

Live from Washington

Coordinating a remote from a previously wired location, such as a news bureau, requires extending the intercom and IFB through a phone line or radio hookup. This often requires the use of a *hybrid*. A hybrid is a 2-wire to 4-wire adapter and an impedance-matching device.

Some systems use back-to-back hybrids. The 2-wire Public Switched Telephone Network (PSTN) combines send and receive audio on one path. A hybrid separates the send and receive into discrete paths. At this point, additional gain and AGC processing can be applied to the audio. Next, the second hybrid recombines the audio into a 2-wire signal for the intercom. If a 4-wire system intercom is used, the second hybrid is bypassed. All of this is necessary because a phone line has an average end-to-end loss of 17dB. It takes more than an impedance-matching transformer to overcome these losses.

Alternatively, the studio crew can use the telephone for cuing, as if it was a 1-party intercom. The disadvantage of this is that it divides someone's attention between the broadcast in progress and the bureau.

Cuing the remote site is simple if the site is in the usable signal contour of the station. Stations can use an air-monitor. Audio from an earphone or external audio outlet on a TV or TV-audio receiver is routed to the talents' earpieces. One drawback of this procedure is that it is not interruptible. The BTSC TV audio standard may have tried to address this need when it specified the *Pro* channel. This signal is an additional subcarrier located above the stereo audio and secondary audio program authorizations. Unfortunately, the allowable deviation specified in the standard is so small that most manufacturers have been unable to come up with any way to use it.

ENG — calling all cars

ENG coordination is most often performed by 2-way radio, although cellular phones can also be used. The advantage of 2-way is that it is easy to transmit to all units at once. Point-to-multipoint commu-

TYPE OF REMOTE	COORDINATION	CUING	PROGRAM
Studio shot	Intercom Hand signs Verbal commands	IFB system Hand signs	Mic & camera cables
Nearby studio shot	Intercom	IFB system	Mic & camera cables
Remote Studio (bureau)	Telephone Extended intercom	Extended IFB Telephone Air-monitor	Fiber or microwave path
Simple remote (ENG)	2-way Cell phone	Air-monitor IFB transmitter Telephone Cell phone	ENG system
Close-in satellite shot	2-way Cell phone	2-way IFB transmitter Telephone Cell phone Order wire	Satellite
Distant satellite shot	Cell phone Order wire	Order wire Cell phone Telephone	Satellite

Table 1. Broadcast communications options.

nication in a cellular environment may be technically possible, but statutes prevent cell operators from operating their networks in a dispatch or broadcast mode.

For ENG cuing, a variation of the air-monitor is the *IFB* transmitter, sometimes called an "alligator." To operate an alligator, feed the received audio from the STL into a 2-way radio at the transmitter site. Often, this radio is a repeater without a receiver, hence the term alligator (all mouth and no ears). It is usually necessary to derate this transmitter so it can operate at a 100° duty cycle.

An IFB transmitter can overcome the non-interruptible limitation of an air-monitor system. Simply feed it the IFB feed instead of program audio.

Alligator feeds are used two ways. If the frequency of operation is close to the frequency of the station's 2-way system, any multichannel hand-held can be crystallized to receive the alligator. Talent in the field can then monitor the IFB by slipping their earpieces into the hand-held's external audio jack.

Some stations have issued pager receivers tuned to the alligator frequency. Talent clip on the pagers, lock out the squelch, and use the external audio jack to feed their earpieces.

A dial-up or cellular telephone can also serve for cuing. Many stations feed their IFB signal to an auto-answering hybrid. The remote site then calls in to the hybrid's number and receives the feed.

Many new devices are coming to the marketplace that help interface cellular or dial-up telephones to traditional audio

equipment. One of these devices replaces the dial-up telephone handset with an audio interface. The unit has a microphone connector and headphone output, with gain controls for each. This allows users to work with familiar audio equipment in a telephone environment.

Cellular phones are not the same as dial-up phones. The Public Switched Telephone Network (PSTN) is a 2-wire network. Cellular, with its radio roots, is a 4-wire system. Adapters are available to interface cellular phones to station audio equipment. There are also adapters that allow a cellular phone to mimic a dial-up phone for use with dial-up phone adapters.

Up in the sky

Satellites have substantially increased the newsgathering range of many stations. However, they have added a layer of complexity to the dispatch and cuing process.

If a satellite truck is within the range of the station 2-way system, dispatch can be identical to that performed in an ENG shot. Cuing, however, cannot. This is because of the delay encountered in shooting a signal up to a geosynchronous orbit and back.

If reporters at satellite vehicles monitored their station's program output, they would hear the program as it is broadcast. If the reporters were to speak on the air, they would hear the station's program, including their own voices. Unfortunately, their voices would be delayed by the time it takes it to beam into space and back. Few people have enough concentration to do a good job of stand-up reporting while

hearing their own voices delayed back to them.

The cure for satellite-induced delay is to use a mix-minus feed for the IFB signal. The mix-minus feed contains all the show elements except the announcer's own microphone.

Satellite phone

The mix-minus IFB can take many paths to the talent. The satellite presents an extra option called *order wire*. The order wire system is essentially a single-channel-per-carrier (SCPC) telephone network. (See Figure 2.)

At the audio console in the station, a mix-minus feed feeds a hybrid. The hybrid dials into the satellite operation center where the satellite is controlled. Dial-ins from all over the country are sent to the satellite and down to the truck. There they are brought out as telephone circuits, which can be adapted for distributing audio to talent.

Real gone

An advantage of the order wire for dispatch is that it allows the truck to contact the station no matter how remote the location. One disadvantage is cost. Users are charged for time spent on the satellite. A second disadvantage is that the truck must be stationary with the dish fully deployed, and a cross-polarity check must be completed before the order wire can be used. This takes time, and, of course, no truck driver is going to stop and unfold the dish on the chance that someone back at the station might want to talk. In this situation, a cellular phone, or a national satellite paging service, can be beneficial.

Cuing distant remotes is the same as local satellite shots, save that 2-way radio and IFB transmitter options don't apply.

Data bridges in the sky

All the communications mentioned so far have been for voice work. Could the newsroom computer benefit from communications with the field? Some promising new developments indicate that it can.

An extension of the X.25 packet protocol, named AX.25 (for the amateur radio community that pioneered it), could allow newsroom terminals to go wireless. Once the domain of hobbyists, AX.25 packet networks are now in use as a data backbone by several commercial users.

The AX.25 protocol operates through a pair of *terminal node controllers* (TNC). The TNCs resemble phone modems. They connect to a computer at one end via the serial port, and to a 2-way radio using the push-to-talk (PTT), ground, speaker and mic signals. In most units, these signals are available on the microphone connector or in the control head.

Although modems often use a protocol called the Hayes command set, AX.25 uses a language called TAPR (pronounced taper). This name comes from the Tucson Amateur Packet Radio Association, which developed it. In Hayes, a sign off is ATH; in TAPR, it's D, for disconnect.

In a packet system, the data to be transmitted is chopped into discrete chunks of uniform length. A head and tail block describing the packet's intended destination and order in the string are appended to the data chunk. Checksum information is also included. This number is derived using a complex equation. At the receiver, the checksum equation is run again. If the checksum obtained is not the one that was sent, the equipment considers an error to have occurred. It then requests that the packet be retransmitted.

Mathematically, there is a small, but finite, chance that the packet could contain

an error. Experienced packet users report, however, that this is never a practical concern.

The packets are addressable. The listening TNC hears all transmissions on the frequency, but only displays or passes onto the computer packets addressed to it.

What about system throughput? Can the AX.25 protocol move newsroom files at a usable rate? Apparently it can. One recent trial shipped a 2,000-word document in less than 30 seconds.

Another question is that of channel loading. How many users can share a frequency? Because of the nature of packet radio, the answer is many. If a packet is corrupted by jamming, the interfering radio and the one interfered against stop. They wait a random back-off interval, and then retransmit. Odds are the second time there will be no contention. If there is more interference, the units back off and try again. Of course, the more users on the network, the slower the throughput.

Some TNCs come equipped with other communications options, such as a mailbox function. This allows them to receive information unattended.

Can voice and data mix?

AX.25 is not enjoyable listening. *Packet racket* consists of rapidly alternating 1,200Hz and 2,200Hz tones. Although voice and data users could coexist, the most effective use of AX.25 would likely be on a repeater dedicated to the purpose. Determining the feasibility of this is an exercise for engineering management.

Another way to integrate data and voice onto the same system is to use a trunked radio system. In a trunking system, a number of transmit/receive pairs are made available to all the users in the group. When a user wants to call, the trunk control system monitors the request for a channel and assigns a vacant one. At the release of the mic PTT switch, the trunk is vacated. When the called unit responds, the process repeats. Trunking assumes that most messages are short and bursty in nature. Such is the case with packet data.

A third method of integrating voice and data depends on certain new radio communications technologies. These include automatic caller identification, as well as select call functions. If voice was given precedence over data, a certain amount of both could be tolerated.

