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December 1990/$4.50

Technology forecast for 1991

Annual index p. 80

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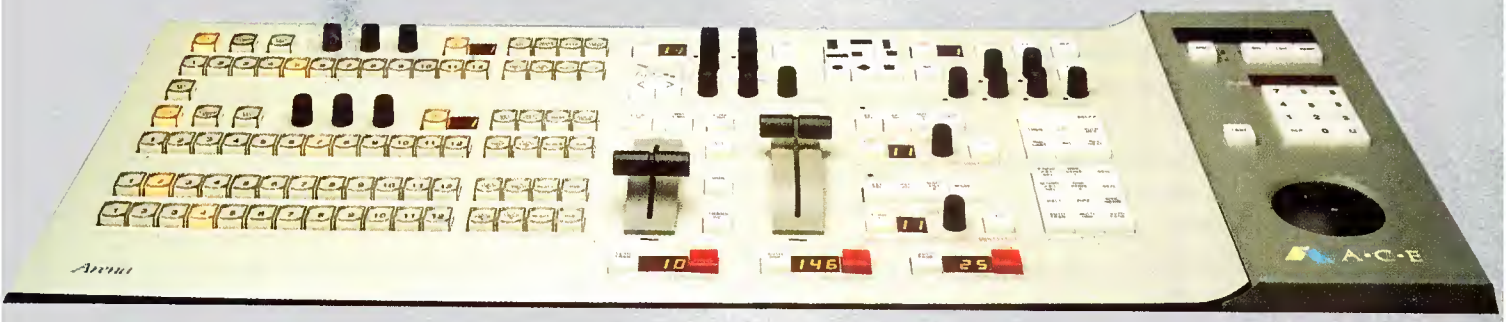

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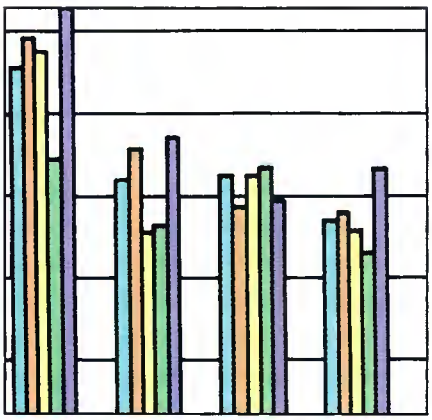

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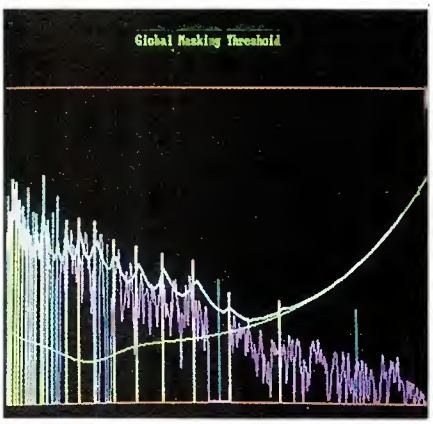

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TECHNOLOGY FORECAST FOR 1991

The broadcast industry is moving rapidly as advancements in technology give stations and facilities new ways to solve old problems. The need has never been greater for detailed and measured planning. Our annual Technology Forecast updates readers on the business side of broadcasting. Learn how much your fellow broadcasters are planning to spend and what equipment they plan to buy in 1991.

DEPARTMENTS

FEATURES:

OTHER FEATURES:

ON THE COVER

The U.S. broadcast marketplace is no longer an island to its own. The worldwide nature of developing new technologies affects how we must respond to the challenges. The effectiveness of our response to these important issues will set the stage for our future success. (Cover credit: FPG/Orion.)

It's time for new directions in television audio.

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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News

Dawn Hightower,
senior associate editor

CBS chairman William Paley dies

William S. Paley, founder and chairman of the board of directors of CBS, died Oct. 26. He was 89.

For more than half a century, Paley was an important figure in American broadcasting. He founded CBS in 1928, served as the company's president until 1946, and was chairman until his death. Paley's leadership enabled CBS to make important and lasting contributions to the industry, including the LP phonograph record and the minicam, which helped give birth to ENG in the 1970s.

Paley's fascination with radio began in the 1920s. He was a visionary who foresaw the enormous potential of radio and, later, television as a mass media of entertainment and information that would eventually transform the nation.

During the industry's formative decades, he helped shape ideas into realities. One of the achievements in which Paley took the greatest pride was his creation of "CBS News."

After World War II, Paley established a radio documentary unit that was the forerunner to some award-winning news broadcasts.

In lieu of flowers, contributions may be made to the Museum of Broadcasting, 1 E. 53rd St., New York, NY 10022.

NAB and Denon to produce stereo tuner

The National Association of Broadcasters (NAB) and Denon America have signed a contract for Denon to manufacture and sell a high-quality AM-FM radio tuner.

The tuner will be manufactured by Nippon Columbia, Denon's parent company. It will carry the Denon and NAB names and should be in stores by early 1991 at a price of $475.

Features of the tuner will include NRSC audio circuits, FMX, AM stereo, AM noise blanking, expanded AM band capability, provision for external AM antenna and a 30-station preset memory.

BROADCAST engineering

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ELECTRONIC IMAGING

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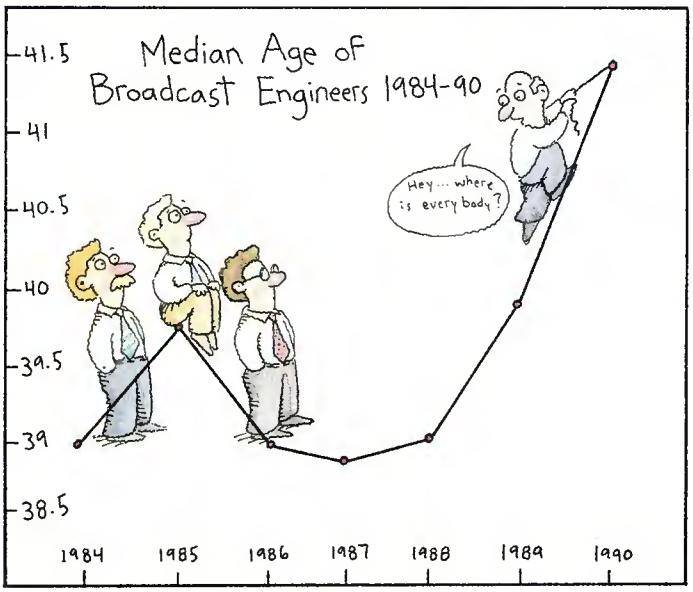
Endangered species?

Broadcasters frequently speak of not being able to find qualified personnel. This problem is especially acute with the technological tasks within the stations. Engineering, technical and operator-type positions require people with highly developed skills and training. Unfortunately, stations are finding there aren't enough people with these skills willing to work at the prevailing wages. And that's only the first part of the problem.

The second issue concerns age. The last seven years of *BE* research shows that the median age of broadcast engineers is increasing. (See graph.) In 1984, the median age of a broadcast engineer was 39 years. This year, the median age for an engineer increased to 41.3 years. This indicates that the engineers in your stations, as a group, are older than ever before. The result is that those with the most experience tend to be those closest to retirement. As these older, skilled workers retire, they are not being replaced by equally skilled younger people.



I recently talked with the employment director at a national electronics school. I asked her how many of the spring graduates entered the broadcast market. Her response surprised me.

"In the past four years, not one of our electronics graduates has entered the broadcast industry," she said. "Two of them tried, but they found that the major market stations, which paid well, wouldn't hire them because they didn't have experience. The small market stations were willing to give them a chance, but the graduates weren't willing to spend five years of their lives barely making a living so they could later move up to the large market stations." I asked her where these two graduates found jobs. She responded, "Both were hired at excellent salaries by medical equipment companies." Broadcasting is losing the battle to other industries in hiring and retaining qualified technical people.

Forty percent of high-school graduates don't go to college and move directly into the workplace. Unfortunately, the United States is one of the few industrialized nations without a formal program for high-school students that allows them to enter directly into the marketplace after graduation.

Furthermore, our high schools don't teach the skills needed in today's stations. Some of these graduates can't even comprehend the employment forms, let alone complex electronic equipment. There is a substantial skills gap between what American business needs and the qualifications of available workers.

The United States is also faced with a shrinking pool of young labor. At the same time, an increasing number of non-traditional workers, minorities and immigrants are available for entry-level positions.

Broadcasting is a complex field. The people who install, maintain and operate the equipment must be highly skilled. Faced with this dilemma, what can stations do to protect their investments?

First, stations should take advantage of people who want to learn broadcasting by spending time teaching them. Give these young people the opportunity to learn — on the job. Apprenticeship programs are the best way to learn, and they benefit the broadcaster and employee.

Second, broadcasters must accommodate the changing needs of modern workers. Today, three out of every five new entrants into the workplace are women. Stations will have to develop flexible work schedules and provide flexible child care, parental leave and fringe-benefit programs.

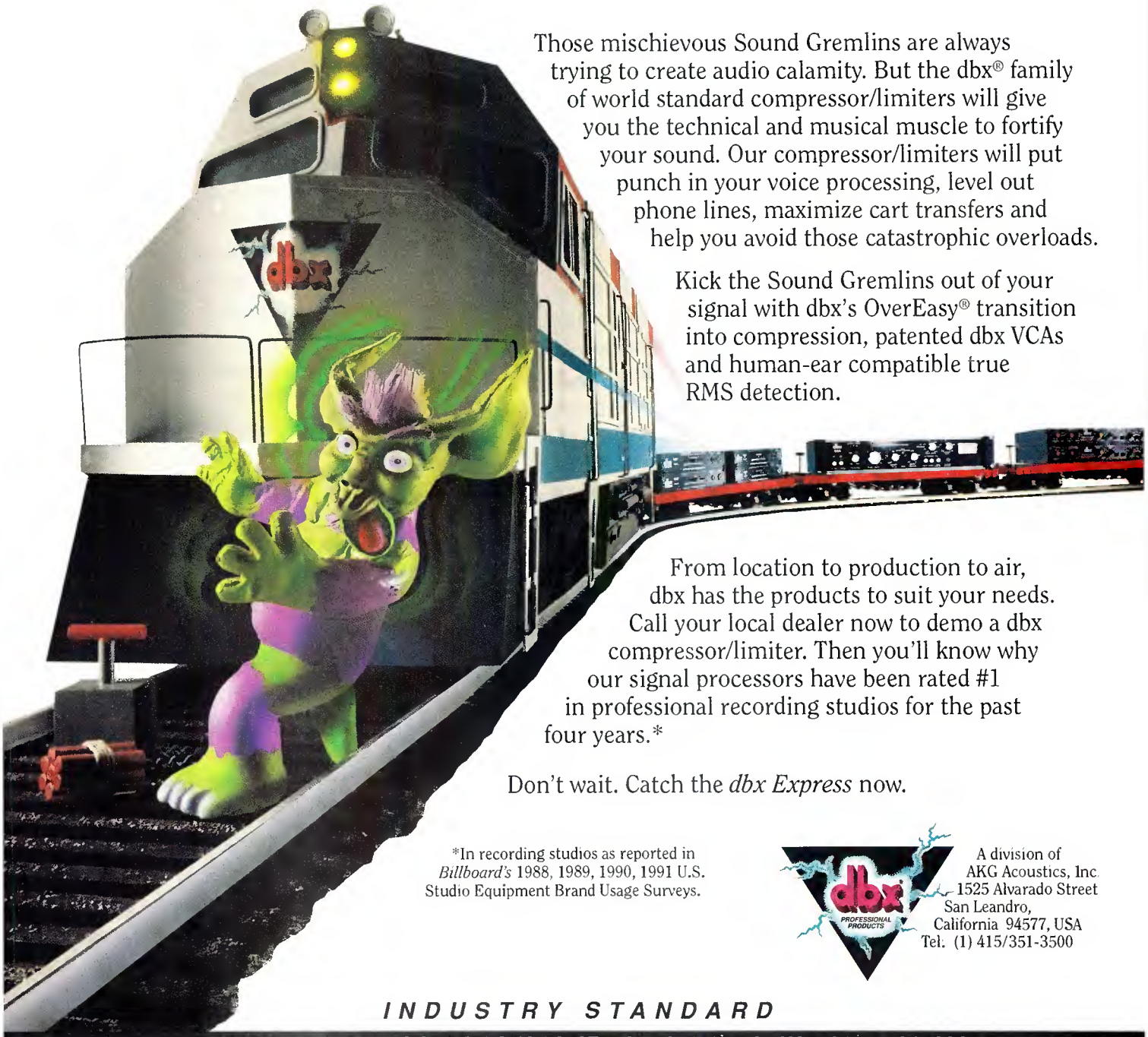
Hiring and training new people can be costly. Flexible benefit programs are uncommon in broadcasting and may increase operating costs. However, unless these issues are addressed, broadcasting faces an uncertain future as older workers retire and cannot be replaced by equally skilled younger people.

Just like maximizing the life of a piece of equipment, stations must learn to maximize the performance and long-term productivity of their employees. The strength of a station comes from the people who work in it. All the equipment in the world cannot replace someone who wants and knows how to solve problems.

Brad Dick

Brad Dick, editor

Don't Let The Sound Gremlins Derail You.



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Rules adopted for "wireless cable"

By Harry C. Martin

The FCC has amended the rules of three separate services that can be collectively used for the provision of "wireless cable," a service that provides multiple video channels through various microwave technologies.

Wireless cable resembles cable TV service in the nature of the programming it provides and its multichannel character. However, it uses radio channels instead of cable to deliver non-broadcast material, such as HBO and ESPN, over-the-air into homes.

The frequencies used for wireless cable are allocated to the multipoint distribution service (MDS) and the multichannel multipoint distribution service (MMDS). In addition, channels are available in the private operational fixed-microwave service (OFS) in the instructional TV fixed service (ITFS) for MDS-type service.

Most of the rules for these services were established in the infancy of the various services they govern, long before the development of the wireless cable industry. Consequently, these rules are obsolete in many respects, and they also vary substantially from service to service. Therefore, the FCC has adopted new rules and modified some existing ones in order to accelerate the introduction of service on additional channels and to improve service capabilities. Specifically, the commission has:

- Instituted a rulemaking to allocate additional channels to MDS service.

- Eliminated the ownership restrictions for MDS channels to increase possible common ownership from six to all 13 available channels.

- Established a 1-day filing period for MDS facilities to reduce the filing of mutually exclusive applications.

- Permitted MDS operators to displace point-to-point uses by ITFS operators grandfathered on the eight MMDS channels where suitable alternative spectrum is available, and the MDS operator will pay the expenses involved in the ITFS move.

- Prohibited a cable system's ownership or use of MDS facilities within its franchise area, unless that area is otherwise underserved.

- Instituted rulemaking to permit the use of vacant ITFS channels by wireless cable operators, subject to obligations that will provide for the eventual use by ITFS operators that may come forward. Proposals include setting aside specific "recapture" hours and an obligation to build ITFS receive sites.

- Simplified interference standards, analyses and processing procedures to speed the processing of applications, facilitate expansion and improvements in service, and introduce additional new MDS and ITFS stations.

- Increased permissible power levels for MDS and ITFS to enhance signal quality.

- Increased and made uniform equipment performance standards for MDS and ITFS to enhance existing service quality and to allow, in some cases, the addition of new stations.

- Permitted MDS and ITFS operators to require upgrades of existing ITFS facilities to reduce their susceptibility to interference, thereby permitting other new stations where the new operator will pay all associated expenses.

- Established administrative procedures to authorize multichannel signal boosters or repeaters.

- Eased some lease restrictions on MDS use of ITFS facilities.

- Made auxiliary frequencies and CARS authorizations available for wireless cable service.

FCC redefines "cable system"

The commission has determined that the term "cable system," as used in the Cable Act of 1984, encompasses only "video delivery systems that use cable, wire, or other physically closed or shielded transmission paths to provide service to subscribers." Adoption of this definition resolves uncertainty over the interpretation of the multiple-unit dwelling exception to the definition included in the Cable Act.

Radio services that do not use such closed or shielded transmission paths outside of individual buildings, including direct broadcast satellites and so-called "wireless cable" (MMDS, ITFS and OFS) facilities, are not cable systems under the act.

Also, satellite master antenna systems (SMATV) and master antenna systems (MATV) that use wire or cable only within the premises of an individual building will not be considered cable systems.

Finally, if individual multiple-unit dwellings are connected to each other by physically closed transmission paths, such SMATV or MATV systems are cable systems, unless the buildings are under common ownership, control or management, and do not use public right-of-ways.

When first interpreting the multiple-unit dwelling exception to the Cable Act, the FCC said, "The distinction between a cable system and other forms of video distribution systems is now the crossing of the public rights-of-way, not ownership, control or management." Subsequent court decisions raised questions concerning the commission's interpretation of the exception and the application and scope of the basic definition itself.

As a result of its review of the language and legislative history of the Cable Act and FCC precedents, the commission has concluded that facilities must use physically closed or shielded transmission paths to meet the statute's threshold requirements for a cable system. Use of radio or infrared transmissions alone does not meet this threshold criterion.

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

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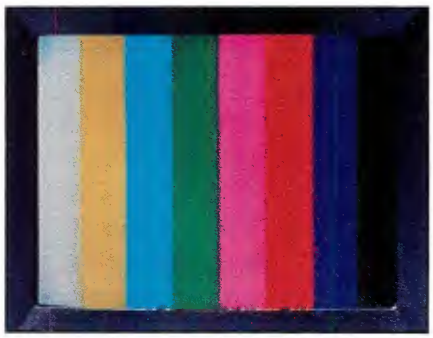

Frequency response monitors system health

By John Horn

Video system frequency-response problems can cause a wide range of system and picture impairments. Among the most obvious are effects caused by chrominance-to-luminance (C/Y) gain and delay errors. C/Y gain error occurs when system gains differ for the chrominance and luminance elements of a video signal. This causes incorrect color saturation in the viewed picture. Delay errors occur when a system applies different timing to the chrominance and luminance elements. The result is color smearing around the edges of colored objects in the picture.

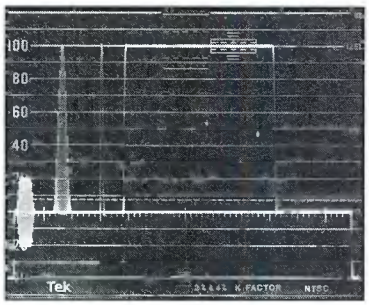

Figure 1. The 12.5T modulated pulse in a pulse and bar signal provides direct evaluation of chrominance-to-luminance (C/Y) gain and delay errors.

C/Y testing

General frequency-response testing with multiburst or line-sweep signals can indicate the potential for C/Y gain and delay errors. However, direct evaluation of these errors is more convenient using such signals as the 12.5T modulated pulse. This pulse consists of a sine-squared luminance pulse added to a 3.58MHz chrominance signal modulated by the same pulse. The pulse is available in pulse and bar, NTC-7 composite and FCC composite test signals. (See Figure 1.)

Gain error appears as a bowing of the base line. (See Figure 2.) Bowing that is symmetric about the pulse's vertical center line indicates gain error without delay error. Low chrominance gain causes upward base line bowing and a decrease in pulse peak amplitude. Excess chrominance gain causes downward bowing and an increase in displayed peaks.

Horn is manager of the TV division training group for Tektronix, Beaverton, OR.

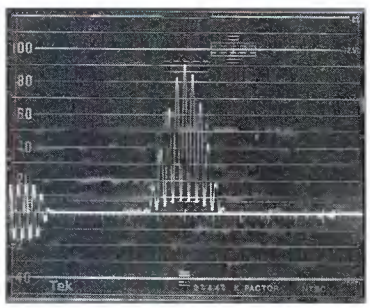

Figure 2. Gain error is indicated by an upward or downward symmetric bowing of the 12.5T pulse base.

Delay errors show up as a sinusoidal distortion of the pulse's base. Delay error alone appears as a symmetric sinusoidal distortion (See Figure 3.) If the leftmost sinusoidal peak is positive going, chrominance is delayed relative to luminance. If it is negative going, chrominance is advanced.

Combined gain and delay errors appear as sinusoidal base distortions that are nonsymmetric. In other words, the sinusoidal peaks are unequal and the zero crossing doesn't occur at the pulse's vertical center line. (See Figure 4.)

This rather complex distortion of the modulated pulse base line is usually evaluated by measuring the (one or two) base line peaks and using a nomograph to find the gain and/or delay errors. The relative gain error can be expressed in IRE, percentages or decibels. Relative delay is expressed in nanoseconds.

The amount of delay in nanoseconds can be computed by:

$$\text{Delay} = 20\sqrt{Y1 \times Y2}.$$

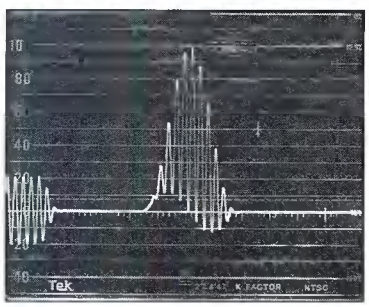

Figure 3. Delay error is indicated by symmetric sinusoidal distortion of the pulse base.

Y1 is the left sinusoidal peak value and Y2 is the rightmost peak value. Measure these peaks relative to 0IRE with the 12.5T pulse peak normalized to 100IRE.

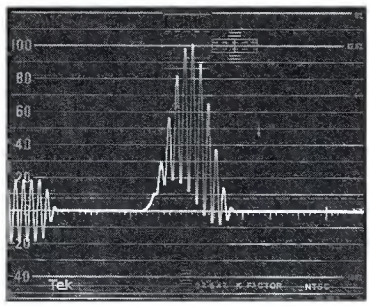

Figure 4. Combined gain and delay error appears as non-symmetric sinusoidal distortion of the pulse base.

If the delay error is small, the gain errors may be read directly from the waveform monitor display. The relative gain error can be expressed in IRE, percentages or decibels. First, normalize the test signal's white bar to 100IRE using the vertical gain control. Read the error (in IRE) as the difference between the modulated 12.5T pulse peak and 100IRE. Percent error is twice the IRE error. (Recall that a gain error will affect the top and bottom of the modulation.) Determine the error in decibels using the formula:

$$\text{Error}_{db} = 20 \log \left(\frac{1 + \text{error } \%}{100\%} \right)$$

The methods of gain error estimation just mentioned are generally accurate to approximately 2% when delay errors are less than 300ns. This is because delay errors have a minimal effect on the pulse's peak value.

As an example, if the peak of the mod pulse is at 85IRE when the white bar is normalized to 100IRE, the difference, hence gain error, is −15IRE.

In all cases, carefully examine the pulse bar for symmetry. If the bowing is not symmetric with the pulse center, then the distortion is actually gain and delay combined — with one of the sinusoidal peaks being severely non-symmetric to the point of almost being zero.

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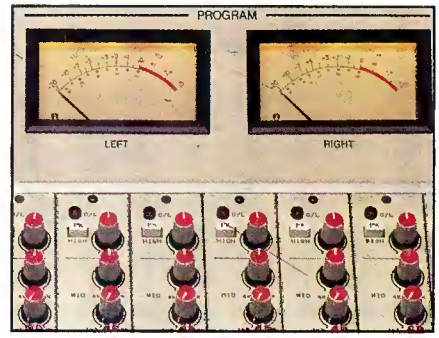


Some thoughts about transmission lines

By John Battison, P.E.

Today we speak of "coax," using the term interchangeably for video and RF. Over the years, coaxial cable has come into common use. You see it everywhere from TV antenna systems to communications systems. But what was used before coax, and how did its use come about?

Old-timers will remember 2-wire transmission lines consisting of two parallel conductors spaced apart by insulators. These lines were generally supported on poles, and were sometimes stabilized by a system of weights that imposed a constant load on the lines to prevent them from twisting in the wind. The impedance of a line depends on the diameter of the conductors and the spacing between them. For instance, with No. 4 wire size and 12-inch spacing, the characteristic impedance of an open wire line is approximately 300Ω. This is different in physical size from the flat 300Ω line generally used for TV-receiver antennas.

An open-wire transmission line such as this is basically balanced, because normally both conductors are equally above ground potential. However, many things can change this and cause undesired radiation. For this and several other reasons, it is common practice to use coaxial line (unbalanced).

One basic, yet interesting, phenomenon applicable to open 2-wire transmission lines is the ability to measure wavelength (frequency) with a length of open 3-wire line known as a *Lecher wire*. This was one of the earliest known means of measuring wavelength, which has since given way to calibrated oscillators and frequency counters.

A Lecher wire is a length of 2-wire line mounted on sturdy supports, with some kind of current-detecting device placed across the wires. This detector is fitted with sliding brushes so that it can be slid along the line while making continuous contact.

In use, note is made of a high-voltage spot along the line and the distance measured to the next one. Wave theory states that these points will occur at distances of a half-wavelength apart. Therefore, you multiply the distance between the two points by 2 in order to determine the length of a full wave. In actual practice, you usually measure between two *low* voltage points when using a lamp indicator. It is easier to determine variations in low-light levels than in high ones.

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

Quarter-wave lines

The quarter-wave line has a number of useful and interesting characteristics. Shortly after World War II, there was a lot of talk about "metallic insulators." Used in microwave systems, the quarter-wave's ability to convert an open circuit to a short proved invaluable in radar work. Any line that is an odd quarter of a wavelength long, such as 90° or 270°, or odd multiples thereof, will convert an open at the transmitting end to a short at the receiving end, and vice versa.

As most hams know, a quarter-wave line will act as a transformer, transforming impedance Z_r at the receiving end to Z_t at the transmitting end. Acting as an impedance converter, a quarter-wave line will raise the transmitting end's impedance if the receiving end's impedance is reduced. It makes a useful transformation between two different impedances in RF networks.

A line that is an even number of quarter-waves long, that is, half-wavelengths (180°, 360° or any multiple thereof), will reproduce exactly the load impedance at the sending end. Therefore, Z_s always equals Z_r, regardless of the line impedance.

This feature becomes useful when you need to measure impedance at some distance from a convenient point to place the bridge. How do you know when the line is exactly a half-wave long? Short one end and measure the impedance at the other end. It will be zero if the line is a half-wave long and there is no appreciable attenuation. If there is a small amount of attenuation, the impedance will read extremely low and resistive.

Some properties of coax

Various equations have been published that describe the characteristic impedance of coaxial line. One that is often used is:

$$Z_o = 138 \log R_2/R_1$$

R_1 is the inner conductor radius, and R_2 is the outer conductor radius.

Choice of line size depends on frequency vs. attenuation and the power to be carried. Contrary to what might be expected, "the larger the line, the lower the attenuation," does not hold forever. For a given size of outer conductor, there is an optimum inner conductor size. This ratio is 3.6 outer to inner, which provides an air-dielectric impedance of 77Ω.

As a general rule, a given line will have three times the attenuation at 9MHz than it does at 1MHz. It can be said that attenuation increases with the square of the frequency.

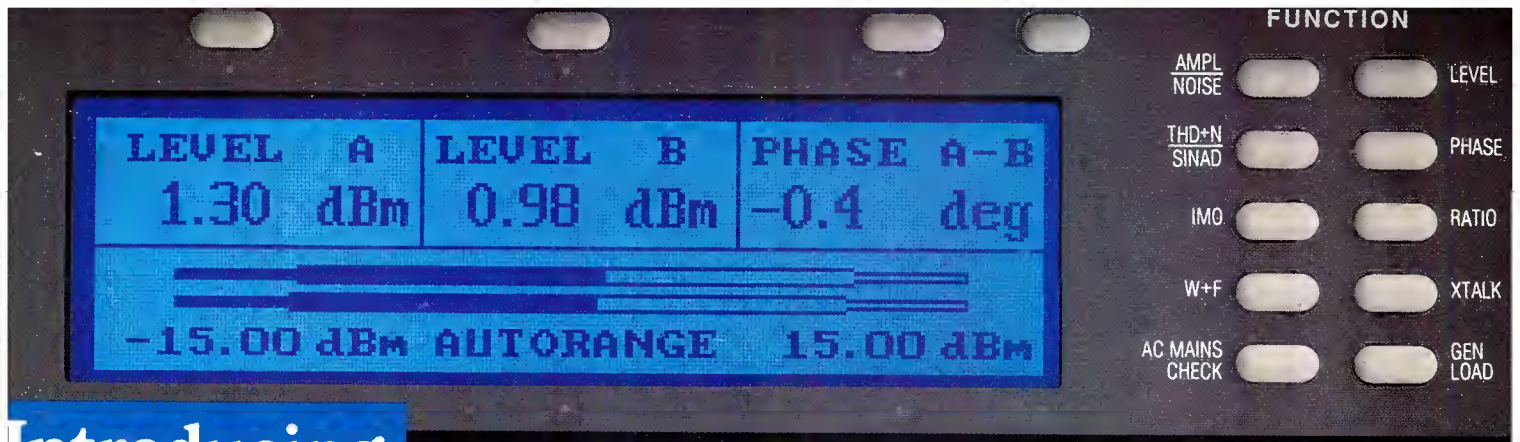
Rigid vs. flexible coax

Although rigid line has been popular for years, it can suffer from a problem caused by bead spacing. The presence of the insulating beads can affect the dielectric constant of the line. This is most pronounced at higher frequencies in the UHF range.

