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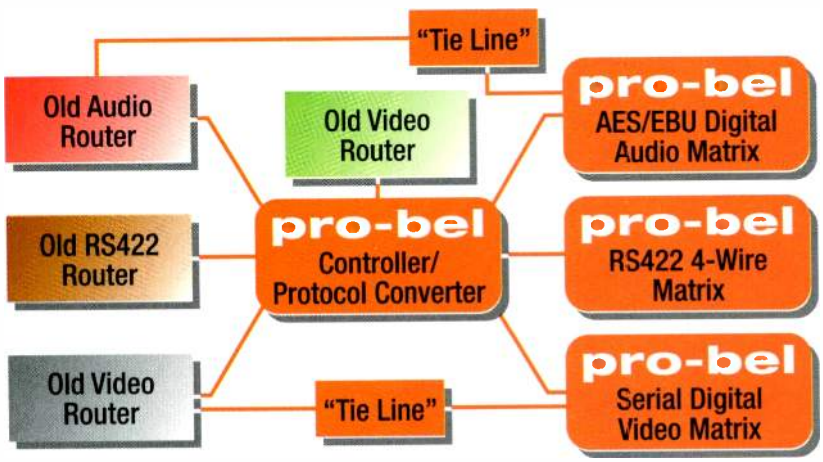

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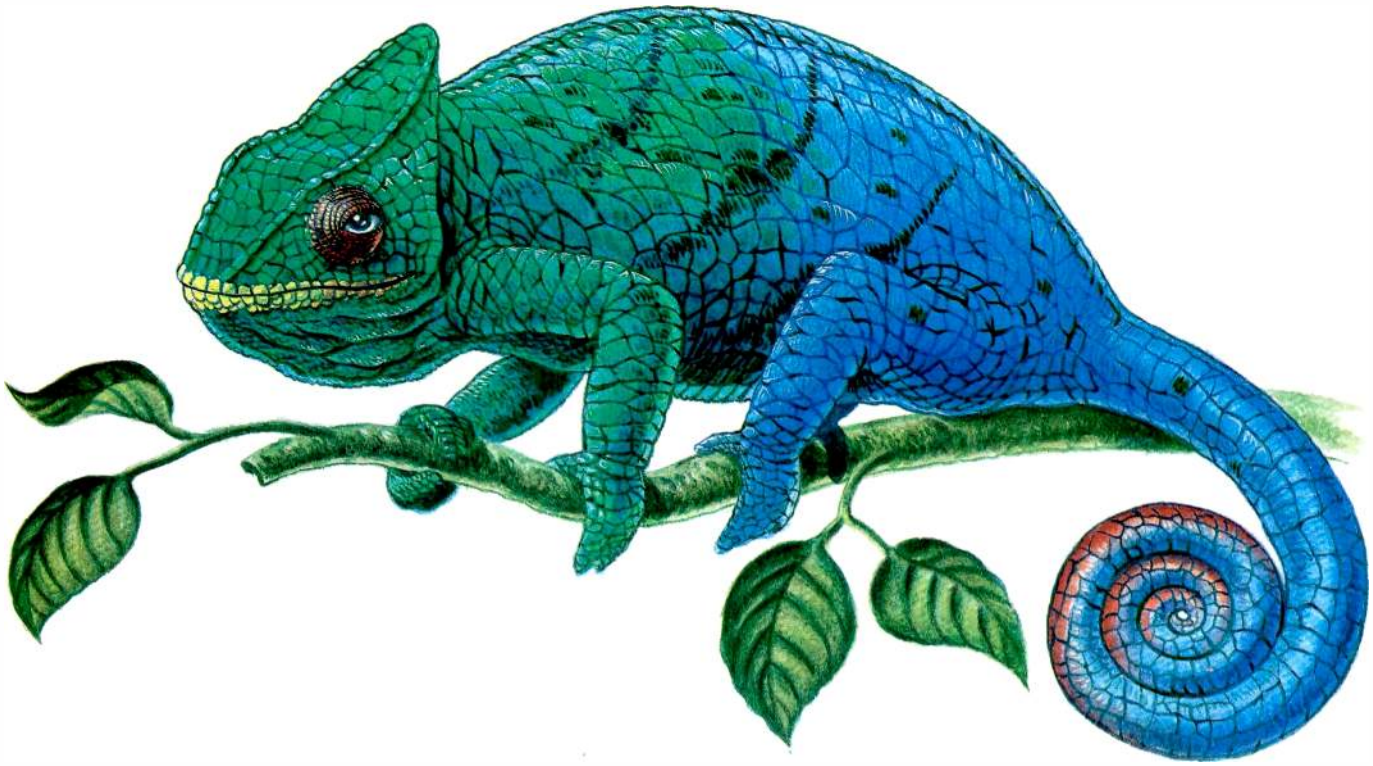

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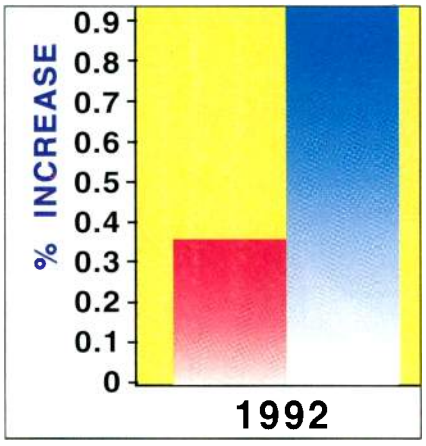

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MANAGING TECHNOLOGY:

In today's fast-paced world, technology managers face many challenges. The objective is to turn the obstacles into opportunities. To do so requires not only an in-depth knowledge of production hardware, but also how to take advantage of the latest technological innovations. This month's issue looks at the changing arena of technical management and how to be as successful as possible.

DEPARTMENTS:

ON THE COVER:

Technology managers are key players in helping broadcast, cable and post facilities remain profitable. Today, their tasks are made easier through the use of modern computer technology. (Cover design by Kim Bracken.)

THIS MONTH...

OTHER FEATURES: *PRODUCTION TECHNOLOGY UPDATE*

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News

By Dawn Hightower, senior associate editor

Candidates sought for engineering awards

The National Association of Broadcasters (NAB) is seeking nominations for the 1994 Radio & TV Engineering Achievement awards. The awards recognize significant advancements in broadcast engineering, which will acknowledge a lifetime's work or a single contribution to broadcast engineering.

Candidates will be evaluated for their inventions, development of new techniques, dissemination of technical knowledge and literature, leadership in broadcast engineering affairs, and other outstanding contributions that might warrant consideration.

NAB must receive nominations no later than Nov. 29. The winners will be selected by NAB's Executive Committee. For nomination packets and other information, contact NAB Science & Technology at 202-429-5346 or (fax) 202-775-4981.

Inter BEE '93 sponsors 29th exhibition

The International Broadcast Equipment Exhibition 1993 (Inter BEE '93) will be held Nov. 16-18 at the Nippon Convention Center (Makuhari Messe) in Chiba Prefecture, Japan. It is sponsored by the Electronic Industries Association of Japan and is supported by the National Association of Commercial Broadcasters in Japan and the Japan Broadcasting Corporation (NHK). The Japan Electronics Show Association planned and managed the show.

The NAB in Japan symposium of broadcast technology also is scheduled concurrent with Inter BEE.

USSB's operational service plan complete

United States Satellite Broadcasting (USSB) completed its direct broadcast satellite (DBS) service plan. Ground has been broken for its state-of-the-art Digital Satellite System (DSS) uplink center in Oakdale, MN. It has extensive backup systems and will be able to transmit high-quality DBS TV service nationwide.

The uplink center is built around 10 17GHz MCL transmitters and two Vertex 9-meter Ka-band dishes, located inside an atrium, which will guarantee 24-hour, year-around serviceability. C- and Ku-band downlinks will serve as the source for USSB's programming, while a technical operations center provides the rest.

The 20,500-foot building will be completed this month. The transmission and control equipment will be ready in December, in time for the launch of America's first DBS satellite.

Neutrik acquires Amber

Neutrik AG, an audio test equipment and connectors manufacturer, has acquired Amber, a Canadian company, formerly a division of Coreco.

The new company will be established under the name of Neutrik Instrumentation Inc. (NIS). It will be responsible for sales, marketing, technical support, repair and calibration for the North American market. The company's headquarters will be located in Montreal, Quebec, Canada. The phone number is 514-344-5220; fax 514-344-5221. The company also has a toll-free number: 800-661-6388.

DRRI to launch digital radio effort

The Canadian Broadcasting Corporation (CBC) and the Canadian Association of Broadcasters (CAB) have formed a new corporation, Digital Radio Research Inc. (DRRI), which will launch experimental digital radio service in Canada by the end of this year.

DRRI's objectives are to build and operate several transmitting installations that will be used for digital radio research and developments, and to commission and publish research studies on digital radio broadcasting technology. The company's headquarters is in Montreal. DRRI's officers will come from the public and private sectors. Michael McEwen, CBC's senior vice president of radio, will be chairman of the DRRI board.

The initial sites of the prototype stations will be located in Montreal and Toronto. They will operate on the 1.5GHz band (L-band) and begin broadcasting before the end of the year by using new or existing programming from the CBC and private broadcasters, and then converting it to digital. The experience derived from the operation of DRRI's stations will form valuable input to the recommendations of the task force on the introduction of digital radio. This task force will report to Canada's Minister of Communications on the implementation of digital radio. ■

BROADCAST engineering

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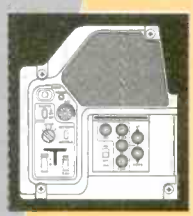

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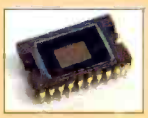

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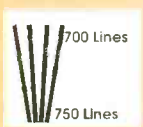

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Editorial

The resolution revolution

A case of schizophrenia seems to have afflicted the audio industry recently. You'll hear that today's 16-bit PCM digital audio standard is either not enough or too much. Some call to increase standard resolution to 20-bit accuracy; others advocate bit-rate reduction (data compression) through perceptual coding down to an effective 4-bit resolution or less.

Everyone likes certainty, so this apparent duality is disturbing. Ideologues on both sides try to paint the issue in black and white, but, as is often the case, the real story is ensconced in shades of gray. The particular context of each application also bears significant weight — there are few "one-size-fits-all" solutions anymore.

Of particular interest to the broadcast community are the discussions on data reduction. Sadly, some recent broadcasters' conference presentations on the subject have hindered rather than helped the industry's understanding. The decidedly unscientific, yet high profile nature, of these presentations offered the audience potentially flawed conclusions. It would be unfortunate indeed if broadcasters formulated any significant action plans on the basis of such pseudoscience.

In fairness, reliable subjective testing of perceptual coders is difficult, requiring rigorous test design and controls that are beyond the capacity of most broadcast facilities. Therefore, the upcoming results of the Radio communications Sector (the former CCIR), perceptual coder analyses (that do possess the requisite controls and credibility), are timely and welcome.

The current controversy has had the beneficial effect of raising the industry's awareness to the real problems that can be caused by repeated application of perceptual coding algorithms. (See "re: Radio," *BE*, September 1992.) Yet it is critical that the industry clearly understand the *true* nature of these systems' limitations *now* — as the technology is being deployed — rather than later, when costly revisions may be required.

Digital audio data-rate reduction through perceptual coding is an enabling technology, making many future systems technically feasible and economically practical. Like any technology, such systems have their applicational limits. The broadcast industry needs and deserves valid, qualified research to determine these limits, with special attention to those degradations that affect subjective quality. This examination must be free from emotional or philosophical bias, allowing broadcasters to fully understand the tradeoffs involved and to make properly informed choices for the design of truly improved and affordable future delivery systems.

Skip Pizzi, technical editor

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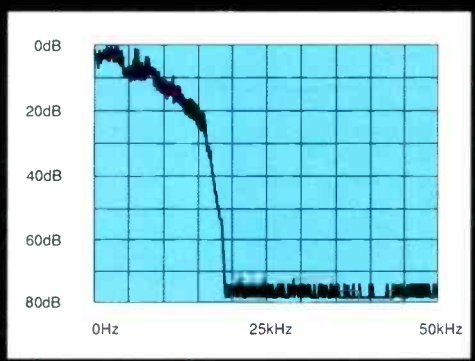

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FCC Update

New FCC user fees

By Harry C. Martin and Andrew S. Kersting

Congress' approval of President Clinton's budget package included passage of a bill requiring broadcast, cable and other telecommunications industries to pay $82 million a year in FCC user fees.