Coming together

Good communications is important to any outside broadcast. Whether it is a newperson reporting live from the scene, or your reporter in Washington, if there is not adequate support communications behind the scene, the results just won't be

Continued on page 54

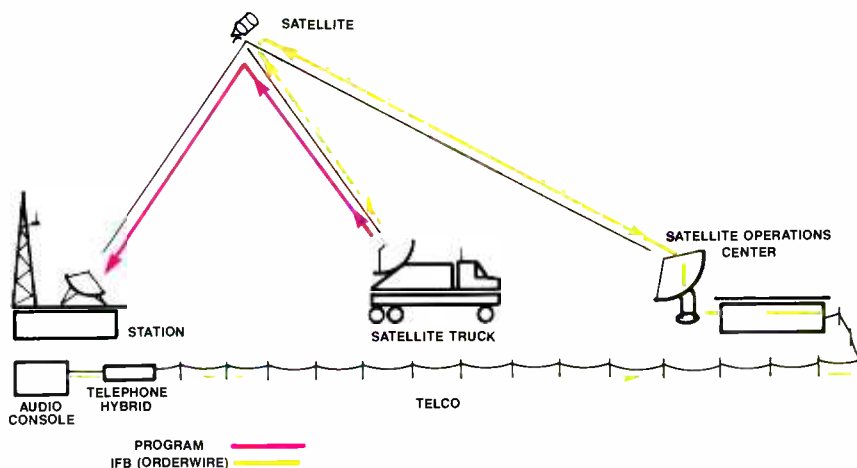


Figure 2. In long-distance satellite work, program audio and video travel to the station via satellite, and IFB travels by phone loop to the satellite communications center, where it is uplinked. This order wire phone link is bidirectional, and can also be used for coordination.

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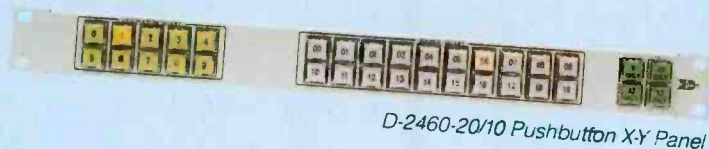
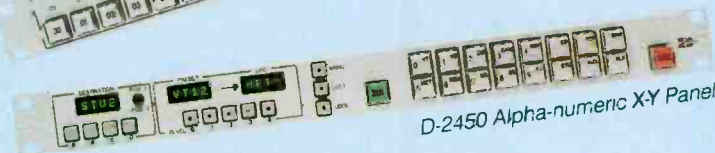
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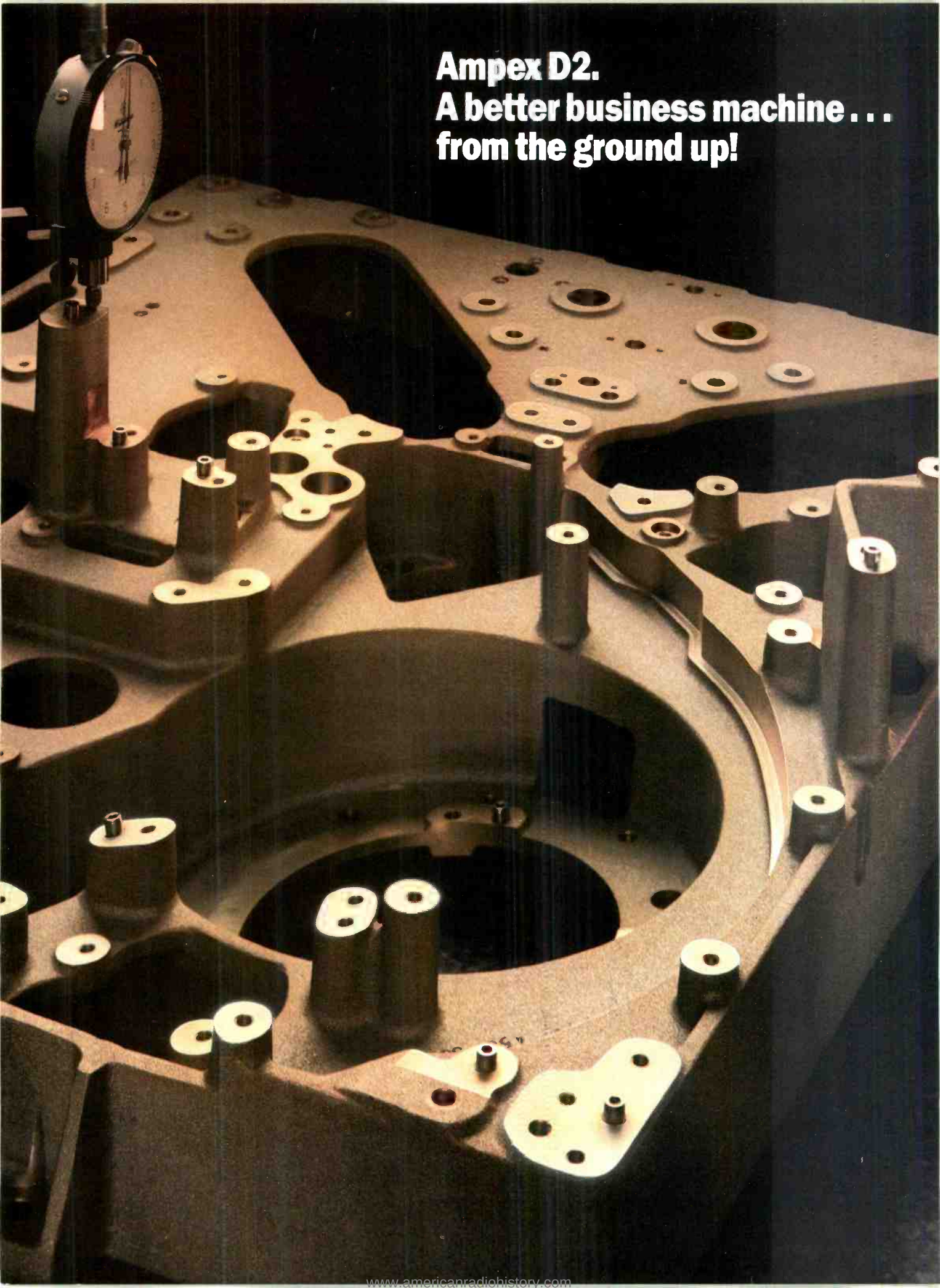


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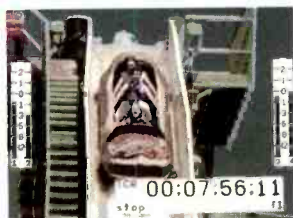




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Continued from page 50

top drawer. As computers share our communication channels, the situation will become simpler, yet more complex. Either way, good communications with the field will be a constant requirement.

Acknowledgments: The author wishes to thank Mike Goddard, Clear-Com Intercom, Berkeley, CA; Ralph Belgique, Comtek Communications Technology, Salt Lake City; Doug Layton, RTS Systems, Burbank, CA; Dave Pedersen, Gentner Electronics, Salt Lake City; Steve Church, Telos, Cleveland; John Downing, Advanced Electronic Applications, Lynnwood, WA; and Bill Sacks, Circuits Maximus, Arlington, VA.

Cellular and the new 2-way: A tale of two radios

Two-way radio has long been a communications staple of broadcasters. It was also until recently, one of the sleepiest of technologies. The industry was so docile, in fact, that most of its manufacturers were caught by surprise when cellular telephone's popularity rocketed. So dramatic has been cellular's rise that many manufacturers have sought to preserve 2-way's place in the sun by changing its name. They are now calling it dispatch radio.

Options, options, options

To complement the name change, manufacturers have cooked up a batch of new features. These include automatic vehicle identification, private radio trunking and analog scrambling. Some of these features are available as after-

market modifications. Others are soon to be incorporated as manufacturer options.

Among the new tricks in this mature technology:

- Automatic number identification (ANI), also known as push-to-talk identification (PTT-ID). This system can eliminate the several seconds of voice identification that precede each exchange:

Reporter: "Desk from Joe Newsnose...Desk from Joe Newsnose..."

Assignment desk: "Go ahead Joe, this is Patty Shrivillvoice..."

With ANI, the first fraction of a second a transmitter keys, it sends a digital burst. This burst identifies the transmitting unit and displays the user's name on a PC terminal at the base. Desk attendants can then enter the call in a transaction log, which will help them be more efficient with the reporter's communication. They will also be able to quickly recall where the reporter was at the last call in. This makes dispatch more efficient.

ANI also promises to eliminate radio horseplay. Few individuals will be tempted to hold the mic to the car radio or tape player if their names show up on a screen at the base.