When the spacing between beads is small compared to a half-wave at the operating frequency, there is no problem. However, if the bead spacing approaches a half-wavelength, a rather violent impedance change takes place at the transmitter end. In practice, cable-makers avoid this problem by arranging beads in groups of two, separated by a quarter-wave. Thus, the reflections tend to cancel each other.

However, spacer beads in an older rigid line installation could slip and change position enough so that standing waves are produced, or dangerous hot spots are created. It's worth considering this possibility in those rare cases when an FM (or TV) line gets too hot or gives you trouble for no apparent reason.

Conductor heating can also lead to early failure if limits are exceeded. The inner conductor dissipates more power and heat, because it is smaller than the outer conductor. This can produce bead melting, slippage and subsequent failure. Ambient air temperature is also a factor to consider when selecting coaxial line. (Editor's note: See "Applied Technology: Eliminating Transmission Line Wear," *Broadcast Engineering*, September 1990.)



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Bylaw revision gets approval

By Bob Van Buhler

At the annual October election, Brad Dick was re-elected as president of the Society of Broadcast Engineers (SBE). Robert Goza was chosen as the SBE treasurer. Vice president, Richard Farquhar, and secretary, Paul Lentz, running unopposed, were re-elected to their offices. A ballot proposal to modify the SBE bylaws was also passed.

Dick, editor of *Broadcast Engineering* magazine, defeated his challenger, Andy Butler, by approximately a 2:1 ratio (989 to 551). Butler is director of engineering at WBAL-AM and WIYY-FM in Baltimore, MA. He is also vice chairman of SBE Chapter 55. Members approved a bylaw revision designed to require minimum attendance at executive committee and board meetings, and to provide a mechanism to replace directors and officers unable to fulfill their SBE responsibilities.

Since Dick's first term began, the attendance and voting records of all officers and directors have been published in several sources, and are announced in official notices accompanying election materials. The bylaw amendment passed by members codifies this publication as a permanent change.

Record attendance at SBE convention

The officially released figure of 3,727 puts SBE's 1990 convention attendance at an all-time high. According to president Dick, a big increase in pre-registration indicates that engineers are planning ahead and budgeting for the convention now. SBE session coordinator and former SBE president, John Battison, expressed his satisfaction with the quality of technical material presented and with the attendance at the seminars. Battison attributes the improved quality in technical papers to the ever-increasing attendance of engineering personnel who work in highly placed positions.

One observation that should please owners and managers who send their engineers to the SBE convention is that the papers are increasingly directed toward operating facilities in more efficient and cost-effective ways. According to Battison, "Today's engineers recognize the need to be bottom-line oriented. They know that equipment decisions are related more to saving costs and improving efficiency than ever before. We've been able to provide this important training, along with the nuts-and-bolts sessions that we've done so well before."

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

Record attendance at Ennes sessions

Nine sessions at the Ennes workshops, held in conjunction with the national convention in St. Louis, had a 20% increase in attendance over last year. Sessions in video production techniques, TV studio design, satellite and earth station technology, RF technology and transmitters, AM stereo and engineering management were sponsored by some of the industry's top manufacturers and vendors.

Plans are under way to videotape some of the Ennes workshops in Houston next year. SBE plans to use the videotaping done at the 1991 Ennes workshops as chapter and collegiate training materials.

TAB joins SBE in Houston

Next year, the regional Texas Association of Broadcasters' (TAB) meeting is scheduled for the same month as the SBE convention in Houston. The TAB meeting has been highly successful. Furthermore, TAB is the largest state broadcast association in the United States.

The TAB had originally scheduled its meetings and exhibits to be held in San Antonio and to run nearly concurrent with the SBE convention. Because of meeting and exhibit space commitments, these shows are often scheduled years in advance. The SBE and TAB reached an agreement to move the TAB conferences from San Antonio to Houston. The TAB meeting will now be jointly held with the SBE convention. The exhibition facilities will be coordinated by SBE's Dallas-based show manager, Eddie Barker.

The show will give engineers and managers the unique opportunity to tour the exhibit halls together, and to make informed purchasing decisions on the basis of firsthand exposure to sophisticated technical resources. The TAB will hold its own management-oriented sessions separately from the SBE engineering seminars. One jointly-held session is aimed at improving communications between managers and engineers. The TAB attendees will be welcomed at the traditional SBE functions, such as the exhibit hall reception and closing-night banquet. The 1991 SBE convention and TAB conference will be held Oct. 3-6 in Houston.

Contracts renewed

Show management contracts with Eddie Barker Associates, exhibition manager for the Denver, Kansas City and 1990 St. Louis exhibits, have been extended for another year. In keeping with the original agreement, long-term contracts for show management are not given, in order to maintain SBE direction and quality of the society's event.

The agreement with *BE* magazine for conference organization was extended for three years. The magazine has been coordinating the technical seminars for SBE since the first SBE national convention in St. Louis in 1986. However, the seminars and exhibition are under the direction of the SBE conference committee. The board also wants to explore avenues to involve all of the broadcast industry trade publications in the conference.

Washington lobbying effort

At the October board of directors' meeting, the directors approved a proposal to initiate the SBE's first official effort at Washington lobbying. Acting upon a motion by director Dane Ericksen P.E., a San Francisco consulting engineer, SBE will seek an amendment to the 1934 Communications Act. The amendment would require at least one of the FCC commissioners to be an engineer.

Ericksen's proposal defines "engineer" as someone who possesses at least a 4-year engineering degree from an ABET-accredited school of engineering, registration as a professional engineer in any discipline in any state, or senior certification or Fellow status in any nationally recognized engineering society, such as SBE, IEEE, SMPTE, NARTE or SCTE.

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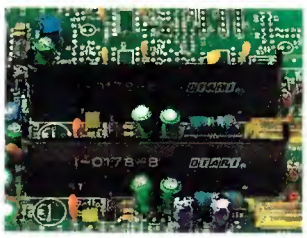

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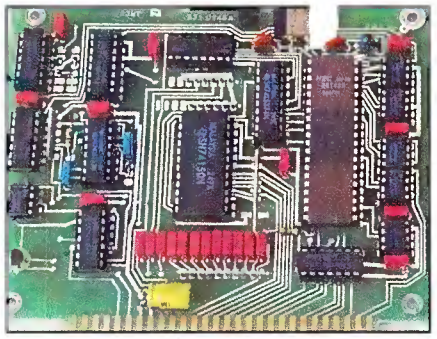
Part 4

Circuits



Building with microcontrollers

By Gerry Kaufhold II

Standard microcontroller IC packages have 40 to 64 pins. When chip designers lay out a microcontroller, they must make sure the proposed device can do its job with the number of pins available. All microcontrollers will require power supply (Vcc) and ground (Vss) pins and a clock. The balance of the pins is used for everything else.

Inputs and outputs

The Z-8 is a multipurpose family of microcontroller devices. Different configurations suit different applications. Versions that contain a program embedded in on-board ROM have no need to connect to external memory. On these versions, such as the Z-8601, the unused pins are used for input and output. There can be up to 32 bits of I/O. This is more than sufficient for interfacing a joystick, small keyboard and several push-buttons to a video game controller.

On the other hand, the Z-8681 provides 24 bits of I/O, most of which is dedicated to the interface for external memory. Because the Z-8 is an 8-bit machine, it makes sense to design the input and output functions as 8-bit units. Each of these 8-bit input/output units is called an I/O port.

A typical microcontroller has three or four of these 8-bit I/O ports. Each bit of each I/O port can be individually set to a 1 or a 0. You can apply the information presented here to microcontrollers from a variety of manufacturers because all microcontrollers use I/O ports.

I/O in a word

The program running in the microcontroller treats all the I/O ports as memory addresses. The process of microcontroller input and output falls into two divisions: external memory control and general purpose I/O. The program that is running inside the Z-8 sets up how it will use each I/O port immediately after the power is applied or after each reset. For the most part, I/O ports 0 and 1 are used for external memory control.

Port 0 uses several 8-bit registers inside the Z-8. Two of these are the mode and data registers. The mode register controls how each bit of the port is used. The data register holds the data that passes through the port. (See Figure 1.)

For the Z-8681, port 1 provides eight bits of address and is multiplexed to provide eight bits of data. Port 0 can be configured to act as an extra four or eight bits of addressing. Eight bits of addressing will access only 256 memory locations. This is not really enough to be of practical use. Twelve bits of address will access 4,096 bytes. Sixteen bits can address 64kbytes.

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 the port 0 and port 1 mode register. This tells the Z-8 to treat the lower four bits of I/O port 0 as an external memory address interface, and to treat all eight bits of port 1 as memory address and data interface.

The mode register for ports 0 and 1 is located at decimal address 248, which is address 0F8 hexadecimal (0F8h).

Port 2 and port 3 are general purpose I/O registers. Each bit can be controlled independently. This is useful to turn on or off external devices. For instance, bit 0 may trigger a transistor that pulls in a tape machine start relay. Bit 1 could sense that the relay has been tripped. Bit 2 could be used to light an LED indicating the tape machine is active. Bit 3 could output an alarm condition if bit 1 failed to sense the relay trip within a preset time interval.

Some of the bits in port 3 can be used for serial input and output. They connect to an asynchronous UART that is built into the chip. These lines go to internal shift registers, which convert the incoming or outgoing serial stream to parallel for processing. This will be covered in greater detail in a future column.

Programming the Z-8

Programming microcontrollers is straightforward. This explains why so many common appliances, such as microwave ovens, video games and automobiles use microcontrollers. When we get to the subject of programming a microcontroller, we will demonstrate just how easy it is to use I/O ports and mode registers.

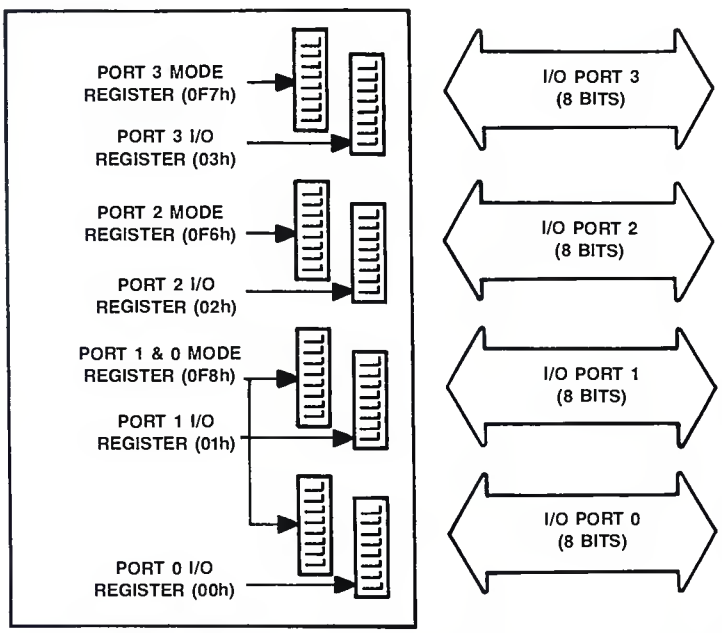


Figure 1. The I/O ports and mode registers on the Z-8 family of microcontrollers are treated as memory addresses (given in hexadecimal). |:-)))|

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

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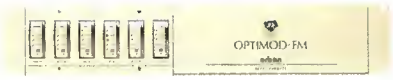

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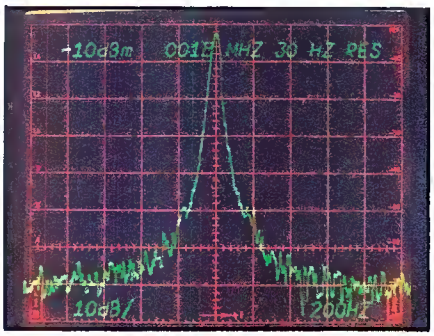
Part 3

Troubleshooting



Servicing your klystrons

By Colin Erridge

Last month, we described in detail the correct procedure to clean the cooling passages of water/vapor-cooled klystrons and associated transmitter equipment. Using that process is only the first step to ensuring the maximum life of your klystron equipment.

The second major factor affecting the life and operating efficiency of vapor-cooled tubes is the purity of the water in the cooling system. If impurities are present, *foaming* may occur. This will inhibit heat transfer, thereby lowering the cooling efficiency of the system. A typical klystron cooling system with purification loop is shown in Figure 1.

The following is a list of impurities that may cause foaming, and directions on how to perform a foaming test.

Impurities that most frequently produce foaming are:

- Cleaning-compound residue.
- Detergents.
- Joint-sealing compounds.
- Oily rust preventives in pumps and other components.
- Valve-stem packing.
- Impurities in tap water.

The following test should be performed after each water change, system cleaning or modification.

Equipment

The following items are needed to perform the test:

- A ½" × 4" glass test tube with rubber stopper.
- A 1-pint glass or polypropylene bottle with cap.

Procedure

1. Fill the cooling system with water and circulate until thoroughly mixed (approximately 30 minutes).
2. Drain the sample of water into bottle and cool to room temperature.
3. If the water sample stands for more than one hour, slowly invert the capped bottle about 10 times. Avoid shaking the bottle because this will create air bubbles in the water. (When the water is static, foaming impurities tend to collect at the surface. This step mixes sample without generating foam.)
4. Using sample water, rinse the test tube and stopper three times.
5. Half fill the test tube with sample water.
6. Shake the test tube vigorously for 15 seconds.
7. Let the sample stand for 15 seconds.
8. Observe the amount of foam remaining on top of water and compare with the drawings in Figure 2.

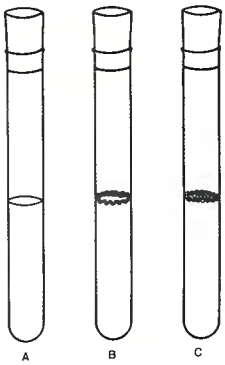


Figure 2. *The amount of foaming in the transmitter's cooling system is crucial to effective operation.*

Evaluation

A completely foam-free water surface and test-tube wall indicate no foam-producing impurities. (See Figure 2A.) If the water surface and test-tube wall are partly covered with foam, but a circle of clear water appears in the center, the impurity level is temporarily acceptable. (See Figure 2B.) A second test should be made in approximately one week.

If the foam layer completely bridges the inside of the test tube, the system should be flushed and cleaned. (See Figure 2C.)

Erridge is product manager, Varian Associates, Palo Alto, CA.

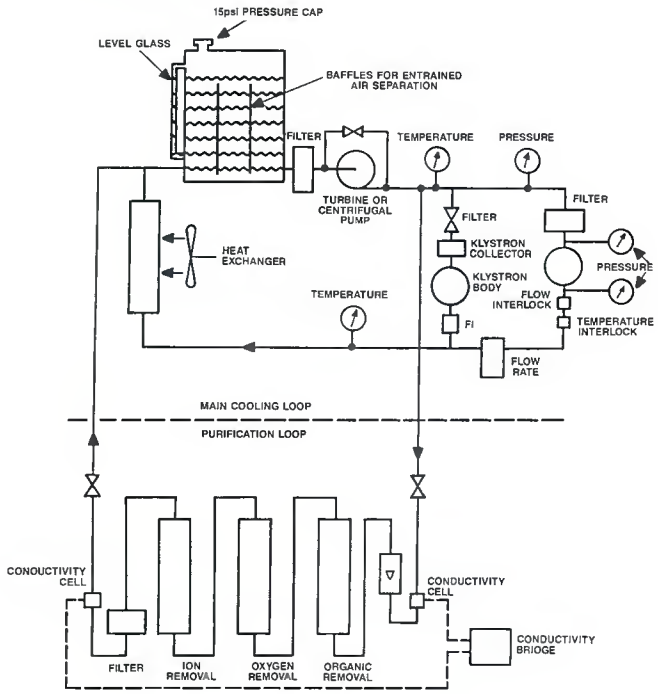


Figure 1. *Klystron cooling system with purification loop.*

Editor's note: Additional information on klystron and Klystrode operation can be found in the following issues of *Broadcast Engineering* magazine:

1. "UHF-TV: Breaking New Efficiency Records." Jerry Whitaker. May 1988, pp. 104-124.
2. "The Klystrode in Operation." Jerry Whitaker. December 1988, pp. 64-82.
3. "Breaking New Ground: The MSDC Klystron." Jerry Whitaker. March 1988, pp. 34-50.
4. "Comparing Klystron Designs." Jerry Whitaker. March 1988, pp. 54-67.

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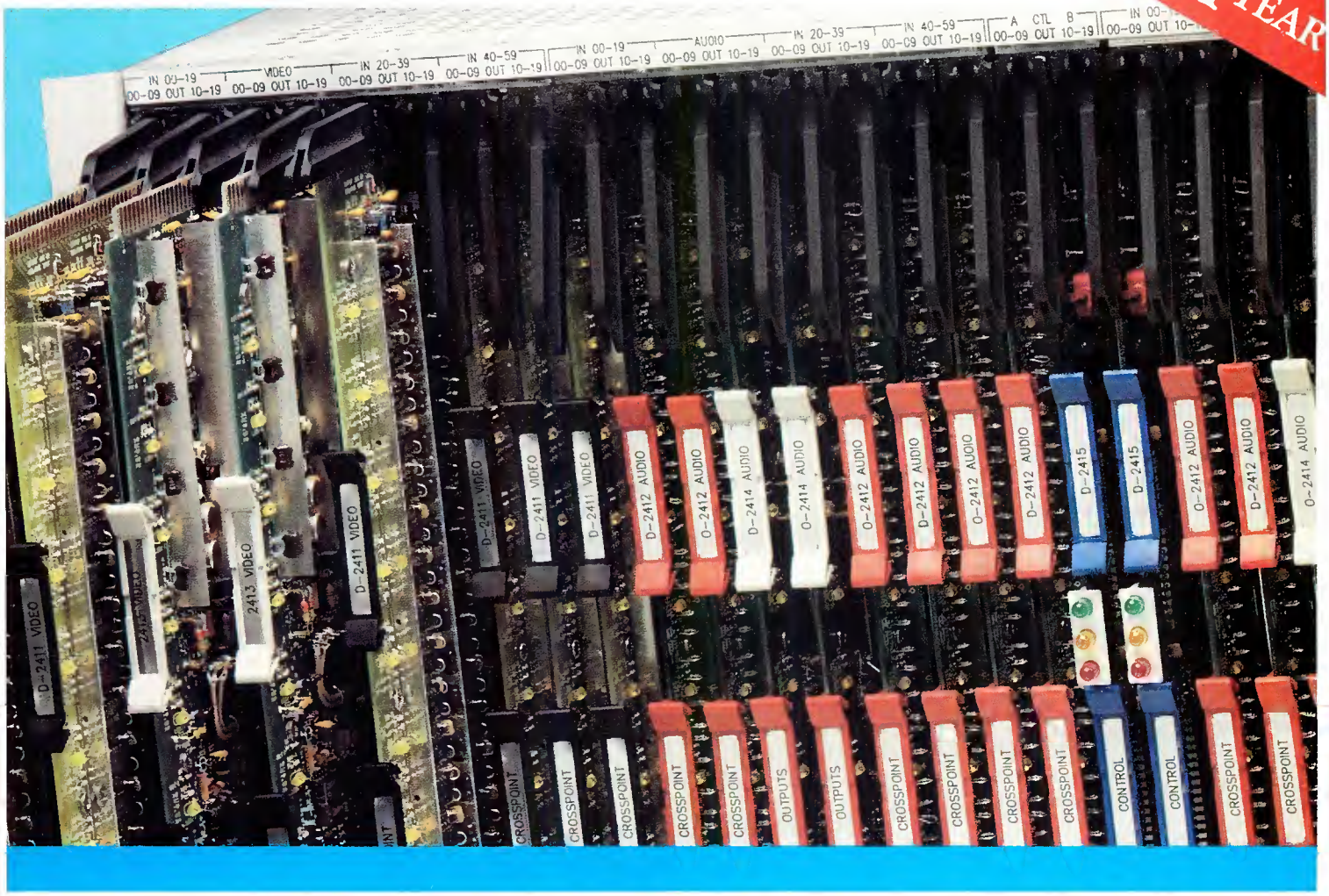

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Part 3

Management for engineers

Project management for engineers

By Judith E.A. Perkinson

Ask yourself the following questions:

- Have you ever felt like you have the weight of the world on your shoulders?
- Have you ever felt like everyone wants a piece of you?
- Have you ever felt like there is too much work and too little time?

If you answered "yes" to any of these questions, then you need a team!

Remember: No one is an island

Too often, we think we have to do it alone. We use lots of excuses:

- If I want it done right, I have to do it myself.
- It takes more time to explain it to someone else than to do it myself.
- I have a hard enough time keeping track of the work. If I have to keep track of people too, I'll never get the job done.

As true as these things might sometimes be, they are still excuses. People who try to do everything only end up hurting themselves. At the worst, they end up with a heart attack. At the least, they limit their upward mobility by proving to upper management that they don't have management capabilities.

If you put together a good team and manage it well, you will save time, free yourself for more important tasks and actually do a better job than you could do by yourself. Even if you don't believe this is true for everyday department management, you need to use a team when you are managing a project.

Three important rules of modern management include:

- Rule No. 1—No one knows it all.
- Rule No. 2—No one can do it all.
- Rule No. 3—You should never feel that rules No. 1 or No. 2 are expected of you alone.

What does a team do for you?

Teams do more than just spread the work around. Experienced project managers understand that a team can:

- Provide you with assistance, support and valuable input throughout the project.
- Get you the "buy-in" you will need in order to get the job done and get the change accepted.

Perkinson is senior member, the Calumet Group, Hammond, IN.

This second element is often overlooked. Change is threatening for most people. People resist change even if it is good for them.

Many non-technical people resist technical changes because their lack of understanding makes them uncomfortable. These feelings breed fear, which is translated into resistance. Involvement in the project team makes everyone more comfortable, promotes understanding and reduces resistance.

Who is on a team?

A team can be more than just your direct subordinates. It can be made up of people in and outside your immediate supervision. When developing your team, consider the following sources for membership:

- *Operations*

Never forget to include the people who will actually use the equipment or implement the change. From planning to final implementation, you will find your operations people have valuable input. Don't underestimate the value of their knowledge as to how the current system has been modified, jerry-rigged or circumvented. They can also be some of your greatest resistance so their buy-in is critical.

- *Vendors*

Vendors who are supplying the equipment, supplies or technical support can either be a blessing or a curse. They will be far more useful to you if they understand the impact they have on the project. Their involvement is valuable because they know the new equipment better than you do, and can assist in any training efforts.

- *Maintenance staff*

When your project is equipment related, the involvement of the maintenance people is essential. The people responsible for the day-to-day maintenance will know a great deal about the current system. In addition, they will need to be trained on the new equipment. The project is an opportunity to combine work and learning. An additional benefit is that their understanding can eliminate or minimize future problems.

- *Project workers*

The most obvious team members are the project staff. This could be any number of people, depending upon the size of the project. Their inclusion on the team will foster greater understanding, which should result in better and quicker work on the project.

Team management

Managing a team is not an opportunity to relinquish your authority. By involving a team, you have dispersed the workload, but not the management responsibility.

- *Communication*

A key element in team management is communication. Your team can be used from plan development to final report, but wherever you use them, you must communicate with them.

Team management, like project management tools, needs an effective communication strategy. Two key problems dominate any communication strategy:

1. How do you find out what is going on?
2. How do you let team members know what is going on?

Circumstances, personal style and physical conditions will determine your actual method of team communication. The most effective tools available include regularly scheduled team meetings, memos, reports, meeting minutes, phone contacts or personal contacts and reporting-in mechanisms. Meetings don't have to be long, and written correspondence does not have to be traumatic. However, you do have to find a way to communicate.

- *Tracking*

In addition to communication, you should have some idea of how you will track progress. Your team should know the system you are using. They should also have access to the information generated by the tracking system.

Making it work for you

Projects vary in size and nature. Teams, large or small, can provide you with the support you need, make valuable information available to you and make a project go smoother. As the project manager, you are ultimately responsible for the success or failure of your project.

Next month, I'll discuss how to develop solutions to problems when things go wrong.

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Technology forecast for 1991

The future is now and computers are at the helm. Don't let your station fall asleep at the wheel when it comes time to upgrade.

I've almost given up asking my broadcast buddies, "How are things going?" The many phrases of doom and gloom are becoming trite. However, I recently returned from a combination sales trip and SBE meeting and I'm more encouraged about broadcasting's future.

While visiting with some broadcast equipment manufacturers, I was reminded of some of the problems they face trying to introduce new products and technology into a mature (not to mention soft) broadcast market. Manufacturers say that broadcasters purchase new equipment not because a new model is better, but because their competitors have one or that the device improves efficiency. Broadcasters are also concerned about purchasing technology that might be outmoded before the hardware is paid for. Fortunately, there is good news to report on this front.

Computers have brought to the marketplace an innovation even more powerful than their number-crunching mastery. Computers only do what they're told, but do it well and fast. Therein lies their beauty.

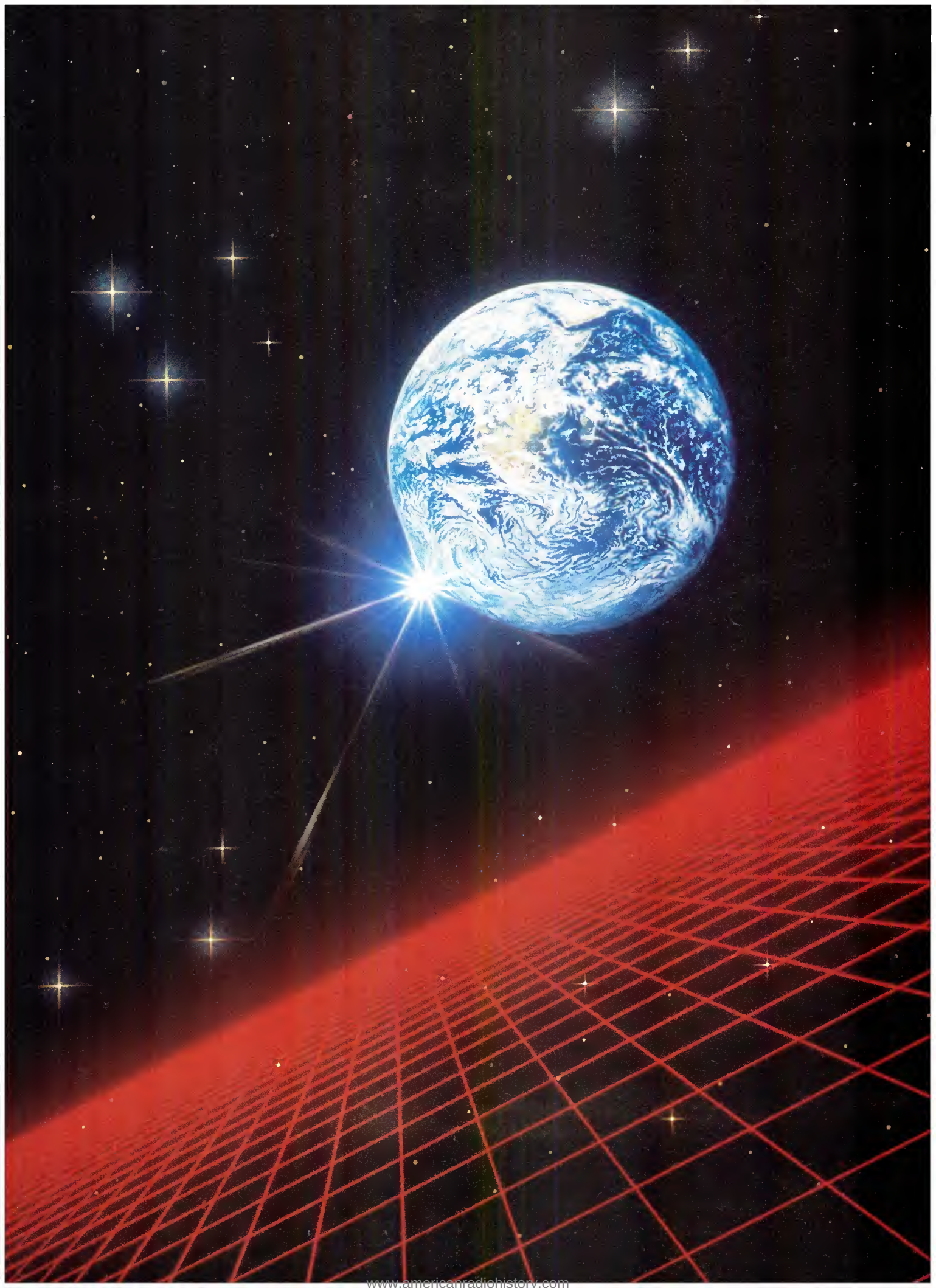
Once I have a computer on my desk, I can teach it to do almost anything quickly. By loading a spreadsheet, the computer becomes a powerful financial analyst. If I press a few keys and wait 30 seconds, it becomes a word processor, worthy of any budding Mark Twain or William Allen White.