The fees will be due on a federal fiscal year basis beginning in 1994, which commenced on Oct. 1. The first fee payments will not be due until sometime during 1994. The FCC may permit installment payments to be made for large fees. The FCC also may require entities liable for small fees to pay several years in advance, but for no more years than the entity's remaining license term.

Adjusted standards for assessing fines

The FCC has made adjustments to its standards for assessing fines, which include: 1) reducing the base amount for certain categories of violations; 2) adding certain violation categories; 3) clarifying that the upward adjustment factor for repeated or continuous violations is not necessarily applied on a per-violation or per-day basis; and 4) allowing a presumption of diminished ability to pay in certain services for individuals. The base fine amounts for broadcasters and cable operators have been adjusted.

Upward adjustment criteria	
Egregious misconduct	50-90%
Ability to pay/relative disincentive	50-90%
Intentional violation	50-90%
Substantial harm	40-70%
Prior violations of same or other requirements	40-70%
Substantial economic gain	20-50%
Repeated or continuous violation	varies
Downward adjustment criteria	
Minor violation	50-90%
Good faith or voluntary disclosure	30-90%
History of overall compliance	20-50%
Inability to pay	varies

Miscellaneous minor violations

The maximum fine allowed under the statute, which is assessed on a per-violation or, in the event of a continuing violation, on a per-day basis, is $25,000 for broadcasters and cable operators. Upward and downward adjustments are applied to the base fine, depending on the applicability of certain factors.

The changes for assessing fines are to ensure that the most significant penalties are applied to violations implicating health or safety concerns. They also seek to ensure that the fines are consistent for similar types of offenses. The FCC reiterated it has discretion to not issue a fine at all in appropriate cases. ■

Date line

On Dec. 1, 1993, annual ownership reports are due for radio and TV stations in Alabama, Colorado, Connecticut, Georgia, Maine, Massachusetts, Minnesota, Montana, New Hampshire, North Dakota, Rhode Island, South Dakota and Vermont. TV stations in the following states and territories must file their renewals by Dec. 1, 1993: Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island and Vermont. Minnesota and North Dakota LPTVs also must file renewals by Dec. 1, 1993. Issues/program lists for the October/December quarters must be placed in the public file of all broadcast stations by Jan. 10, 1994.

ANNUAL FEES	
AM stations:	
Class D daytime	$250
Class A full-time	$900
Class B full-time	$500
Class C full-time	$200
Construction permits	$100
FM stations:	
Classes C, C1, C2 and B	$900
Classes A, B1 and C3	$600
Construction permits	$500
VHF stations:	
Markets 1-10	$18,000
Markets 1-25	$16,000
Markets 26-50	$12,000
Markets 51-100	$8,000
Remaining markets	$5,000
Construction permits	$4,000
UHF stations:	
Markets 1-10	$14,400
Markets 11-25	$12,800
Markets 26-50	$9,600
Markets 51-100	$6,400
Remaining markets	$4,000
Construction permits	$3,200
Low-power TV, TV translator and TV booster	$135
Broadcast auxiliary	$25

Violation	Base Amount	Violation	Base Amount
Misrepresentation/lack of candor	$20,000	Violation of main studio rule	$10,000
Construction and/or operation w/o service authorization	$20,000	Violation of broadcast hoax rule	$10,000
Unauthorized substantial transfer	$20,000	Failure to engage in required frequency coordination	$10,000
Violations of rules relating to distress & safety frequencies	$20,000	AM tower fencing	$10,000
False distress communications	$20,000	Failure to comply with prescribed lighting and marking	$8,000
Alien ownership violation	$20,000	Violation of public file rules	$5,000
Failure to permit inspection	$18,750	Unauthorized discontinuance of service	$5,000
Malicious interference	$17,500	Use of unauthorized equipment	$5,000
Exceeding authorized antenna height	$15,000	Construction or operation at unauthorized location	$5,000
Transmission of indecent/obscene material	$12,500	Violation of transmitter control and metering requirements	$5,000
Violation of political rules: reasonable access, lowest unit charge, equal opportunities, and discrimination	$12,500	Failure to file required forms or information	$5,000
Fraud by wire, radio or television	$12,500	Violation of sponsorship ID requirements	$5,000
Exceeding power limits	$10,000	Violation of requirements concerning broadcasting of lotteries or contests	$5,000
No licensed operator on duty	$10,000	Broadcasting telephone conversations without authorization	$5,000
Failure to maintain directional pattern within prescribed parameters	$10,000	Failure to make required measurements or conduct required monitoring	$2,500
Failure to respond to commission communications	$10,000	Violation of enhanced underwriting requirements	$2,500
Unauthorized emissions	$10,000	Failure to provide station ID	$1,250
Using unauthorized frequency	$10,000	Unauthorized pro forma transfer of control	$1,250
EBS equipment not installed or operational	$10,000	Failure to maintain required records	$1,250
Violation of children's TV commercialization or programming requirements	$10,000	Miscellaneous minor violations	$625

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Part 10

Strictly TV

Strictly HDTV

One step at a time

By Curtis Chan

At its last meeting, the Motion Pictures Experts Group (MPEG) moved forward in its standardization process by freezing the three different profiles of MPEG-2, but left the Grand Alliance (GA) AC-leak compression out of the picture.

The AC-leak approach provides improvements in the system's picture quality, speed during channel changes and improved error resilience. MPEG members cited the AC leak technology did not qualify as a separate tool for inclusion in the profile despite its technical merit. Although GA chips still would be able to decode MPEG signals, an MPEG chip would not be able to decode GA signals using the AC-leak approach. MPEG will not change the profiles unless some portion of the three proves defective. The GA noted that AC-leak remains in the proposal, but the committee intends to review the implications of the decision.

On formats

Even though the MPEG participants did not endorse the AC-leak proposal, they did include the GA's scanning format proposal of 1,080 active lines by 1,920 active samples per line as a separate level of high-definition video within the standard. Alliance participants, though stressing the issue remains open, acknowledged the 1,080 approach presents added compression challenges and creates a need for additional receiver memory.

Also noted was the question of including B-frames in the compression system. B-frames are a feature of the main profile of the MPEG-2 standard. At the technical subgroup meeting, alliance representatives said B-frames added complexity and channel acquisition time to the system, and they had tentatively decided against including the B-frames.

Also, the standard simple profile does not carry the B-frames in its specifications for high-definition video. Including the B-frames in one profile and their absence from another will allow GA to maintain MPEG compatibility whether the B-frames are included in the final standard. GA members voiced plans to present their system as a separate HDTV profile within MPEG.

Chan is principal of Chan and Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton CA.

FCC focus on interoperability and zoning restrictions

Recently, FCC acting chairman James Quello gave the GA proponent system his vote of confidence on interoperability, but stressed the FCC would conduct a full examination of the issue before final endorsement. His approval was in response to a series of questions from House Telecommunications and Finance Subcommittee chairman Edward Markey. Quello said the GA appears to understand the need for an open systems approach in the terrestrial broadcast HDTV system to provide a gateway for interface with other electronic video media.

GA members plan to present their systems as a separate HDTV profile within MPEG.

To keep an eye on the development, Markey submitted questions to the FCC concerning digital television and the Grand Alliance. Some of the questions posed included:

1. Has the GA fulfilled its commitment to consult with the computer industry and others?
2. Has the Advisory Committee on Advanced Television Service (ACATS) included representatives from other industries in its process?
3. What impact will a proposed digital VCR standard have on interoperability and the HDTV standard-setting process?

Quello stated that the FCC was not directly following the GA consultations with the computer industry, but the new system will be digital and carry several additional design and operating features intended to promote interoperability.

A recent study done by the Association for Maximum Service Television (MSTV) concluded that many homeowners will need an outdoor antenna to receive ATV signals because of propagation differences from NTSC. The commission was urged to extend an inquiry into local zoning restrictions on satellite dishes to include all outdoor antennas. MSTV said the low power levels of digital ATV will create a need for antennas in homes that currently do not require them to receive broadcast television. MSTV also announced it was likely every TV station implementing ATV will need to erect an additional transmission antenna, and possibly a new tower. Because of this possibility, the association urged the FCC to begin a proceeding to pre-empt state and local zoning regulations that would frustrate the federal interest of ensuring the fair, efficient and equitable distribution of TV service.

NAB's HDTV guide

NAB has published a report called, "1993: Guide to HDTV Implementation Costs." The report details projected costs of HDTV implementation and reasons for jumping in with both feet. The report predicts broadcasters might market commercials during sports or feature films at premium rates or transmit high-profile programs at different times on the two channels within the same 24-hour period to effectively double the market exposure, hence revenues. The report states that although these considerations do little to combat the competitive thrust of the HD cable and HD home video, ATV service will at least remain competitive with other media. The report also offers insight into digital ancillary subscription services.

The discussion of revenue sources emphasizes the importance of local broadcasting because digital technology allows broadcasters to add new interactivity to local programming. The report culminated its findings by stating that localism is the quality differentiating broadcast television from other delivery media. It should be made a key feature in marketing local events and local news, and can be coupled with local response, local polling and local interaction from the viewer, forging a sense that the station is an integral, responsive and vital element in the community it serves. ■

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re: radio

It's that time of year

By John Battison, P.E.

Not long ago, I received a call from an AM/FM station owner who uses his FM tower for a non-directional AM antenna. The old AM tower is detuned and stands close by.

The chief engineer reported that the AM transmitter had suddenly dumped, and he couldn't get any base current. He had already checked the line, the ATU and all components for opens or other failures.

My first thought was that the AM tower might be mismatched. So I went to the station and measured the base operating impedance. As I had suspected, the resistance was ridiculously high and the reactance was astronomical. We called for a tower crew because it looked as if the problem was probably the tuning stub for the FM line to tower ground that had failed. Nothing else that I could see could have caused this large impedance change.

While waiting for the tower crew to arrive, I tried to rematch the transmitter to the offered impedance. To my surprise, with the simple TEE ATU network I was able to obtain an apparent match. But the transmitter did not like it and would only put out 40% power. I wasn't suprised, considering the strange load hanging on the end of the line.

Eventually, a tower technician arrived and went up the tower. I was gratified when he came down with a piece of rotted bonding material in his hand. He had made a temporary connection while on the tower, so I quickly rechecked the match. Indeed, the base operating resistance was only 2Ω more than its original design value, but the transmitter still didn't like it.

When a permanent fix for the FM ground to the AM tower was made, the impedance returned to exactly its original figure, and then the transmitter's output was rated at 1,000W.

This installation had been up for approximately 20 years without any inspection or checking, apart from routine tower painting. Winter is coming, and as you read this it will be upon our northern stations. If you have a combo AM/FM with the FM antenna mounted on the AM tower, it would be a good time to check your tuning stub line insulators.

If your installation uses a small variable capacitor across the FM to the tower at its base for fine-tuning the match, it's advisable to inspect this for damage, moisture, corrosion and insect or rodent intrusion. Small bodies lying across the fixed and moving plates have caused many impedance changes.

Short skirts are back

Another client with a detuned tower close to his directional AM antenna called me in great distress. Suddenly, one of his monitor points had gone out. Only one of three points was out, and only by a small amount, approximately 20% high. All of the operating parameters were normal except that tower two had a slight varying increase in phase, but it was within limits. Base currents also were within limits. There was no apparent reason for the change in phase, and a small adjustment of the phasor corrected the discrepancy. Yet the one monitor point remained high.

As conductors and affiliated items age in the elements, the importance of regular checks cannot be overemphasized.

Everything looked normal, with no obvious wires broken and nothing running hot. The detuned tower looked normal, but I was suspicious of it. The detuning skirt looked all right and so did the insulators. Nevertheless, I had the chief engineer disconnect the detuning circuit from ground and isolate the skirt off the tower. A quick check with an ohmmeter showed an unwanted intermittent connection to ground from the detuning network. Up went the tower technician. At the top of the tower he found a broken insulator that allowed one skirt drop wire to contact the tower, partially shorting the detuning skirt.

The insulator was replaced. The antenna monitor showed an out-of-limit phase on tower two (the one we had adjusted), and when this was corrected, the monitor points all came in perfectly, with all other parameters normal.

The moral is that as conductors and affiliated items age in the elements, the importance of regular checks cannot be overemphasized.

The bullet and the bullet

An FM station called me about an erratic FM transmission line. Sometimes the line was normal; sometimes the VSWR protection circuit put the station off the air. This called for a time domain reflectometer (TDR).