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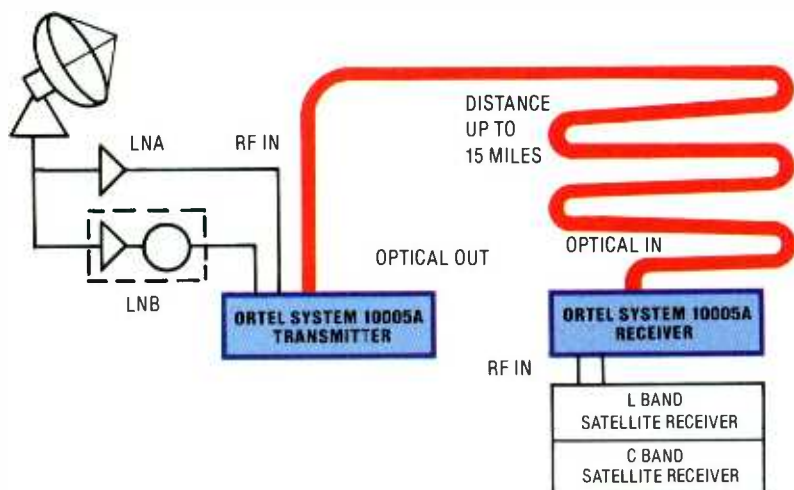
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• **Status.** Probably less than a dozen messages constitute the bulk of 2-way traffic: "I'm out of the car," "I'm back in the car," "I'm making a pit stop — give me five." These messages can also be sent as fractional-second bursts instead of time-consuming voice messages. Status may be sent as part of each ANI, or automatically when changed by the user. In some systems, the status burst repeats until the base acknowledges receipt.

The status transmit panel can be simple. A few push-buttons on the control head could suffice.

• **Radio check.** This frequent chore can be accomplished quickly in burst mode. The mobile can query the base by touching a button on the status panel, or the desk can check on the mobile. No more calling a dozen times to see if someone has the radio turned off.

• **Selective calling.** An advanced call privacy system, selective calling prevents a message from activating non-intended receivers. This is one of the technologies that could enable data and voice to share frequencies.

• **Emergency.** A hidden push-button or a position-sensing "man-down" switch makes the radio emit an emergency

burst signal that instantly identifies the unit in trouble. In some systems, the unit-in-distress then mutes to prevent hostiles from knowing that help has been summoned.

• **Stun.** A stunned radio is one that has received a special command that mutes its audio and disables its transmitter. This renders lost or stolen radios useless. A stunned radio can be ordered to transmit on command to aid in direction finding. This could be useful in tracking stolen vehicles. A revive signal re-enables a stunned radio.

• **Remote control.** A radio equipped or modified to provide the preceding features could also provide many remote-control functions. This could increase the utility of an ENG vehicle. In automated audio testing, for instance, a calibrated series of pulses shoots up the line to the station, where it is compared with a reference. (See, "Automating Audio Measurements," by Adolfo Rodriguez, *BE* August 1990, pg. 42.) Advanced 2-way technology could start the test without troubling the ENG vehicle operator. Similar controls could test video, and perhaps, even orient the ENG antenna.

• **Analog scrambling.** The same scanners stations use to keep up with public

safety officials can also monitor competing stations. Digital radio systems are highly secure, but are costly. It would be difficult to upgrade the entire system. Analog scrambling systems fall into five categories:

1. Masking tones that cover the audio by mixing in one or more competing tones. Notch filters at the receiver remove the tones.

2. Frequency inversion uses a fixed audio carrier as a base line, and turns all frequencies upside down.

3. Rolling code is similar to inversion, but the frequency of the inverting carrier periodically shifts.

4. Variable split band is similar to rolling code, except more than one carrier operates on the signal.

5. Time domain shifting, in which audio segments are recorded and played back out of sequence.

The bad news is that all of these methods except for time domain shifting can be decoded by people who have rudimentary equipment and know what they are doing. The good news is that the FCC has strict privacy laws. It should be easy to prove that someone who has bothered to break your security scheme meant to invade the privacy of your

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communications. It would be difficult to prove such intent if your communications were in the clear and intercepted on a common scanner.

Cellular: sunshine today, cloudy tomorrow

Cellular, for its part, is still growing. More areas than ever are served. Also, cellular has proved extremely reliable. The morning after the 1989 San Francisco earthquake, only one cell was reported to be out of commission. Cellular's robustness is demonstrated by many telcos. They use it to back up their 911 exchanges. If the lines go down, cellular bypasses the calls to the next nearest 911 center.

There are some storm clouds on cellular's horizon, however. Hand-off agreements between different systems are coming slowly. This could cause a call to dump without warning. Cellular operators have not been strongly motivated to solve the problem because studies indicate most calls last only a few minutes. Broadcasters, who may need continuous service over long stretches of highway must wait out the hand-off negotiations.

Cellular is also embroiled in a controversy about conversion to digital stan-

dards. The conversion is necessary because a digital system can accommodate many times more users than an analog system. The conversion is hampered by warring factions as to which digital format should be adopted.

Cellular also faces unexpected competition from the reviving 2-way industry and other competing services. One possible new threat is a service called cordless telephone 2 (CT-2). In CT-2, users carry cordless telephones with them and use them when they are within designated service zones.

Another dark spot on cellular's horizon is a proposed new system called personal communications. In this scenario, there is no such thing as a phone number. Instead, everyone has a personal identification number. The switching systems today that locate a given phone would be replaced by ones that locate a given person.

This service is a threat to cellular because investors entered the cellular industry with the belief that they could amortize their investment over decades. Instead, they have to modernize to digital immediately, with even more drastic modernization still to come.

What is IFB?

One of the most bandied about acronyms in the remote business is IFB. What is IFB? From where does the name come?

IFB stands for *interruptible fold back*, although many people insist on calling it *interruptible feed back*. The term *fold* is of British origin, and has its roots in audio recording. It refers to that part of the sound folded back, or returned, to the performers on stage. Foldback allows the performers to hear how they fit in with the rest of the program.

Feedback, on the other hand, is the squeal you get when a microphone picks up a loudspeaker that is reproducing the microphone. Feed back, interruptible or otherwise, is best avoided in TV work.

Many of the consoles used in audio recording or studio production work have a fold or studio fold output or *send*. The console operator builds up the mix that the performer needs to hear, and sends it to the studio fold amplifier. Audio assistants position roll-around monitors

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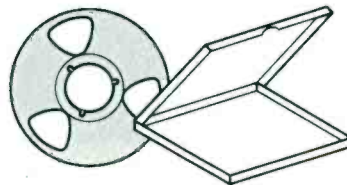
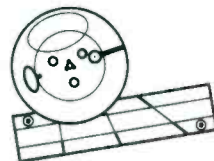
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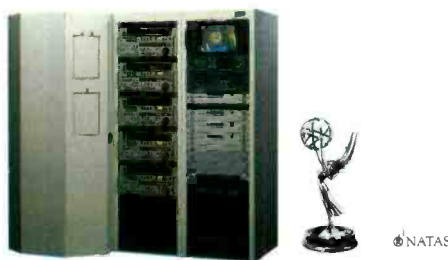
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Sharing the crowded spectrum

By Richard Rudman

Freedom from broadcast auxiliary interference requires cooperation.

Family life teaches sharing. If a surprise guest shows up for dinner, family members put some more water in the soup, and squeeze in another chair at the table. Good manners prevent most people from commenting on the reduced space and soup quality. Peace and harmony prevail. In broadcast auxiliary, there are hard limits to the amount of water that can be added to stretch the spectral soup. And when peoples' backs are to the wall, manners may be forgotten and fighting may break out.

To continue the metaphor, many broadcast engineers feel that the Federal Communications Commission's (FCC) recent spectrum allocation policy has taken the form of, "Let's see how much we can water the soup before malnutrition sets in." Yet somehow, broadcasters all have to live peacefully and professionally in a world of shrinking spectral resources.

Attempts to obtain new spectrum for Part 74 use have not been successful. In fact, broadcast auxiliary's spectral domain has actually shrunk, as other users have promoted their own interests. There has been talk about releasing some military spectrum for private sector use. But even if this does happen, with all the voices clamoring for spectrum, Part 74 may be lost in the general din. Satellite, wireless electronic devices, cellular communications and direct broadcast interests all have their powerful voices in Washington.

Rudman is chief engineer at KFVB-AM, Los Angeles.

The new golden rule ("Those with the gold, rule") may be the deciding factor. Indeed, during the months leading to the World Administrative Radio Conference (WARC) in 1992, new segments of the domestic electronics industry may try to take away more Part 74 spectrum. Perhaps new technologies will improve spectral efficiency here, but as yet, this has not occurred.