Using PCs as a base, a computer-graphics workstation can be used all day by the most creative person on your design staff. Then, at night, the maintenance engineer might load a program on that same computer to help track preventive maintenance for your entire production house or station.

As broadcasters examine where they are today, they must not lose sight of tomorrow. Nothing we do can change that. We can either prepare for it, or be passed by it. Those stations that want to be successful will hold onto this lightning-paced monster for all they're worth.

Brad Dick

Brad Dick, editor



What it was like shooting in

For all those cameramen who've ever been forced to compromise or even miss a shot because of tough lighting conditions, Sony has some good news. The BVW-400 Betacam SP® camcorder. Now even the most difficult situations will never leave you in the dark.

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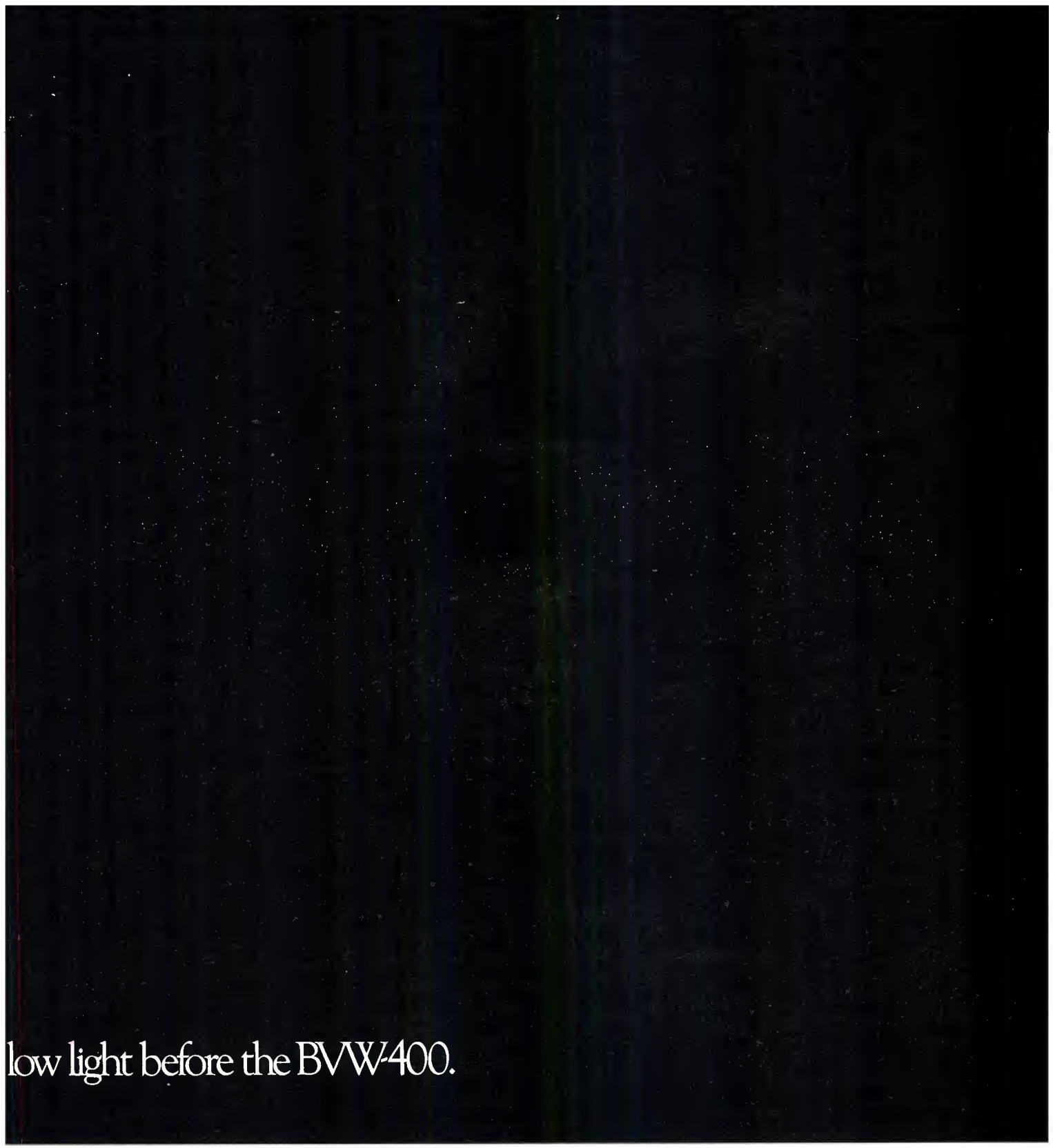
The BVW-400's extraordinary light sensitivity lets you shoot with more creative freedom. For



example, you can shoot an hour earlier and an hour later, so you can use more natural light. You can also shoot with less lighting equipment. Which means less set-up time, fewer hot lights, and less wear and tear on your talent. And in optimum lighting, the BVW-400 gives you the flexibility to shoot with greater depth of field.

But low light isn't the only area where the BVW-400 shines. It also gives you a sharp, clear image with over 700 lines of resolution and virtually no vertical smear. And it features genlock, center and safe zone markers, and a lightweight, one-piece camcorder body.

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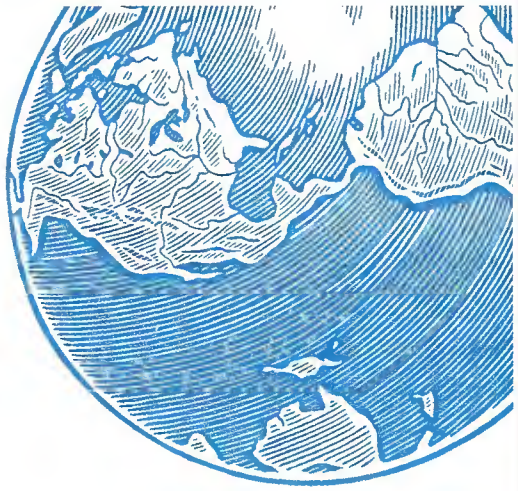

There's good news coming — if we can hang on.

By Brad Dick, editor

There's good news and there's bad news.

First, the bad news. The broadcast industry is still in a slump.

Now the good news. We're not sinking as fast as we were at this time last year. Much of the shakeout has already occurred. Stations are learning to cope with backbreaking debt. Best of all, some areas are even showing signs of improvement.

Light at the end?

It's too early to say that there's light at the end of the tunnel, but the worst may be over for many stations.

There is still plenty of bad news if you want to look for it. Staff sizes continue to drop in TV stations. Budgets are generally smaller. Fewer stations are planning for equipment purchases than last year. However, once you get past the obvious, there are some signs that if we can hang on for the near term, a settling down could be in the offing.

That's not to say that good times are back. We still see stations suffering from crushing debt resulting from the trading madness of the past few years. As we've learned, the selling of broadcast properties seldom improved station operations. Rather, the station ownership typically shifted from those who'd built the stations and invested in their communities, to large corporations and brokers looking for a fast buck. The operative phrase was "buy it and sell it." Although these trades often produced a nice profit for the owners and the brokers, the station staffs reported little benefit of such trafficking. The most common result was decreased staffs, slashed equipment and personnel budgets and, worst of all, devastating debt that will last for years.

Few people in the stations benefited from these practices. The winners were the brokers and the original owners who often reaped huge profits in these transactions. Many stations now find themselves strapped with such high debt service that they can no longer serve either the staffs or community at the levels they used to. Enough about how we got in to this mess. Where is the good news mentioned earlier?

Internal strength

What appears to be happening is that stations, straddled with these high levels of debt, are learning to cope. There still isn't the amount of capital for improvements we'd all like, but the strong stations continue to invest in technical improvements. It appears that short of a long-term recession, the broadcast industry will survive the mistakes of the past few years.

Figure 1 shows the percentage of TV and radio stations planning upgrades based on market size. The top 50 and noncommercial TV and radio stations lead the way in planning for newer facilities and equipment. This is the first year that we see strong performance by the noncommercial category.

The survey

The *Broadcast Engineering* annual state-of-the-industry survey is the second of a 2-part overview of the trends and conditions within broadcasting. The October issue of *BE* contained the results of the salary survey, which was the first half of our industry study. That issue looked at salaries and benefits paid to radio and TV management and engineering and operations personnel. The state-of-the-industry survey completes the task by providing an overview of purchasing and budgeting plans.

The survey was scientifically conducted by the marketing research department of Intertec Publishing, under the direction of Vicki Kerns-Vall. On June 22, 1,851 questionnaires were mailed to *BE* subscribers with technical and engineering management titles on an "nth name" basis. By August 31, 707 usable questionnaires had been received, representing a response rate of 38.2%. The data contained in this report is based on those responses. All results represent median values.

TV plans

Repeating last year's results, four of five markets show a decrease in the percentage of TV stations planning upgrades for 1991. In the total TV market category, approximately 6% fewer stations (74.3% vs. 80.5%) plan upgrades in 1991 than they did in 1990. The TV upgrade plans from 1987 to 1991 are shown in Figure 2.

The most significant change in upgrade plans occurs in the below top 100 TV markets. We see a 19.8% increase in the percentage of stations planning upgrades. The

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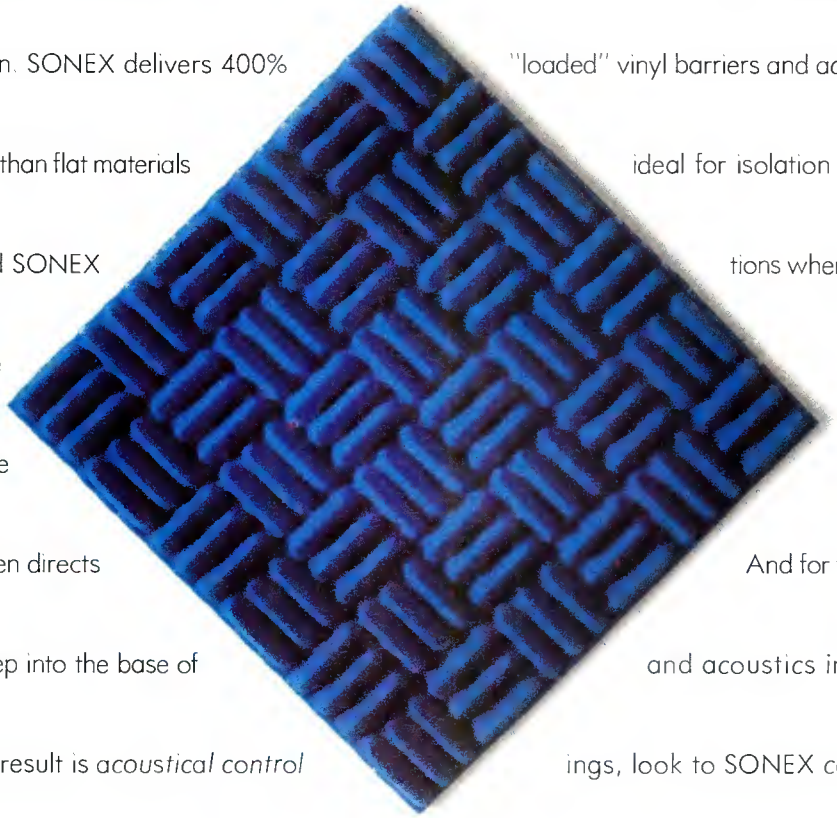

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net change is from 53.6% to 64.2%. Although that category has the smallest percentage of TV stations planning upgrades, the net change is in the positive direction.

The highest percentage of TV stations planning upgrades occurs in top 50 markets. Almost 79% of the TV stations are planning to improve their facilities.

Overall, the TV market appears weaker than last year. Even so, the rate of decrease in the number of TV stations planning upgrades has leveled, and that is good news. Using a forecasting model based on the past five years of data, it appears that the percentage of total TV market stations planning upgrades will settle around the 74% point over the next five years. Although that may not be as high as we'd like, it indicates that the precipitous drop of 15.5% we've seen since 1987 may not continue.

TV budgets

The median equipment budgets of TV stations are again being stretched. (See Figure 3.) The pattern is similar to that of the upgrade plans. Overall, total budgets are down by 4.4% to $236,500. Median budgets of the top 50 stations are up 5.3% to $400,000. The median budget for a top 100 market TV station is down 21% to $184,200. Below top 100 market TV budgets show no change from last year and remain at $75,000. The equipment budget for non-commercial stations is down significantly to $91,700. That may be a reflection of the tightening of the federal dollars.

When asked about plans to spend more, less or the same for hardware in 1991 than in 1990, TV stations showed more, with 31.8%, less with 18.5% and the same at 43%. In other words, a larger number of stations are planning to spend less and

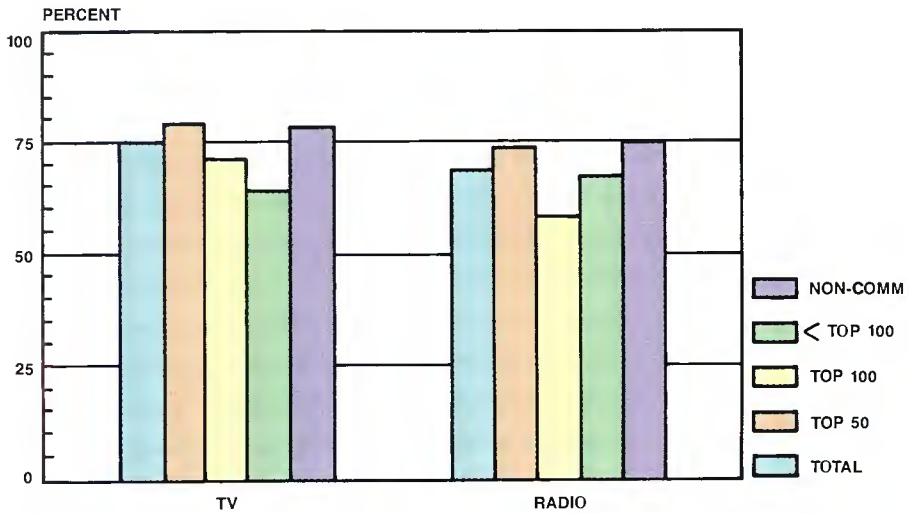

Figure 1. *The overall percentage of TV and radio stations planning to upgrade facilities in 1991.*

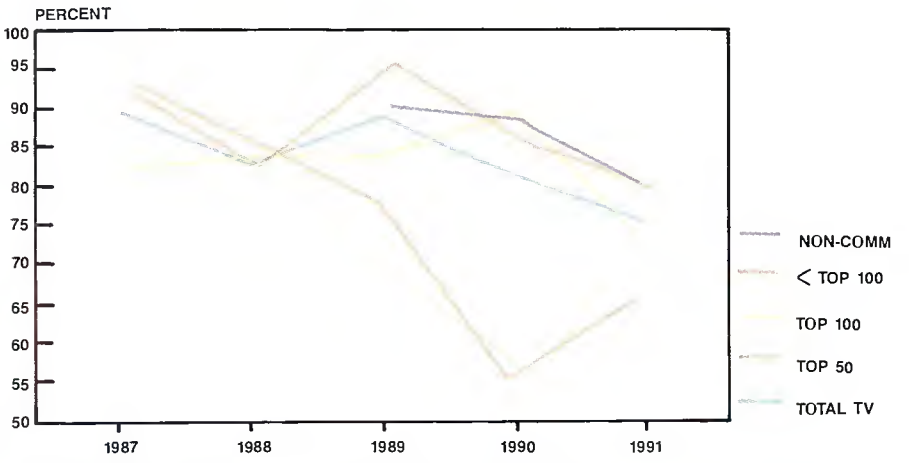

Figure 2. *The chart tracks the percentage of TV stations planning upgrades from 1987—1991. Four of five market categories show a drop in the number planning upgrades. The future, however, looks brighter.*

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.

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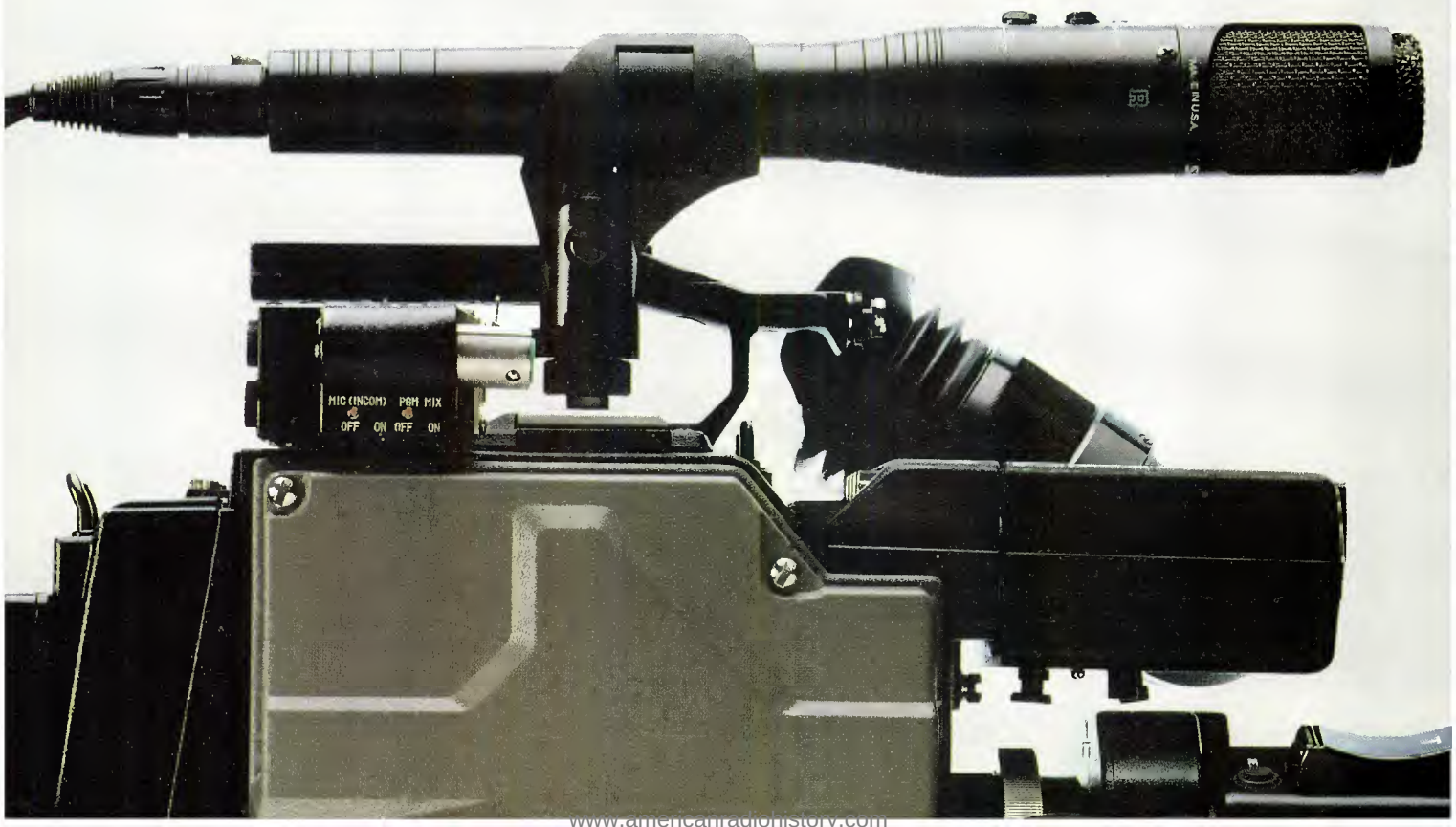

fewer stations are planning to spend more (than last year).

What equipment is hot?

The equipment spending plans for TV stations are summarized in Figure 4. The chart shows the percentage of stations planning to purchase equipment in the listed category.

The most common type of equipment considered for purchase is production hardware. Measured over all markets, 63.9% of the TV stations said they were planning to purchase production items. That's down only slightly from last year.

The second most common equipment category in the total TV market is master-control equipment, at 52.5%, about the same as last year. Following closely was editing equipment, with 43.8% of the stations reporting planned purchases. The least likely item to be purchased was remote-control hardware (16.5%).

Some interesting information is available in Figure 4. The graph shows that the equipment buying plans between the various markets are different. Editing equipment is a hot item for non-commercial stations, but less so for top 100 and below top 100 TV stations. Antennas and transmitters are also on the non-commercial stations' purchasing plans. Although remote-control equipment is relatively important for the top 50 markets (22.5%), this type of hardware is of less importance in the below top 100 markets (2.9%)

Radio plans

The wide swings seen in the salaries and spending plans of TV stations are not reflected in the radio markets. Figure 5 tracks the percentage of radio stations planning upgrades from 1987 to 1991.

Four of the five market sizes show a decrease in the percentage of radio stations planning upgrades. Only in the below top 100 radio markets do we see a larger percentage of stations planning equipment purchases next year, a mere 2.4%. The overall decreases seen in the other markets is similar percentage-wise to that of the same TV market sizes.

Similar to TV stations, the radio stations in the top 100 markets show a double-digit drop in the percentage of stations planning upgrades. Only 58.8% of the radio stations in these markets plan equipment purchases for 1991. That's the lowest percentage of any market category for radio and television.

The non-commercial market has the highest percentage of radio stations planning upgrades, 74.5%. The percentage of radio stations planning upgrades in the other markets is: over all markets, 68.6%; top 50 markets, 73.4%; and below top 100 markets, 67.1%. Using the same projection model as in television, the forecast shows that in the total radio market, the percentage of stations planning upgrades will slowly decrease to approximately 68%.

Radio budgets

There is little good news here. Over all markets, radio budgets are down from last year. Median budgets for all markets, measured from 1986 to 1991, are shown in Figure 6. The median 1991 equipment budget, measured over all radio markets is $18,900, which represents a 17.8% drop from last year. Even the top 50 radio markets took a hit, falling 15.4% to $42,200 from $49,900. This market was at its peak in 1989 with a median budget of $52,000.

Radio budgets haven't been cut (percentage-wise) as much as TV budgets, but there's less to cut. The top 100 radio market median budget is up to $20,400 from $17,000. Below top 100 market budgets are off by 9% to $12,100 from $13,300. The median non-commercial equipment budget is up 10% to $14,200 from $12,800. That's good news even if these stations' budgets are small.

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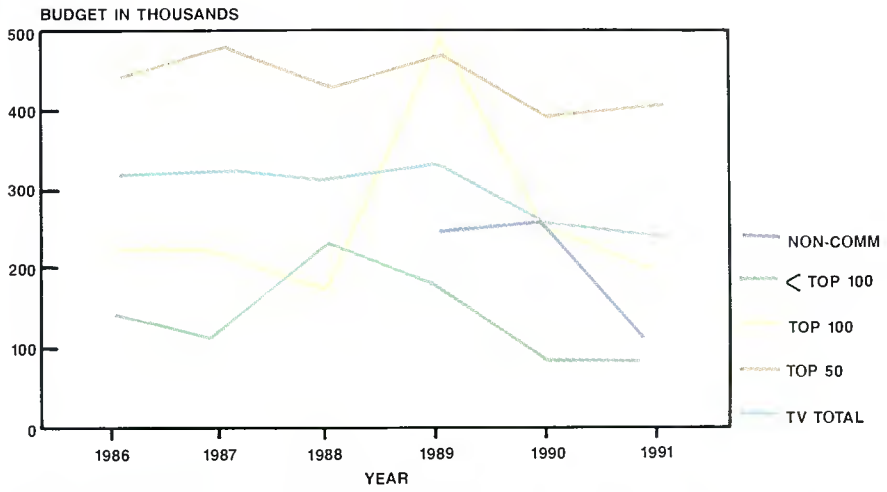

Figure 3. Although the total TV market equipment budget is down by 4.4%, the top 50 TV market is up by 5.3%.

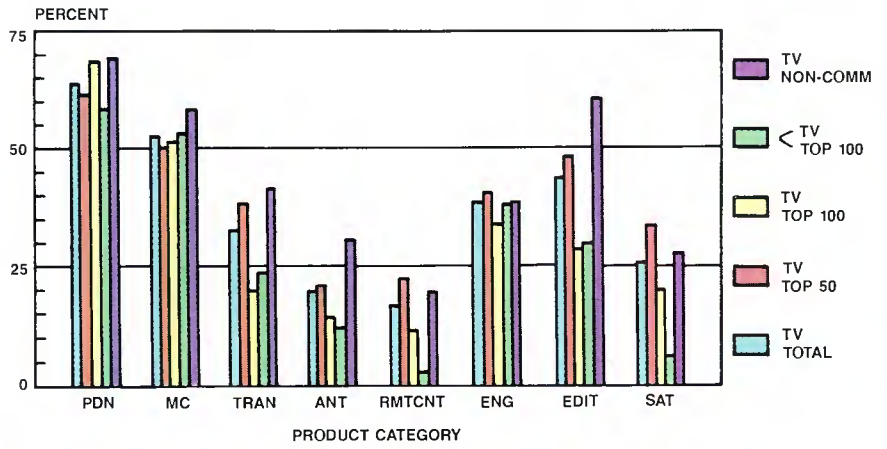

Figure 4. Planned spending by TV stations, broken down by market size and equipment category. Production and master control remain top picks for most stations.

Two interesting factors are evident in Figure 6. First, unlike the wide range in TV budgets vs. market size shown in Figure 3, four of the five market sizes' radio equipment budgets seem to be converging on a value between $15,000 and $20,000.

Second, the chart shows that the equipment costs to support a radio station in any but the top 50 markets are similar. Note that for all but the top 50 markets, equipment budgets range around $15,000. However, the median equipment budget for a top 50 market radio station is $42,200, almost three times higher.

This may indicate that competitive forces in these top markets require the stations to be more conscious of the advantages of new hardware. It may also indicate that many of these stations rely on more live entertainment and less on satellite-delivered and automation-based programming.

If so, then the relative equipment costs to operate a radio station are similar, no matter what the market size. Therefore, once the costs of source-programming equipment are established, the primary other expense that can be adjusted is personnel costs. This would force bottom-line thinking to be directed to personnel as the chief operating expense. A review of the data contained in the 1990 salary survey in the October 1990 issue of *BE*, make such pressures seem evident.

Radio wants

Measured overall, fewer radio stations plan to upgrade than do TV stations. In most categories, fewer radio stations indicate the need to purchase equipment than in the same equipment category for TV stations. Equipment purchasing plans by category and market size are shown in Figure 7.

Continued on page 38

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The formula starts with the outstanding performance of the *SVHS* format. With improved processing circuitry for even greater Y/C component accuracy through multiple generations of recording.

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+ RS-422A + XLR = $6,500

jitter, skew, head impact error and color blurring. The Panasonic AG-7750 also incorporates field coefficient dynamic noise reduction *(DNR)*. It increases the signal-to-noise ratio by reducing video noise during playback for optimal results.

To insure frame accurate editing, there's vertical interval *(VITC)* and longitudinal *(LTC)* time code capability. Both internally through an optional plug-in board, or through external connection.

For advanced system integration, the Panasonic AG-7750 has a built-in *RS-422A* interface. So you can easily take advantage of the unit's high performance with virtually every professional and broadcast video system available.

There's even *XLR* audio connectors with individual three-position level selectors. To help preserve the high quality sound of your productions throughout the editing process.

And it only adds up to *$6,500* (suggested list price).② That's about half of what you would pay for a comparable editing VCR package. And that's no alternative.

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And even though the AG-7450 weighs in at a mere 7.5 pounds, it delivers heavyweight performance. Because it provides you with all the exceptional recording and playback characteristics you demand. Like the economy of two-hour recording on a single cassette, Y/C signal separation with over 400 lines of resolution and a signal-to-noise ratio in

With No Strings Attached.

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So if you're looking for a lightweight dockable VCR that performs like a heavyweight, take a good look at the AG-7450. You won't have to look any further. It's Panasonic field recording. With no strings attached.

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Continued from page 32

The largest category of equipment needs parallels that seen for television — production equipment. The least planned for purchase for radio is for editing equipment. In all but two equipment categories, a higher percentage of non-commercial stations show a desire for the equipment than any other market.