Disconnecting the rigid line from the transmitter and applying the TDR showed a reflection near the base of the line, just above a 90° elbow at the tower base. I put my hand on the line at this point and nearly burned myself. Dismantling the elbow showed a burned transmission line "bullet" and inner conductor and a scored inner surface on the outer conductor. About five feet above, the remains of a 22-caliber slug protruded into the line slightly. There was a small dent in the inner conductor. The slug's tip was burned and showed signs of melting. Down at the elbow, signs of lead were found at the burned area. The gunslinger had struck once again.

When an antenna system goes awry, there are many things to look for. Broken insulators add guy lengths to a tower and can improve or spoil coverage, base insulators can get iced up and crack, joints in a tower can rust and reradiate at all kinds of odd frequencies, components can become victims of drive-by shootings — the list goes on. The more you see, the more you learn.

■

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

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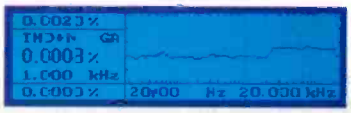

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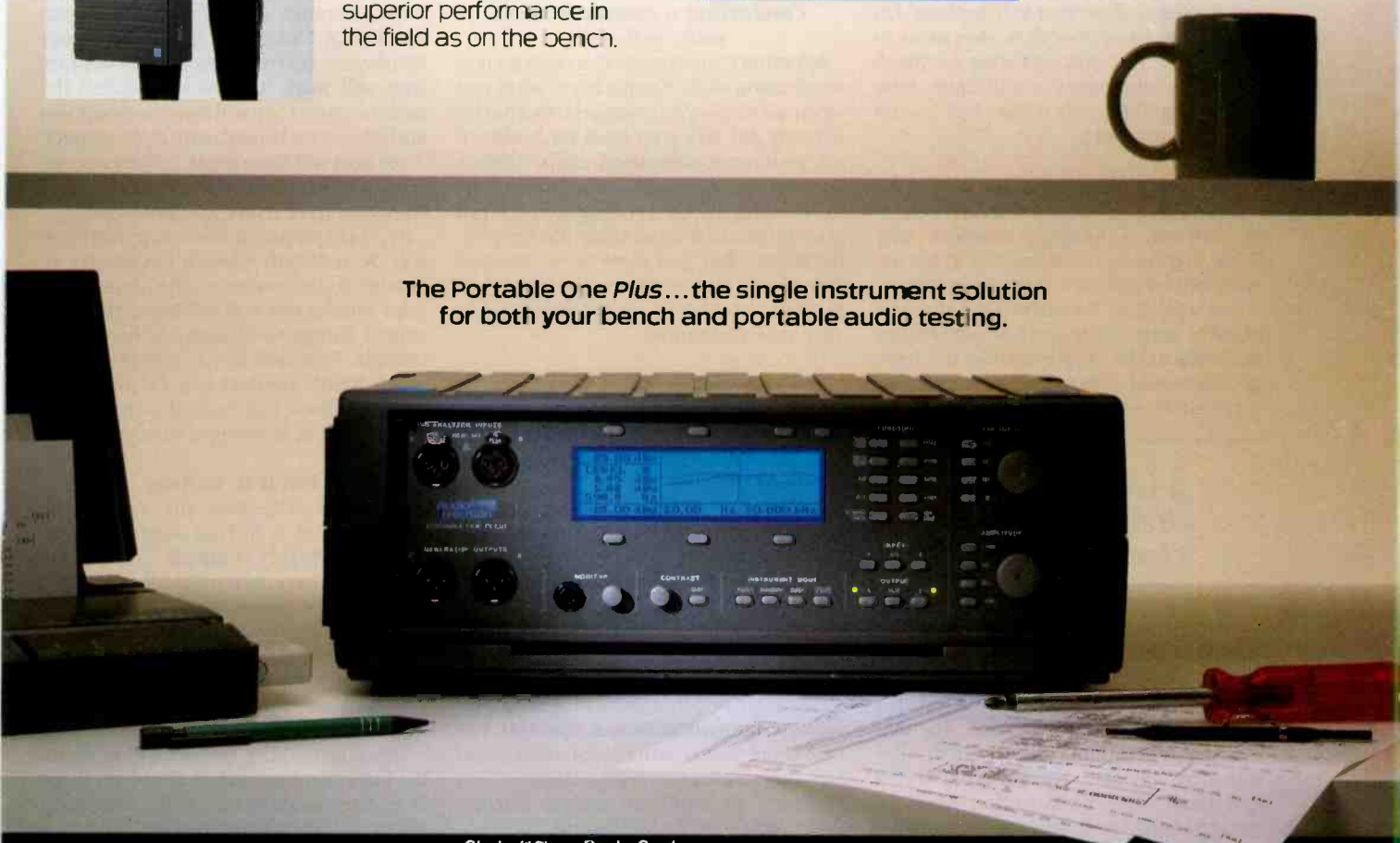

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Management for Engineers

The importance of communicating

By Rick G. Morris

The ability to communicate clearly and effectively with employees is the most important skill of a manager. If a manager cannot communicate, the likelihood of the employee accomplishing a desired result is reduced. In this case, the fault lies with the manager. A manager who doesn't know he is a poor communicator will decrease the morale of his employees and will not receive respect from those he supervises.

How does a manager determine that he needs to work on his communication skills? Look for objective signs: Do you have a good employee who doesn't seem to be able to follow your instructions? Do you always have to explain your ideas to your boss? Are you receiving feedback that your employees would have done something differently if they had known what you wanted?

Effective messages

A message is not effective until it's clearly received. Although a manager may think that he has communicated his desires to the employee, this may not be so. A manager may be ineffective, disorganized or inarticulate and not even realize it. Similarly, the employee may not have good listening skills or may have attached some other meaning to what was said.

A message is not effective until it's clearly received.

The importance of a received message is shown by the game "Telephone." A message is whispered into the ear of a child, who whispers it to the next child until it's received at the end of the line. The end message is invariably different than what was originally said. The game illustrates individual interpretations that influence communications. It only takes one repetition for a message to be garbled.

Morris, a former TV engineering manager, is an assistant professor of radio/TV/film at Northwestern University, Evanston, IL.

Verifying that the message was clearly received

After you have communicated specific objectives, ask the employee how he will accomplish the task or how he feels about what you said. This allows you to close the feedback loop to see whether your message has been understood. Asking the employee to repeat the information is counterproductive and an insult. However, asking the employee how he is going to approach the problem, and listening to him, will let you verify your communication and show interest in the employee.

Conducting a communication skills self-audit

Ask others how they perceive your communication skills. Keep a log of what you say to an employee, compared to what he actually did. Ask your boss for feedback on your communication skills. Gather some of your memos and read them. How do they sound? Ask a colleague outside of your business to read them. Do they understand what you were trying to say? Buy a book on business writing and read it. After you finish your self-audit, apply your new techniques.

Special problem areas for media managers

Certain external influences in the broadcast industry can make effective communications difficult:

1. Broadcasts are live events, which are subject to contingencies beyond the manager's control.
2. Shows, projects and commercials can be cancelled at a moment's notice.
3. Broadcasting involves waiting for others to record the events of the day, events over which the manager has no control.

This state of confusion can lead to confusing communications. A manager can overcome these situational difficulties by being an effective communicator. Two problems to avoid are unclear instructions and changing your mind.

When you give unclear instructions, the employee becomes confused. This wastes time and energy, raises employee frustration and lowers morale. To guard against unclear instructions, verify the message. If the employee participates in laying out the course of action, understands the company's vision, reviews the instructions before carrying them out, and discusses possible contingencies to project or broadcast changes, then he can adapt and respond during the most stressful and changing situations.

If you cannot let the employee in on the big picture, he will be prone to mistakes. Hire good employees, give them the information they need to do their job, share the vision, communicate effectively and trust them to use their judgment.

Avoid changing your mind on a regular basis, because it will undermine your credibility. Once you have given your employees instructions and guidelines, they will work hard to accomplish the task, because they will have an emotional and intellectual investment in the project. They also will have pride in their accomplishments and satisfaction in the ways they may have overcome problems.

If you are prepared, changing your mind will be reduced. Remain responsive to changing circumstances. Be honest with your employees and tell them that you expect things to change as the project unfolds. You will be surprised at how much input, support and help you will receive. Open and honest communication is part of building a stronger team.

Put it in writing

Be sure to write down any communication that has a lasting impact, importance or is highly complex. This will ensure that others understand them. These types of communication include your company's vision/mission statement, the department's goals and guidelines, employee policy manuals, contracts, complex assignments and employee evaluations or discipline reports.

There is nothing embarrassing about having a communication problem. What is embarrassing is not doing something about it. Effective communication is a manager's greatest skill. Nothing makes a stronger impression than how you communicate. ■

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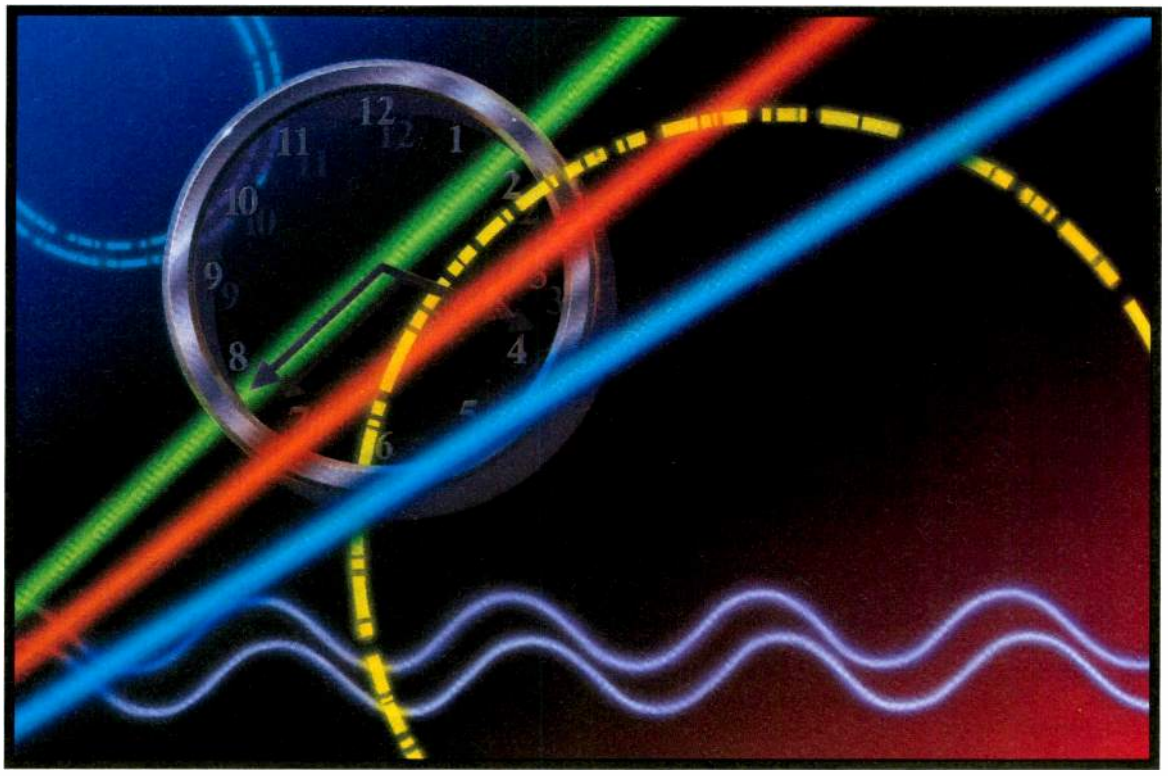

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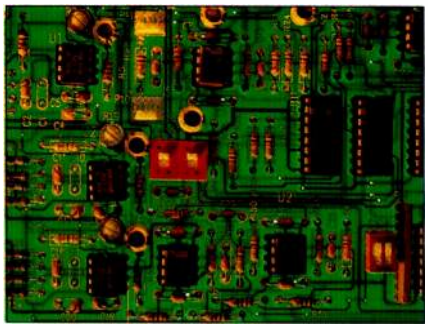
Part 1

Circuits



Serial control

Applications

By Steve Epstein, technical editor

For the previous three months, this column has looked at serial communication standards. This month, we'll discuss some broadcast applications. Both broadcast and post-production facilities are full of equipment with serial ports. VTRs with RS-422 ports are probably the most common, with editing equipment close behind. The protocol used for controlling Sony's BVW-75 seems almost universal, with numerous manufacturers incorporating emulation software into their equipment. Digital tape machines, DVEs and even some audio recorders will emulate a BVW-75. With all of this equipment available, how can you make the most of it?