The regulatory approach

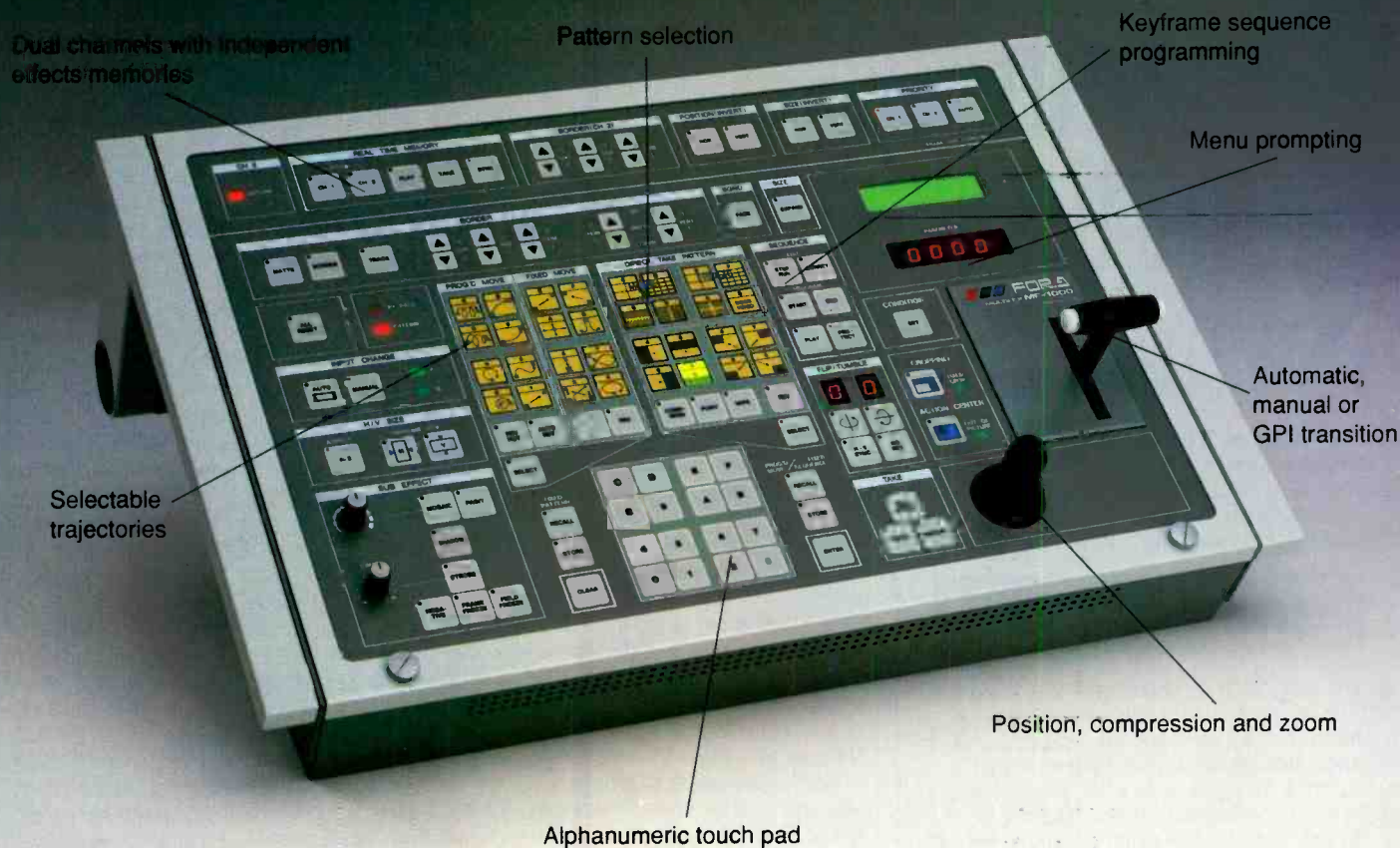
FCC Docket 82-334 set the tone for the sharing conditions between broadcasters, cable companies, common carriers and some private and government users. The cable antenna relay service (CARS) now shares 13GHz channels with broadcast microwave links, and we share the 2.5GHz and 7GHz bands with common carrier microwave companies, and even government public safety users in some regions. Signs of strain and incompatibility are showing, especially in the major markets. It is hard to get all of these divergent interests to just attend coordination meetings.

There are some FCC allocation policies intended to solve some specific problems. Ten years ago, the FCC set a deadline of October 1991 for broadcasters to bring fixed-TV STL microwave links into compliance with Category A standards for transmitting antennas. The cost of compliance will be high for many stations, but the gain in adjacent-channel protection is

thought by many engineers to be worth it. Some licensees are prepared to make a showing to the FCC that they cannot comply, however. They claim that their existing microwave antenna structures cannot support the added burden of the larger Category A microwave dishes. The FCC will have to review such requests, and will probably grant some waivers.

Unfortunately, the FCC does not control specifications for *receive* antenna size. Licensees using smaller microwave dishes who experience interference should seriously consider upgrading *both* ends of their links to protect themselves, and to be good neighbors to adjacent-channel users.

Furthermore, although the FCC's rules make reference to "frequency congested areas," the term is never defined. The Society of Broadcast Engineers (SBE) has proposed to the FCC that all standard metropolitan statistical areas (SMSAs) as defined by the U.S. Census be presumed to be "frequency congested areas," along with a list of specific sites outside SMSAs that have become heavily congested because of their favorable location and height. As of the 1980 census, there were 309 SMSAs. The FCC adopted the SBE's rulemaking request on Oct. 16, 1990, asking in its Notice of Proposed Rulemaking (NPR) that steps be taken so no microwave stations will be required to install Category A antennas if frequency congestion does not exist in their area of operation,



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which may be the case in some of the smaller SMSAs. The SBE has asked local coordination groups to supply information so this important question can be resolved.

Changes for TV ENG

Other methods are being employed to accommodate a growing list of users in the 2GHz band, which is favored for TV ENG. Plans that give local TV ENG users "home channels" have met with success and are spreading to other markets via coordination committees. These plans formalize ways for users to contact one another when channel(s) other than their own "home channel" are needed. These users may also agree to split the 25MHz-wide channels in this band. Other helpful elements for TV ENG users include frequency-agile portable transmitters, high-performance mobile and receive-site antennas, low-noise receivers using pre-amplifiers and channel filters, observation of source identification procedures, and the use of minimum required power.

Many coordination groups have been working with licensees to move fixed links out of the 2GHz band. More channels have been made available for TV ENG, and fixed links have been moved to bands where they are less likely to experience interference.

Changes in aural STL and RPU

Upgrades for radio and antenna systems used in the aural STL band are available, with more on the way. Earlier this year, the FCC granted a 3-year postponement to its upgraded transmitter performance standards (allowing time for even more spectrum-efficient equipment to come to the marketplace), but broadcasters should not wait until July 1, 1993 to make sure their links are in compliance.

Changes in the aural STL rules to encourage 200kHz-wide channels for AM stations and 300kHz-wide channels for FM stations, as outlined in Docket 85-36, are not in place yet. The FCC's computer program has to be modified to accommodate the new split channels, although the docket was approved more than five years ago. Some are not satisfied with the FCC's basic channel splitting plan, anyway. They say more options than 200kHz and 300kHz channels are needed, and are working on plans to implement changes for their individual regions in the 950MHz band on a waiver basis.

New users are putting additional strain on the limited number of aural STL and RPU channels in congested markets. High-quality mono or stereo transmission for program-length remotes cannot be accomplished in many markets' Part 74 channels. This is because of the noise floor increase from land mobile interference sources. High-power paging transmitters are allowed to operate less than 1MHz from Part

74 channels in the 450MHz band. A casual spectrum analysis in any major market will show spikes from unstable land mobile transmitters marching up and down the 450MHz band, with a noise and adjacent-channel interference that challenge even the best receivers. Although not yet recognized officially by the FCC, a new class of temporary, high-quality aural service is being used by several broadcasters on a waiver basis with the support of local coordination groups. It uses narrowband operation on "splinter" channels, along clear paths in the 950MHz band. Narrowband digital STLs for the 950MHz band may also help; the first of these are expected in 1991.

The RPU bands face another problem from airborne traffic services. The FCC's 15W limit for airborne RPU transmitters can still block or cause harmful interference to a channel for hundreds of miles in all directions. Newer receivers with better filters can help, but many coordinators are asking traffic services to voluntarily restrict airborne transmitter power to perhaps as low as 1W if ground-based receivers use antennas optimized for aerial coverage. Placing non-airborne-service RPU receivers in protected quiet sites away from traffic service flight paths is another technique. Many stations have already realized that a receiver located in a quiet spot close to its channel's transmitters in the field can buy more signal improvement than hundreds of transmitter watts.

Coordination is the key

The FCC's new Form 313 has ushered in an era of coordination awareness. Question 16 on the form asks if a coordinator was contacted. This shows that progress is being made in educating licensees about the necessity of prior coordination. Contacting a local coordinator prior to sending in Form 313 can assure that new systems and modifications will neither cause nor be the victims of harmful interference.

The SBE has been active in frequency coordination efforts. It maintains the National Frequency Coordinators' list, updates it quarterly, and sends it to the FCC, networks, and all broadcast and cable coordinators, free of charge. Its database is also available to any recognized coordination body. The SBE will soon publish a how-to manual for those interested in becoming involved in volunteer coordination. Excerpts will appear in the upcoming *NAB Engineering Handbook*, 8th edition.

Recognition of the value of coordination is also important among non-technical managers. A news director who asks personnel to follow proper coordination practices may have the edge on a competitor who does not. General managers who support their engineers' volunteering of time

Continued on page 67



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Continued from page 64

and knowledge for coordination efforts are really protecting their own Part 74 interests.

Also worth studying is the concept of *compatible sharing*. Canada's Department of Transportation (its FCC) permits aural STLs to share spectrum with satellite service in the 1.7GHz band. The U.S. military will not allow the FCC to do the same in the United States. Coordinators believe that this approach would work here because fixed aural STL links are engineered to tight coordination standards, and satellite antennas are pointed in a different direction. As in the Canadian model, case-by-case evaluation would prevent an STL in that shared band to interfere with the primary satellite service. Compatible sharing also includes the grouping together of several similar fixed link services. The FCC generally supports this type of sharing, but co-channel and adjacent-channel incompatibilities still exist between many fixed and mobile services, making coordination a real challenge.