After production equipment, master control, transmitters and antenna systems are the most popular items for radio stations. Master-control equipment follows close behind. Remote-control systems, which were the least desired equipment category in television, is the fifth most popular item for radio stations.

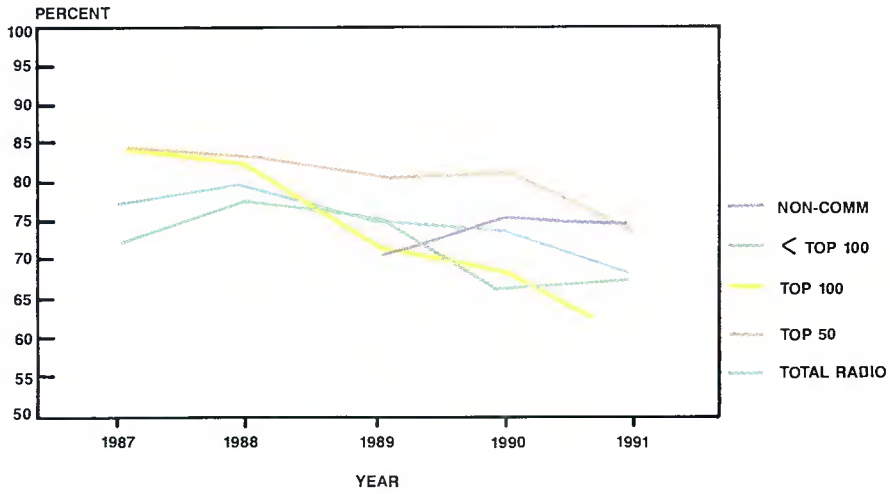


Figure 5. *The chart tracks the percentage of radio stations planning upgrades from 1987-1991. Although this year's trend is down in some areas, things look better over the long haul.*

Staff size

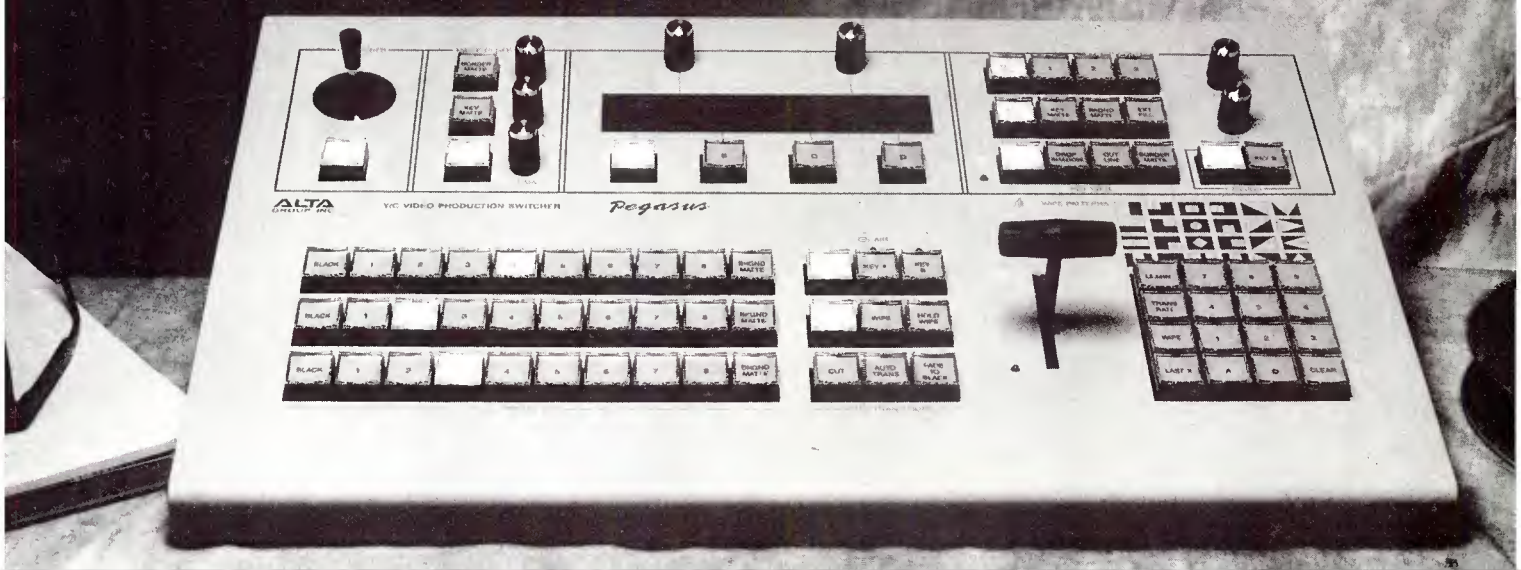
Television continues to see gloom and doom in terms of technical staffs. Figure 8 summarizes the median engineering staff sizes for the past five years. The downward trend seen in television since 1986 continues. Last year, we saw a 20% reduction in the median staff size at TV stations. The trend continues with a 11.8% drop to 9.7 engineers per station. This represents a 52% drop in the median staff size in the last five years.

Radio stations have seen a small increase in the number of engineers. Last year, the median radio engineering staff size dropped to 2 from 2.3. The median size increased back to 2.3 this year. Maybe the pendulum is swinging back to reality in the radio markets.

Only in the TV area is staff size highly dependent on market size. Over all TV markets, we see a median staff size of 9.7 engineers. In the top 50 markets that increases to 24.4, but the number falls rapidly. The top 100 TV markets show a median engineering staff size of 8.6, below top

Continued on page 42

JUST SAY NO TO GRASS.



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	GVG-100N	Pegasus	GVG-200-1
Video formats	Composite only	Y/C or composite	Composite only
No. of inputs w/ color & blk	10	10	20
No. of video levels on-air	3	4	5
Color wash gen	No	Yes	Yes
Mem. system w/ event storage	16 events Opt.	100 events Std.	Std.
No. of wipe patterns	10	27	30
No. of ext. key inputs	2	4	6
No. of keys over wipe insert	1	2	3
Key priority assign	No	Yes	No

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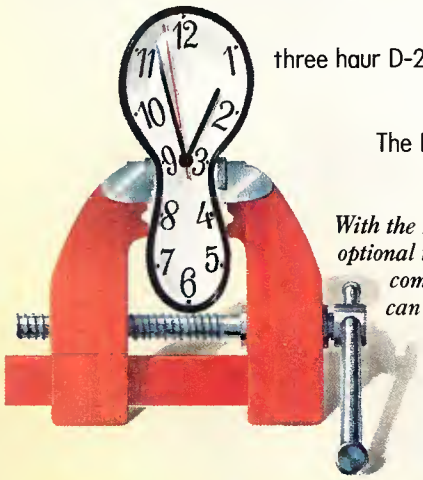
D-2 has expanded the li
Now it can co

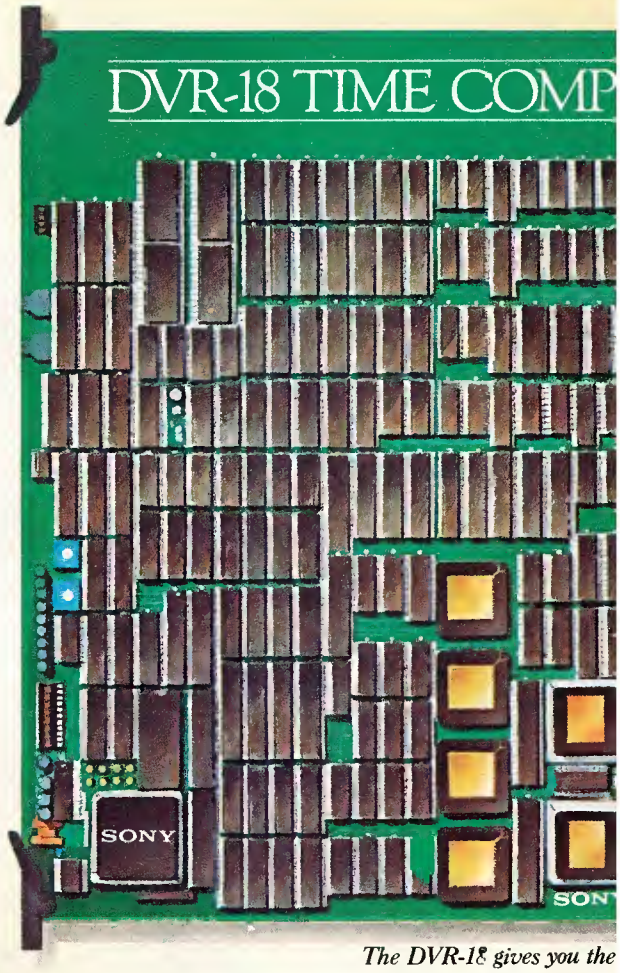
It was only a matter of time. Naw Sany D-2 campasite digital videa affers braadcasters same-thing they've been waiting far. Time campressian. It's an aptian naw available an the DVR-18, Sany's three haur D-2 VTR.



With the DVR-18's optional time compression, you can squeeze more out of the time you've got.

The DVR-18's time campressian and expansian feature is remarkably advanced. A single plug-in module pravides full audia data recavery as well as precise digital pitch carrectian far twa sterea pairs af audia signals at the same time. Far example, yaur main audio channels and yaur SAP. All withaut the need far any external equipment.

Plus, the DVR-18 gives yau Sany's advanced picture pracessing far the highest quality videa playback. And since it's digital, yau'll get a time



The DVR-18 gives you the

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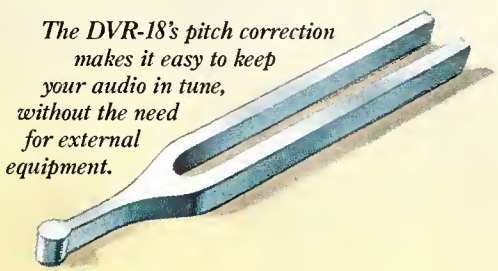

The DVR-18's pitch correction makes it easy to keep your audio in tune, without the need for external equipment.

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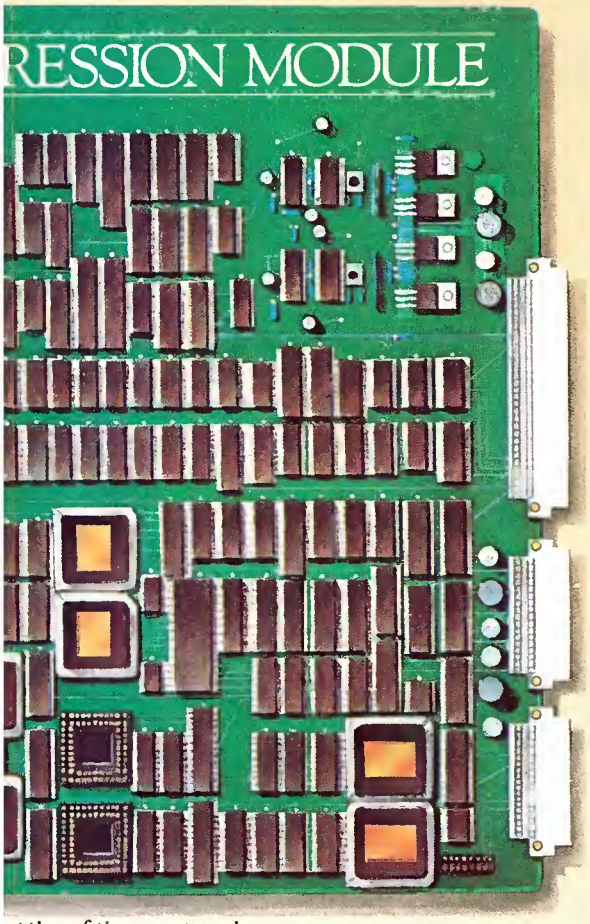


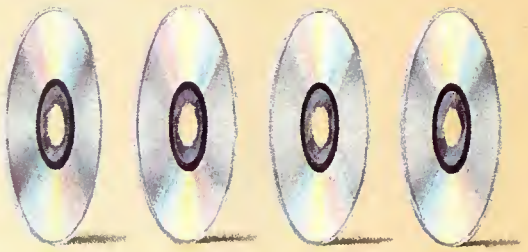
option of time compression.

casters shauld cansider D-2. The DVR-18 affers recognizable calar pictures at shuttle speeds up to 100X play speed. It can alsa accammodate all three D-2 ccssette sizes. Sa it can give yau a full three hour capacity. And it can pre-stripe tape stack at three times narmal speed far insert editing.

The DVR-18 also has an aptianal serial digital interface. Which means simple, canvenient cannection ta ather digital equipment.

When you compare the size af a Sany DVR-18 ta a regular 1-inch video tape recarder, yau'll find the DVR-18 ta be abaut three times smaller. That's a pretty big advantage to a TV statian, where space is always at a premium.

Ta find out mare infarmatian about the



The DVR-18 lets you compress four audio signals at the same time.

DVR-18, call 1-800-635-SONY.

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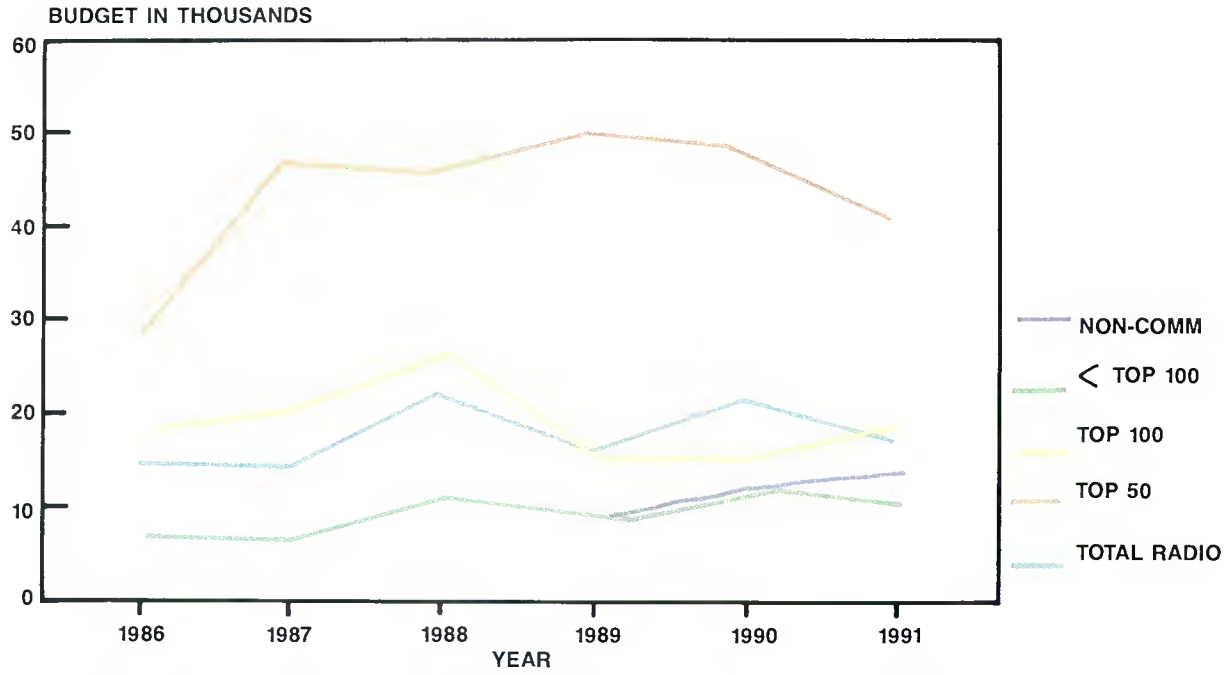

Figure 6. Radio station median equipment budgets for 1986—1991. The top 100 market equipment budgets are up by 20% over last year.

Continued from page 38

100, 4.7 and the non-commercial TV stations have 7.9 engineers.

An examination of the similar data for radio shows little change based on market size. Over all markets, the median engineering staff size is 2.3. The top 50 market sees this increase to only 2.5. Other market sizes and the median engineering staff size are: top 100, 2.1 below top 100, 2.1; non-commercial, 2.5. The similar staff sizes between markets parallels the similar budgets previously discussed.

Convention plans

Increasing travel costs appear to be taking its toll on engineers' convention plans. Fifty percent of the radio engineers and approximately 68% of the TV engineers plan some travel to conventions. That's down about 3% from last year for radio engineers and up 0.5% for TV engineers.

This year's results are summarized in Figure 9. The NAB convention continues to be popular for radio and TV engineers. The second most popular show in all categories is the SBE convention.

Although planned convention attendance may be off for 1991, it's still higher than the lows of 1986 and 1989. Those two years showed the lowest planned attendance since *BE* began tracking this factor. In those years, radio dropped to as low as 46.4% and television was as low as 62.4%.

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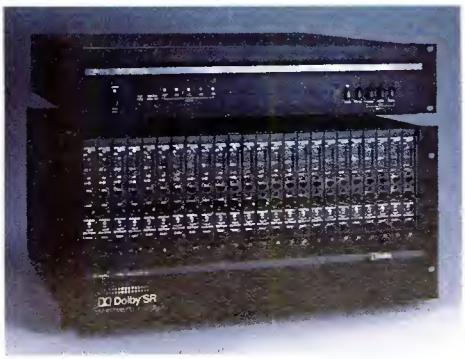

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Convention planners are going to have to offer a big bang for the buck to draw today's engineers. There are enough options that cost-effectiveness will become an important factor as engineers may have to choose to attend only one show.

Survey comments

Like last year, the survey comments were depressing and humorous. The per-

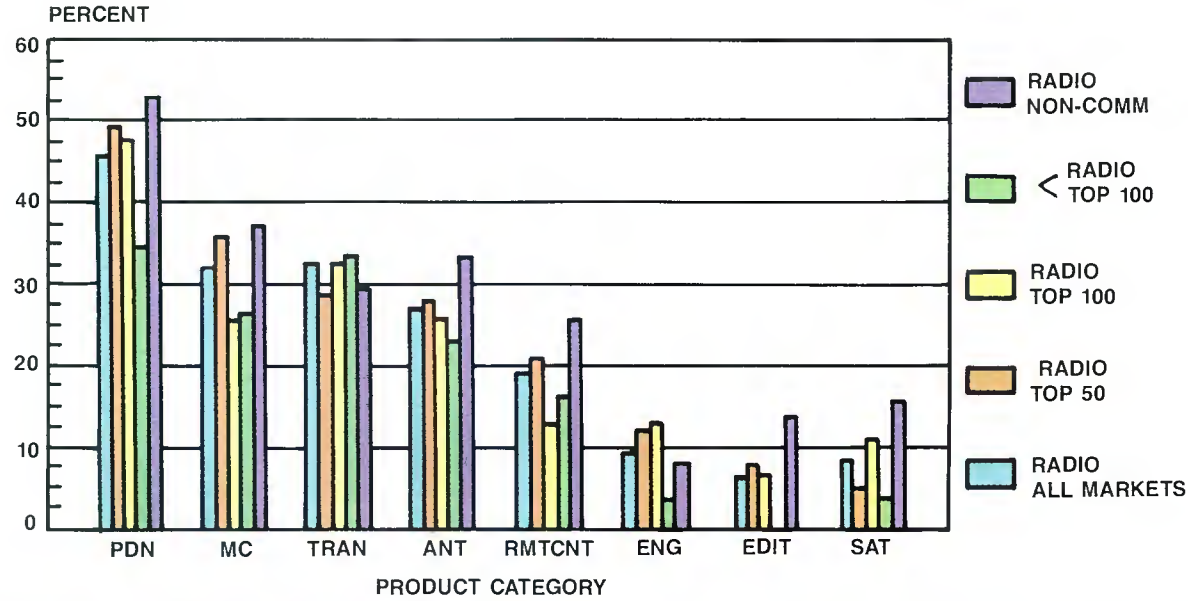

Figure 7. Planned spending by radio TV stations, broken down by market size and equipment category. Non-commercial stations lead the pack in most categories.

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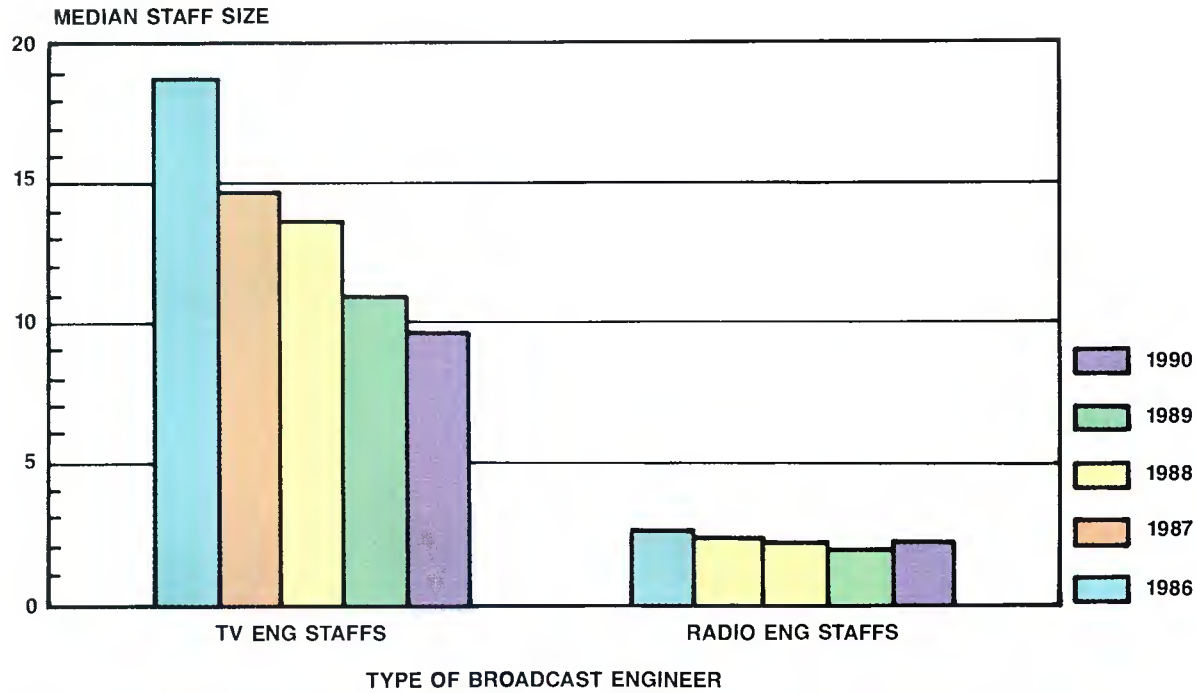

Figure 8. Median staff size at TV and radio stations. Although TV lost for the fifth year, radio rebounded by 15%. The job loss at TV stations may be a factor in title changes, rather than wide-spread layoffs.

centage of negative comments remained about the same, but the direction of that anger has changed.

There were six most-often mentioned categories of gripes or comments. Twenty percent of the respondents commented about the increase in competition. Sometimes it was directed at other stations, other times at future technologies, such as cable and DBS.

The most common complaint was about competition from alternative delivery mediums. The AM engineers complained about competition from FM stations first and then other delivery systems. The TV and FM engineers saw digital, HDTV, cable and telco as the villains.

The second most common type of comment concerned what became known as the "greedy manager" syndrome. Eighteen percent of the respondents say that today's managers are looking only at the bottom line with little concern about the station's future. Many comments struck hard at the FCC for allowing station trafficking. Debt, as the result of leveraged buyouts, was the single most-often mentioned reason for the poor financial condition of today's stations.

There were also comments about the poor state-of-affairs in the AM industry. From competition, to FM, to interference, to the lack of an AM stereo standard, engineers are fed up with what they see in

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the AM band. Only a few mentioned the lack of AM stereo receivers as a major problem.

The third most common complaint concerned technological and inadequate staff issues. The technological issues were often viewed in combination with the competitive aspect. Respondents saw HDTV as a threat and as something exciting to be conquered. The same was seen with DBS, although only a few mentioned direct broadcast satellite for radio. Perhaps the idea is too new to have attracted much attention.

Engineers saw staff compensation, training and recruitment as significant issues in today's marketplace. Under this category, finding and retraining qualified technical staffs were the primary concerns.

For the first time, the FCC came in last. Only 11% of the comments were directed negatively toward the FCC. The issues centered on the deregulation that has taken place and the desire, on the part of many respondents, for more regulation.

Future opportunities

At the beginning of this article, I said there was good news as well as bad news. So where is the good news?

I'll admit that you have to look harder to find anything positive about this year's state of the industry. However, hidden among the minus signs are a few pluses.

For the first time since I've been writing this yearly article, the trends don't appear to be going down as steeply as before. There is a settling in the industry, in terms of money being spent and overall upgrade plans.

If you track this year's data with that of the past few years, you'll notice that the wide swings seen earlier are less common. Recognizing that double-digit profits are a thing of the past has forced station managers to be better managers.

Broadcasters can't expect to return to the days of being the only game on the block. What we can expect is more competition from new technology.

Gold mine

There may be a gold mine that is not evident in any of the data here or the forecasting above. There may be a wealth of financial opportunity for the broadcasting industry in the form of the 1992 Olympics and the 1992 national elections.

These events generate huge amounts of revenue in various forms. For the local station, local and congressional elections offer the best opportunity for quick financial gains. Political spots can be cheaply produced, resulting in high profit margins. There is often little production cost for these commercials, and even those costs are often passed on to the client. This additional revenue can mean the purchase of new production and editing equipment for radio and TV stations. Few other activities offer the opportunity for stations to generate more money in a short time.

Future looks brighter

Broadcasting is not dead and shows no sign of a terminal illness. Nothing appears to suggest that any of the new technologies is going to wipe terrestrial broadcasters from the face of the earth. The audience will always want local news and weather and traffic. No matter how fine a satellite or HDTV signal is, the local perspective is what makes the U.S. broadcast system unique and successful. Europe and Japan have invested a huge amount of money to support satellite-delivered programming. It may work for them. However, just because a technology works in another part of the world doesn't guarantee it'll work here.

An important factor to a station's success will always be the continued investment in new technology. The successful stations won't stop purchasing equipment just because HDTV is supposed to be around the corner or that someone has proposed a satellite-delivered radio signal. Remember that first calculator you bought? It was expensive and had limited features. Today, you probably can purchase one 10 times more powerful for one-tenth the cost. The issue then becomes: Would you have been better off waiting until now to buy that first calculator? I believe that most would argue for buying new technology now, rather than later. Yes, you may pay a price for leading the way, but you also gain the competitive advantage of new capability.

The stations that will survive over the long haul will be those that recognize the importance of remaining competitive through technology and high-quality staffs. As those savvy station managers look for help in negotiating the maze of new ideas and products, it will be today's "profit-smart engineer" who will lead the way. Those technical managers (and their stations) who prepare now for the exciting future stand every chance of profiting from the changes that are coming.

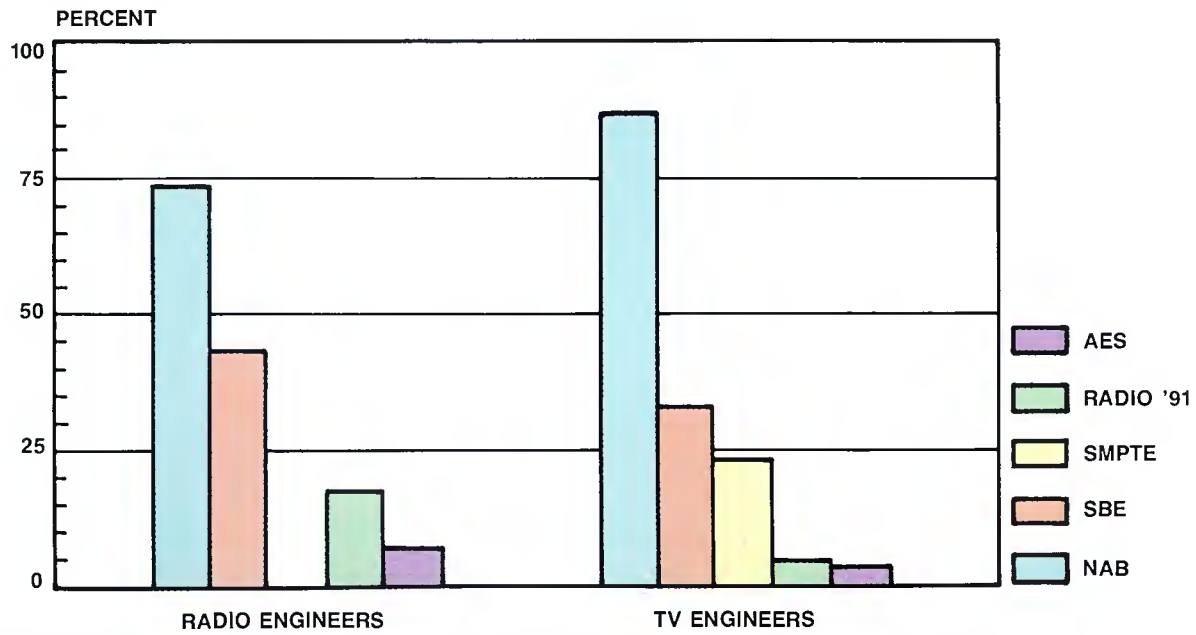

Figure 9. Planned convention attendance is up slightly for TV engineers and down slightly for radio engineers.