Patch panels

For some time now, manufacturers have been making VCRs capable of controlling other VCRs. Today, editing only requires two smart machines, instead of two machines and an edit controller. During editing, these machines allow remote control of one machine from the front panel of another. The 9-pin RS-422 remote connection requires only four wires plus ground. Twisted pair stereo audio cable works well for connecting machines via the 9-pin remotes.

Flexibility can be increased by wiring machines through a centrally located patch panel. Controllers, including editors, automation systems and even the shop computer, can be placed on the top row. Tape decks, DVEs and other controllable equipment are then placed on the bottom row. (See Figure 1.) During normal operation, the controllables (VTRs) are controlled by the controllers (editors). Because VTRs can be either, decks along the bottom row can be patched together for remote control of one deck from another.

Using patch panels in this manner allows idle equipment in one area to be used in another. For example, a spare playback deck in an edit suite can be used for making dubs, or when master control needs to grab an extra satellite feed, an extra recorder in another room can be patched into the automation system. In addition to patch panels, routers can be used to switch and distribute control signals.

EDITOR OUT #1	EDITOR OUT #2	EDITOR OUT #3	EDITOR OUT #4		SHOP COMPUTER
VTR 1	VTR 2	VTR 3	VTR 4	DVE CONTROL PORT	

Figure 1. *Possible patch panel layout with edit controller outputs on top row, tape machines on the bottom. With the addition of the DVE and shop computer, editor control ports can be patched to the DVE or the computer can be patched to the decks. Additionally, decks 1 and 2 can be patched together as well as 3 and 4. Assuming two of the decks are recorders, each group can be used as a dub/edit station.*

Computers

Among the controllers previously listed is the shop computer. Why the shop computer? Several years ago at NAB, Cyclesat gave away a demo disk containing technical formulas, common connector pinouts and a program that could control a single VTR. This program can be an effective troubleshooting aid. Connecting the shop computer to the patch panel and using this program can be a quick way to troubleshoot tape machine control problems without dragging the decks back to the shop. It also can be an effective remote control when added to PCs located around the facility.

Communication (modem) programs can be used to control devices if you know and understand the protocol. This can be a time-consuming process, but once the basics are understood and the initial setups complete, it can become an efficient troubleshooting aid. With some programming knowledge, simple programs can be written to assist with routine alignment and troubleshooting.

While we're on the subject of computers, several manufacturers are building ethernet adapters for their equipment. These black boxes are used to adapt the serial and parallel ports of broadcast equipment to ethernet connections. Combined with the right software, these boxes provide users with tools that allow broadcast equipment to become part of a computer network. Various cabling schemes allow distribution on an as-needed basis, without the need to change facility layout.

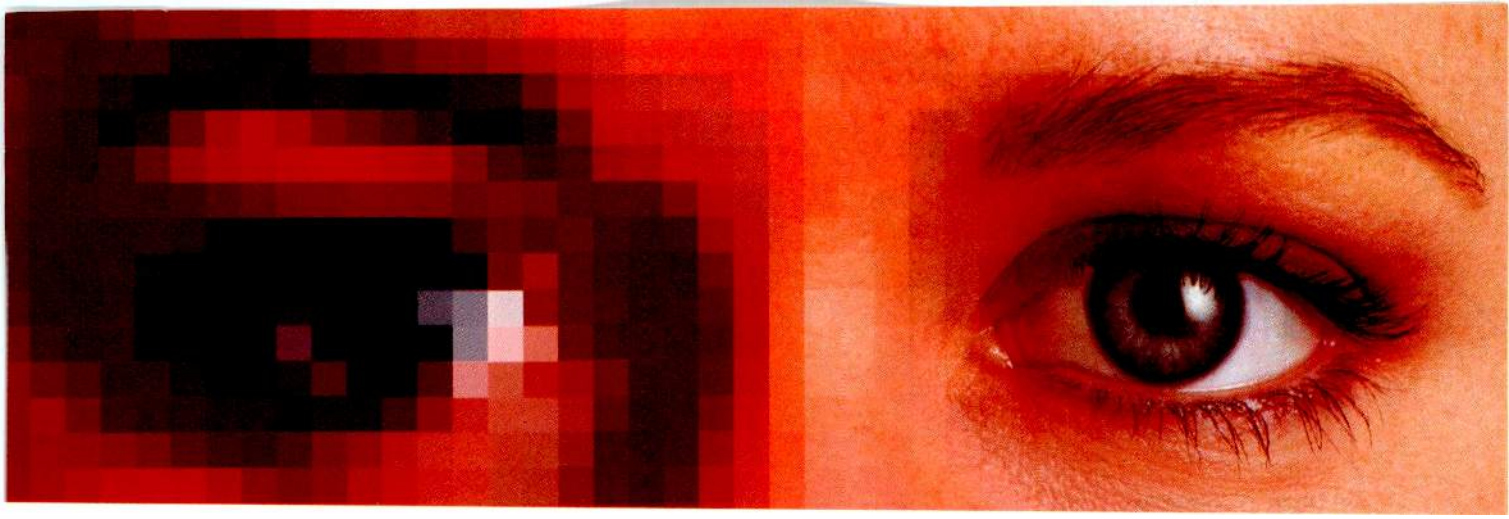
Process control

Moving from the studio to the transmitter, serial control can be used for controlling water flow, air flow and monitoring the transmitter and related systems. Transmitter remote controls have used dedicated phone lines and RS-232 transmissions for years. In addition, many systems have allowed for PC and telephone access.

Granted, there is something to be said for the simplicity of a manual water valve and flow meter. However, industrial control systems are available that continuously monitor water flow and adjust valves to maintain proper flow rates. Many of these stand-alone process controllers have serial ports, and can be monitored and adjusted remotely.

With HDTV on the horizon, many stations are faced with keeping older transmitters on-line until they can be replaced with an HDTV system. Many of these older transmitters have ongoing minor problems that are a result of flaws in the original design or installation (for example, borderline cooling and/or water flow). Under normal circumstances, the systems work adequately, but during the hot weeks of summer they tend to be touch and go. These problems are ideal candidates for industrial process controllers. Although not advocating a complete retrofit to microprocessor-based control systems, careful analysis of long-term problems might reveal areas that could benefit from a high-tech approach.

➡ *For a copy of the Cyclesat software, circle (302) on the Reply Card.* ■



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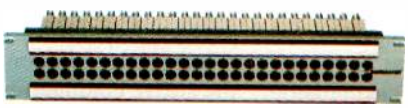

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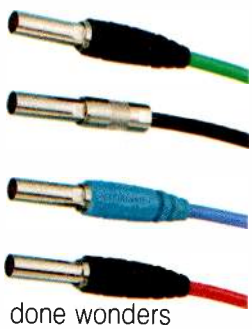

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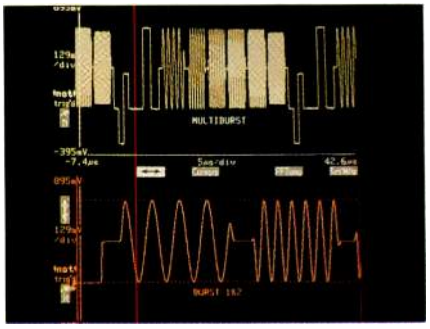
Part 8

Troubleshooting



Care and feeding of coaxial transmission lines

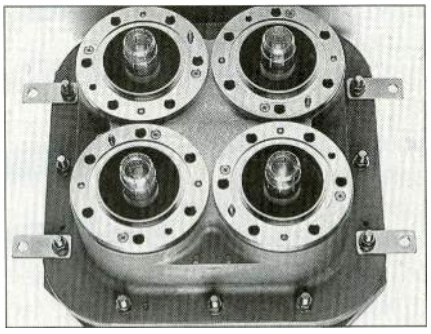
The final touches

By Dean W. Sargent

In Parts 1-7, we discussed a general overview of how to assemble a transmission system, which included the different types of transmission line components, and how to correctly size and install them. The final part of the series will address putting the final touches on a system, whether it is a new one or an upgrade of an older system.

Depending on the complexity of the transmitter, (whether it is a single transmitter, parallel transmitter or alternate/main transmitter), your job can be much simpler if you install patch panels or electrical RF switches. The patch panel makes it easier to get into the system for measurements, instead of having to break down the coax to install a transition fitting. Switches, on the other hand, are ideal for changing the system configuration, especially by remote control.

In order to change the system configuration using patch panels, you need to go to the site, shut the transmitter down, change the patches, and then turn the transmitter back on. If you have electrical switches, this process can be done in seconds by remote control. However, there is a drawback to this system: In order to get into it for measurements, you have to break it down just as if there were no patch panel(s).



A 3$^{1}/_{8}$-inch coax switch. (Photo courtesy of Delta Electronics.)

If your system is simple, stick to a manual patch panel, because you can change patches quickly providing easy access into the system. If you have a complex system, consider installing electric RF switches and a patch panel to get into the transmission line and antenna for measurements. If you have a single transmitter, the patch panel can allow you to feed the antenna or dummy load while providing measurement access to both (check the dummy load occasionally).

Sargent is president of D.W. Sargent Broadcast Service Inc., Cherry Hill, NJ.

Patchbays

Regardless of the system's design, there are some things you need to know about switches and patch panels. Patch panels are the simplest and least costly of the two types of switching equipment. Like transmission line components, patch panels come in a variety of styles. The most common version uses a variation of the sleeve coupling similar to unflanged transmission line. An unflanged patch slips into a larger outer with slits in it, and a hose clamp is used to make the final contact. This works well up to approximately 3$^{1}/_{8}$ inch line. Above this size the force required to move and reinsert the patch will be great, especially if the spacing is not perfect.

Two other patch systems are used that solve the problem of removing and installing the patch. The most common was originally used by RCA. It is the universal flange system and uses flanges on the patch and the panel. The flange on the patch is the female and the male is on the panel. A marmon clamp is installed around the mated flanges and torqued. Removing and inserting the patch is easy because there is no holding by the outer, and only the inner connector (in the patch portion) needs to be pulled out. This type is available in all coax sizes and is still available.

Another variation of this system uses a regular flange blank (no bolt holes), which is machined with a taper much like the RCA universal flange. This system uses identical flanges (sexless) on both the patch and the panel, and a marmon clamp is used as described for the RCA type.

With the RCA universal type flange, the outer does not offer much resistance when being removed or inserted. It does have a small amount of holding that is handy until you get the clamp installed around the flange. In the larger sizes, there is a "catch" that helps hold the large patch while you put the clamp around the flanges.

Coax switches

Switches are another important component. They need to have good isolation between the ports and a good switch will provide 80dB of isolation. This is important if you are using it to switch a transmitter into an antenna or dummy load.

The patch panel makes it easier to get into the system for measurements.