The role of the coordinator

It has been almost 10 years since the FCC asked the broadcast industry to compile and submit a list of volunteer coordinators. Without the efforts of these volunteers today, much Part 74 activity would be brought to a heterodyned halt.

Coordination is, at best, a relatively thankless task, and at worst, a cause for conflict-of-interest accusations from those who do not get their way. To avoid the latter, coordinators must never *assign* frequencies. Instead, they should dispense information using databases they compile and maintain. This information then promotes the licensee-to- licensee contact essential to the coordination process.

Coordinators should be experts in the art of the possible, and always strive to include new users. To do otherwise may be perceived as restraint of trade. They should be able to offer suggestions on which bands and types of equipment are appropriate for a given use. They may also suggest that a prospective user consider other services like cellular, satellite, and wired digital for remote pickups, and private radio service spectrum for communications.

Sharing a crowded spectrum will not get easier. The electromagnetic equivalent of "the good fence that makes good neighbors" hasn't yet been devised. Good manners may be the most important element of the coordination process. Liberal doses of the original golden rule will help. "Doing to others as you would have them do to you," is a good criterion to apply whenever there is potential for conflict.

Editor's note: For more information on the SBE coordination process, contact Paul Lentz, SBE secretary, at 419-882-5906.



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SBE convention shines in St. Louis

By Brad Dick, editor

The SBE national convention returned to its origin, holding its 1990 convention Oct. 4-7, in St. Louis. Capitalizing on the success of the 1989 convention in Kansas City, MO, the show drew many attendees and exhibitors seemed pleased.

Sessions successful

The forte of the SBE show has always been its technical sessions. This year was no exception with more than 45 sessions, panels and papers presented at the convention. From practical here's how to do it, to here's the future, the sessions provided important and timely information to the attendees.

A special panel of FCC, FAA and industry experts was held on the opening day. The panel, "FCC vs. FAA: Are solutions in sight?" was somewhat contentious, but well attended. Broadcasters generally perceive the FAA in a controversial manner. The panel addressed problems and proposed solutions to the location of transmitters and antennas near airports. When the panel concluded, the attendees may have not heard the answers they wanted, but they understood better the issues involved.

Look to the future

Many of the standing-room-only sessions addressed the direction and future of broadcast technology. Michael Rau, senior vice president of Science and Technology for NAB, was the opening session speaker. He told attendees that many changes are in store for radio and TV engineers.



The technical sessions were well attended with capacity crowds for the entire three days.



Based on the recent advances in digital technology, Rau reviewed some of the important issues concerning direct audio broadcast (DAB). Calling it a political issue, Rau said that no one knows for sure exactly where the technology is going to take the industry. He noted that terrestrial and satellite delivery systems are being proposed. He also reminded engineers to remain aware of these challenges so they can help their stations take advantage of any new technologies.

Another leading-edge technology, radio data systems (RDS) received keen interest from attendees. Gerald LeBow, Sage Alerting Systems, described how a broadcast signal could be encoded to provide listeners with new services and stations with the potential for new revenue. The service would allow stations to customize special services that would be receivable only on new types of receivers. From traffic reports to weather bulletins, stations could provide immediate information to listeners within their areas.

HDTV coming in clear

Improved TV images are just around the corner according to some of the presenters. Ben Crutchfield, ATTC, reviewed the tests and procedures for the various proposed high-definition television (HDTV) systems.

Broadcasters shouldn't think that entertainment is the only thing HDTV is useful for. The technology will also find widespread application in medical and scientific areas. According to some presenters, those applications may become commonly available even before broadcasters begin to embrace the technology in a widespread form.

Ennes workshops

The SBE convention has become known for its highly successful technical sessions. However, it has been the Ennes workshops that have received significant notice in the past two years.

The Ennes workshops were held on Wednesday, the day before the show officially opened. More than 200 people attended the workshops that were sponsored by leading equipment manufacturers and suppliers. Topics covered in the

workshops included: medium- and high-power transmitters, C-Quam AM stereo systems, S-VHS, ENG and production techniques, studio design with personal computers, earth station technology, satellite communications, RF workshop, management for engineers and RF technology.

Disaster preparation

A standing-room-only crowd greeted the speakers at the Sunday morning "Preparation for a Disaster" session. Attendees



The society's first president, John Battison (right) moderates the opening panel while Michael Rau (NAB) discusses future technology.

learned from those who had real world experience with recent natural disasters. Peter Hammar, Hammar Communications, reviewed how some San Francisco stations were successful in riding out the earthquake, while other stations found themselves sorely prepared.

Bill Ruck, KFOG/KNBR, San Francisco, described many of the failures of the area's EBS system after the earthquake struck the region. The lessons learned from the disaster forced major changes in how the city's EBS system is operated.

Not everyone has to deal with earthquakes, but most of us have encountered other forms of Mother Nature's fury. David Bird noted that, in some cases, broadcasters have to join forces to battle the elements. Despite the fact that hurricanes can be tracked and are not unexpected like earthquakes, the preparations stations should undergo are similar.

Most of the papers presented at the convention are contained in the *SBE Proceedings*. Additional copies of the 1990 *Proceedings* are available from the SBE office.

[:;-))]]



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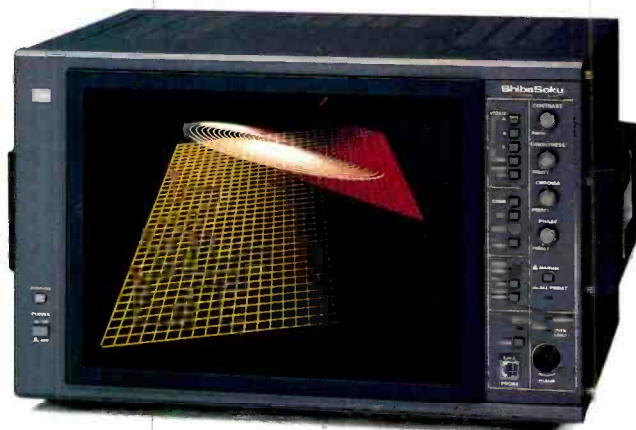
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Europe takes
the forefront in
DBS testing.

DBS in the United Kingdom

By Brad Dick, editor

While the United States continues the search for an HDTV standard, and direct broadcast satellite (DBS) has yet to arrive, Europe is moving forward on both fronts. In the United Kingdom, the first step toward DBS took place last April with the launch of a new British satellite network. The British Satellite Broadcasting company (BSB) can broadcast up to five program channels to subscribers in the United Kingdom.

The DBS bird

BSB officials recognized from the onset that success of any direct broadcast technique was predicated on the use of small receive antennas. This criteria required the use of a higher-power satellite than is used in other satellite broadcast applications.

The satellite, called Marcopolo, was manufactured by Hughes Aircraft and was launched last August from Cape Canaveral. The bird is located in a geostationary orbit. It is expected to have a life span of approximately 10 years. The satellite consists of three single-frequency conversion 17/12GHz transponders. Each RF channel is 27MHz wide. The transponders provide automatic level control, which can compensate for uplink rain fades of up to 15dB and up to 10dB of ground-commandable gain steps of 0.5dB.

EIRP within the area is specified to be a minimum of 59dBw. The satellite, a Hughes manufactured unit, provides a redundant transmission system. A total of 12 55W TWTs are parallel connected in pairs to provide six 110W RF output am-

plifiers. Three of the amplifiers can operate simultaneously at full power.

Further redundancy is provided by connecting the six amplifiers in a full-ring configuration. This allows all five channels to operate simultaneously with a total RF power not exceeding that of the 3-channel, full-power output configuration. The satellite's functional diagram is shown in Figure 1.

D-MAC encoding

The BSB network provides subscription-type services and pay-per-view programming. The D-MAC transmission system was adopted because of the sophistication in supplier controls, high quality and the need to be able to handle future develop-

ments, such as HDTV. D-MAC is the fourth variant of the multiple analog components (MAC) originally proposed by the U.K. Independent Broadcasting Authority (IBA) in 1981. The standard combines analog and digital processing for the video and audio channels of a TV transmission. The D-MAC signal consists of video and combined audio and data carried on separate carriers, typically separated by 10.5MHz. The carriers are either frequency modulated for transmission through a satellite link as in the BSB system or amplitude modulated for use on a cable system. The audio plus data component uses a ternary duo-binary code format that reduces the required signal bandwidth. The D-MAC waveform is shown in Figure 2.

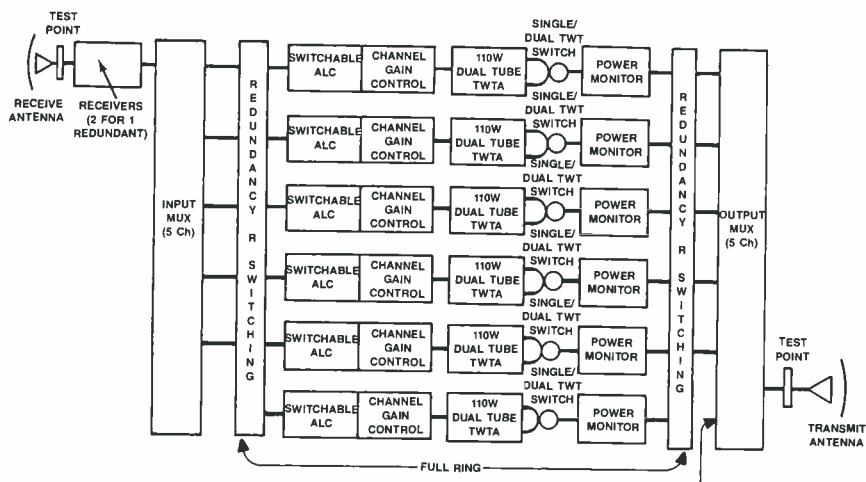


Figure 1. The satellite is highly redundant, providing in essence, dual backup parallel TWT systems.