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- A small appetite for rack space and archive real estate
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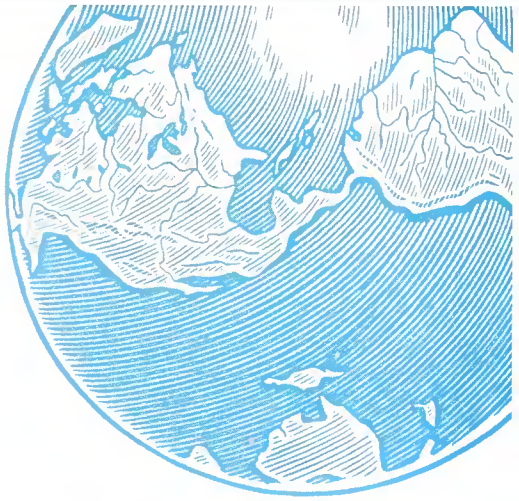
Bottom-line quality in broadcasting



Companies committed to quality can improve their bottom line.

By Robert M. van Zyl

Quality is usually perceived to be the condition of a product you purchase, or the cost of that product (high cost is associated with high quality, low cost is associated with low quality). We talk of quality in terms of goodness, luxury or shininess, and express it as "good quality" or "bad quality." The quality revolution that is occurring in the United States as the result of the invasion of highly competitive foreign products has completely changed our perception of quality. Thanks to the teachings of Deming, Juran and Crosby, American business is learning that quality means the conformance to all requirements, is quantifiable and applies to all work, including the production of goods, the performance of services and the management of activities.

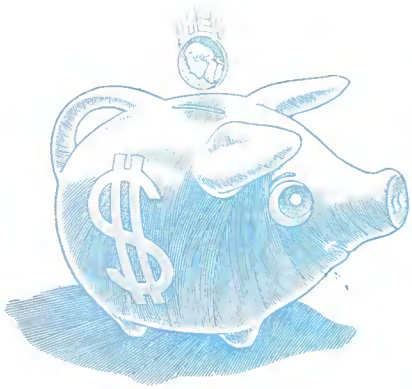
Meeting the requirements

The application of these new principles of quality is extremely important to the broadcast industry. Any broadcast is the result of a series of carefully coordinated events in which individuals must do their jobs correctly and on time. Script errors, timing errors in on-air deliveries and missed commercial breaks are examples of people-generated poor quality. They did not meet the requirements of their jobs. The ability to achieve those requirements is also dependent on a wide variety of highly sophisticated electronic equipment that must function to requirements every time. In the teleproduction industry, hundreds of thousands of dollars are invested by production facilities in equipment. If this equipment is sitting on a repair bench, the facility is losing money, and the equipment is not generating the revenues for which it was purchased.

van Zyl is vice president, operations at Videotek, Pottstown, PA.

Profit by doing it right

What does poor quality cost? It has been shown that in a typical manufacturing company (equipment manufacturer, production or post-production facility, broadcaster, etc.), the cost of poor quality is 25% of sales. In a service business (banks, insurance companies, restaurants, etc.), the amount is 30% of sales. In a $1 million-a-year company, $250,000 is wasted by doing things wrong. Doing things right every time would add that amount to the profit line. In addition, the hassles that we all experience in our jobs (missed schedules, overruns, failure of equipment, etc.) would be reduced or eliminated.



Improving your quality

Two years ago, our company decided that in order to compete in the worldwide broadcast market would require not only a quality product, but also quality management. The Philip Crosby Quality Process was used to achieve that goal. The process involves the education of the entire organization in the principles of quality, the role of the individual and of management in attaining quality, and the implementation of systems to control the process. The principles are applicable to all video equipment manufacturers, production and post-production facilities, as well as broadcast studios. The benefits of attaining a world-class quality organization and products can be staggering. Our company achieved measured cost savings in excess of $1 million. Of equal importance was a change in the work environment. A chaotic, stressful environment in which "putting out fires" was a way of life has been changed to an enjoyable, hassle-free workplace. Customers have also benefited. Could your staff, station and, most importantly, your audience, benefit from such a program?

Quality is an ongoing process

For the quality improvement process to be effective, management must be totally dedicated and committed to the process. The first step is for management to be educated in the quality principles and

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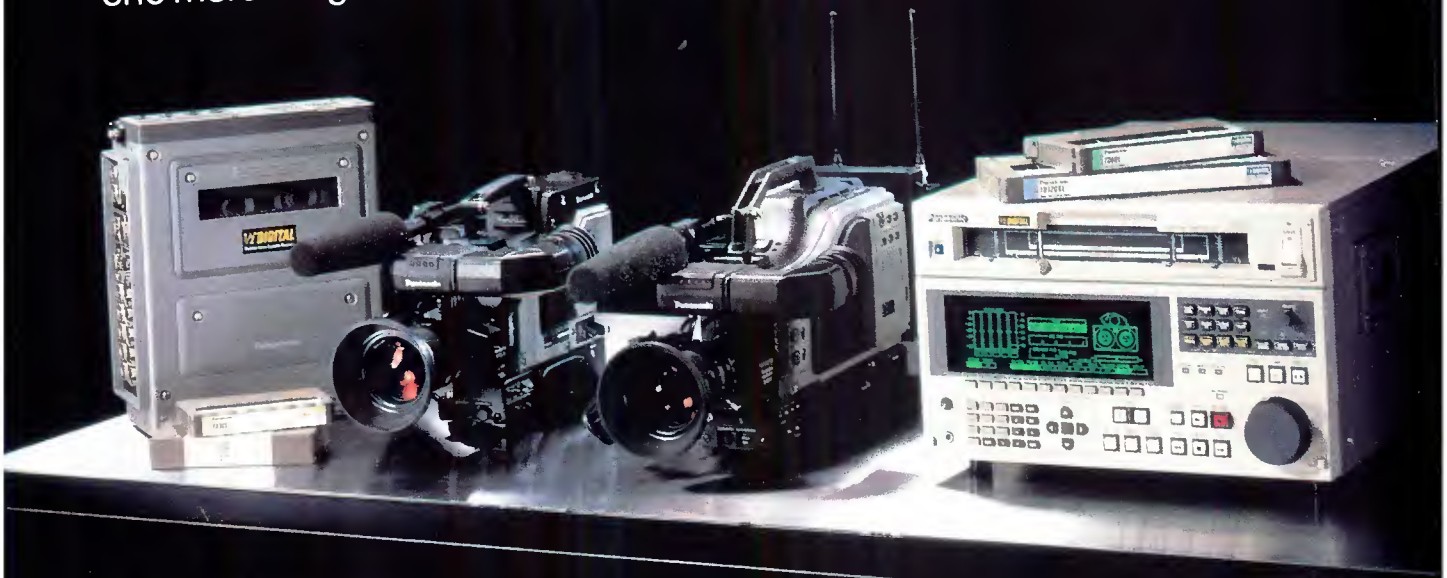
- Shoot-to-edit on the same cassette
- A camera/recorder
- A 245 minute half-inch cassette
- Robust cassette interchange for editing and cart machine use
- Edit point guard band and enhanced error correction
- Lower tape consumption
- Variable speed digital audio and viewable video at shuttle speeds up to 100X
- Small physical size for ease and economy
- Worldwide acceptance
- Unlimited future development (Component Digital and High Definition on the same 1/2-inch technology platform)

Panasonic Half-Inch Digital Recording Systems bring you all this and one more thing that was worth waiting for—affordability.



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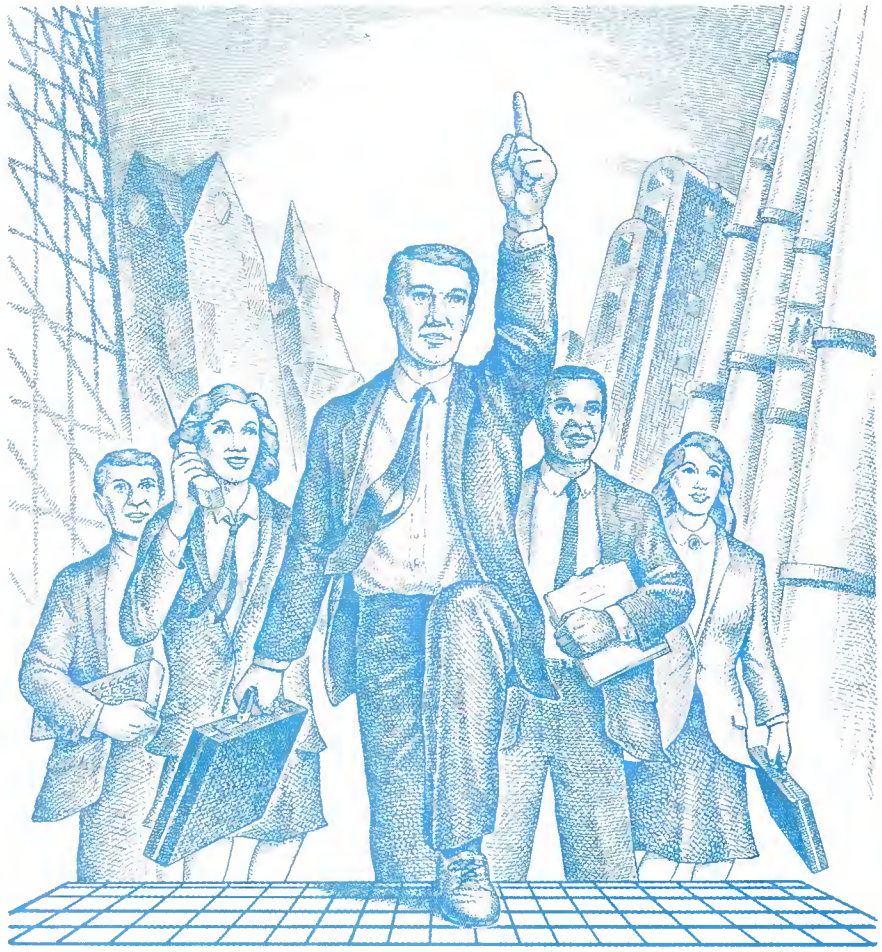
the corporate steps that must be taken to support the process. Notice that I refer to the process, not a program. Programs have a start and a finish, but a process is never ending. Quality improvement is ongoing and must continue for the life of the business. The quality process is based on four basic principles — "The Four Absolutes of Quality:"

1. *Definition of quality:* Conformance to requirements.
2. *System of quality:* Prevention.
3. *Performance standard:* Zero defects attitude.
4. *Measurement of quality:* Price of nonconformance.



Conformance to requirements completely defines quality and takes the vagueness and uncertainty out of understanding what is meant by quality. In our business, one requirement is that all video signals have −40IRE of sync and are 1V peak-to-peak. Videotapes produced with signals not meeting the signal requirements are not quality tapes, regardless of the production content. How often are the signals in your facility checked with a waveform monitor and vectorscope? Are picture monitors properly set up before making signal evaluations? Is there a defined requirement to have other pieces of equipment in the facility calibrated or checked by a qualified technician? Each step in the system has a direct effect on the video signal and the final production. To maintain consistent high quality, all the requirements for any work process must be complete, clearly defined and understood by the supplier and the customer. Pitfalls that companies experience in this area are a complete lack of requirements, incomplete requirements, assumed requirements or requirements that are not mutually agreed upon by the supplier and customer. A company should review, update and define requirements and procedures for every operation involved in purchasing, receiving, production, quality assurance, engineering, shipping, service, sales and marketing. The requirements should then be mutually agreed upon by each internal "supplier" and "customer." For example, the receiving department is the supplier to the warehouse (its customer) and the warehouse is the supplier to production (its customer). Each individual and each department, thinking in terms of the customer/supplier relationship, can break down internal barriers and create an environment of cooperation and a goal to satisfy "customers" by meeting their requirements.

Setting a quality standard

Broadcast equipment and production companies use appraisal as the system of quality. This involves the inspection of incoming materials for adequacy, in-process inspection to find production mistakes and final tests to determine which units don't meet specifications. The focus is on finding the defects. If the defects are found, costly rework is performed. If they are not found, they are shipped to the customer. The system of quality should be a system of prevention. This involves implementing a formal corrective action system and an error cause removal system. These systems should be used by every employee to identify items that are causing problems in any work process. Supervision is required to act on each item to fix the problem, and, more importantly, to take corrective action so that the problem will never occur again. The focus of the system is on preventing defects from happening in the first place.

The quality standard should be zero defects. This doesn't mean that errors won't happen. What it does mean is that employees have a zero defects attitude and are striving to meet the requirements of their job, every time. Conventional wisdom sets quality acceptability levels, such as 95% defect-free. This indicates that it is all right to produce 5% rejects. Often, we hear the phrase, "we'll fix it in post," in reference to glitches in a videotape production. This may refer to having signals that are not in phase with each other or exhibit amplitude difficulties. A quality-conscious individual would do it right the first time, saving valuable time, money and hassles in post-production. With a zero defects attitude, prevention steps are immediately taken to reduce the defects further.

Measuring quality

How is quality measured? In conventional terms, the measurement is percent defective, AQL levels or other vague measurements that are difficult to relate to. These measurements do not indicate the effectiveness of the operation. Quality can be measured in the universally understood terms of money. What is it costing the company to manufacture non-conforming products? The price of non-conformance is used as a measurement quality that is clearly understood by the work force and management. At our company, monitoring systems were put into place to track the cost of doing things wrong (the price of non-conformance). These include a bar code system to report labor productivity

and rework hours, measurement charts of major non-conformances in each department and financial tracking of non-conformances, such as purchase order errors, shipment errors, excess inventory and design errors. The price of non-conformance is reviewed monthly by the quality improvement team (a group of managers responsible for implementing the systems and monitoring the success of the process).

Of extreme importance is the role of the individual in causing quality improvement to happen. Involving every employee is necessary for the quality improvement process to be effective. After management is educated in the four absolutes of quality and the corporate steps required to implement the process, employees undergo up to 20 hours of education in their role in causing quality improvement. Quality work groups from each department meet weekly to review those items that are causing hassles and preventing them from doing their jobs right the first time. Also, the employees investigate those areas that have a high price of non-conformance and take corrective action to prevent these non-conformances from happening again. Charting the group's performance keeps employees aware of their progress toward a goal of zero defects.

Commit to quality

The quality improvement process is applicable to any business, not just for companies that manufacture equipment or are involved with programming. Think of how much less hassle it would be to do business with suppliers, customers, banks, restaurants, gas stations or any other companies that are committed to quality and meet requirements every time.

Companies in the teleproduction and broadcast industry must work toward a policy of producing a quality product. Those who do not will face an uncertain future. Our industry is littered with the remains of companies who did not follow this simple premise. Today's worldwide competitive marketplace will not tolerate goods and services that fail to meet the quality requirements of the customers. Only companies that produce quality products and have quality management will survive in the years ahead.

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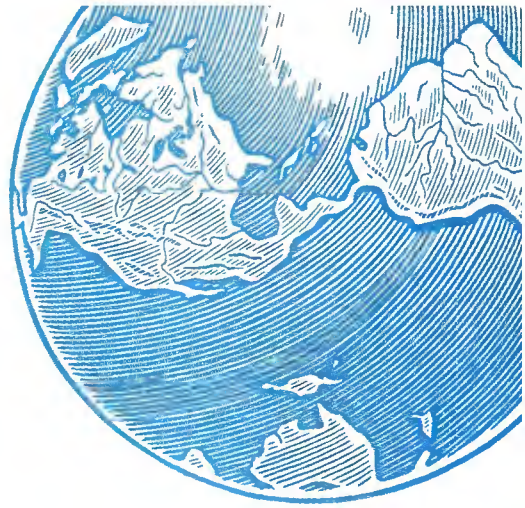


View from the top

By Skip Pizzi, technical editor

A roundtable of engineers ponder who and where we are.

1990 has been a year of many changes, not the least of which are occurring in broadcasting. The process of keeping abreast and holding fast to an appointed direction has become more difficult. Should you set course and tie yourself to the mast, with blindfold and earplugs in place, or constantly microcourse-correct?

Information theory helps here: The more you know about your exact location, the less you know about where it is in the big picture. The road map is a good example. The more detail it shows, the less area it can contain on a given-size sheet, and vice versa.

People in broadcasting know a lot about their specific places. But it helps every so often to test the winds, and survey the landscape from some higher ground. A look from too high a perch won't help if you can't see your house from there. So here's a view, not from geosynchronous orbit, but from just over the next rise. It's a place where *BE* found a few practitioners to help with the lay of the land on the other side. These well-versed people have their fingers on the future's pulse, but their feet are firmly planted in the real day-to-day life of broadcasting. *BE* organized the panel discussion at the SBE convention in St. Louis last October. The highlights are presented here.

The panelists

Marvin Born is vice president of engineering at WBNS stations, Columbus, OH, and has held the same position at other TV stations in Laredo and Corpus Christi, TX. He has taught college-level business, and is a published author.

Mark Durenberger is director of technical operations for Midwest Cable & Satellite, Minneapolis. He is a technical writer with an extensive broadcast background and is currently managing a major fiber-optics system's installation.

Richard Farquhar, vice president of TSI, Louisville, KY, was vice president of a teleproduction firm, and manager of engineering for WTHR-TV, Indianapolis. He is an Emmy award winner, an engineering committee member of the ITS, and vice president of the SBE.

Michael Starling, an attorney and engineer, is currently senior engineer at National Public Radio, Washington, DC. His prior position was chief engineer at KPBS-FM, San Diego. He is vice chairman of the recently formed Committee for Digital Radio Broadcasting (CDRB).

The discussion

BE: What do you see as the role of today's broadcast engineer, and what advice do you have for him or her?

RF: Right now, the broadcast engineer is in production video and audio, AM, FM and TV transmission. Some have moved into telco systems or corporate video and audio production, in-house staging, conferences — whatever. But I think every engineer is going to have to be aware of *all* the technology. He has got to attend conferences and read all the trade journals, so he can go to his management with recommendations of what the new technology is going to be like next week, next year, two years, 10 years. He can no longer sit back in his shop behind closed doors, replacing a chip every now and then. Years ago, a videotape machine required 200 adjustments. In the late '70s, a machine came out with about 20 adjustments. With the digital video machine now, we are down to about eight. What's it going to be in two or three years?

BE: What kind of recommendations do you all have for doing that, for keeping up?

MB: Study.

MD: Go to trade shows.

RF: Be a member of professional organizations, subscribe to a trade journal. There's several of them out there that are actually delivered free to members of the industry. Study the articles.

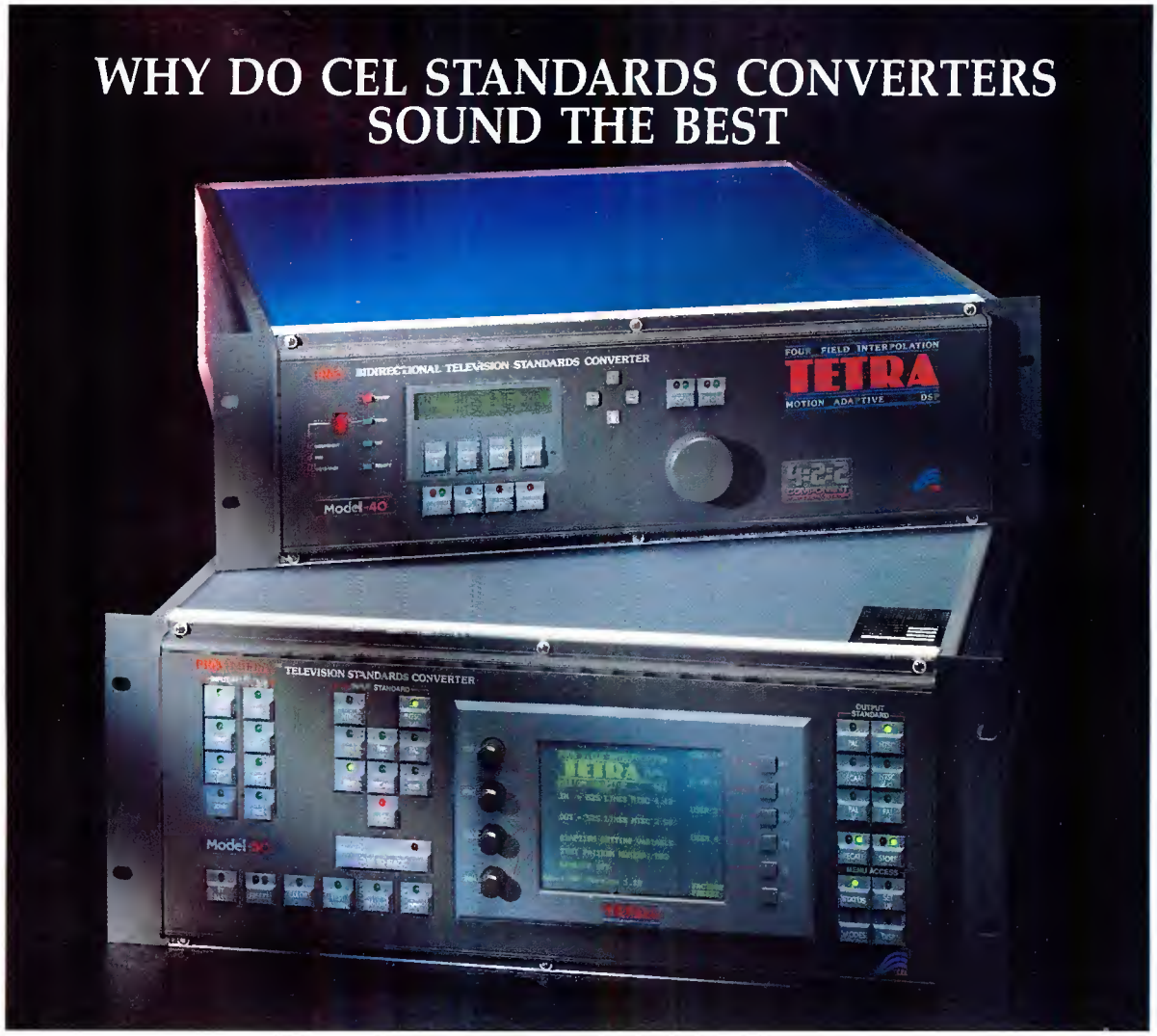
MD: Network with people.

RF: Yes. Attend meetings — SBE, SMPTE, IEEE, AES, ITVA — they all have meetings to help promote your chosen profession.

MS: The broadcast engineer has also got

Continued on page 56

WHY DO CEL STANDARDS CONVERTERS SOUND THE BEST



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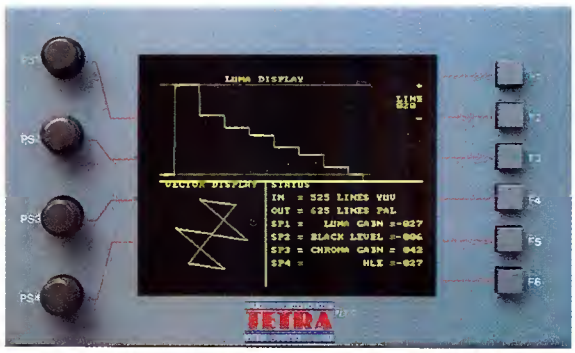

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Television News
circa 1960

Television News
circa 1990

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Continued from page 52
to become pretty savvy about business law and about accounting principles, and always view things with the bottom line in mind. As it is now, broadcast engineers are often the "jail-house lawyers" when it comes to FCC rules and regulations, and that is something we can build on. Computers have invaded every nook of our operation, yet a lot of engineers say, "I don't want to have to mess with that stuff. I just tell the general manager to get a service contract." I think that's a mistake. If you're not the in-house computer consultant and expert on the newest software, while advising them how new things will affect the bottom line, then what in the world are they going to need you for?

MB: We're down to board-changing now on a lot of equipment. It doesn't take a BSEE degree to swap a board. There's even a service available now where your transmitter can be monitored and controlled from a remote point, not in your own plant, but halfway across the country.

MD: There is also a lot of new, sophisticated hardware where you simply plug in a modem and talk to the factory if something's down, and they will tell the secretary to replace board A3.

MS: One manufacturer has it in its FM transmitters. You can call your transmitter and ask it, "Where does it hurt?"

Marvin Born

MB: Your department's going to be getting smaller — that's a given. I think the operator-type is going to be less needed, especially in a TV operation, where we're going more to automation.

MS: The need for production expertise is shrinking back to the major market centers only, where they can afford to have that many people on staff.

"The broadcast engineer cannot be a specialist."

RF: The broadcast engineer cannot be a specialist. He has to be a systems person. There are a lot of stations using contract engineers, but I think if you have an engineer on staff, he has ownership in that product — the product of that music, that video — and he is going to make it the best he possibly can. When I first started, it was a great thrill to be in broadcasting.

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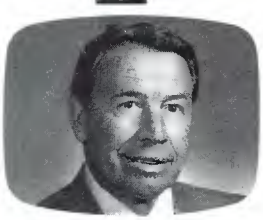

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NBC

"With the M.A.R.C. we wanted to have even more efficiency—and we have."
—Kenneth Erickson
WHO-TV

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"The M.A.R.C. is great! The walkaway time sure beats having engineers load tapes."
—Robert W. Bell
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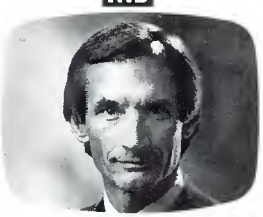

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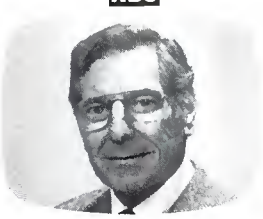

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—Hilliard Gates
WKJG-TV

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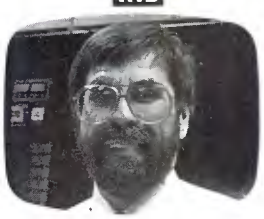

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MS: It still is. The magic is not going to go away.

RF: And I still enjoy it. But the industry has changed, and the engineer must change with it.

MS: There's a new title that you'll be seeing, I think, at corporate levels, called a chief technology officer, a CTO. Just as a chief financial officer not only understands budgets, but also has a pretty good say in the way a station operates, these chief technology officers will understand a lot more than the human resources issues and the technology in a station. They will literally have to be global technologists. It's our chance to make sure that we advise our companies so they make the correct investment and technology decisions. Engineers are a tremendous body of knowledge that is not present anywhere else in the broadcast industry, but you've also got to be a good communicator.

"Engineers are a tremendous body of knowledge that is not present anywhere else in the broadcast industry."

BE: Amidst all the talk about the dwindling role of the engineer, what you're saying sounds like an explosion of opportunities.

MD: Absolutely. Opportunities. And there's nothing you can't learn. I'm convinced that as awesome as some of this looks, you just need to know what questions to ask. Then listen.

RF: There's an old saying, "There are two ways to climb an oak tree. You can sit on the acorn and wait, or you can go climb the tree."

MS: And take a look around when you get up there. It's the long-term view that's really going to make the difference in whether you push your company toward real smart decision-making or drive it down some blind alley.

Mark Durenberger.

BE: Getting back to your current view of things, what are things you'd like to see changed?

Continued on page 62

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plus air lubricated tape guides, and . . . but you get the idea.

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AMPEX

BE-120-V200

Continued from page 58

MD: I think if I have a problem, it's disappointment in the fact that a lot of progressive companies that once were technology leaders are now so highly leveraged that technology investment is no longer a priority for them, and that's sad because those people used to make contributions.

BE: The R&D is gone?

MD: The resources aren't there any more. The money's going to the bank.

MS: That's why the jobs are going overseas. That's where they're investing in R&D that builds an industry of 10- or 20-year propositions. That's been abandoned at home.

"You've got to be a good communicator."

BE: What do you think can change that?

MS: You know, I'm probably the lone wolf on this issue, but I think that we don't spend enough money with our government regulators that have the overall picture and the ability to interplay on an international level to move standards issues from the U.S. standpoint. You look at the FCC, they've got a $115 million budget, and they're trying to regulate and actually assist a multibillion dollar telecommunications industry, and they don't have the resources to even go to the overseas meetings where all the standards issues are being driven. I think it's also unfortunate and a mistake that NTIA has always had a research arm, but has very little money to do anything with. You take a look at the FCC labs out in Laurel, MD — I mean, you want to talk about a research museum, that's what it is.