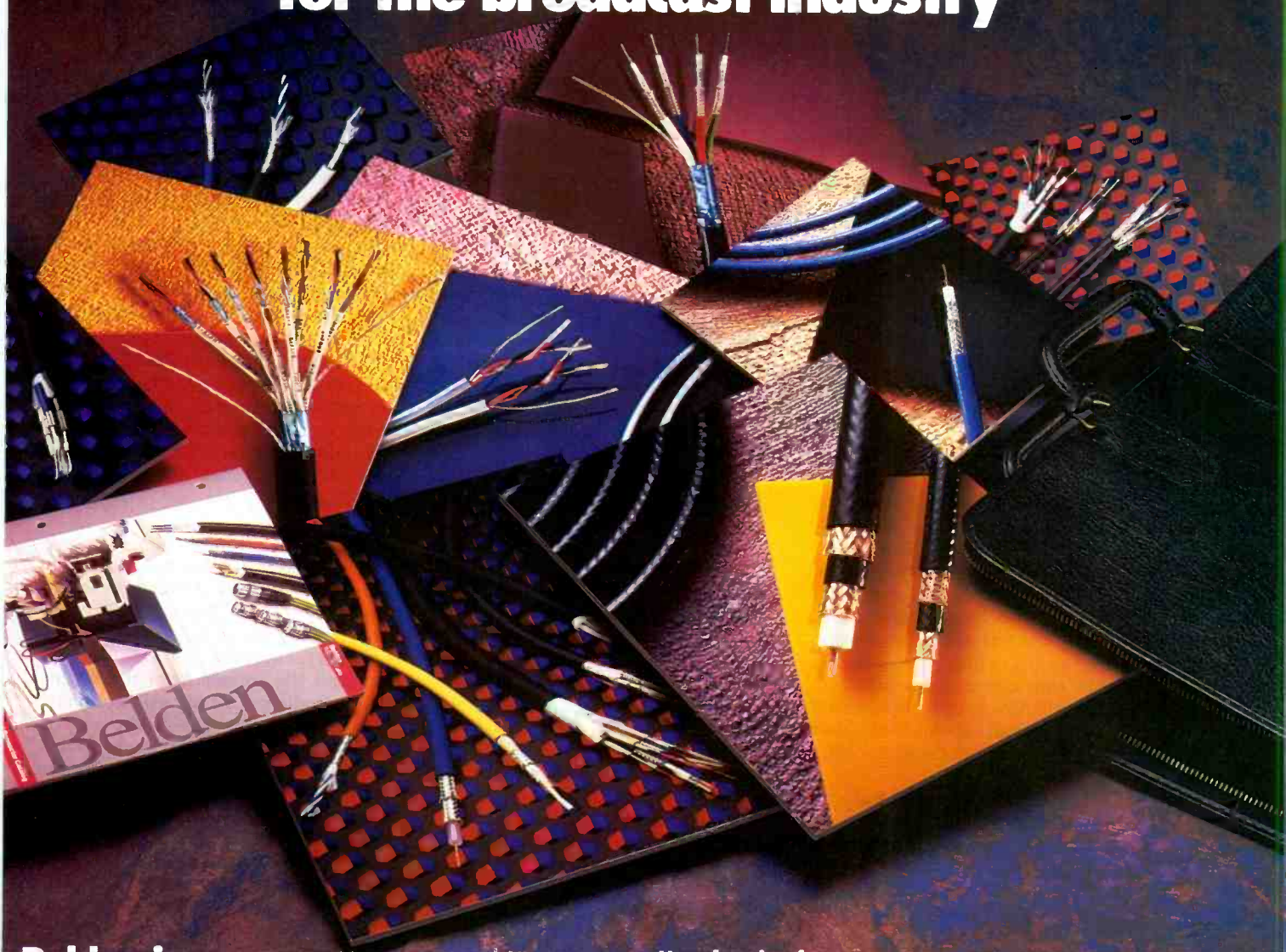
Some larger coax switches are nothing more than motorized patch panels. The patch is actually "pulled" down, rotated and then "pushed" back up in place. The outer conductor contact is assured by the pressure being exerted on the flanges by the motor. This type of switch has the same isolation as a patch panel system, but requires a lot of space because it is so large. Any RF switch should have logic provisions built in so you can know exactly what position it is in. This is usually indicated on the station remote-control system. Make sure the switch you purchase has the necessary interface.

When assembling the system, do not locate gas barriers, wattmeter sections, patch panels or switches and elbows together. Space them with sections of straight line.When these things are stacked on one another, you run the risk of several components all being damaged at once.

Many things about coax could not be covered in this limited series. But if you know the basics, you can usually think your way through.

➡ *For more information on transmission lines, circle (303) on Reply Card.* ■

Belden has BIG NEWS for the broadcast industry



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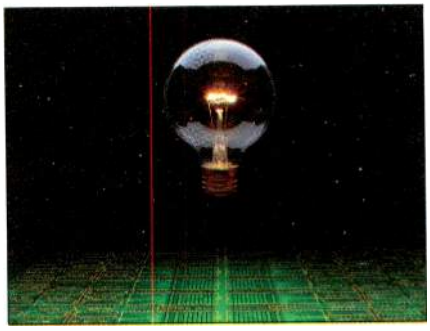

By Curtis Chan

Within today's entertainment market, there are significant conflicts among various groups. In 1968, the Motion Picture Association of America introduced four rating categories. Currently, the rating system has five audience categories: G, PG, NC-17, PG-13 and R.

Despite public outcry against sexually explicit and violent material in movies and TV programs, they continue to draw the largest audience share. In an industry where revenues are generated in proportion to the size of the viewing audience, and expenses are incurred through production and distribution costs, producers must balance between the tastes of the viewing public and financial disaster. Government regulators are faced with conflicting pressures. Movie studios, networks, advertisers and viewers opposed to depictions of violence, but tolerant of sexually explicit displays, viewers opposed to sexual content but tolerant of violence, civil libertarians, and those who don't fall into any of these categories all press their own claims and demand action. As a result, Congress has addressed the TV industry with threats that either the industry must act or Congress will.

The nature of conventional programming

These conflicts arise from an unavoidable aspect of the entertainment industry — its single-source, multiple viewer nature. Although there is only one film or broadcast center for each show, there are many viewers. Of the potential viewing audience, some will be entertained, some will watch for the violence or steamy sex scenes, some will be appalled, and others will be shocked by the controversial topic or offensive language. The result is that people will change channels, shut off the TV set, refuse to attend a movie or rent a videotape. Central programming is bound to lose a large portion of the potential audience, and efforts at self-censorship will only substitute one group of viewers for another.

Chan is principal of Chan and Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton CA.

An alternative

A San Diego-based company has developed a cost-effective technology that will enable home viewers to control the type and amount of explicit material available from videotapes, video disks, and pre-recorded or live TV broadcasts and cablecasts. This control is made possible by encoding each video frame with VideoFreedom (VF) information before it is broadcast to viewers. As a result of the encoding process, there is user-selected blurring of audio and visual elements viewers may find objectionable.

The process requires less than 16 hours for a 2-hour video presentation.

At home, the viewer can reduce this blurring by selecting the amount and type of de-blurring to take place on the receiver. The technology, with some modifications, can be applied to film. In time, the owner of a theater will be able to control the amount and type of decoding appropriate for any given audience.

VF encoding and decoding

The VF encoding process is straightforward. Each video frame is divided into a 64-part grid, eight columns wide and eight rows deep. Using industry standards and a special editing workstation, trained reviewers encode VF information to blur portions depicting sex/nudity, violence, adult situations and language. The process requires less than 16 hours for a 2-hour video presentation. With four content ratings and four levels of blurring. VF technology applies as many as 16 ratings to 64 portions of the video frame, 30 times per second for the duration of the program. A 2-hour movie would incorporate roughly 166,000,000 potential judgment calls, instead of one rating for the entire movie. Aside from X-rated movies, a typical movie might only lose brief portions. For encoding live broadcasts, a delay loop would be required and entry of encoding information by multiple reviewers working simultaneously in real time would be needed. On the decoding or receiving side, viewers can select the amount and type of decoding to take place on the TV receiver.

The four categories subjected to VF blurring are: 1) sex/nudity, 2) violence, 3) adult situations, and 4) language.

The blurring can take place within each of the first three categories at three levels of intensity, plus the fourth level, which is no blurring. These categories are 1) nearly complete elimination of controversial or explicit material, suitable for children; 2) some blurring, suitable for young adults; 3) mild blurring, suitable for adults; and 4) no blurring.

An example

An extremely graphic depiction of a man being shot, for example, can be selectively obscured at each level of VF self-censoring. Level 1 would obscure the entire part of the frame showing the slain man, and the sounds from the victim would be indistinct. Level 2 would obscure all the bloody portions of the victim. Level 3 would obscure the impact point of the bullet, and level 4 would involve no blurring. With each of the four possible levels, blurring is applied only to selected portions of the screen or soundtrack. Color and brightness are retained in the blurring process so there are no sudden shifts of blurred and unaltered material.

In the end, you have to wonder who decides what material should be censored. At present, much of this subjective decision making (based on the rating scale) and subsequent editing has been done to raw footage long before the public sees it. VideoFreedom's proposed implementation gives the viewer the ability to be one step closer to being in charge of his or her discretionary tastes.

Acknowledgment: Thanks to Dr. Douglas Palmer of VideoFreedom, San Diego, and the Townsend Agency, San Diego.

➡ *For more information on VideoFreedom, circle (304) on the Reply Card.* ■

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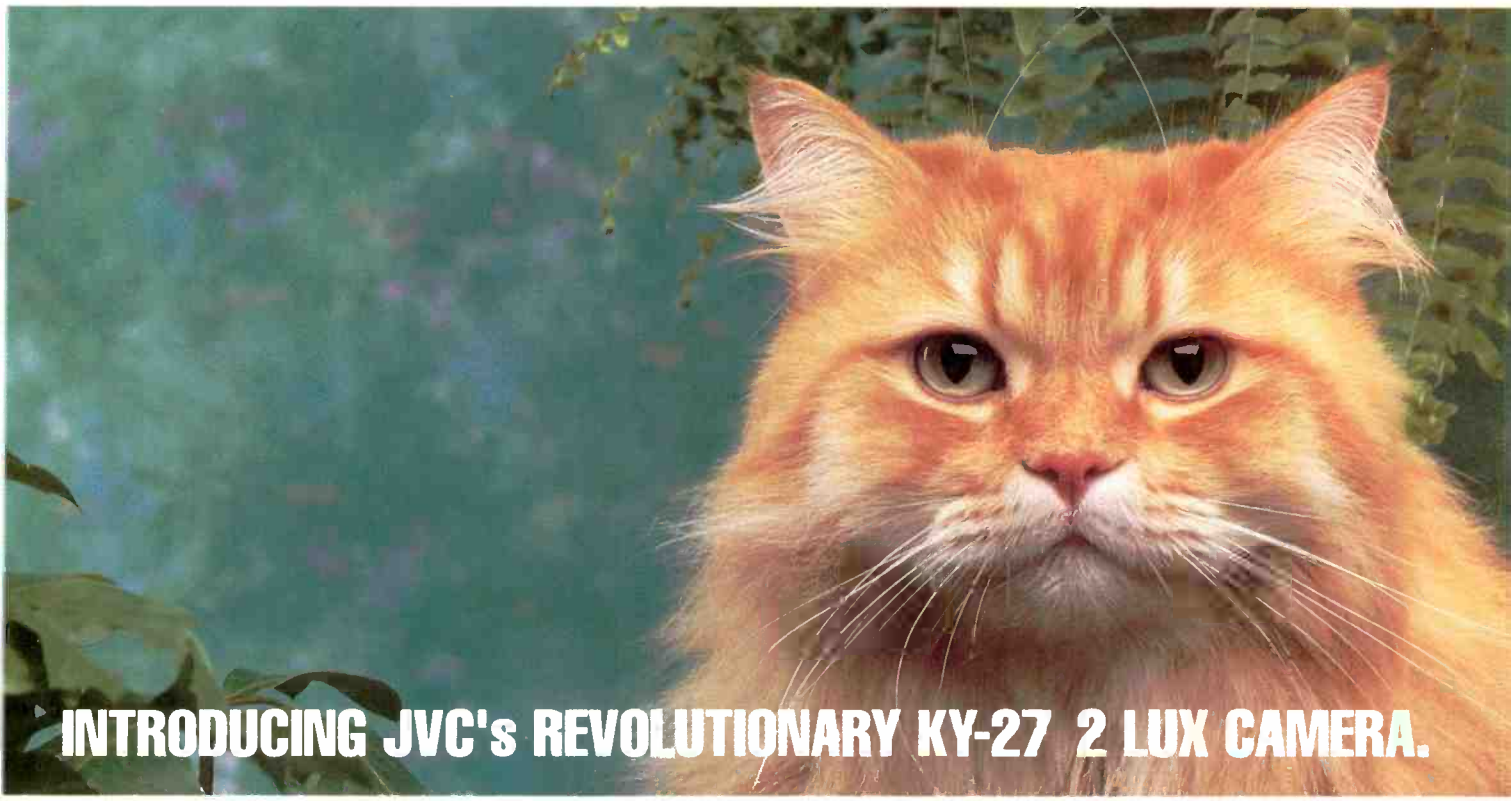

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Managing technology

Managing technology is the key

to broadcasting's future.

In preparing this year's article on salaries, I remember some of the comments from earlier years. Some six years ago, engineers were in the midst of turmoil. The FCC had eliminated the First Class license. Stations were being sold so fast that employees were never quite sure just who the current owner was. Responses from readers during that period were pessimistic and angry. Broadcasters did not like the changes and made no bones about it.

Times have changed. This year's survey responses have a markedly different tone. Technical managers recognize that they can no longer do business as they did before. Competition is tougher, technology changes faster, and mistakes are more costly. The goal of the effective engineer is to help the production, cable or broadcast facility be profitable. And, profit is no longer a dirty word. Responses to the salary survey showed that readers are more optimistic than ever before.