Another advantage of the D-MAC format is that the audio plus data channel can be uplinked from a separate ground station. This permits the digital channel of the satellite transponder to be used for other purposes when not needed for TV broadcasts.

D-MAC's 20.25MHz transmission rate can be divided in many ways. Digital stereo audio is sampled simultaneously, coded separately and then transmitted alternately. The number of potential stereo channels depends on the coding method used and the level of error protection needed. As many as eight channels of audio can be transmitted. We'll see why this is important later.

The D-MAC transmission scheme also provides for a DBS HDTV signal to be viewed without the need for a special receiver. This was first demonstrated at the International Audio and Video Fair in Berlin in 1987. The demonstrated system took a 1,250 line signal and processed it into 625 lines, which is the standard for most of Europe.

The signal bandwidth is then reduced using motion compensation techniques. Still images must be transmitted with a higher bandwidth than moving ones, and certain movement can be predicted rather

than actually transmitted. The 625-line signal is then transmitted in conventional D-MAC. This feature helps ensure compatibility with not only today's receivers, but future ones that may use baseband inputs. Standard HDTV reception will require the purchase of a wide aspect ratio television and an HDTV BSB receiver.

Receiver design

Providing these technical requirements

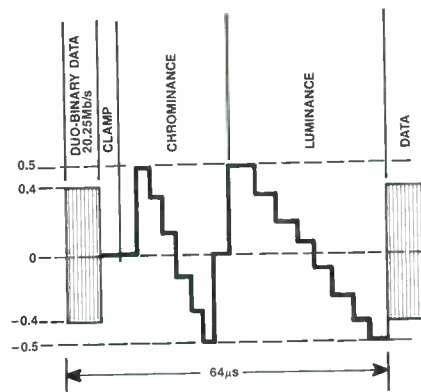


Figure 2. The D-MAC signal provides a 20Mbit/s data channel in addition to the visual signal.

with the necessary user features complicated greatly the receiver design. Although the eventual plan is to provide HDTV-quality signals through the entire transmission/receive system, today's hardware must serve terrestrial-based PAL receivers.

This approach requires the use of an intermediate decoder/converter. The basic consumer interconnect diagram is shown in Figure 3.

The indoor decoder/converter accepts DBS signals as a block of channels in the 950MHz-1,350MHz range. Custom ICs decode and recover the original video in RGB form, together with several audio signals. The primary signal processing is handled by the system information (SI) subsystem. The SI subsystem decodes the special control signals that provide the location of the video and sound/data multiplex components, the type of scrambling being used and the format (bandwidth, coding and error protection used) in the audio channels.

In some cases, the programs will offer a selection of sound channels. The decoder/converter allows the viewer to select the desired audio signals. The U.K. design means that a subscriber can often choose between watching a film in its na-

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tive language or choosing to hear it dubbed into English.

In addition to controlling the D-MAC signal decoding process, the operating system provides several unique operational features. Via the front panel and TV on-screen messages, the viewer can choose between subscription and pay-per-view programs and activate the parental lock-

out. Because each decoder is addressable, a blackout feature allows the programmers to control where their signal is received, as would be necessary for sporting events.

Although the decoders are not user-serviceable, special front-panel and on-screen diagnostic information is available. By operating a switch, the viewer or technician can determine current bit error rate

and authorization status. Depending upon the particular decoder design, other technical parameters, such as signal strength, receiver address, manufacturer ID and signal information present may be provided.

The eventual intent is to have the decoder output a baseband signal directly into the receiver. However, because that type of receiver is not yet widely available, the decoder outputs a PAL-encoded RF signal on a UHF channel.

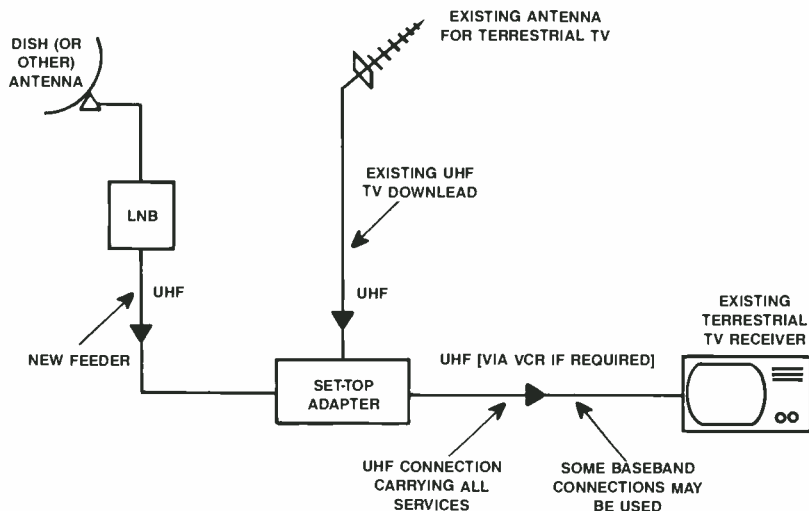


Figure 3. The DBS system was designed so that a consumer could install the hardware. Unlike a cable decoder, the BSB system provides easy access for a terrestrial broadcast signal.

Encrypted signals

The BSB broadcasts are encrypted using the Eurocypher Conditional Access System developed by General Instruments. Eurocypher provides control over the reception of its programs by addressing each receiver through the Marcopolo satellite. Receivers can be authorized individually to receive particular channels or particular programs. This allows for subscription-based and pay-per-view options. The encryption allows the DBS signals to be received only by subscribers in the United Kingdom and is highly robust against piracy.

The parental control feature forms a central element of the receiver. All programs broadcast by BSB are given a classification indicating whether violence, sex

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or foul language is present within the show. This parental guide information is displayed on the viewer's TV screen. Viewers can then decide what programs may be unsuitable for their children. If desired, that programming can then be blocked by the parent, allowing each household to control what type of programming is available on the television. Adult-rated programs can still be viewed by entering a personal identification number (PIN). A person's PIN can be changed at any time by the user.

Small antennas needed

Because the DBS programs are transmitted from a high-power satellite, only a small receive antenna is required. This turned out to be a major factor in the system's acceptance. The company recommends either of two small antennas. The first, a 40cm×40cm Squarial antenna was developed especially for DBS use and resembles a small, shallow square box. A compact 35cm diameter compact dish can also be used.

The Squarial antenna is unique because of its appearance and design. The key to the flat plate appearance is the use of hundreds of small receiving elements to collect the correct polarity satellite signals.



The success of any DBS system is highly dependent upon the use of small antennas. Shown here is a 35cm diameter compact dish.

A LNC located on the back of the antenna performs the signal conversion and amplification before feeding the signal to the decoder located near the television.

The acceptance of DBS signals is not yet certain. Although Europe and Japan have launched efforts to draw viewers to this delivery method, it's success is not certain.

Several companies have attempted to establish a DBS transmission system in the United States. So far, none have been successful. The primary reason for their failure has been the need for widespread acceptance (that means subscribers) for the system. Recently, several companies have proposed new adventures into the DBS

arena. Whether they are successful may be predicted in how well the BSB system is received (pardon the pun) in Europe.

Acknowledgment: Thanks to Heather Refetoff, vice consul, British Consulate General, for her help in preparing this article.

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1:7-9)))

Soundtracs established in Scotland

Soundtracs plc, Surrey, England, has established a production division in Glenthroes, Scotland. The 20,000-square-foot facility is equipped with automated production lines, including robots, and will create jobs for more than 150 people.

Nikon relocates headquarters

Nikon has relocated its national headquarters to Melville, NY. The 132,000-square-foot facility will be home to the corporate offices, the photo group and the instrument group.

GVG establishes subsidiary in Tokyo

Grass Valley Group (GVG), Grass Valley, CA, has established GVG Japan, a Tokyo-based subsidiary that will serve the Japanese market. After the United States, Japan is the largest market country for GVG.

Sony Business and Professional Group relocates

The Sales and Marketing Company,

Sony Business and Professional Group has relocated its national sales, marketing and product management functions to a headquarters in Montvale, NJ. The address is Sony Corporation of America, 3 Paragon Drive, Montvale, NJ 07645-1735; telephone 201-930-1000.

Quanta relocates headquarters

Quanta, a Dynatech Broadcast Group company, has relocated its headquarters within Salt Lake City. The 20,000-square-foot facility is located at the Salt Lake City International Center, across the street from its sister company, Utah Scientific. The address is Quanta, 180 Wright Brothers Drive No. 670, Salt Lake City, UT 84116; telephone 801-328-8872; fax 801-328-3668.