RF: To me, probably nothing is as irritating as poor-quality audio and video. I believe that the station that sells quality is going to remain No. 1 in its marketplace.

BE: Do you think that the "powers that be" are underestimating the audience?

RF: Yes. The audience at one time in our industry was not so educated about the new technology, but now they understand video. They buy their own video cameras. How many homes are equipped with VCRs and cable now? You not only have to provide what they deem to be quality, you must lead. Flowers follow the sun. You're going to have to set an example and show them good quality, and further educate your audience.

BE: And the sun, in this case, has been manufacturer-driven more than broadcaster-driven, hasn't it?

RF: Absolutely correct. In technical quality, we should be second to none. We should be leading, creating, thinking ahead.

MB: Some of the corporate managers and GMs don't know how to compete. They'd been on a gravy train for so many years, and now there's cable and VCRs and satellites, and they're confused. Meanwhile, we've become a Wall Street commodity, and we are bought and sold just like gold and silver. The people that are controlling those purse strings have no idea what broadcasting is.

MD: They expect an artificial rate of return that's no longer going to be there. There was a time when 30% and 40% made a nice risk, but you get below 20%

Richard Farquhar.

and they panic. And 20% is a lot of money for most businesses.

BE: So what do you think the near future holds for the broadcast industry?

MB: If the telephone company gets involved, it's possible that we won't need TV transmitters any more.

MD: In 1992, it's projected that fiber and copper will have the same per-mile installation cost. There is no question that we will soon be a wired nation with broadband interactive information.

"If the telephone company gets involved, it's possible that we won't need TV transmitters any more."

MB: Think about this possibility: You pick up your telephone and press 2, and a TV program comes on — you're dialing up what you want. The computer at the phone company is going to bill you for the program, but it's also going to make a record of what you watched. Other computers around the country already have your financial information, your driver's license number, and what you buy at the grocery store, because you go through the scanner when you check it out. You can couple all that information together and the advertising people automatically know what your profile is, and where to place their advertising.

MD: Although a computer terminal is required for these sorts of things today, there's some private radio rulemaking to extend the intelligent network right onto your person, where literally you could have the entire services of the intelligent switch right with you wherever you go. We're not very far away from that.

MS: It's going to be a whole new service category, called personal communications services (PCS). It'll be covered probably under private radio or common carrier.

MD: They're talking about maybe two franchises in every market, just like the cellphone approach.

MS: There's a ton of interesting issues with that, not the least of which are some of the novel privacy aspects, because it'll have a record of exactly where you were when. So they'll know exactly which airline to target you for with your next commercial.

BE: What do you see broadcast engineers' roles there? Another opportunity?

Enough said.

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MB: Somewhere down the line I think the word "broadcast" will disappear from our namesake profession, and it could be called whatever you want to call it.

Michael Starling.

MD: In 10 years you will have all the radio networks' distribution on ISDN, and not on satellite. There'll probably be one more renewal round of replacement satellite for radio, and after that, there is no reason to be doing it that way any more. It'll all be terrestrial.

MS: Well, except for some outposts.

BE: So, you're saying that if we just stand still and let everything go by...

MB: That's the worst thing you could do.

"Somewhere down the line, the word 'broadcast' will disappear from our profession."

RF: Well, we'll always need a person that can look at these systems and figure out where the problem is, and repair it in a quick turnaround. As broadcasters, we pride ourselves on always being up, never being down. We solve problems and we will continue to do that.

MS: Murphy guarantees it.

MD: I think the role of the engineer at the company level will be using technology to create new profit centers. There are an awful lot of areas that we are all familiar with in which we can lead our companies, if they have any entrepreneurial bent at all. That's another reason to learn how to do a *pro forma*, and to read a P&L, and to be able to take a technological concept, do some minimum research and sell it to your financial people. That's the easiest way to be a hero, and that is our real challenge — to get beyond the soldering iron and board replacement, and start thinking about how can I assimilate all of the knowledge I have of my life and my planet, and go over there and say, "Here is a way to make some money." Because that seems to be a language that everybody understands, and here is the opportunity.

RF: Get involved in station operation,

AMEK
CLASSIC
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VIDEOLONDON, STUDIO 4

Photo: Litrick Patchfield

AMEK's CLASSIC offers a unique range of facilities for all types of audio production work. Unparalleled flexibility of configurations is possible using the numerous chassis, module, automation, metering and jackfield options.

The CLASSIC at VIDEOLONDON'S new film and video post-production suite is a perfect example. The console is equipped with 24 mono and 8 stereo inputs, 8 stereo subgroups, and 24-track buss/tape monitoring. Stereo inputs and subgroups have both image width and pan controls. NTP plasma meters have been specially supplied and the jackfield is remoted for rack-mounting. Extensive machine control switching has been built into the central section of the console.

Automation for VIDEOLONDON'S CLASSIC is the GML Moving Fader System which is fitted to both mono and stereo channels and subgroups. The GML System, with 10-bit resolution, uses several 68020 processors combined with hard disk and massive RAM to allow high speed precision control over both levels and mutes. Complete mix editing subroutines are standard equipment, and the system will slave to all forms of SMPTE.

VIDEOLONDON is one of the UK's leading post-production houses and has chosen the AMEK CLASSIC as the best console for the next step in their dynamic growth. Some of the many notable users worldwide include ABC, Central TV, Granada TV, Molinare, Turner Broadcasting, TV New Zealand and TV2 Denmark.

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Circle (48) on Reply Card

From left, Marvin Born, Michael Starling, Richard Farquhar, Skip Pizzi and Mark Durenberger.

get involved in the station product — that would be my recommendation to broadcast engineers for the 1990s.

MS: And don't tolerate second-rate quality.

MB: Remember, that the tube was developed back in the '40s. That was only 50 years ago. If technology increases exponentially, what is going to happen in another 50 years?

***BE**: Well, there again is the value of education — keeping ourselves up on it. That process alone is going to continue to get harder, and maybe "information management" is another area where we should concentrate?*

MD: It is really the role of what I call the technologist citizen. You are faced with a bewildering array of information sources, and you've only got so much time to assimilate this to decide what information you need to do your job and what you can do without. That is pure information management.

MB: Where are you getting all these good terms you've been using today?

MS: He's been studying.

"At first we considered digital too costly and exotic for our needs. In reality, it was neither."

– Bill Dowd, Operations Manager, KTUU-TV, Anchorage

We all know that perception can differ from reality. Just mention Alaska and it conjours up images like the one above. Cold and remote. But can you imagine temperatures reaching 90 degrees, a rain forest, or even a desert in the arctic?

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. . .Bill Dowd

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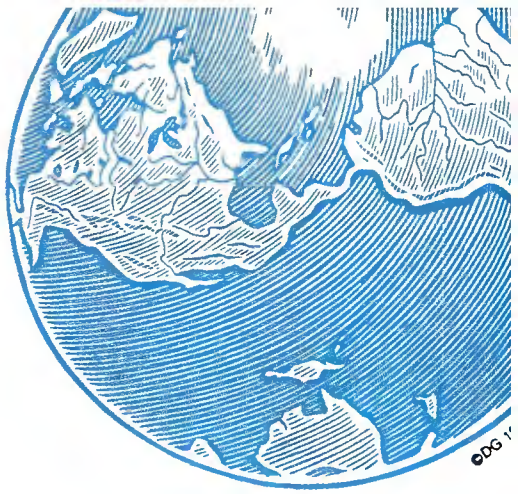
Digital radio. promise and perils



Is digital radio broadcasting (DRB) in the senior medium's future?

By Michael Starling

Digital radio is an idea of tremendous force, presenting possibilities never before broached in the history of radio broadcasting, to wit, the delivery of CD-quality sound plus ancillary services, in a multipath-free, highly spectrum and power-efficient package, with the possibility of all stations having equal, full-market coverage areas.

Digital radio may become viewed as an inevitable development in the silicon revolution, which begat miniaturization, which begat increased circuit complexity, which begat the software revolution that has relegated many analog hardware constraints to history, broadcast audio quality among them.

Digital radio broadcasting (DRB) has had numerous surprises, but the biggest story may be how unexpected this development has been to most American broadcasters. With little fundamental research and development being done in the United States, digital radio is a classic example of how economic clout may follow innovation. The European Broadcast Union (EBU) members masterminded, built and tested the so-called "Eureka Project 147/DAB" (digital audio broadcasting) design before any rival systems were ever proposed. To date, it is the only group to have demonstrated a digital radio broadcast system.

The pros and cons of various digital radio proposals demand our close attention and thoughtful deliberation. The facts concerning specific system designs should be of paramount concern in discussing new systems that American broadcasters and consumers might have to live with for decades. The FCC will ultimately rely on the assessments of engineering advisers as to how specific designs will affect the interests of broadcasters and the public.

Starling is senior engineer for the engineering and operations department of National Public Radio, Washington, DC.

Assessing proposed systems

To date, three major system concepts have surfaced: the *EBU/Eureka* system, *CD Radio* (formerly called "Satellite CD Radio") from Stanford Telecom and *Power Multiplexing* from J.N.S. Laboratories. The first two have been recently revised and appear more similar to each other,

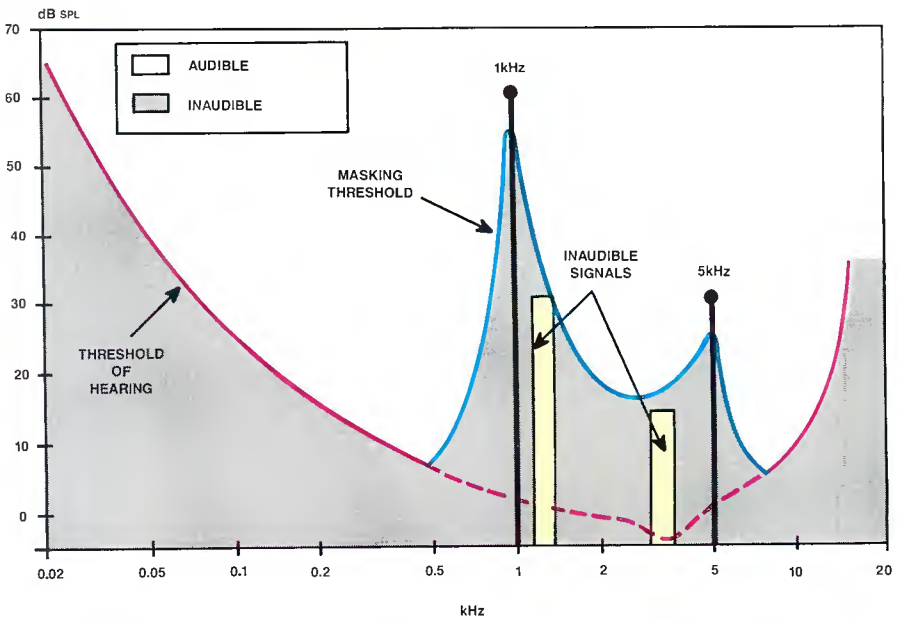


Figure 1. Masking spectrum produced by a 1kHz tone and a lower level 5kHz tone (values approximate). A sample of actual program audio would typically exhibit many more predominant tones ("tonal masters"), thereby producing more "tentpoles" for masking spectrum to bridge across, and providing a correspondingly greater inaudible area under the curve. As long as any quantizing noise added by compression algorithm falls below the masking threshold, it remains inaudible.

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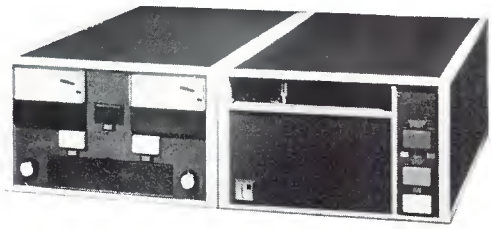

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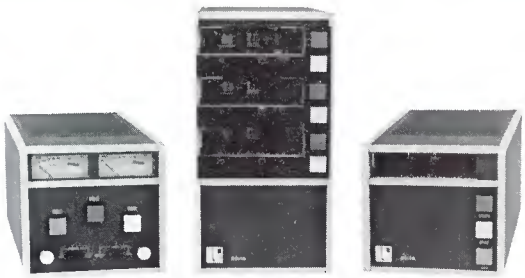

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while the third is the first "FM-compatible" concept to emerge. This is still the earliest stage in the development of digital radio. Future proposals are likely taking shape on drafting boards and CRTs across the globe.

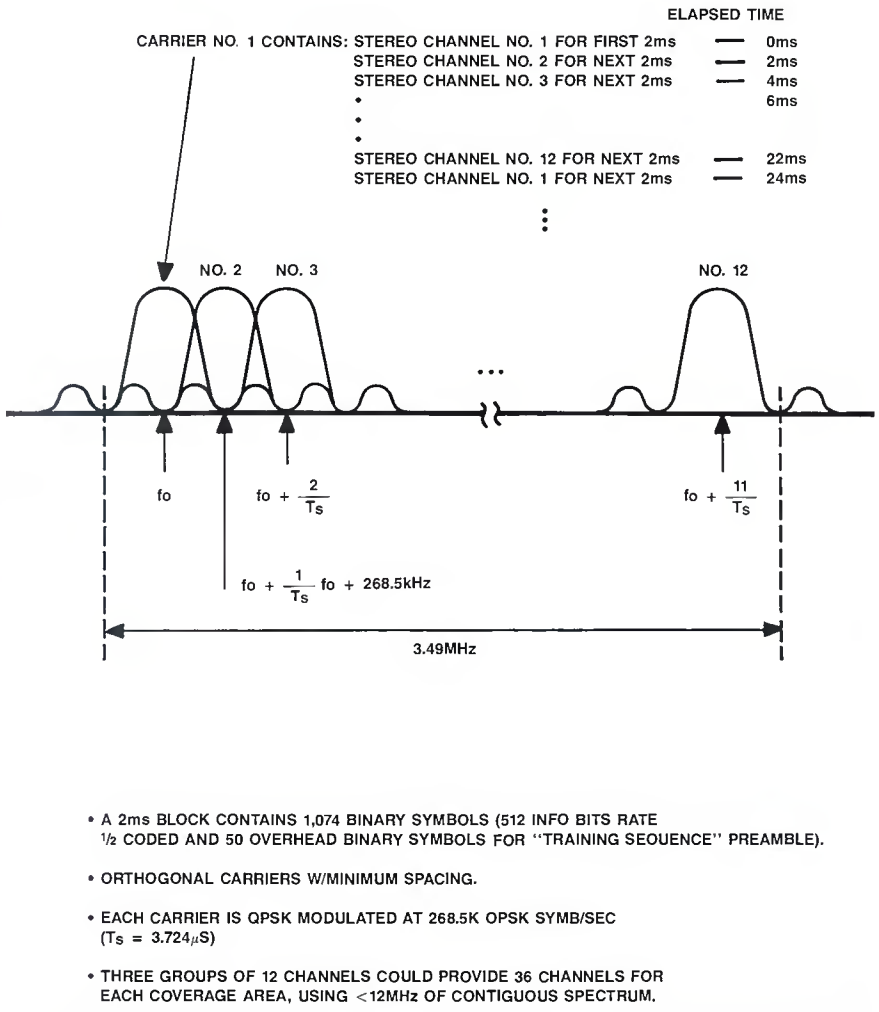
Each U.S. DRB proposal will be initially judged on how well it addresses certain "flashpoint" technical and political issues. The primary considerations for judging specific DRB system proposals are (in no particular order):

- How much spectrum is required and where?
- How close is the sound quality to CDs?
- How well does it address the multipath problem?
- Does it degrade gracefully or "fall off a cliff?"
- What are its power requirements?
- How does it affect the existing competitive balance between AM and FM services and station classes?
- What opportunities does it present for U.S. manufacturing interests? (For example, what is the effect on American jobs and the U.S. balance of trade?)

The relatively sudden interest in DRB systems can be traced to the Eureka DAB demonstration in Geneva at the 1988 WARC-Orbital Conference (the World Administrative Radio Conference, the body that coordinates geostationary orbit allocations). The Eureka system is based on a marriage between the masking-pattern universal subband integrated coding and multiplexing (MUSICAM) audio coding ("source coder") system and coded orthogonal frequency-division multiplexing (COFDM) "channel coding" and modulation techniques.

A close look at each of these components reveals that both are evolutions of pre-existing theories and established techniques. Although neither component

Continued on page 74



- A 2ms BLOCK CONTAINS 1,074 BINARY SYMBOLS (512 INFO BITS RATE ½ CODED AND 50 OVERHEAD BINARY SYMBOLS FOR "TRAINING SEQUENCE" PREAMBLE).
- ORTHOGONAL CARRIERS W/MINIMUM SPACING.
- EACH CARRIER IS QPSK MODULATED AT 268.5K OPSK SYMB/SEC (T_S = 3.724μS)
- THREE GROUPS OF 12 CHANNELS COULD PROVIDE 36 CHANNELS FOR EACH COVERAGE AREA, USING <12MHz OF CONTIGUOUS SPECTRUM.

Figure 2. Proposed channel-coding spectrum of CD Radio format showing orthogonal alignment of 12 carriers. Twelve stereo channels hop among these carriers, with a single block of data from each channel sent during each hop. Hopping pattern has a repeat period of 12, but is non-consecutive, such that adjacent data blocks are widely separated in frequency.

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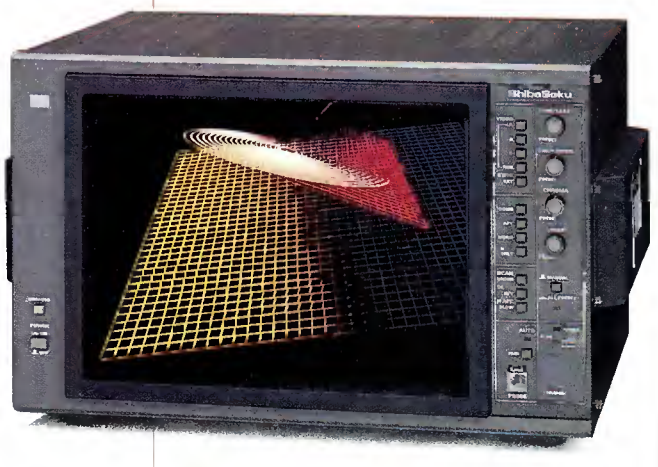

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Continued from page 70

might be considered a breakthrough, few would argue that the total system is anything less. The Eureka system, in its various proposed permutations, calls for 12 to 16 stereo channels to be multiplexed in a spread-spectrum-like method, across 4.5MHz to 7MHz. This provides full metro-area coverage with a transmitted power on the order of 1kW or less, for multipath-free, CD-like quality. The same spectrum could be re-used in neighboring markets with much closer spacing than current allocations allow.

Source-coding 101

All DRB work and theories rely on discoveries of "masking phenomena" in the human auditory system, dating back to the Fletcher-Munson research era of the 1920s. The functions described in the resultant "critical band theory" of that period, and its later revisions, enable the lion's share of data reduction to be possible, thereby making digital radio viable.

Basing a compression algorithm on such a psychoacoustic model has allowed transparent audio data reduction from 705kbit/s per channel (at CD rates of 44.1kHz sampling with 16 bits/sample, without error correction overhead) to something around 100kb/s or less. Source coders, as these compression schemes are called, are currently available from various manufacturers with outputs of 128kbit/s, 96kbit/s or 64kbit/s per channel, for 15kHz to 20kHz audio. These data rates are also referred to as 4-, 3-, or 2-bit/samples respectively, or as 4:1, 6:1 or 8:1 compression algorithms. The latter ratios compare the 16-bit input samples with the respective outputs' average word size.

The operation of these coders relies on the principle that sounds close in frequency to another louder sound are often inaudible — "masked" by the louder sound — depending on the specific frequencies and amplitudes involved. Relationships of those frequencies and relative amplitudes as measured in large-sample listening tests are the basis of the critical band theory, and a seminal element of psychoacoustic research.

With modern VLSl implementations and sophisticated mathmetical techniques, virtually instantaneous spectral analysis can be performed and this "masking effect" computed, below which all sounds are inaudible, based on the psychoacoustic model. See Figure 1 for a typical spectral masking "snapshot." Above the masking threshold, the highest amplitude discrete frequencies — so-called "tonal masters" — are quantized with a resolution just necessary to keep the quantization noise below the mask. Additional data efficiency is achieved by considering temporal masking factors, by which a loud sound masks quieter ones that occur just before or just

after it.

Topologies used to accomplish this compression fall into two categories: subband coders (such as MUSICAM) and transform coders (such as Dolby Labs' AC-2 system used in the CD Radio format). Both perform their analysis of the audio against masking thresholds in the frequency domain. The only real differences to the user are: 1. Throughput delay, in which the transform coders generally exhibit longer times because of their higher order and complexity of calculations. 2. Failure modes, in which most subband coders degrade to random noise, while transform coders may degrade to discrete tonal bursts or "chirps."

Other applications of such source coders include satellite links, STLs and other digital point-to-point transmission paths in which spectrum efficiency and robustness are required.

The multipath menace

There appears to be near unanimity among FM engineers that multipath is the broadcaster's biggest enemy in delivering high-quality audio. Because multipath is a frequency/time/space problem, it is not surprising that redundancy in some or all of these domains will comprise a solution to the phenomenon. With DRB channel coding, this is readily accomplished in a variety of ways.

The Eureka system employs time interleaving and frequency diversity via the 448 separate COFDM carriers used in its 7MHz implementation. The original CD Radio design relied extensively on space-diversity reception (multiple receive antennas), but was subsequently modified to include time-interleaving and adaptive equalization as well. Nevertheless, concern remained about multipath problems for non-automotive radios, in which space diversity implementation might not be feasible. A further modification has recently added frequency diversity to the CD Radio design, creating a function that its designers call "dynamic SCPC" (D-SCPC). D-SCPC is a technique in which successive program data blocks are transmitted sequentially across whatever number of carriers are present at the transmitting antenna. The actual number of carriers used is equivalent to the number of program channels required, although all program channels are transmitted sequentially on all carriers, in a continuous cyclical pattern of "hopping" from carrier to carrier.

The Eureka and CD Radio's systems are said to be suitable for either satellite or terrestrial use. Both approaches require common transmitting points for each "group" of stations, and both employ QPSK applied to orthogonal carriers for maximum spectrum efficiency. For either system to be spectrally efficient and multipath-immune, a minimum number of

co-located channels must be used. Current proposals for both systems place that lower limit at four stereo programs, with an upper limit of 12 stereo channels. For a 4-stereo channel system, Eureka will require 2MHz, while CD Radio claims a 1MHz minimum; Eureka expects 12 stereo channels to require 4.5MHz, whereas CD Radio specifies 3.5MHz. For the full 12 channels, Eureka uses approximately 400 carriers, each with a 15kHz RF bandwidth, and 15kHz spacing between centers ("orthogonally spaced"), while CD Radio uses only 12 orthogonal carriers, each 268.5kHz wide. (See Figure 2.) In theory, the latter's degree of frequency diversity, in conjunction with its adaptive equalizer, should result in a digital radio system with superior intersymbol interference immunity (ISI, equivalent to multipath immunity) over that achieved by the Eureka system.

Finally, the coding gain of both systems allows much lower transmitter power to be used, with the Eureka on-air tests showing it to be 100 to 1,000 times more power efficient than FM for equivalent coverage.

The "in-band" approach

"In-band" refers to a digital broadcast method that requires no new spectrum and would co-occupy existing FM channels compatibly. As in the early stages of ATV systems, there has been a fair amount of interest in such an approach. To be successful, little or no degradation can occur on the existing signal, but a dramatic increase in quality over that achieved by standard FM must be evident to those with digital receivers. Most engineers have considered an in-channel compatible system as unlikely because of the minimum digital bandwidth requirements, even with the most efficient compression and modulation techniques. Proposals to use the spectral capacity of the SCA region have been spurned because of the the limits in quality that can be achieved in the 53kHz-99kHz baseband region. The contractual commitments many FM stations have to continue SCA to customers provides an additional disadvantage.

But the breakthroughs in source-coding make it undisputed that rendition of a near-CD quality signal within the full 200kHz bandwidth of an FM channel is achievable. An "overlay" technique has been proposed by J.N.S. Electronics of San Jose, CA, whose idea is based on "power-multiplexing." This process was developed initially to increase the capacity of land-mobile narrowband FM systems, and is premised on the well-known FM "capture effect." Depending on the signal and receiver characteristics, signals 10dB to 25dB below a dominant FM carrier are ignored by the FM discriminator. This feature is exploited in the J.N.S. proposal.

Because the digital signal has an inherent coding gain between 20dB and 30dB, a digital carrier that far below the parent FM signal should come close to duplicating the coverage of the main FM station. In theory, standard FM receivers would have little trouble rejecting the proposed out-of-phase, double-sideband, suppressed-carrier, which is multiplexed with the main FM carrier some 20dB or more down. The degradation to the main channel would presumably be nominal on most FM radios, but this will require field verification. Additional questions remain on the impact this would present to FM subcarriers.

The power-multiplexing channel-coding concept has not yet been married to a source-coder, and also does not address multipath performance. Convolutional coding and adaptive equalization could be expected to correct most mobile multipath echoes. But "stoplight" fades would persist because of a flat-fade due to antenna

DAB CLASSES	INTERFERENCE-FREE DAB CONTOUR (MI)	EQUIV AM POWER (DAY)	EQUIV FM CLASS
I	18	250W - 1kW	A
II	24	1kW - 5kW	B1/C3
III	32	5kW - 10kW	B/C2
IV	45	10kW - 25kW	Max C1/Min C
V	57	25kW - 50kW	Max C (>1,500')

(Courtesy Strother Communications)

Table 1. *The Strother proposal for "Eureka II" implementation in the United States addresses the station parity issue by introducing five classes of DAB, showing their equivalent AM (daytime) power levels and FM classes. Each DAB class in a market would require a separate transmitter and antenna (accommodating four to 12 stations each).*

location at a multipath cancellation node. This could result in unrecoverable signal loss. Only by combining diversity antenna reception in automotive applications and adaptive equalization techniques would most of the multipath problem disappear in this scheme.

Because the licensee would determine the power level of the "interfering" digital signal, power multiplexing vests complete control over the level of interference with the individual station. Furthermore, the competitive balance and spectrum allocation issues of the common transmitter/antenna systems disappear. As with all untested systems, over-the-air demonstrations are necessary to determine technical performance. Such a system would, however, leave AM broadcasters alone as the last analog audio medium, and might further accelerate the decline in AM listening.

Eureka: A new system two?

In addition to making an application for Eureka system tests in Boston and Washington, DC, Strother Communications of Hammond, LA, has filed a petition for rulemaking to establish a DRB service. It has since modified it to address the competitive station-balance issue head-on. The Strother plan would group Eureka assignments in five different power categories aimed at a correspondence with existing AM and FM station classes and power levels. (See Table 1.) This would require channel assignments in 2MHz channel blocks, with all stations of the same class in a given market or submarket emanating from the same transmitter and antenna.

This Eureka "II" design may also inherit a major new feature in digital radio technology: graceful degradation. The basic premise is the same one used in combating multipath: randomizing errors. The Eureka designers believe that the greater randomization or "statistical independence" of their second-generation design may lead to an increase in noise that would accompany increasing bit errors. Whether this graceful degradation will be achieved in actual practice should soon be known. This might be an important transitional factor, because embracing a system that fails abruptly (as the current Eureka and CD Radio systems do) could be difficult for some policymakers.

The search for Hertz

Three bands are being considered as

possible candidates for a digital radio service: UHF spectrum 728-788MHz (channels 57-66); 1,493-1,525MHz; and 2,390-2,450MHz. None of these options are especially favorable for terrestrial DRB. Above 1GHz, building penetration is difficult without significant increases in power. The UHF spectrum is zealously guarded by TV interests, and there are approximately 100 stations operating on these channels. The FCC is unlikely to displace existing users from some 20MHz to 60MHz of spectrum. Meanwhile, the NAB will conduct a spectrum study for DRB, but the significance of its results may depend upon their degree of access to the federal government's actual frequency usage.

Why fix FM if it isn't broken?

The latest listening trends from Arbitron and Birch show no decrease in radio listening. But AM listening is on the decline. Starting this year, two new competing aural media are being unveiled in the United States: DATs and digital cable audio services. Before this decade is out, FM radio could rank sixth in terms of the audio quality it can deliver behind CDs, DATs, cassettes, digital cable audio services and digital radio satellite services. Unlike the prerecorded nature of the first three media, these last two new arrivals can provide the same real-time companionship function radio has traditionally given, and satellite radio could reach the portable and mobile markets, over a wide area. Three of the five sitting FCC commissioners have already made public pronouncements indicating that they do not wish to foreclose radio satellite development.