This year's salary survey provides new information. In addition to the traditional information on broadcast salaries, detailed information about cable and production facility salaries also is included. Now, non-broadcast readers have at their disposal the same kind of useful information as our radio and TV readers.

New opportunities

Industry changes have resulted in two noticeable changes. One of the industry changes has been the staff reorganization at broadcast and production facilities. In an effort to be more efficient, companies have had to realign employees with job tasks. One result is that many engineers have elected to start their own businesses.

Being self-employed is quite different from being an employee. This month's issue provides insightful information about how to make a successful transition into the world of contract engineering. Here is the chance to learn the ins and outs from someone else so you can avoid making the same mistakes.

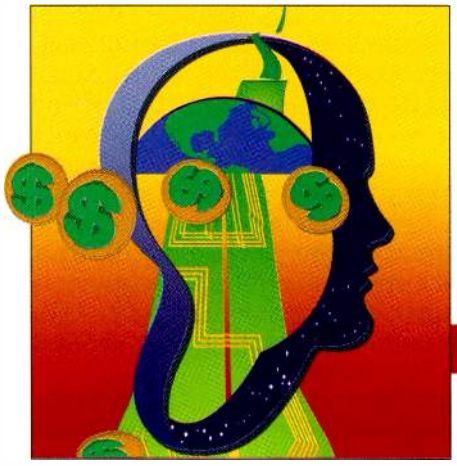
Mergers are becoming a common practice for some stations. When this happens, staffs have to adapt and grow in a new corporate climate. In "Managing Mergers," Dennis Ciapura provides first-hand advice on surviving what can be a traumatic experience. Learn how to make the most of what can be an opportunity.

One of the most challenging tasks for TV stations will be the transition to HDTV. When to budget, what to buy and dual-use systems are all important questions for technology managers. In the article "Planning for an HDTV Future," you will learn how one small-market TV station is boldly stepping forward into the future with the installation of a dual-use transmitting antenna. Bill Ellis reviews how important it is to plan now for HDTV, thereby minimizing the total cost — and risk.

Brad Dick

Brad Dick editor

Becoming a contract engineer



Contract engineering from a business point-of-view.

By Marvin C. Born

The Bottom Line

Because radio stations no longer need large engineering staffs, whether it is due to cutting costs or because of the lack of work, engineers are finding themselves turning part-time work into a full-time career. The idea of contract work for a living is turning many engineers' heads. If owning your own contract engineering business sounds appealing, you will need to know the groundwork and some real world tips for what it takes to make it a real success.

$

Several years ago, broadcast stations were required to employ a technician with a First Class Radio Telephone license to operate their transmitters. Whenever the transmitter was on-air, a licensed operator was required. Through the years, the costs of employing operators has increased while the stability of the transmitters also has increased. Thus, the broadcasters convinced the Federal Communications Commission (FCC) to reduce the licensing requirements to maintain a transmitter.

Station management rejoiced at the reduced costs, because they could hire almost anybody via the instant license process for the restricted radio telephone permit. The license mills were responsible for some of the problem by turning out licensed operators that had memorized the answers to the questions, but had no technical skills. Stations responded by employing only one competent licensed technician. As time passed and the rules relaxed, stations started sharing these technicians to further reduce their costs. Thus was born the "contract engineer."

Starting out

The contract engineer is mainly a radio station stronghold, because TV stations generally have enough equipment maintenance requirements to provide full-time employment for at least one engineer. However, the trend of contract engineers is moving toward television, especially LPTV stations.

Today, many engineers make a full-time living by working several part-time positions. Going one step further, these part-time engineers have become self-employed. In order to become self-employed, you need experience in the industry and experience in the business of being in business. You must establish a reputation, set a goal, survey the local market to see what work is available and market yourself.

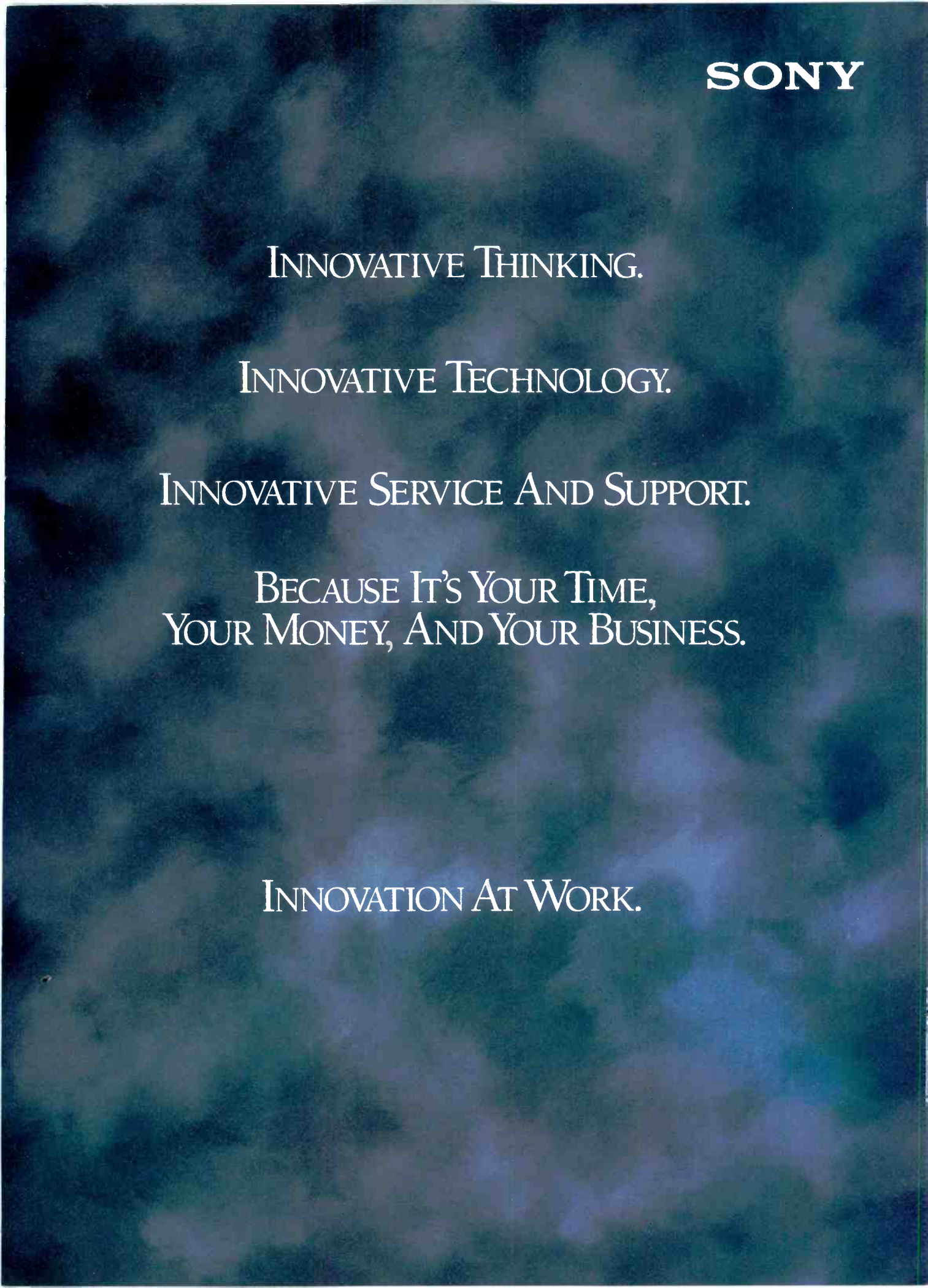
Now that stations do not need or cannot afford full-time technicians, they can save on employee benefits and taxes by hiring part-time help. Stations will call on part-time technicians any time a maintenance problem arises. However, this is where problems can arise for the self-employed technician.

1. As an independent business operator, you will need to face the "costs of doing business" nemesis. What are the hidden costs in this business and how will you handle them?

2. Because you cannot make enough money with one client, you will need to recruit additional stations. Murphy's Law says that any problems at both stations will occur at the same time, so there must be provisions to cover this. You must have an understanding with your clients as to the exact extent of your duties.

3. If you make a mistake, who pays? If a station employee makes a mistake, it will

Born is vice president of engineering for WBNS stations, Columbus, OH.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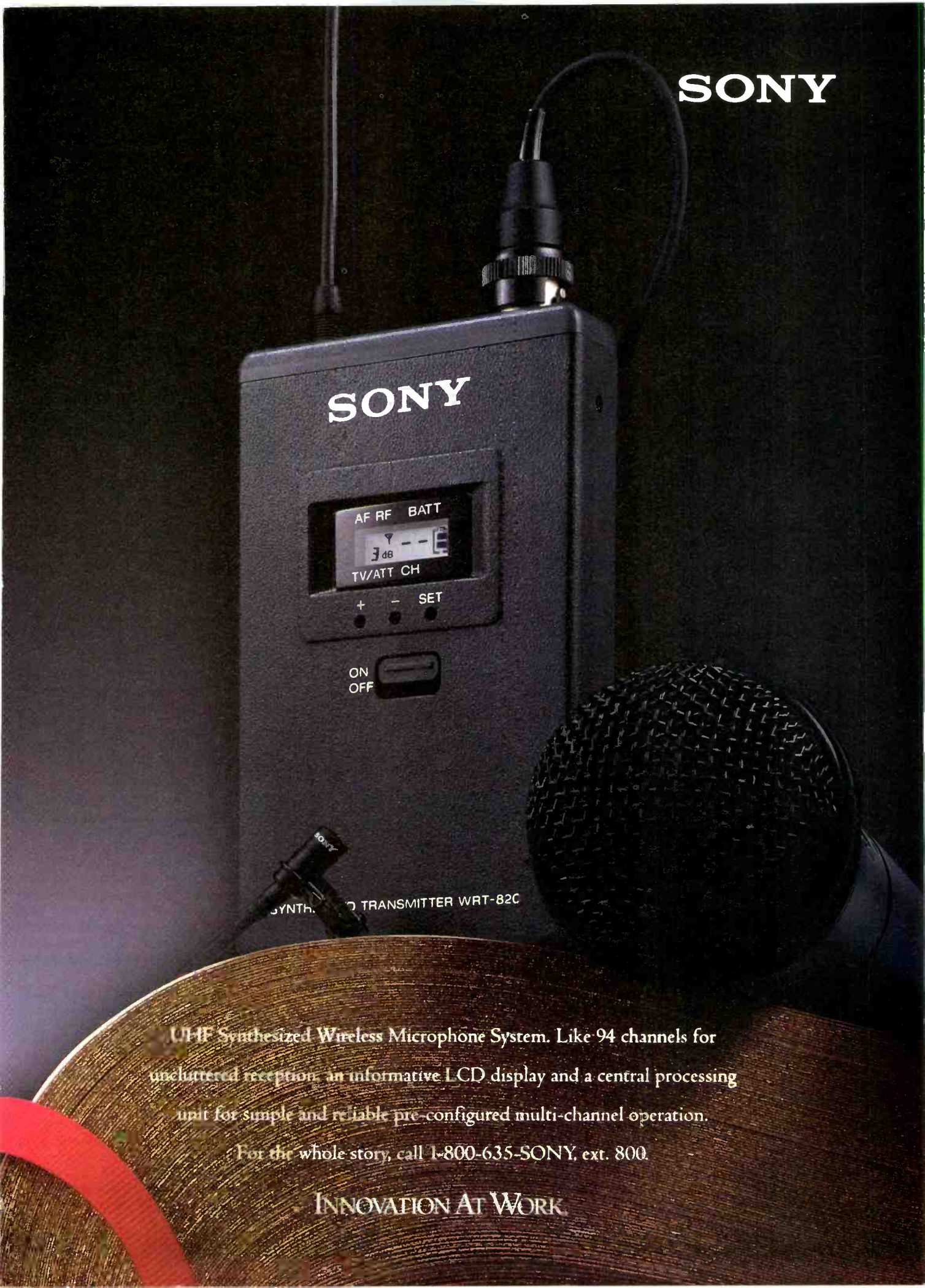

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be covered by the station because it's covered by insurance that protects the station and the employee. It is important that you have liability insurance to cover your business (more on this later).