Harris Allied expands U.S. radio field sales

Harris Allied, Quincy, IL, has expanded its domestic radio field sales organization and established a broadcast telemarketing center. The company added three U.S. radio field sales positions. In addition, the broadcast telemarketing center will enable broadcasters to phone a toll-free num-

ber to receive information about any Harris Allied radio product or service, to place orders and to contact or arrange for a visit from a field representative. Through Jan. 1, U.S. radio broadcasters can phone toll free 800-622-0022 for information on studio equipment and 217-222-8200 (ext. 3110) for information on radio RF equipment.

TTC announces Intelco acquisition

Telecommunications Techniques Corporation (TTC), Germantown, MD, has acquired the assets of Intelco, a manufacturer of fiber-optic test equipment. Following a transition period, the entire Intelco operation, several key technical founders and other personnel will relocate to TTC's headquarters.

Klark-Teknik chosen as Milab distributor in Canada

Klark-Teknik, Farmingdale, NY, has been chosen as the exclusive distributor for Milab microphones in Canada. ☺



Flexible remote control By R-Tec Systems



• **RK50, MC50:** keypad and machine control units; connect by single twisted cable pair to provide remote control of five functions; adaptable to almost any piece of equipment; five buttons on keypad use DTMF signalling to rack-mounted machine control unit to initiate a contact closure; controller relays can be programmed for pulse, toggle or interlock modes.

Circle (350) on Reply Card

Audio test product

By Audio Precision

• **Portable One:** 2-channel audio test system with 12 measurement functions; push-

button selection; entire package housed in a portable case with captive protective cover on the front panel.

Circle (351) on Reply Card

Power frequency converter

By International Computer Power

• **RotoPlus:** combines power-line conditioning with line frequency conversion; bi-directional 50Hz-60Hz operation; allows equipment designed for use in the United States to be operated in other countries; protects equipment from transients, surges.

Circle (352) on Reply Card

Batteries, chargers

By Perrott Engineering Labs

• **Models 441, 441-90:** combination charger, discharger for Nicad batteries; 441 for NP-1s, NP-1As; 441-90 for BP90s; each unit is capable of discharging and charging four batteries; LEDs show status of each of the four independent ports in charge, discharge cycle.

• **PE 90 A:** BP90-style battery; enhanced for 25% longer run time; packaged in Kydex molded case; rated 12V, 5Ah.

• **ACPS series:** AC power supplies in clip-

on or BP-90 configurations; allow equipment operation via AC rather than battery; 115/230VAC input power; 12VDC at 4Ah.

Circle (353) on Reply Card

TV transmitters

By ITS

• **ITS-115A:** 10W transmitter for LPTV service; aural section is BTSC stereo ready; integral power supply; requires seven inches of rack space.

• **ITS-1240:** 10kW UHF transmitter; 1-tube TH-382 design with solid-state drivers; external diplexed with separate visual, aural chains; low-power consumption.

• **ITS-234A:** 2kW UHF transmitter; for LPTV service, particularly with CP transmission system; parallel 9017 tetrodes operate in Class A.

Circle (354) on Reply Card

Low noise, hybrid amps

By Microwave Solutions

• **Model MSH-7103201-WW:** low-noise amplifier for CARS microwave spectrum; 12.1-12.5GHz; 3dB noise figure; 8dB minimum gain with +9dBm output power; runs from 24VDC; usable with STL, ICR

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frequencies.

- **Hybrid amplifier:** 41dB gain in 5.85-6.425GHz range with +18dBm output and maximum noise figure 5.7dB; 12VDC operation; 1.6:1 VSWR rating for input and output.

Circle (355) on Reply Card

Image storage, timer

By Leitch Video of America

- **4:2:2:4 still file:** component format still-store; D-1 interface; stores images with full linear key signals; networking permitted between component and established composite still file systems; 2-user capability; Film Transfer software option; 380-image basic storage expandable to 10,000 stills; removable media storage available.
- **UDT-5700 timer:** programmable, 2-channel; count up, down in hours-minutes-seconds or minutes-seconds-frames; EBU/SMPTE time-code output; stopwatch, time calculation operations; RS-232, RS-422 inputs, GPI inputs and outputs.

Circle (356) on Reply Card

ENG mixer

By Comrex

- **FPM312:** portable audio mixer by Opus Audio, Sweden; switch selection of mic or line on all three inputs, each with adjustable limiting; 9V lithium batteries; weighs 1.9 pounds; reference oscillator, 48V phantom power, optional 12V adapter.

Circle (357) on Reply Card

Multiformat TBC

By Nova Systems

- **Model 950:** combines transcoding among composite, component and Y/C format video sources with 4x1 switcher and image processing; enhancement, noise reduction, black stretch processing functions; wideband TBC includes freeze, fade-to-black modes; integral color bars available for system setup.

Circle (358) on Reply Card

Audio effects device

By Lexicon



- **LXP-15:** digital multi-effects system; dynamic MIDI remote control of 27 variables; five inputs for foot switches or pedals, each can be patched to any effects parameter; memory contains 128 preset effects, storage available for 128 custom programs combining pitch shifting, stereo delays and reverbs.

Circle (359) on Reply Card

Time code, test generators

By Multidyne Electronics

- **VDG-800:** time-code display generator; translates numeric time information from BVU-800 VTR control panel for insertion into video picture; stable-lock feature permits visible time characters during high-speed forward, rewind modes.
- **TS series:** video test units; TS-4 with NTSC color bars, sync, character generator for visible or VBI identification and

SSR-90 solid-state recorder for audio ID; TS-8-MTS combines TS-8 NTSC digital test signal generator with stereo MTS, SAP capability, eight digitally generated 8-bit video test source, composite 1kHz audio tone, H/V triggers.

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Condenser microphone

By Countryman Associates

- **Isomax EMW:** omnidirectional electret;

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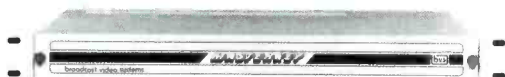
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Backup switching

By Fairchild Data Corporation

- **MS291**: modem redundancy switch; for MS290 series modems in satellite data transmission service for domestic or international networks; unit switches only the reference clock when the Tx signal clocks out the Rx buffer; independent 1:1 transmit, receive switching of baseband terrestrial inputs, IF signals.

Circle (361) on Reply Card

Maintenance accessory

By Charles Beseler Company

- **Dust Gun 22**: pressurized dust, lint removal can; uses HCFC-22 as an active component for reduced damage to the ozone layer; from 5-ounce to 15-ounce sizes; initial pressure at 120 pounds per square inch.

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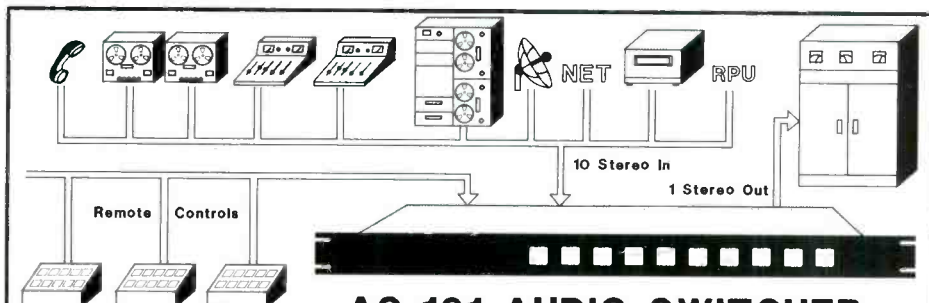


Test signal generator

By Consultronics Ltd.

- **PG3000 stereo source**: audio signal generator for use with PC3000 to perform short interval audio tests on active program channels; tone bursts inserted into 5s period between programs permits wide range of system performance measurements to be made.

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Audio quality measurement

By FM Systems

- **SPM-1**: stereo performance meter indicates the degree of stereo separation in 1dB steps on 50dB bar graph display; measurement based on cross-correlation comparisons of frequency, amplitude and phase of components in the left and right audio channels.

Circle (373) on Reply Card

Equipment security

By Winsted

- **Sectional wall cabinet**: locking wall-mount enclosure; mounts on 16-inch centers giving 17.5 inches of rack space; hinge pins used to mount rack cabinet and door allow opening from right or left; 13

gauge steel construction; louvered for ventilation.

Circle (376) on Reply Card

Audio distribution

By Videoequip Research Ltd.

- **Phase 3 series:** 2-channel audio distribution amplifier for 1-in, 4-out; balanced inputs, outputs; each output has individual gain adjustment; stand-alone or desktop packaging; 0.015% THD, ± 0.1 dB response from 20Hz-30kHz.

Circle (374) on Reply Card

Equipment consoles

By Cabtron Systems

- **Front slope:** series of equipment enclosures with 30° front slope openings; available in different panel widths, frame depths, range of accessories; 14-gauge steel construction with 11-gauge corner gussets; bottom-mounted ventilation options.

Circle (375) on Reply Card

Film accessory

By Evertz MicroSystems Ltd.

- **FILMKODE reader:** pickup head for telecine, film-to-video transfer system,

reads Kodak KEYCODE bar code data printed on the film; with decoder shows film edge numbers for logging, scene correction, editing applications.

Circle (377) on Reply Card

UHF power device

By Richardson Electronics Ltd.