With radio listening remaining constant, it would be speculative to predict dire consequences befalling the AM and FM services without their upgrading to CD quality. But the prospect of being stranded on an analog island in a digital sea is neither technically nor economically appealing.

Because digital techniques are closely allied with computation, once audio is liberated into a digital domain, manipulations of the program content will be possible, and new ancillary services will be likely, thereby redefining the nature of radio. Continuous promotional text, time, weather, traffic, format information, program identifications, direct addressability and a host of other options could turn radio into a less time-sensitive medium, and radio stations into information hubs for a variety of yet-to-be-conceived over-the-air consumer services.

In time, DAB could become viewed as the most significant development in broadcast history since KDKA signed on in 1920. Then, as now, great and cooperative efforts bore such fruit as today's radio-consuming public takes for granted. Perhaps the work ahead for DRB will sprout a medium that tomorrow's more demanding listeners will find themselves equally served and comforted by.

|:(:-)))|

SYSTEM	ISSUES					
	MULTIPATH SOLUTION	PARITY ISSUES	SPECTRUM REQUIRED	DESIGN ORIGIN	DEVELOPMENT STAGE	FAILURE MODE
Eureka II	COFDM	5 Classes	New	French/ German	Publicly Tested	"Graceful" Planned
CD Radio	D-SCPC	Not Addressed	New	U.S.	Paper	Abrupt
Power-Multiplex	None	No Disruption	No new spectrum	U.S.	Paper	Not Addressed

Table 2. Summary of DRB issues and their treatment by each of the three proposed systems.

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Circle (61) on Reply Card

1990 Annual Editorial Index

January 1990
Theme: Broadcasting From the Field

Editorial (page 6)
❖ New York or bust
(The 131st SMPTE convention, Los Angeles, vs. the 132nd in New York.)

FCC Update (page 8)
✧ Some operation rules remaining in force include licensed/chief operators, station logs, tower lighting, EBS tests, power levels, AM arrays.
✧ Fines levied: areas of safety, interference; operator position metering; frequency, modulation tolerance; authorized operation of FM non-commercial; incomplete public files; availability of station authorizations.

Strictly TV (page 10)
❖ Using wireless microphones
(Proper selection of operating frequencies, frequency coordination.)

re: Radio (page 12)
❖ Another trip to the lost and found
(Operating a directional array depends on correct monitoring points.)

Uncommon engineers (page 14)
❖ Hilmer Swanson

Circuits (page 16)
❖ How to construct a Smith chart
(Resistance, reactance curves approximate relationship of current, voltage.)

Troubleshooting (page 18)
❖ CD troubleshooting, Part 8
(Error correction, concealment, muting hide missing data.)

Management for engineers (page 20)
❖ Just in case you missed the point
The concept that "to the degree you give others what they need, they will give you what you need," is too often reversed to "when I get what I want, I'll give you what you want."

❖ **On the road with CBS News (page 26)**
by Bebe F. McClain, B. F. McClain Productions
Focus on a network news operation notes equipment portability, modular designs, needs for communications.

❖ **Making the most of remotes (page 38)**
by Rick Lehtinen, technical editor
Successful remote operation requires planning for the unexpected.
Related material: **ABC goes golfing with NOMAD** - Unpredictability of remote events countered by RF link supported by balloon or crane to relay microwave from roving cameras.

❖ **Broadcasters respond to the quake (page 50)**
by Peter Hammar, broadcast consultant
1989 San Francisco Bay earthquake shows better preparedness is needed for unexpected disasters.
Related material: **EBS: Did the system fail?** - Engineers say ignorance of EBS system curtailed effective use.

SBE Update (page 82)
✧ Ennes Foundation incorporated as the educational arm of SBE.
✧ Certification stats study members certified as of October 1989.
✧ Certification level for operators who held third-class operator licenses.
✧ Software forms interactive computerized certification study guide.

Show replay (page 84)
❖ HDTV (round 8) big news at SMPTE
(An electronic intermediate converts 35mm film to data for manipulation on image workstations and reconverts to 35mm film for theater release.)

Show replay (page 88)
❖ SBE: Labcoats to laptops
1989 SBE convention, Ennes Foundation special workshops in Kansas City rated highly successful.

February 1990
Theme: Digital Technology

Editorial (page 6)
❖ We told you so
(FCC's marketplace era, deregulation, AM stereo indecision undermines confidence; NAB AM improvement group wants higher standards, reregulation.)

FCC update (page 8)
✧ Study analyzes use of market forces for cable rate regulation.
✧ License fees to increase June 1, '90.

Strictly TV (page 10)
❖ Review your local EBS tests
(EBS tests high in FCC inspections.)

re:Radio (page 12)
❖ Check the array of your DA
(AM arrays fail in directionalization if common point resistance changes.)

Uncommon engineers (page 14)
❖ K. Blair Benson

Circuits (page 16)
❖ More about Smith charts
(Calculating VSWR.)

Troubleshooting (page 18)
❖ CD troubleshooting, Pt 9
(Tracking test discs simulate CD media problems; shows CD player reactions.)

Management for engineers (page 20)
❖ Think first, judge later
(We often make judgements without knowing all of the facts when our emotions take an upper hand.)

❖ **The great video/computer merger (page 26)**
by Rick Lehtinen, technical editor
Lines between RS-170(A), computer, RGB or other video formats decrease with add-in cards, scan-conversion.

❖ **Digital audio mixing (page 36)**
by David Shapton, Digital Automation, and Mark Mattingley-Scott, Thorn/EMI
Digital audio mixing and processing may suffer from compromises between audio quality and cost.

❖ **Using MIDI in the production room (page 46)**
by Brad Dick, technical editor
MIDI offers production effects once considered impossible.

❖ **The more things change (page 64)**
by Dennis Ciapura, Noble Broadcast Group; Teknimax
Study of AM improvement and receivers shows older radios used circuits similar to improved AM designs.

Applied Technology (page 70)
❖ Throwing effects for a loop
(Review of switcher structure notes methods to interface digital effects.)

Station-to-station (page 82)
❖ The phono pre-amp is still in style
(Construction article outlines moving-coil, moving-magnet phono pre-amp.)

Field Report (page 94)
❖ Panasonic SV-3500 R-DAT

❖ **Rethinking switchers (page 106)**
by Robert R. Ramsaur
Production switcher trend to simpler control, expanded keying, smaller physical size.

SBE Update (page 112)
✧ Oppose reallocation of 940-944MHz for roaming cordless phone service in New Jersey.
✧ Better communications sought with SBE members.
✧ Discussion topics: administrator, mandatory certification for members, exclusion of non-members from meetings, regional management seminars, awards program combining SBE certification with other organizatons.

March 1990
Theme: NAB Preview; Facilities Design

Editorial (page 6)
❖ Quit whining
(Insecure feeling calls for changed emphasis, learning new skills.)

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FCC Update (page 8)
✧ Local cable-rate limits relaxed, based on material offered.
✧ Alternatives to determine if cable systems face effective competition.
✧ Study adoption of uniform reporting, accounting, financial reports.
✧ Evaluation of CATV RF radiation, where levels exceed ANSI guidelines.
✧ Notification deadline for aural STLs, ICRs postponed until July 1, 1993.

Strictly TV (page 10)
❖ Check CAV with Lightning displays
(Lightning display quickly evaluates CAV quality with standard color bars.)

re: Radio (page 12)
❖ Bring your array back into tolerance
(Array adjustment focuses on phasing networks, transmission line lengths.)

Uncommon engineers (page 14)
❖ Ogden Prestholdt

Circuits (page 16)
❖ Using Smith chart scales
(Radial, magnitude scales for graphic solutions to math problems.)

Troubleshooting (page 18)
❖ Aerosol cans can be deadly
(Avoid exposing aerosol cans to high temperatures.)

SBE Update (page 22)
✧ Delay requested on July 1, 1990, STL, ICR technical standards.
✧ Membership survey to identify needs, desires of SBE members.
✧ Renewal for SBE memberships contains demographic survey.
✧ Computer systems for SBE spearheaded by Gerry Dalton; V2.9 frequency coordination database complete.
✧ Washington luncheon brings FCC, CPB, public and commercial stations, training foundations, consultants and trade press together; service award to Charles Hallinan, SBE 2nd president.

Show preview (page 26)
❖ Frankly, my dear, it's time to pack
(An overview of 1990 NAB, Atlanta, lists sessions and workshops.)

❖ **Facility design in a changing world (page 40)**
by Fred Powers, SAIC/Broadcast Systems
Facility design, market trends force facilities to evaluate operations for survival in growing competition; ability to adapt to change needed.
Related material: **Planning for good acoustics** - Sound control improves acoustical properties.
Related material: **New options in wiring** - Needs of wider bandwidth, more signals, new cable.

❖ **Hardening broadcast facilities (page 54)**
James C. Ritchie, Cooper, Carlson, Duy & Ritchie; and Rick Lehtinen, technical editor
How well can a broadcast facility withstand a catastrophe? Designs and evaluations should consider construction techniques to reduce damage.
Related material: **If there's fire...** - Reducing risk of fire, safety measures, "fire triangle" of fuels, heat and oxygen.

❖ **Planning a satellite uplink (page 80)**
by Tim McCartney, contract engineer
Planning and implementing a satellite uplink, downlink for Boise (ID) State University and NPR.

❖ **Hardening towers (page 94)**
by Rick Lehtinen, technical editor
The tower is vulnerable to the elements and is the greatest liability of a station to surrounding environment.

❖ **Voodoo engineering (page 108)**
by Dennis R. Ciapura, Noble Broadcast Group & TEKNIMAX
Technical decisions require logical testing; before-after comparisons may be psychogenic - you expect improvement, so you hear improvement.

❖ **Equipment Exhibitors & New at NAB (page 133)**
A list of manufacturers, new products expected at NAB '90 in Atlanta.

Station-to-station (page 233)
❖ Frame-line generator defines picture area
(Article describes a "safe title area" generator with 10% and 90% points horizontally and vertically, cross hairs mark center.)

Field Report (page 238)
❖ Lexicon LXP-1 effects processor and MRC MIDI controller.

Field Report (page 244)
❖ Ampex Vista production switcher with DigiLoop effects link.

April 1990
Theme: Automation Special Report

Editorial (page 6)
❖ Legal beagles
(Broadcast regulation requires clearly defined rules, dedicated people.)

FCC Update (page 8)
✧ Wireless cable rules proposed for MDS, ITFS uses.
✧ Cable signal leakage rules enforced; Form 320 to ensure safe use of aeronautical frequencies.
✧ FCC forfeiture authority increased in rule violations.

Strictly TV (page 10)
❖ Lightning quick evaluations
(Interpreting Lightning waveforms and making adjustments based on understanding of waveform, dots.)

re: Radio (page 12)
❖ In-line bridge measures conditions
(Making measurements with the transmitter in operation.)

Uncommon engineers (page 14)
❖ Nathan Hughes

Circuits (page 16)
❖ Using the Smith chart overlay
(Plastic overlay coordinates plotting, measuring admittance.)

Troubleshooting (page 18)
❖ Battling power amp ACV line sag
(Power amplifier operation subject to line voltage supply.)

Management for engineers (page 20)
❖ Dodging the corporate ax
(Do corporations have consciences; trade-offs in value of the employee versus corporate survival or bankruptcy.)

❖ **Radio automation for the '90s (page 26)**
by Steve Walker, Broadcast Automation.
Radio automation offers varying degrees of ease in programming, expandability, flexibility, failsafe features.

❖ **Automatic program delay units (page 32)**
by James W. Lindelien, Time Logic
Program delays have conventional time zone conversion capability, other tasks. Cart systems may not provide some functions wanted for delay use.

❖ **The cart machine takes charge (page 44)**
by Tim Crabtree, Odetics
Cart machine's sequential programmability and high level of computer control forms a hub of master control and news operations.

❖ **Picking up the pieces (page 49)**
by Rick Lehtinen, technical editor
When the carrier is off, revenue stops; steps to staying on-air.
Related material: **Selecting a UPS**

❖ **Making digital connections (page 54)**
by Bruce Lilly, Sony Broadcast Products
Digital signal transmission removes pitfalls of analog systems, equipment interconnections.

❖ **Surviving changes in station ownership (page 64)**
by Brad Dick, editor
Changed environment requires new outlooks, new skills, a survival plan.

SBE Update (page 68)
✧ Baumgartner resigns.
✧ Communicating with members not assigned to specific chapters.
✧ Membership directory available.
✧ Administrator position defined, a focus on membership and benefits.
✧ SBE-sponsored VISA card; 1989 convention on videocassette.

Applied Technology (page 70)
❖ System compresses digital audio data
(Data compression cuts costs in transporting digital audio signals, but may affect signal quality.)

Field Report (page 82)
❖ Denon DN-950FA CD cart player

Station-to-station (page 122)
❖ Battery test system streamlines work
(Commodore C64, forms test system to keep batteries at peak capacity.)

May 1990

Theme: RF Transmission Systems

Editorial (page 6)
❖ The RF mystique
(Today's engineers should help others learn by sharing knowledge.)

FCC Update (page 8)
✧ FM translator rules regarding microwave, satellite relays; AM broadcasts over FM translators ban retained.
✧ FCC chairman views commission role in the '90s: to strengthen ability to compete; to expand opportunity; promote, encourage excellence.

Strictly TV (page 10)
❖ Hawaiian pattern is for the birds
(Transmitter site on Maui protects bird species, avoids interference with astronomy observatory.)

re: Radio (page 12)
❖ Install your NRSC-1 now
(NRSC-1 equipment to be in place by June 30; proof of compliance required by June 30, 1994; NRSC-2 rules define measurements and procedures.)

Uncommon engineers (page 14)
❖ Lew Wetzel

Circuits (page 16)
❖ Matching impedances with Smith charts
(Designs for power transfer.)

Troubleshooting (page 18)
❖ Tracking those pesky culprits
(An operator error or a true equipment problem? Guidelines to systematically track hard-to-find answers.)

Management for engineers (page 20)
❖ Finances & today's engineer, Part 1
(Station success is more financial performance than "ratings" and market share; engineers must understand technical aspects of the work and station finance and accounting.)

❖ **RF technology: setting new standards (page 26)**
by Jerry Whitaker, associate publisher
Solid-state devices find new applications in RF engineering because of device characteristics.

❖ **Is your STL ready for the 1990s (page 50)**
by Dane Ericksen, Hammett & Edison
Antenna standards for microwave between 2GHz and 31GHz outlined.

❖ **Tower lighting update (page 63)**
by Rick Lehtinen, technical editor
Obstruction lighting makes hazards visible to aeronautical world.
Related material: **Lighting system design.**

❖ **Remote-site security primer (page 70)**
by Gerry Kaufhold, SGS-Thomson Microelectronics
Regulations, practical reasons for security provisions at broadcast facilities protect people and equipment.

Applied technology (page 84)
❖ Variable circularly polarized UHF antenna
(Parameters in variable CP UHF antennas and effects of "variable" elements.)

Station-to-station (page 90)
❖ Taking the measure of video processors
(Wider bandwidth of video processors challenges measurement of equipment performance above 10MHz.)

SBE Update (page 98)
✧ Proposed coordination criteria to determine if broadcast market is a "congested area."
✧ Category A, B antennas include half-power beamwidths of 14° and 16° for aural STLs and 2GHz, 7GHz TV auxiliary frequencies; rule changes above 13GHz involve FCC bureaus besides broadcast division.
✧ SBE examines future convention sites for assured success.
✧ Logo and service mark "SBE," the exclusive property of the society.

Field Report (page 100)
❖ Nytone video slide scanner

Field Report (page 104)
❖ MCG surge protectors

June 1990
Theme: NAB '90 Review

Editorial (page 6)
❖ Passing the buck
(Bickering between FCC and FAA slows license approvals; neither admits responsibility.)

FCC Update (page 8)
✧ Policy for improved AM: eliminate grandfathering of existing authorizations; acceptance of certain contingent applications; study of minimum level of service.
✧ Interference is basis of improved methods to determine skywave, groundwave field strength in AM band.
✧ Proposed for AM improvement: tax certificates to AM stations reducing co-channel, adjacent-channel interference; relaxed multiple ownership; re-implementation of AM-FM non-duplication; AM technical standards.
✧ Fees increase 12.6%, May 21; new fees imposed on other services.

Strictly TV (page 10)
❖ Clarifying EBS modulation levels
(One EBS tone produces a minimum of 40% modulation; combined tones to cause 80% modulation; FCC to clarify requirements.)

re: Radio (page 12)
❖ RF, the earth connection, Part 1
(The ground connection in AM forms a portion of the antenna system.)

SBE Update (page 14)
✧ SBE direction debated; professional management report of SBE accepted; membership list rental approved.
✧ Software, hardware in Indianapolis computer system increases efficiency;

accounting software will also serve at convention sites.
✧ SBE officers met broadcasters from 36 countries during NAB convention.

Circuits (page 16)
❖ Measuring reactance, susceptance (Determining capacitative susceptance, inductive reactances.)

Troubleshooting (page 18)
❖ Reviewing video basics, Part 1 (Series of tutorial discussions defines basic terms of video.)

Management for engineers (page 20)
❖ Finances & today's engineer, Part 2 (Why have a budget? There are advantages and disadvantages.)

❖ Perspective on the convention (page 26)
by Brad Dick, editor
50,000 broadcasters found many "new" products as improvements on established ideas and products. HDTV asks, "Should broadcasters move toward HDTV or risk *AM-ization* of local TV broadcasting?" Q&A session with FCC discusses licenses held hostage by FAA. For FM, considerable confusion remains on FM peak modulation measurement. FCC pledges solutions in measurement procedures.

❖ NAB Engineering Conference report (page 32)
by Brad Dick, editor
Conference focus on practical information; papers deal with financial bottom line of broadcasting, getting positive results; the cost of modifications for HDTV. Scenarios on HDTV conversion includes simulcast transmission. NTSC support continues with ghost cancellation added to improvement techniques.

Graphics-animation focus on making graphics work for broadcasting. Engineers should be aware of creative objectives of the artist and help in technical and operational information without bullying the designer.

Radio sessions featured digital techniques with the DAB Eureka Project and coded orthogonal frequency division multiplexing for broadcast, methods offering higher efficiency terrestrial transmission; digital satellite transmission format compresses 16-bit to 4-bit data.

AM radio improvement discussion continues as FCC vigorously enforce NRSC-1 rules. NRSC-2 will not guarantee all interference is avoided.

❖ The Pick Hits of NAB '90 (page 48)
by Rick Lehtinen and Skip Pizzi, technical editors
Products for TV: **Abekas** A82 composite digital video switcher; **Steadicam** EFP support system; **Digital Processing Systems** DPS-265 synchronizer; **Ergo Industries** ElP-7500T tilting rack-mount kit; **J-Lab** battery operated DAs; **National Photonics** Sidewinder ENG video system; **Panasonic** LQ-4000 rewritable optical disk recorder; **Sony** DVR-2 portable D-2 VTR; **Sony** BVP-270 studio camera; **Tektronics** VM700A Opt 40 audio measurement package. *Products for radio include:* **360 Systems** Digicart digital audio recorder; **Broadcast Devices** UNI-200 universal remote interface; **Computer Concepts** digital commercial system; **Consultronics** PC-3000 stereo audio analyzer; **CRL Systems** audio signature processor; **Gentner Electronics** Lazer FM generator, limiter and PeopleLink telephone system; **Harris** GATES series AM transmitter; **Radio Design Labs** NRSC stick-on circuits; **Will-Burt**: hurry-up telescoping mast.

❖ Show of shows (page 68)
A listing of hundreds of new products introduced at NAB.

July 1990
Theme: Audio Technology Update

Editorial (page 6)
❖ Making order out of chaos
(Broadcasters should become a part of their local coordinating committee.)

FCC Update (page 8)
✧ FCC and fairness "corollaries."
✧ NRSC-2 compliance in effect.
✧ FCC air-hazard regulations place requirements on towers, lighting.
✧ FCC acts on abuses of process; rules, proposals to deal with comparative hearings, FM/TV allocations.

Strictly TV (page 10)
❖ Interchannel timing in component systems
(Component signals with Lightning, Bowtie displays locate timing errors.)

re: Radio (page 12)
❖ RF, the earth connection, Part 2
(Grounding in the studio makes a difference in clean audio and various undesirable noise characteristics.)

Uncommon engineers (page 14)
❖ Charles Rhodes

Circuits (page 16)
❖ Selecting Smith chart design components
(Normalized values from Smith chart can be used to select real circuit component values.)

Troubleshooting (page 18)
❖ Reviewing video basics
(TV sync timing, gen-lock and subcarrier/horizontal sync phase.)

Management for engineers (page 20)
❖ Finances & today's engineer, Part 3
(Phases of budgeting - include planning, preparation and control.)

❖ **Performance aspects of digital oversampling (page 26)**
by Richard Cabot, Audio Precision
Concern over some specifications on digital audio equipment result in serious degradation of others.

❖ **Audio interconnection (page 48)**
by Skip Pizzi, technical editor
Voltage-source interconnection permits input, output impedances other than 600Ω and reduced requirements for matched terminations.

❖ **User's guide to TVRO performance (page 66)**
by Warren H. David, Jr., Standard Communications
Tutorial on satellite equipment examines aspects of receiving system.

August 1990
Theme: Video Technology Update

Editorial (page 6)
❖Leading the challenge
(A successful engineering staff is excited about technology; alternative *if it ain't broke, don't fix it* leads to mediocracy.)

FCC update (page 8)
✧ Forfeiture authority to $25,000 per violation, or day of a continued violation, to total not exceeding $250,000 for single act or failure to act.
✧ Rules amended allowing broadcast stations to advertise lotteries conducted under specified conditions.
✧ IF protection rules for FM affirmed for a receiver located in an area served by two strong IF-related stations.
✧ Construction permitted without prior FCC authorization requires applicant to determine environmental impact prior to construction.

Strictly TV (page 10)
❖ Interchannel timing in component systems, Part 2
(Dual timing pulses track timing of components with signals converted among 3-wire, 2-wire and composite.)

re: Radio (page 12)
❖ Save our AM system
(The FCC operated within confines of Communications Act of 1934 until 1962 with regard to issuing AM licenses.)

Uncommon engineers (page 14)
❖ Robert Gross

Circuits (page 16)
❖ Filter functions with Smith charts
(High-pass, low-pass, bandpass and notch filters designed with the chart.)

Troubleshooting (page 18)
❖ Reviewing video basics, Part 3
(Mathematically derived relationships in SC/H phase; frame synchronizer, TBC, color field ID pulses.)

Management for engineers (page 20)
Finances & today's engineer, Part 4
(The best approach for budget approval - sell your needs to management in plain terms.)

❖ **Integrating systems: WFTV's story (page 26)**
by Bebe McClain, consultant, and Paul Warnock, WFTV
Cox Broadcasting facility in Orlando designed for 21st century with distribution and routing system permitting master control, two production studios and an editing suite to access all sources with priority levels and machine control.
Related material: **How far can desktop video go?** - DTV workstations in automated newsrooms.
Related material: **The emerging role of ethernet in broadcast.**

❖ **Automating audio measurements (page 42)**
by Adolfo Rodriguez, Tektronix
Demands for improved audio, stereo for TV places additional requirements on measurements; digitally implemented 30-second test established by CCITT accomplishes complete system evaluation of all critical parameters.

❖ **DAT in the professional environment (page 50)**
by John Monforte
Digital audiotape (DAT) moves from consumer to professional applications with six data formats and room with possible expansion.
Related material: **Care and handling of DAT cassettes.**
Related material: **SCMS - the Serial Copy Management System** - system to protect copyrighted material.

❖ **Audio: the sound product (page 68)**
by Ronald F. Balonis, WILK-AM
Sound is an empirical, psychophysical subjective perception. It is important to understand the mechanism (and limitations) of human hearing and effects introduced by the audio chain.

Show preview (page 74)
❖ IBC is larger than ever
(International Broadcasting Convention, Brighton, England, September 21-25, covers array of advanced subjects.)

SBE Update (page 76)
✧ Society hires executive director, Stephen L. Ingram, to guide activities at Indianapolis national headquarters.
✧ Slate of candidates for national offices released; ballots to be returned to the national office by October 1.
✧ SBE and DANTES discuss adopting SBE certification program in the U.S. military services.

Field Report (page 78)
❖ TASCAM CD-701 CD player

Station-to-station (page 86)
❖ Building a remote switcher
(Features developed to control remote satellite receiving system outlined.)

September 1990
Theme: Audio-Video Control Systems

Editorial (page 6)
❖ The digital audio revolution continues
(Interest in CDs and growing interest in DAT indicates audio consumers appreciate quality. DAB to bring quality, range of technical pluses over FM.)

FCC update (page 8)
✧ Evaluations stricter regarding basic character qualifications of broadcast applicants and licensees.
✧ Misconduct will not disqualify an applicant, but results in observations.
✧ Rules clarified on time-critical ap-

plications filed for broadcast and common carrier in response to filing windows, cutoff lists.
✧ 24-hour ban on indecent broadcast programming adopted.

Strictly TV (page 10)
❖ Keep equipment safe on the road (Remotes present possibilities of damaged equipment or theft. Suggestions on security may keep your remote equipment on duty.)

re: Radio (page 12)
❖ How to protect your antenna system (Almost any construction rising above 50 feet near an AM antenna system can have an affect on operation.)

Uncommon engineers (page 14)
❖ Carl E. Smith

Circuits (page 16)
Use microcontrollers for station projects, Part 1
(Single-chip microprocessors do surprising tasks with added circuitry.)

Troubleshooting (page 18)
❖ Reviewing video basics, Part 4
(The reference sync generator locks all equipment in the station together. Delay devices (or cables) can control the reference to correct timing.)

Management for engineers (page 20)
❖ Finances & today's engineer, Part 5
(The best time to start planning for next year's budget is now. Give yourself time to think about what you want and need to run the station.)

❖ **Present and future facility control systems (page 26)**
by Don Reynolds, DYNAIR Electronics
A facility can operate only as well as its control system permits, placing burden of responsibility on the designer to consider how needs may change over time.

❖ **Making the switch (page 36)**
by David L. Bytheway, BTS
Signal distribution and routing grows in importance as production facilities become more complicated. The distribution system must be able to expand without introducing degradation.

❖ **Fiber optics in the broadcast industry (page 50)**
by Michael W. Pugh, Grass Valley Group
Background material on optical communication wavelengths of 850nm, 1,300nm and 1,550nm, attenuation characteristics, common optical sources and the nature of light through optical fibers.
Related material: **Fiber-optic measurement and testing**. Transmission loss, discontinuities in fiber path require special instrumentation for measurement and troubleshooting.

❖ **Understanding and using VCAs (page 84)**
by Ron Dow and Dan Parks, Precision Monolithics
A VCA has an input, an output and control port. At its heart are closely matched NPN and/or PNP transistors.
Related material: **Alternative technologies: the other gains in town.** Electromechanical, photoelectric and field effect devices used in D/A, A/D converters, digital signal processing.

Show preview (page 98)
❖ See you in St. Louis
(The 1990 SBE national convention, October 4-7, will be held in St. Louis.)

Show preview (page 114)
❖ SMPTE returns to New York
(132nd SMPTE technical conference, equipment exhibition convenes October 13-17, Javits Center, NYC; theme: "Film & Television - One World.")

Field Report (page 116)
❖ Ampex ADO 100 effects system

Applied technology (page 124)
❖ Designing a routing switcher for the 1990s
(SMT, system architecture, thermal concerns, power and control distribution in router design.)

SBE Update (page 130)
✧ Society initiates strategic planning for '90s, assisted by executive director.
✧ Annual elections approach, ballots due at national office by October 1.
✧ Ennes Workshop program precedes the convention in St. Louis.
✧ SBE cites first certified female engineer, Deborah Proctor, WCPE-FM.
✧ Professional licensing discussed; congressional members request GAO study of state involvement in licensing for radio, telecommunications engineers, technicians.

Station-to-station (page 132)
❖ Remotely piloted ENG helicopter
(A helicopter from a kit, equipped with 2GHz downlink, brings ENG pictures from confined or dangerous locations; more challenges in "piloting" than in camera operation.)

Applied technology (page 138)
❖ Eliminating transmission line wear
(Motion, wear from thermal change of inner conductors produce conditions for transmission line flashover, power losses and local hot spots.)

October 1990
Theme: Broadcast Management for the '90s

Editorial (page 6)
❖ Farewell to a friend
(Blair Benson, long-time friend and consultant to *Broadcast Engineering* and industry pioneer dies.)

FCC update (page 8)
✧ FCC studies digital audio radio service, seeks public comments on DAB.
✧ Report to Congress on cable TV, notes program services not duplicated by local broadcast.
✧ Recommendations to Congress to control CATV, protect broadcasters.