As an independent contract engineer, you may be knowingly or unknowingly accepting responsibilities for your actions. Can you afford to replace an audio board when you drop a screwdriver onto a powered circuit board? Who pays for the lost commercials that did not run while the board was down?

Jim Morgan and George Phillippi performing maintenance at WRVF-FM, Columbus, OH.

Some costs of doing business

Following is a brief look at a few of the operating costs a contract engineer will assume during a year. We will need to make a few assumptions about costs and purchases. First, a vehicle needs to be leased, with liability insurance and assessed taxes paid. The test equipment will be purchased used.

The costs will be divided into two areas: *fixed and variable*. Fixed costs occur each month at the same rate, regardless of the amount of business you do. The vehicle lease is such a cost. Fixed costs are more damaging during the early period of a business because they can eat away at your operating capital. (Operating capital pays for parts, etc., in advance of receipt of your accounts receivable.) It is important to keep fixed costs to a minimum. With low fixed costs your survival during a slack business period is longer, and during good business times your profit margin is greatly enhanced. If you have to borrow money, one of the first things a banker will look at is the ratio of income to fixed costs, because he wants to know if you can pay back the loan.

A variable cost occurs only when you do business and changes with the amount of business. Maintenance, fuel for the vehicle, office supplies and telephone expenses are examples of variable costs. Although you may think of parts as variable costs, they are billable expenses. You will pass these charges on to your customers after adding a handling charge, which is usually 15%. If you can buy parts or items at wholesale, you will add to your profit.

Broadcasting has a few variable costs, but most of the costs are fixed. A public service announcement costs the same to run as a commercial. The station needs the transmitter and electricity to operate it. The master control operator is needed to push the button. The station account representative's commission is one of the few examples of a variable cost. Your engineering services are considered a fixed cost because transmitter maintenance is required regardless of what is passed through as program material. Your service while installing a new console would be a capital expense to the station, but the accountant would amortize the cost over several years, which makes your service a fixed cost.

Costs	Fixed	Variable	Total
Vehicle	$2,400		
Fuel		$1,100	
Maintenance		$ 500	
Insurance	$ 600		
Liability insurance	$2,000		
Health insurance	$1,200		
Business expense		$1,500	
Telephone	$ 66	$ 150	
Yearly costs:	$6,266	$3,250	
Total *(fixed and variable costs)*			$ 9,516
Hand tools	$1,000		
Test equipment	$5,000		
Initial costs taken over 5 years			$ 1,200
Total expenses for first year *($9,516 + $1,200)*			$10,716

Table 1. *Sample expense statement.*

Contract engineers also have initial costs, which are expenses to get started in business. Tools and test equipment are examples of this. The down payment of a vehicle is an initial cost. Other initial costs include local zoning permits and state sales tax permits. Many contract engineers operate from their home, but if you rent space, the modifications to the rental space are initial costs. The monthly rent would be a fixed cost.

Establishing the business

Now that you have decided to become a contract engineer, you realize that your vehicle is too small to haul tools, test equipment and materials for your customers. A 4-wheel drive would be a nice investment and a selling point with the stations you work with because you could get around during bad weather. You find a truck for no money down and $200 monthly payments. If you travel more than the 15,000 miles allotted per year, you can bill the customer for the additional mileage. Because the vehicle gets 15 miles per gallon at $1.10 per gallon, the fuel costs for the year will be $1,100.

You may already have a few tools, but you need to spend $1,000 for a few more necessities to round out the toolbox. As a contract engineer, you also have to purchase some mechanical tools. Transmitters and transmission lines require socket sets and wrenches for installation. You will need minimum test equipment, such as an audio generator analyzer, digital voltmeter and a portable oscilloscope. If you plan to work on transmitters, look for a wattmeter and some type of operating impedance meter. Total cost in the used market will be approximately $5,000.

After you pay liability insurance you are ready for business. Let's look at your first year's income. Your first contract calls for 10 hours per week at $50 per hour, for a yearly income of $26,000. Your second contract also is a yearly maintenance agreement for an additional 10 hours per week, for a total yearly income of $52,000. Whether you can get station managers to sign contracts for $26,000 depends on the market. To some stations that figure is a good deal. In other markets, $26,000 could buy a full-time engineer. As you develop your business plan think about where you are and how attractive you will have to make your service. Always keep in mind the cost of doing business vs. income. (See Tables 1 and 2 for sample statements.)

Total income	$52,000
Total expense	$10,716
Income before taxes	$41,284
Taxes (at 33%)	$13,623
Stockholder equity	$27,660

Table 2. *Sample income statement.*

The term stockhold equity (see Table 2) is the bottom line that you will have to live on for a year. From this example, you can see how the fixed costs can affect your bottom line. In the example we only used 20 hours of a 40-hour work week. Allow approximately 10 hours a week for business time, such as finding new accounts and paperwork. If you can sell another contract your income will increase another $15,000 or so, after costs and taxes.

These oversimplified charts provide an idea of how business works in the real

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The Q600 system provides continuous, full-duplex, hands-off communications between up to six people plus an unlimited number of "listen-only" users.

The QTR-600 beltpack remotes are extremely easy to use and provide operation similar to that of hard-wired intercom beltpacks. They are compatible with popular dynamic or electret headsets, such as Beyer, Clear-Com, and Telex. The cases are welded aircraft aluminum alloy with a high-impact, molded Cycolac (ABS) control panel that will withstand the roughest use.

One QX-600 master station supports up to six QTR-600 remotes with "hands-free" two-way communications, and an unlimited number of PL-2 receivers for listen-only users. Circuitry is provided to interface external line audio with the system or to link two QX-600s into a 12-user system. The master station is directly compatible with all standard wired intercom systems such as Clear-Com, RTS, ROH, Telex, and many others via internal programming switches. A local headset position and extensive control, adjustment, and monitoring provisions are also included.

The PL-2 VHF mini-receiver provides a high-performance, low-cost solution to providing one-way "listen-only" communications. Very often, individuals need to receive instructions but are not required to speak. Using PL-2 receivers for this application avoids the expense of additional full two-way remotes and can significantly lower the cost of a typical system. The PL-2 is fully compatible with the Q600 system and is designed to provide reliable communications in the most demanding RF environments.

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world. Plug in the numbers from your business plan to see what you may be facing. A 33% tax rate was used in the example. In the real world you will face different taxes from the federal, state and local governments, all due at different times.

In this business example, the contracts were for a year and provided fixed income. Consider what you would face without the fixed income and had to rely only on equipment failures for your income. Consider the money and how much time would be devoted to generating new business and the resulting increase in phone and office expenses.

The contract

The contract that has been discussed throughout this article is a written agreement between you and the customer. It states what you will and will not do, when you will do it and how much you will get paid. It also states your responsibilities and those of the client. When the contract is signed by both parties, the terms can be enforced in court. Contracts are the domain of lawyers, so use a lawyer to write and explain your contract. There are traps in the contract that can affect your livelihood for a long time if you are not aware of what you are signing.

One example is the paragraph that states that you are responsible for your actions. If you damage a transmitter, antenna or audio board, the client will look to you for payment, which brings up the second important aspect of a contract. Purchase liability insurance for your own protection. Any good station manager or lawyer will require you to have it.

The language of the contract will state that you, the engineer, are skilled in and capable of providing engineering services of the type required by a broadcast station and that you hold the required FCC license to provide maintenance on a broadcast transmitter facility. There will be language stating the need for the station to maintain its equipment in such a manner as to comply with the FCC rules and regulations and have need of the services of a qualified engineering individual or firm to provide such services.

The contract also states the need for an agreement. The contract will define the terms of the agreement, such as defining the duties of the engineer. This is important because it defines what you will get paid to do. It also will allow you to have additional clients and that no specific time periods will be dictated to any specific station. Further language will describe how other duties would be assigned and how they would be billed and how to resolve conflict between parties.

The engineer in our sample contract is an independent contractor who is hired

Continued on page 35

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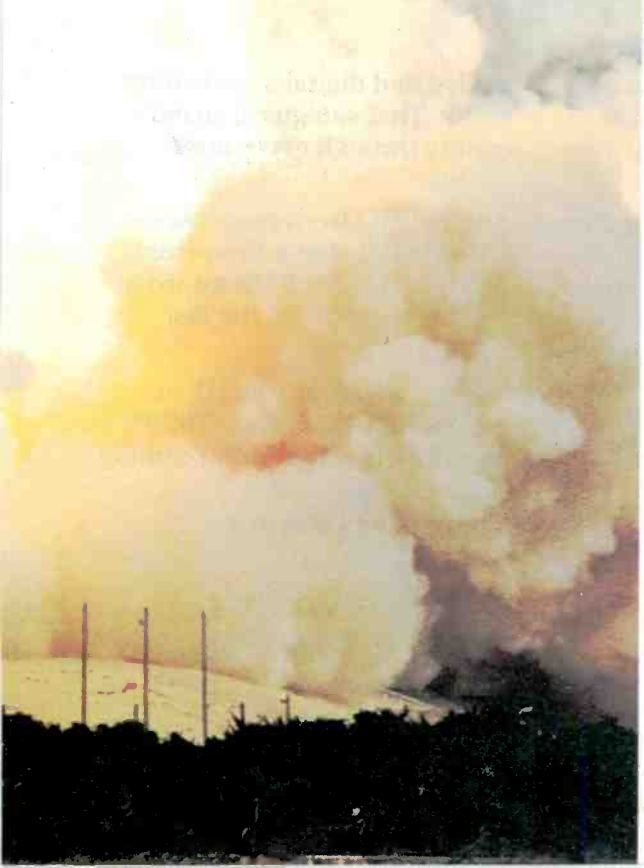

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Continued from page 32

to perform a piece of work according to his or her own methods and using his or her own tools and equipment and not subject to the control of the station except as to the result of the work. The engineer is retained only for the purposes set forth in this agreement or as otherwise agreed to in writing. This paragraph protects the station and you from becoming a station employee under the terms of the tax laws. If you are an employee, the client must withhold the various taxes required.

The station may require the contract to define the engineer's qualifications. You will agree to maintain your FCC license validity, and that you or anyone you employ will be qualified to perform the assigned work and that you have adequate knowledge of the FCC rules and regulations governing maintenance and operating of transmitting equipment.

When you are self-employed you will want to get paid for your work. The contract should define how the work will be paid whether it be hourly, daily or by bids. If the work does not have a fixed fee, how will the work be billed?

A section called "Status of Engineer, Indemnification and Hold Harmless," states that whatever happens, it is not my fault, unless I caused it. In that case, it is not your fault. The wording protects you and your employees from a lawsuit or damages by stating that you are not an agent, employee or servant of the station. Furthermore, you or your employees are not a part of the station ownership, such as a partnership or joint venture. This clause holds you harmless for violations of the FCC rules for which you had no part.

The other side of this paragraph is that you hold harmless and promise to defend the station for acts or omissions that are your obligations under the terms of the contract. You, as the engineer, will bear the risk of loss, death or injury to yourself or your employees except for undisclosed hazards. This is a dangerous paragraph, so look to your lawyer for advice before signing a document with such a hold-harmless or risk-assignment clause.

Non-disclosure and conflict of interest

Good business ethics require that any and all information obtained by an engineer concerning a station's programming, operations or people be protected. You will be asked not to reveal any information without permission. Your part of this agreement would be to reveal past or present employment that may place you in a conflict of interest between two competing stations, such as in the same market. Although you may be able to keep

Hiring a contract engineer

A manager's perspective

By Bob Kirby

Outsourcing is the buzzword of the day. Companies control costs by consuming goods and services as needed, and radio engineering ranks have been hit hard by this trend. As more stations rely on contract engineering, opportunities are created for engineers with the technical skills to do the work and the management skills to run their own businesses. As engineers contemplate starting self-owned contract engineering services, they should probably consider the issue from a general manager's perspective.

Radio general managers hope to accomplish four goals by contracting out technical services

Radio general managers hope to accomplish four goals by contracting out technical services. First, managers expect the engineer to maintain technical operations and EBS logs in compliance with FCC rules. Second, the engineer will restore on-air operations ASAP after equipment failure. Third, the engineer should provide service as inexpensively as possible. Finally, the relationship poses no surprises.

When a contract engineer begins negotiations with a station manager about maintenance, a host of issues surface, which fall under four categories: professional, legal, financial, and terms and conditions of work. These concerns are prioritized from the cost-conscious manager's perspective.