- **NL347:** power amplifier tube with cavity for 1kW multiplexed visual-aural UHF TV transmitter; direct replacement for Thomson TH 347; from National Electronics.

Circle (378) on Reply Card

Facility furnishings

By Peerless Sales Company

- **Jumbo mount:** wall or ceiling monitor mounting systems for screen diagonals from 20 inches to 35 inches; heavy gauge steel construction; three sizes, satin black finish, ceiling or wall mount.

Circle (379) on Reply Card

Camera dollies

By egripment

- **Widebase dolly 123:** for use with or without tracks; steel construction with four pneumatic 16-inch wheels; vertical

column with main bearing assembly, push-pull bar; storage area for counterweights.

- **Dinky Dolly 156:** 4-wheel steer dolly with steel base frame, pneumatic or hard rubber wheels, push-bar; steering mechanism for tight, accurate circles; can be used on curved or straight track.

Circle (380) on Reply Card

Back-up power

By ICS

- **1200 series UPS:** computer-grade backup power sources; less than 3% total harmonic distortion; rated 7.5kVA, 10kVA, 15kVA; extensive monitoring, self-diagnostic LCD panel; internal, maintenance-free lead acid batteries provide 10 minutes of operation at full load.

Circle (381) on Reply Card

Time-code lock

By Mitsubishi Pro Audio/Neve

- **CS-1 synthesizer:** retrofit to X-880 digital audio recorders; permits chase lock to time-code source within 1/8 subframe or approximately $\pm 50\mu$ s; lock time reduced to $\pm 20\mu$ s between two Mitsubishi digital ATRs; individually adjustable offset trimming.

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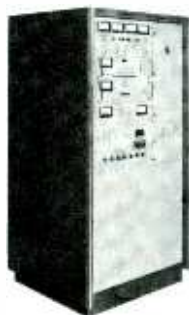
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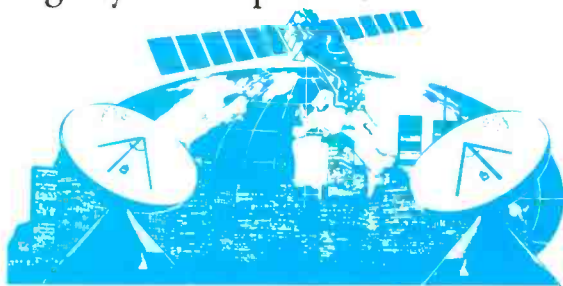
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Battery components

By Energex Systems

- **XCP13/14:** replacement cell pack for Propac 13/14 SnapOn batteries; 5Ah capacity offers 25% longer running time; repair of Propac units with these cells can be accomplished with a screwdriver.

Circle (367) on Reply Card

Product literature

By LNR Communications

- **Data sheets:** descriptions, specifications on low-noise amplifier products for C-, K-, L- and X-band communications; additional material on UEV video exciters and DRV video receivers.

Circle (368) on Reply Card

Power control

By Perma Power Electronics

- **CR-560 Power Commander:** combines surge suppression with five switched outlets for use with computers, monitors and other peripheral equipment; front panel indicates operating surge protector circuit with 1ns response time; 15-amp main breaker.
- **LS-812 surge suppressor:** 8-output unit with hybrid protective circuitry using metal oxide varistors and avalanche diodes in conjunction with typical capacitors and inductors; 5µs response time; all sockets accommodate ground pin.

Circle (369) on Reply Card

Power conditioner monitor

By Dranetz Technologies



- **Model 658:** power quality analyzer offers metering of true rms voltage and current with power disturbance and harmonic distortion analysis; digital oscilloscope display with zoom capability, graphic printer and 3.5-inch disk drive to store event information.

Circle (370) on Reply Card

Video production control

By Vistek Electronics Ltd.

- **T8000 switcher:** in NTSC and component formats; 10-input, including black, color background; three bus mix-effects with linear, luminance and downstream keying; newly designed wipe pattern generator offers 95 different wipes, including wipe with-in a wipe; serial interface to editing controller.

Circle (383) on Reply Card

PC audio recorder

By Ariel

- **SDI system:** signal-to-disk interface uses data acquisition processing for recording, playback of 16-bit audio; sampling rates to 50kHz simultaneously on two channels; 600Mbyte optical drive with read/write capability and other media options; recorded signals can be viewed graphically, edited.

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The PC has invaded the domain of stand-alone effects stations with surprising speed. Today's PC systems offer features and effects never before possible.

• Magneto-Optical Storage

Magnetic-optical storage is not a coming technology; it's already here. This article looks at one way to record high-quality signals with ease and reliability.

• Electromagnetic Radiation

A case study of one station's encounter with the FCC, OSHA and state regulations on RF radiation.

March...

NAB CONVENTION PREVIEW

• NAB Engineering Convention Preview

A summary of the major technical papers and issues to be addressed at the convention.

• Products and Exhibitors Preview

A complete roundup of exhibitors that will be attending the show, along with the products they plan to display. This year's coverage will list the products by product category, thereby making it easy for the readers to locate the companies they need to see.

• Map of the NAB Show

Even though we return to Las Vegas, the show's configuration and dates have been changed. This makes the BE map even more important. Attendees won't get lost with their personal BE guide to the show floor.

• Facility Design Special Report

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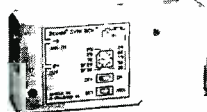
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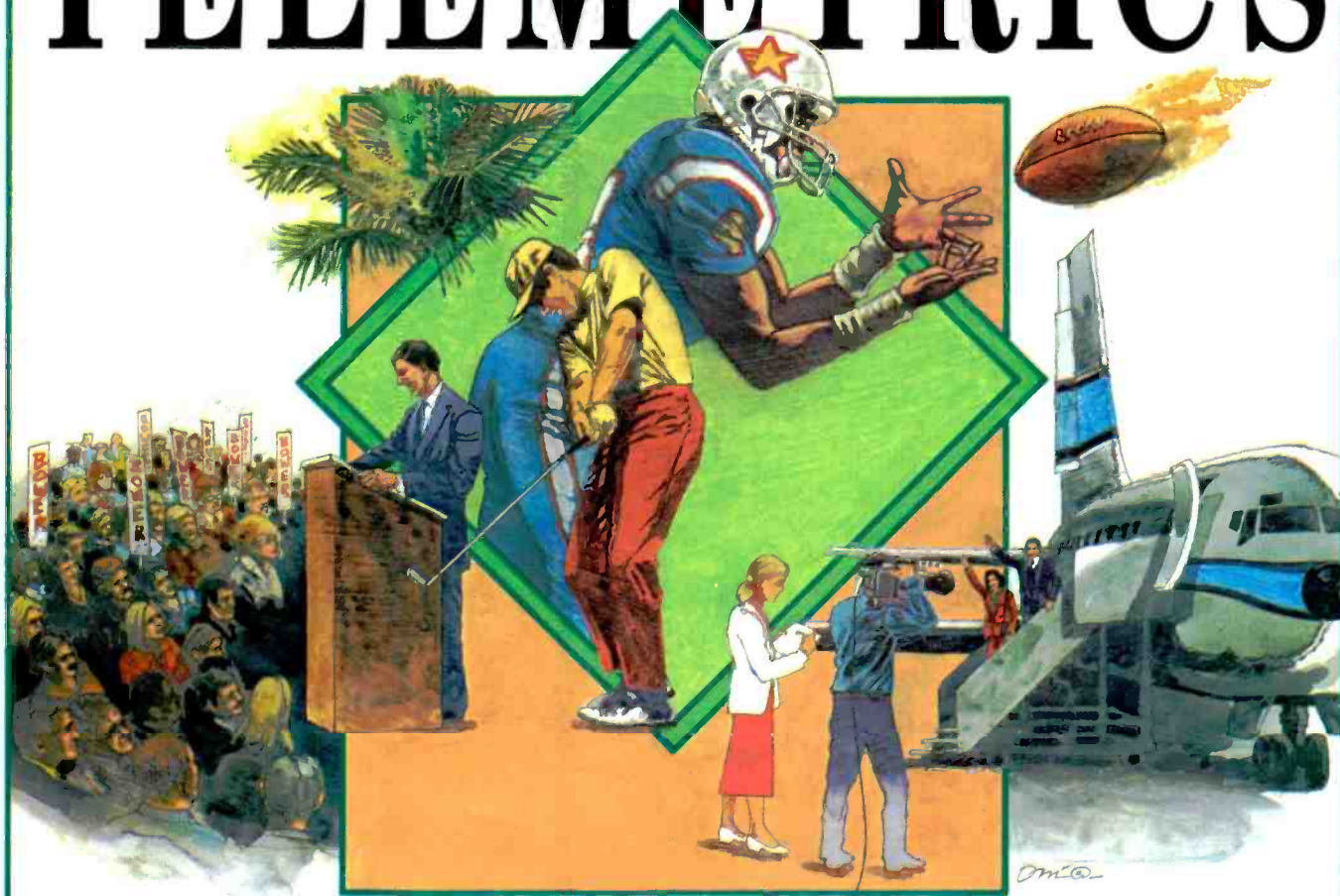
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April 16, 1990

Gary C. Snow, President
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Al Centrella, Audio Engineer

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