Strictly TV (page 10)
❖ A case for refinement
(Better designs are often simpler, not by cutting corners, but through refinements that produce better solutions.)

re: Radio (page 12)
❖ Tubes and modulation
(A review of modulation principles examines tube technology.)

SBE Update (page 14)
✧ Financial future looks bright, in large part through efforts of the executive director; in the post as a professional association manager, broadcast-related qualifications are not essential.
✧ Member survey shows 53% make a living working in radio with 34% in TV; the remainder come from other fields; 56% of respondents are SBE certified, 70% paying their own certification fees.

✧ Membership campaign conducted offering incentives for recruiters and local chapters.

Circuits (page 16)
❖ Use microcontrollers for station projects, Part 2
(Outline of initial stages in designing with microcontroller devices.)

Troubleshooting (page 18)
❖ Servicing your klystrons, Part 1
(Cooling systems have important role in klystron-equipped transmitters.)

Management for engineers (page 20)
❖ Project management for engineers, Part 1
(Organizational structure for managing and a good fundamental plan to guide the project to its successful conclusion are often missing.)

❖ The 1990 salary survey: Dividing the pie (page 26)
by Brad Dick, editor
Radio engineering salaries, down less than 1%, and median TV engineering salaries, up by 3%, were overshadowed by 11% increases in operator salaries. Operators fill many positions once considered as engineering-only, while engineers' tasks and skills have changed.

❖ The broadcast engineer and changing technology (page 49)
by Brad Dick, editor
Engineers should concentrate on their skills and adaptability to new technology to survive changes in engineering departments.

❖ Developing an engineering budget (page 64)
by Ronald F. Balonis, CE, WILK-AM
An engineer and a business manager may have little in common, but seek a common goal, a profitable broadcasting operation.

❖ FM subcarriers in the 1990s (page 80)
by John Kean of Moffet, Larson & Johnson
FM SCA operation carries various services to the public with opportunities for additional income.

❖ Bringing in the feeds (page 92)
by Peter Hamnar, Hammer Communications
An overview of facilities at the Goodwill Games, Seattle, July 20-August 5, focuses on broadcast center, remote vehicles and international satellite links serving a potential audience of more than one billion viewers.

November 1990
Theme: Maintenance Report

Editorial (page 6)
❖ A modest proposal
(An engineer on the FCC?)

FCC Update (page 8)
✧ Violations found in political advertising rules
✧ Most AM stations comply with new emission limits to reduce adjacent-channel interference.
✧ FCC examines rules and policies regarding a TV station operating as a "satellite" for a distant station.

Strictly TV (page 10)
❖ Frequency response monitors system health
(Frequency response is an indication of overall video system health; minor degradations in frequency response can predict larger problems to come.)

re:Radio (page 12)
❖ More on modulation
(Heising or choke modulation and positive vs. negative modulation.)

Uncommon engineers (page 14)
Irv Rosner

Circuits (page 16)
❖ Building with microcontrollers, Part 3
(Clock signals for microcontrollers.)

Troubleshooting (page 18)
❖ Cleaning and flushing klystron water and vapor cooling systems
(Cooling system maintenance is essential with klystron systems.)

Management for Engineers (page 20)
❖ Project Management, Part 2
(Planning needs thought, organization; management takes thought, organization and response.)

❖ Test equipment for RF systems (page 26)
By Jerry Whitaker, associate publisher, and Don Markley, P.E.
Having the right RF test equipment is important in the maintenance effort. Guidelines to various categories of equipment for better understanding of test products, their applications and operation.

❖ Troubleshooting digital systems (page 44)
Jerry Whitaker, associate publisher
Microprocessor-based hardware requires a different maintenance approach.

❖ Maintaining a classic tower site (page 60)
By Steve Walker, Broadcast Automation, Dallas
A 12-tower AM array presented operational problems, attracted pilots.

❖ Is magnetic tape an endangered species? (page 65)
By Skip Pizzi, technical editor
Positive, negative attributes of all current recording media indicate continued viability of magnetic tape. Optical media recording density is determined by the wavelength of the light used in writing and reading data.

Show Replay (page 82)
❖ A postcard from Brighton
(A swan song heard at 1990 IBC in Brighton, England; for 1992, IBC moves to Amsterdam.)

SBE Update (page 84)
✧ A case for SBE certification
(SBE certification program, only such program widely accepted by the industry; leads to improved understanding of station facilities.)

Applied Technology (page 96)
❖ CCD imagers are new and improved
(Review of CCD technology introduces the HAD, hole accumulator diode, sensor.)

Station-to-station (page 116)
❖ A baffling mystery, an unusual culprit
(Earth around a directional array behaves capacitatively; becomes more noticeable with changing of seasons.)

❖ Manufacturer test techniques at the end-user level (page 122)
By Paul McGoldrick, Magni Systems
Whatever the complexity of an operation, verification that all the pieces in the equipment chain are working at optimum levels is needed.

Field Report (page 112)
❖ Comark 60kW UHF Klystrode transmitter

December 1990
State of the Industry

Editorial (page 6)
❖ Endangered species?
(Supply of people interested in broadcast technology is limited.)

FCC Update (page 8)
✧ Rules adopted for "wireless cable" service.
✧ "Cable system" redefined beyond video delivery systems.

Strictly TV (page 10)
❖ Frequency response monitors system health
(Chroma-to-luma gain and delay errors cause saturation and smear problems.)

re:Radio (page 12)
❖ Some thoughts about transmission lines
(There are more kinds of transmission line besides coax.)

SBE Update (page 14)
✧ Bylaw revision sets minimum attendance at executive committee, board meetings; provides mechanism to replace officers, directors unable to fulfill their responsibilities.
✧ Brad Dick re-elected president; Richard Farquhar returns as vice president; Paul Lentz returns as secretary; Robert Goza becomes treasurer.
✧ Convention attendance at 3,727; Ennes attendance up 20% from 1989.
✧ 1991 convention in Houston combined with TAB; Barker continues as exhibition manager.
✧ SBE to lobby for at least one FCC commissioner to be an engineer.

Circuits (page 16)
❖ Building with microcontrollers, Part 4
(Tying microcontrollers to the world through inputs, outputs.)

Troubleshooting (page 18)
❖ Servicing your klystrons, Part 3
(Cooling water purity affects life, efficiency of vapor-cooled tubes.)

Management for Engineers (page 20)
❖ Project management for engineers
(Successful project management calls for a team approach.)

❖ State of the industry report (page 26)
by Brad Dick, editor
There's good news coming - if we can hang on; industry remains in a slump, but not sinking as fast last year.

❖ Bottom-line quality in broadcasting (page 49)
by Robert M. van Zyl, Videotek
American business is learning that quality means conformance to requirements, is quantifiable, and applies to all work including the production of goods, the performance of services and the management of activities.

❖ View from the top (page 52)
by Skip Pizzi, technical editor
A roundtable of engineers ponders who and where we are. Marvin Born, Mark Durenberger, Richard Farquhar and Michael Starling discuss the industry.

❖ Digital radio: promise and perils (page 68)
by Michael Starling, NPR
Digital radio broadcasting, DRB, an outgrowth of the EBU's Eureka and digital audio broadcast promises a good deal for FM operations - high efficiency, extended coverage.

❖ 1990 Annual Editorial Index (page 80)

Broadcast Engineering Readers:

The 1990 Editorial Index will be available for browsing or downloading as an ASCII data file in BPForum on CompuServe by mid January 1991.
At any prompt, type:
GO BPFORUM.

People/ Business

Jerome J. Meyer has been named president, chief executive officer and director of Tektronix, Beaverton, OR.

Michael Dorrough was awarded a Fellowship at the 89th annual Audio Engineering Society Convention awards banquet, held on Sept. 24 in Los Angeles. The fellowship honors his innovative contributions in the field of audio, recognizing his split-band audio processor and the Dorrough loudness meter as outstanding achievements.

Ron Chubb has been appointed district sales representative for JVC Professional Products, Elmwood Park, NJ. His territorial responsibilities include San Diego, Orange County, Los Angeles and parts of Burbank and Hollywood.

Kelly K. Hannig has been appointed director of research and development for Gentner Electronics, Salt Lake City. He is responsible for coordinating product ideas, obtaining customer input on new or updated products, and for overseeing all R&D projects. His primary responsibility is to match product development with customer requirements.

Merrald Shrader and **Don Priest** have received an Emmy Award for outstanding achievement in engineering development. It is shared with Nat Ostroff of Comark Communications. The award is in recognition of their creative efforts in developing the Klystrode tube and transmitter for UHF TV broadcast.

Tech-Sym purchases Continental Electronics

Tech-Sym, Houston, has completed the purchase of nearly all of the business and assets of the Continental Electronics Division of Varian Associates through a newly formed, wholly owned subsidiary. The subsidiary, named Continental Electronics, has assumed certain liabilities of the Continental Electronics Division. The purchase price is subject to certain post-closing adjustments.

Nikon relocates headquarters

Nikon has relocated its headquarters. The address is Nikon 1300 Walt Whitman Rd., Melville, NY 11747-3064; telephone 516-547-4200; fax 516-547-0299.

JVC president sees increased acceptance of S-VHS

Mike Yoshida, president of *JVC*, Elmwood Park, NJ, has advanced the company's S-VHS products into many professional video markets since his appointment to the position last April.

The acceptance of the S-VHS format is apparent by the company's increased sales of S-VHS camcorders, complete S-VHS editing systems and the initial sales of S-VHS tri-duplicators for distribution.

New products

ENG camera support

By Miller Fluid Heads (USA)

• **Miller 2-Stage:** new alloy tripod uses 2-stage design for ENG or EFP use; height range of 15.7″ to 58.5″ permits wide variation in camera angles without excessive tripod setup adjustments; total weight with spreader is 8.8 pounds to support camera weights to 55 pounds; accepts most 100mm ball pan/tilt fluid heads and flat-base heads to 4″ diameter with adapter unit; easily adjusted for use on uneven terrain.

Circle (365) on Reply Card

Enhanced editing system

By Montage Group

• **Picture Processor IIH:** hybrid, non-linear, off-line editing control; switchable between analog, digital playbacks; proprietary video compression technique for access to any edited sequence within 0.5 seconds.

Circle (366) on Reply Card

Wireless mic system

By Samson Technologies

• **UR-4 UHF series:** consists of true diversity receiver with beltpack or hand-held transmitter units; rack-mounted receiver provides 10dBm signal without clipping from a balanced or unbalanced output; operation in 938-952MHz spectrum; transmitters available with various elements or lavalier mics.

Circle (372) on Reply Card

Replacement knobs

By Selco Products

• **Soft Touch series:** thermoplastic rubber, push-on control knobs; integral polypropylene cap with pointer requires no assembly; standard body color is black; cap, pointer color selected from standard or pastel color list; 6mm standard shaft size with 18 splines; special orders possible.

Circle (373) on Reply Card

Multifunction recorder

By Symetrix

• **2/4-track recorder:** based on DPR100 digital processing recorder; enhanced random-access, editing, mixing, processing functions; simultaneous 2- or 4-track record/playback; compatible with original 40-track material; real time or time-code control of EQ, compression, limiting, gating; interlock with video through time code, video, word clock; Macintosh II control surface.

Circle (375) on Reply Card

Time code with PC

By Telcom Research

• **Model T102:** generator and reader for SMPTE/EBU time code; RS-232C interface allows use with desktop or laptop PCs; jam sync and continuous jam sync modes; EFP electronic front panel software emulates display and switches of the unit on an EGA or VGA monitor, with mouse or keyboard control capability; TC-LOG tape logging package, EDL list software; package includes sample programs and software drivers; IBM, Macintosh, DEC, Amiga, Atari PC-compatible.

Circle (377) on Reply Card

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	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest To Filing Date
A. Total No. Copies Printed (Net Press Run)	42,823	42,200
B. Paid and/or Requested Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	—	—
2. Mail subscriptions	35,340	35,383
C. Total Paid and/or Requested Circulation	35,340	35,383
D. Free Distribution (including samples) by mail, carrier delivery or other means	2,728	2,547
E. Total Distribution (Sum of C and D)	38,058	37,930
F. Office use, left over, unaccounted, spoiled after printing	4,755	4,270
G. Total (Sum of E and F should equal net press run shown in A)	42,823	42,200

I certify that the statements made by me above are correct. (Signature of editor, publisher, business manager, or owner.)

Sandra Stewart,
Circulation Director

Multipurpose mixer

By Otari

• **Series 54:** 24-bus audio console serves production, recording, broadcast and post-production functions; each input module contains separate dual paths, including faders, access to EQ, auxiliary sends and assignment to either of two stereo mix buses; may include DISKMIX 3 moving faders and automation systems; configurations to 60-channels with 120 independent inputs.

Circle (425) on Reply Card

Bandwidth enhancement

By DYNAIR Electronics

• **Dynasty 100 upgrade:** extended frequency response to 120MHz for high-resolution, multiple-level component video in RGB or monochrome formats; 10×10 to 50×100 size matrices; plug-in modules accommodate coaxial or fiber-optic inputs and outputs.

Circle (387) on Reply Card

Integrated production center

By VATEK

• **UNITY:** combines an 8-input component analog and D-1 signal switching with dual-channel digital effect unit; CCIR-601 processing with full bandwidth key channel; input capability for component analog, RGB, Y–C and composite video; D-1 input and output options; $4\times F_{SC}$ D-2 version in development; keyframe storage of switcher transitions, keys, effects parameters and input gain settings.

Circle (388) on Reply Card

Audio measurements

By Lindos Electronics

• **LA100 Analyzer:** combines tests for distortion, noise, frequency response, phase, crosstalk, wow/flutter and quantizing distortion in addition to frequency and level measurements; LA101 synthesized oscillator and LA102 measuring set units; single tests or test sequences initiated by single-button operation or by RS-232 control; LCD panel provides numeric values, graphics, pass/fail indication; output port for documentation on most standard printers.

Circle (396) on Reply Card

Video encoder

By Broadcast Systems Design

• **Model 130:** produces RS-170A composite NTSC as well as Y/C, Y/688 and Y/629 component signals from RGB components with composite sync, 800-line resolution; available in PAL version; avoids chroma-luminance crosstalk, chroma smear and crawling edges without the use of comb filter circuits.

Circle (376) on Reply Card

Video processing systems

By James Grunder & Associates

• **DTC 2604:** bidirectional standards converter; supports NTSC, NTSC-4.43, PAL, PAL-M, PAL-N and SECAM as well as ½-inch, ¾-inch, 1-inch, S-VHS and component video formats; 4:2:2 8-bit processing offers full time base correction, with 4-field, 4-line interpolation for adaptive motion processing; features include noise reduction, image enhancement; from International Video.

Circle (401) on Reply Card

Test products

By Tektronix

• **TSG-120:** signal source for maintenance shop provides composite, Y, C and Y/C outputs as well as a stereo audio signal.
• **TSG-130:** multiformat generator; includes NTSC, Y/C, Y/R–Y/B–Y for Betacam and MII and CTDM signal formats; includes stereo audio outputs.
• **TSG-273:** PAL digital source; produces 10-bit parallel composite digital signals; digital gen-lock with analog, digital outputs; analog black source for use as sync generator.

Circle (397) on Reply Card

International VCR

By Instant Replay

• **World Traveler:** videocassette recorder plays cassettes recorded in NTSC, PAL and SECAM standards; playback may be viewed on a receiver of any of the three standards; NTSC and PAL/SECAM tuners, multiple voltage power supply permits recording off-air.

Circle (426) on Reply Card

Camera support products

By QuickSet International

• **QRT-1M:** miniature tripod supporting loads to 100 pounds; 8.8 pound unit with black finish has maximum height of 29 inches with a minimum height of 13 inches; tripod plate accepts 100mm ball base or Mitchell base; convertible spike to rubber feet.

Circle (404) on Reply Card

Band I antenna

By Comad Communications (SIRA)

• **Band I panel system:** constructed in a modular fashion to greater applicability in different situations; wideband power distribution system uses quadrature hybrid couplers, star power dividers; 4-panel tier typically requires 19.5m of tower space with a weight of 25 tons; two inputs with two feeder cables driven from a drum splitter for improved wideband performance; Lorenz filter combiner uses 3-pole bandpass filter to reject unwanted interaction of multiple channel signals.

Circle (368) on Reply Card

Titling system upgrade

By Paltext Imaging Systems

• **Fast Font processor:** five-fold increased speed in typeface processing available in Version 6 software for Aston 4 and Caption character generator systems; page boundaries are deleted for roll and crawl operations permitting simplified addition or removal of rows of text; automatic page sequencing with varying dwell time for each page if desired; batch function allows sequential processing of 100 display fonts.

Circle (386) on Reply Card

Expanded music library

By QCCS Productions

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Circle (74) on Reply Card

Professional services

Preview

January 1991...

BROADCASTING FROM THE FIELD

- **Getting Your Signal Back Home**

Remote broadcasts can be a lucrative or a losing proposition. The difference usually depends on the technology needed to distribute and back-haul broadcast signals.

- **Communicating With the Field**

One of the most crucial aspects of remote broadcasting is effective communication with the crew working away from the station. This article looks at cellular technology as one effective method to keep in touch with remote crews.

- **Sharing Part 74 Spectrum**

Today's compact frequency spectrum means that everyone has to cooperate — or everyone loses. Because the FCC has, for the most part, washed its hands of frequency coordination, it's more difficult than ever to find an interference-free frequency.

- **SBE Convention Replay**

Show wrap-up for the SBE National Convention and *Broadcast Engineering* Conference in St. Louis.

- **Direct Broadcast Satellite in the United Kingdom**

Europe is running full speed toward DBS broadcasting. Last April, the United Kingdom implemented five channels of TV satellite broadcasting using D-MAC encoding and 1-foot-square receive antennas.

February...

WINNING WITH DIGITAL TECHNOLOGY

- **A Look at High-Performance Recording Formats**

At least three digital and two new analog video recording formats are available for today's video productions. Each format has its own characteristics and benefits.

- **Using PC-Based Effects Systems**

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 video signals with ease and reliability.

Classified

HELP WANTED

MIDWESTERN UNIVERSITY: Looking for Chief Engineer for new Radio/TV facility opening 1/91. Applicant should have full working knowledge of mid-market TV/Radio or university equivalent including: audio/video maintenance, component-level repair, and good troubleshooting skills. TV facility includes Hi-8, Beta, ¾", plus Grass Valley, Sony, and Ikegami equipment. Facility will also house community local access channel. Radio facility includes Logitek, Dennon, Technics, Grass Valley, and Gates transmitter. Applicant will work with all levels of users, strong interpersonal skills a must. Start ASAP. Send Resume and supporting items to: Center for Contemporary Media, 109 Asbury Hall, DePauw University, Greencastle, IN 46135. AA/EOE. Women & minorities encouraged to apply. 12-90-1t

SOUTHERN CALIFORNIA FM seeks a Broadcast Engineer, good salary, benefits, large growth potential. Studio & Transmitter Maintenance, Satellite, and Live Music Recording. Experience preferred. Contact: Garry Greth, 1288 Bellflower Blvd., Long Beach, California 90815. 12-90-1t

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RF ENGINEERS AND SATELLITE EARTH STATION TECHNICIANS. Military experience OK. Please send resume to: S.T.A.R.S., 16250 Filbert St., Sylmar, CA 91342. Attention: Diane Streett. 11-90-2t

HELP WANTED

OKLAHOMA EDUCATIONAL TELEVISION AUTHORITY seeks a Network Maintenance Engineer. Successful applicant must have previous experience in the maintenance of television transmitters and associated RF equipment. Microwave experience a plus. Salary up to $33,820 with comprehensive benefit package. For immediate consideration, send resume to OETA Personnel Department, P.O. Box 14190, Oklahoma City, Oklahoma 73113. AA/EOE. 12-90-1t

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HELP WANTED

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Expansion has created excellent opportunity for TV/VIDEO expert to work on **Broadcast Engineering** and **Video Systems** magazines. Will write articles on technical aspects of television and video, edit materials from outside contributors and offer technical assistance and expertise to other publications within electronics group. Must have extensive experience and knowledge of television/video engineering and computers. Technical degree preferred. Send complete resume and salary requirements to:

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Classified

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Signature required

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2 **Please check the ONE type of facility or operation that best describes your business classification.**

20 ☐ TV Station
21 ☐ AM Station
22 ☐ FM Station
23 ☐ AM & FM Station
24 ☐ TV & AM Station
25 ☐ TV & FM Station
26 ☐ TV, AM & FM Station
19 ☐ Low-Power TV Station
27 ☐ CATV Facility
39 ☐ Cable Television
28 ☐ Non-Broadcast TV including CCTV
29 ☐ Recording Studio
30 ☐ Teleproduction Facility
40 ☐ Post Production Facility
31 ☐ Microwave, Relay Station or Satellite Company
32 ☐ Government
33 ☐ Consultant (Engineering or Mgmt.)
34 ☐ Dealer, Distributor or Manufacturer
35 ☐ Other (Specify) _____

3 **Which of the following best describes your title? Write the number in the box (select one number only):**

A ☐ **Company Management**—(1) Chairman of the Board, (2) President, (3) Owner, (4) Partner, (5) Director, (6) Vice President, (7) General Manager (other than in charge of Engineering or Station Operations Mgt.), (8) Other Corp./Financial Officials

B ☐ **Technical Management & Engineering**—(9)Technical Director/Mgr., (10) Chief Engineer, (11)Other Engineering or Technical Titles

C ☐ **Operations & Station Management/Production & Programming**—(12) VP Operations, (13) Operation Mgr./Director, (14) Station Mgr., (15) Production Mgr., (16) Program Mgr., (17) News Director, (18) Other Operations Title

D ☐ **Other:** Specify _____

4 **If you checked 19 through 26 on question No. 2, which of the following best describes your over-the-air station? (check only one):**

A ☐ Commercial
B ☐ Educational
C ☐ Religious
D ☐ Campus Low-Frequency
E ☐ Community
F ☐ Municipally Owned

5 **What is your annual budget for equipment purchases? (check only one):**

A ☐ Less than $25,000
B ☐ $25,000 to $49,999
C ☐ $50,000 to $99,999
D ☐ $100,000 to $250,000
E ☐ Over $250,000

6 **What is the ADI rank of your station?**

A ☐ Top 20
B ☐ 21 to 50
C ☐ 51 to 100
D ☐ Over 100

7 **Which statement best describes your role in the purchase of equipment, components and accessories?**

A ☐ **Make final** decision to buy specific makes, models, services or programs
B ☐ **Specify** or make **recommendations** on makes, models, services or programs
C ☐ Have **no part** in specifying or buying

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16	49	82	115	149	183	217	251	285	319	353	387	421	455	489	523	557	591
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18	51	84	117	151	185	219	253	287	321	355	389	423	457	491	525	559	593
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26	59	92	125	159	193	227	261	295	329	363	397	431	465	499	533	567	601
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28	61	94	127	161	195	229	263	297	331	365	399	433	467	501	535	569	603
29	62	95	128	162	196	230	264	298	332	366	400	434	468	502	536	570	604
30	63	96	129	163	197	231	265	299	333	367	401	435	469	503	537	571	605
31	64	97	130	164	198	232	266	300	334	368	402	436	470	504	538	572	606
32	65	98	131	165	199	233	267	301	335	369	403	437	471	505	539	573	607
33	66	99	132	166	200	234	268	302	336	370	404	438	472	506	540	574	608
RDA			133	167	201	235	269	303	337	371	405	439	473	507	541	575	609

FOR ISSUE OF DECEMBER 1990
USE UNTIL APRIL 1991
(After this date, please contact supplier directly)

1 **IMPORTANT: Do you wish to receive/ continue to receive *Broadcast Engineering* FREE?**
☐ Yes ☐ No

_____
Signature required

Title _____

Date _____

2 **Please check the ONE type of facility or operation that best describes your business classification.**
20 ☐ TV Station
21 ☐ AM Station
22 ☐ FM Station
23 ☐ AM & FM Station
24 ☐ TV & AM Station
25 ☐ TV & FM Station
26 ☐ TV, AM & FM Station
19 ☐ Low-Power TV Station
27 ☐ CATV Facility
39 ☐ Cable Television
28 ☐ Non-Broadcast TV including CCTV
29 ☐ Recording Studio
30 ☐ Teleproduction Facility
40 ☐ Post Production Facility
31 ☐ Microwave, Relay Station or Satellite Company
32 ☐ Government
33 ☐ Consultant (Engineering or Mgmt.)
34 ☐ Dealer, Distributor or Manufacturer
35 ☐ Other (Specify) _____

3 **Which of the following best describes your title? Write the number in the box (select one number only):**
A ☐ **Company Management**—(1) Chairman of the Board, (2) President, (3) Owner, (4) Partner, (5) Director, (6) Vice President, (7) General Manager (other than in charge of Engineering or Station Operations Mgt.), (8) Other Corp./Financial Officials
B ☐ **Technical Management & Engineering—** (9)Technical Director/Mgr., (10) Chief Engineer, (11)Other Engineering or Technical Titles
C ☐ **Operations & Station Management/ Production & Programming—**(12) VP Operations, (13) Operation Mgr./ Director, (14) Station Mgr., (15) Production Mgr., (16) Program Mgr., (17) News Director, (18) Other Operations Title
D ☐ **Other:** Specify _____

4 **If you checked 19 through 26 on question No. 2, which of the following best describes your over-the-air station? (check only one):**
A ☐ Commercial
B ☐ Educational
C ☐ Religious
D ☐ Campus Low-Frequency
E ☐ Community
F ☐ Municipally Owned

5 **What is your annual budget for equipment purchases? (check only one):**
A ☐ Less than $25,000
B ☐ $25,000 to $49,999
C ☐ $50,000 to $99,999
D ☐ $100,000 to $250,000
E ☐ Over $250,000

6 **What is the ADI rank of your station?**
A ☐ Top 20
B ☐ 21 to 50
C ☐ 51 to 100
D ☐ Over 100

7 **Which statement best describes your role in the purchase of equipment, components and accessories?**
A ☐ Make **final** decision to buy specific makes, models, services or programs
B ☐ **Specify** or make **recommendations** on makes, models, services or programs
C ☐ Have **no part** in specifying or buying

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S-VHS 3/4"

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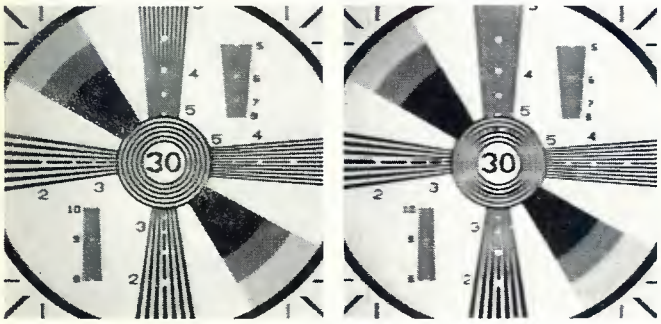
3/4" @ 66¢ per minute
3/4" SP @ 73¢ per minute

Average cost based on tape manufacturers' suggested list prices.

S-VHS 3/4" STANDARD



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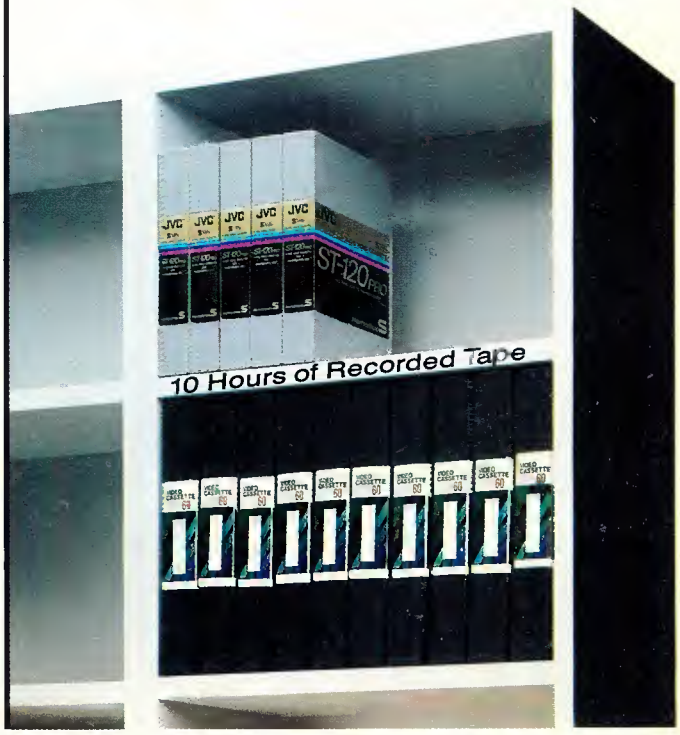

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