Professional issues

1. *References, education, experience:*
The contract engineer is applying for work, so a resume is in order. Or, the engineer should market his or her services in a brochure that would include what services are provided, names and phone numbers of customers and previous employers, educational accomplishments and SBE certification.
2. *Conflicts of interest:*
The engineer should disclose existing clients and his obligations to those clients. The engineer and manager should discuss how the engineer will service emergency on-call needs of the engineer's clients. The manager deserves to know

Kirby, a former radio station manager, is a freelance technical writer in Kansas City, MO.

where his station fits in the engineer's priority list.

How will the engineer protect the station when on vacation, traveling or repairing a competitor? When the transmitter blows a final, the manager doesn't care where the engineer is or what he is doing; he wants back on the air now. In the contract, the engineer should specify how he will protect the station in his absence.

3. *Confidentiality:*

The station manager has the right to expect that what the engineer overhears while in the station will not leave the premises.

The manager views the engineering service as a necessary expense, the benefits of which are remaining on the air.

Legal issues

1. *Willingness to certify compliance:*

The manager may want verbiage incorporated in the contract in which the engineer certifies he or she will maintain technical operations and EBS logging compliance with FCC rules. The manager views the engineering service as a necessary expense, the benefits of which are remaining on the air, protecting the license and passing field inspections without citations.

2. *Evidence of insurance:*

The manager will insist the engineer carry workers' compensation and liability insurance and probably will want certificates of insurance delivered to the station's insurance agent.

3. *List of duties:*

This should be less of a concern if the engineer provides the station "full-service" preventive and emergency on-call service. But what about the penny-pincher who contracts only for restoration service when the transmitter fails? To what extent might the engineer be liable if this station should be fined during an inspection? If willing to provide a station limited or partial service, the wise engineer will insist that duties be spelled out in the contract.

Financial issues

1. *Professional fees:*

How will the engineer charge for services? Will a monthly blanket rate cover everything, or should actual time be billed at an hourly rate? Should a premium be charged for responding to a transmitter failure at 3 a.m. New Year's Day? Managers like predictability. On what day of the month can the manager expect billing for last month's services? And by what day can the engineer expect payment?

2. *Reimbursables:*

How will out-of-pocket expenses be paid? Will the station grant the engineer authority to charge long-distance calls made in the station's behalf from home? What about FedEx charges, faxes and Radio Shack components? Or, will the engineer pay for nickel and dime items and expect reimbursement? By which day of the month should an expense report be submitted, and on which day can the engineer expect reimbursement? The contract should include those arrangements.

3. *Expensive repairs:*

Discuss with the manager and agree in writing the procedure for getting authorization to purchase unplanned, expensive items. Will the manager blanket-authorize the engineer to order anything necessary to restore the station's signal? If not, who would grant authorization or issue a PO number in the manager's absence? Has the station budgeted reserves for unplanned engineering expense? What does the manager consider a major expense? Will your input be considered for future budgets?

Terms and conditions of work

1. *Type of service to be provided:*

What is the manager requesting, and what are you willing to provide? Regular studio and RF preventive maintenance? Emergency on-call repairs to studio, STL and transmission gear? Or one-stop, full-service maintenance? This question should be in the contract you negotiate.

2. *Channels of communication:*

Who will define and prioritize work? If the engineer charges an hourly rate, which staffers will be authorized to call with a problem at 3 a.m.?

Discuss with the manager and agree in writing the procedure for getting authorization to purchase unplanned, expensive items.

3. *Workspace, tools and equipment:*

Where and when will equipment maintenance be performed? Should station personnel expect a regular predetermined work schedule? How much station workspace will be required? Will the engineer provide necessary test equipment and tools? What about secure storage space for tools and equipment? Will the free-lancer expect to receive mail, faxes and calls at the station?

Managers will appreciate and respect contract engineers who have analyzed these issues and can discuss them comfortably with prospective clients.

each station's business separate, should the information leak you could damage yourself by not revealing to both clients your employment with the other. Such disclosure could cost you some business in the beginning, but it is good business in the long term.

In your contract, protect your right to solicit additional work with other broadcast facilities in the market. Be aware of exclusive language that could keep you from earning a living in your market during the contract and afterward. The contract must include language to cover Murphy's Law, which demands that all of your client stations fail at the same time. Most emergency repairs will be the result of some natural disaster or act of God that affects many stations at the same time. Allow yourself the option of deciding which station gets your attention first.

The last area of discussion will be the term of the contract and whom to contact regarding the contract. This area must be specifically written for your client. If it is general maintenance for a weekly fee, at least one year would be fine, but two years would be better. Provide termination clauses and automatic renewal language. Sometimes, after two years both parties forget about the contract renewal and you could be working without the protection of a written agreement.

Finally, the contract should designate a single person to act as the station representative with respect to your work under the contract. This person should be the signer of the agreement on behalf of the station.

Concluding business

If you are thinking of becoming a contract engineer, fill in your numbers on the sample income statements to see how you might do. Then obtain a sample contract and determine how you feel about signing such a legal instrument. Finally, call your insurance agent and learn what insurance coverage will cost. Now you are ready for the real world of contract engineering.

Editor's note: Chip Morgan of Chip Morgan Broadcast Engineering (CMBE) and Chris Imlay of Booth Freret & Imlay are authors of the contract referenced in this article.

➡ Copies of the CMBE\SBE contract will be available to all SBE members. For more information, contact SBE headquarters at 317-253-1640 or circle (305) on Reply Card.

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Managing mergers

Radio station consolidations pose considerable challenges for broadcast technologists.

By Dennis R. Ciapura

The Bottom Line

The radio industry is undergoing the most fundamental business change since the advent of television, and many engineers are unhappy and confused by it. Duopoly mergers are resulting in common ownership of multiple stations within a single market. The goal of the merger is to consolidate operations and to reduce staff and operating expenses. This usually means increased engineering workload and, in some cases, fewer engineers. For the good engineers who remain, however, duopoly may mean opportunity.

$

A new era is dawning in radio broadcasting. In many ways, this age of duopoly is functioning as a shakeout period, wherein the smartest and most aggressive department heads survive — including chief engineers and other technical managers. Astute managers react to changing conditions by assessing the underlying reasons for the changes, and then developing a strategy for exploiting them. The losers are usually those who wait for change to affect them and then react. Proactive response to an impending duopoly is an infinitely better strategy than a reactive approach. To pull it off, however, you need to thoroughly understand what duopolies are all about.

The drive to survive

First of all, it is necessary to understand that most duopolies are not motivated by greed, but by necessity. Since the Carter Administration, the number of radio stations in the United States has nearly doubled. Some industry sources estimate that in 1992, 60% of commercial radio stations lost money. Figure 1 shows the astounding decline in recent radio revenues, which the industry has struggled to deal with. After years of 6% annual growth, 1991 revenues were actually 4% *lower* than 1990, and 1992 revenues — although up from 1991 — were still below 1990 levels.

A 4% revenue reduction may not sound like much, but it subtracts directly from cash flow. With typical station operating margins around 30%, that is approximately an 11% cash flow drop. For many companies, this was enough of a drop to cause loan ratio compliance problems, if not outright default. Others managed only by virtue of falling interest rates. Although some of the industry's problems certainly resulted from poor fiscal management

Many "irreplaceable" engineers are out there, scrambling for contract work today.

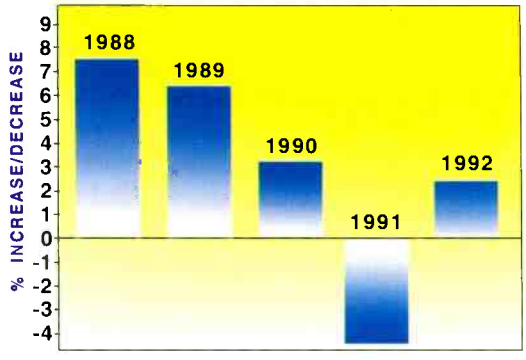

Figure 1. Recent radio station revenue trends.

Ciapura is executive vice president, Noble Broadcast Group, San Diego.

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"Rocky peaks, icy winds, knee-deep mud, earth tremors, a rumbling volcano, the dreaded Inca Curse . . . but our Ikegamis keep on rolling."

"We were in Ecuador's remote Llanganati Mountains with the 60-person Discovery II Expedition. The group was composed of archeologists, botanists, historians and high-tech equipment operators. Our goal was to find the legendary treasure of Atahualpa, estimated to contain 780 tons of gold. My mates and I formed a four man, one woman videographic crew from American Video Productions of Dania, Florida. Our job was to record the expedition for the television documentary, "Legends of Inca Gold". The story had already gained a worldwide reputation as being a real life Indiana Jones adventure, and as we were learning quickly, that was not just hype.

The horrible weather was no surprise. It was a total shock.

We gathered in Quito, Ecuador where the weather is eternally spring-like. We carried two Ikegami HL-V55 Beta SP cameras and thought that if the weather in the mountains was the same as we were experiencing in Quito, this assignment would be a piece of cake.

We quickly learned that the South American winter was two-faced. Reaching Chury Ucto, a town at the edge of the Llanganati Mountains, we were told that the cold, drenching rain had persisted -for the past six weeks and showed no sign of letting up. Worse than that, the cloud cover was so heavy and constant, the Ecuadoran Army helicopters scheduled to fly us into the mountains were grounded.In effect, we were on our own and if we wanted to go ahead, we'd have to walk. That's exactly what the expedition leader decided to do.

Our cameras and gear were packed in watertight, rubberized cases, but we were concerned that the thick, persistent fog would limit our ability to get good pictures.

The "cave of gold" was 100 feet deep, with a water trap and a nest of secret tunnels.

We stopped outside Chury Ucto to explore what natives believed to be a secret Inca gold repository. At a depth of 100 feet, expedition members found hand-chiseled tunnels, a water trap so

This narrative was supplied to Ikegami by American Video Products. Photo credits: Michael Mancusi and Wayde Klipper.

ingenious it would have ended the career of Indiana Jones, and a wall of stones not indigenous to the area. This led Discovery II archeologists to believe this site had been a hiding place for gold. In the dim, artificial light carried with us, our Ikegamis passed their first major test. The

hyper-gain feature was especially useful in helping us record this spectacular scene.

From the cave, we snaked our way into the mountains. At 15,000 feet, icy wind gusts threatened to fling us off treacherous trails, sections of which were knee-deep in mud. At night we were awakened by the rumbling of nearby Tungurhua, an active volcano. The tremors shook the precarious ledge on which we had pitched our tents. We were getting all the adventure we had bargained for, and then some.

The buried Inca temples were right beneath our feet. But so was the mud.

Standing above a canyon on our march into the mountains, the expedition director spotted the outlines of a buried roadway leading to several symmetrically arranged grassy mounds. Infra-red scanners and magnetometer readings indicated the presence of ruins beneath the grassy mounds. Had we reached our destination? This was the Maqui Valley and it was decided to settle in and wait for a change in the weather so preliminary excavations could begin.

It was a long wait, four weeks to be exact. Four weeks of constant driving rain, accompanied by freezing temperatures and thick fog. Digging out around the mounds was useless as each hole would quickly fill with muddy water within minutes. Morale fell as supplies dwindled. We were reduced to breakfasting on two saltine crackers and a mug of lukewarm tea.

Weather or not, our own video crew was buoyed by the fact that our Ikegamis allowed us to do our job of recording the grandeur, albeit dark and cloudy, of the surrounding mountains and the frustrations of the expedition.
If we were not to discover hidden gold, at least we'd bring back an exciting story.

When snow came, leaving was a choice of now or never.

Snow came and some of us began to believe that Inca spirits were sending us a message to get out and leave their secrets alone.

With food and medicines almost gone, we walked out of the Llanganati Mountains as we had walked in, only this time battling sickness, hunger, exhaustion and snow drifts. The search for Inca Gold would be continued another time.

Had we failed? Obviously, the archeological team would have liked to achieve what they had set out to do, but they would be back. As for our crew, we were thankful that our Ikegami HL-V55 cameras were able to withstand adverse conditions and adjust to dampness, darkness and below freezing temperatures. Lightweight and compact, they gave us

the capability to carry them anywhere to get some of the most spectacular shots any television audience will ever see. For us, gold or no gold, it was 'mission accomplished' ".

during the up cycle that peaked in 1987, the most basic problem is the existence of too many stations for the available advertising revenue.

Regulatory changes

With the industry pressing for relief, the FCC recognized this problem and sanctioned *Limited Management Agreements* (LMAs) in 1990. In September 1992, new ownership rules were passed, allowing common ownership of multiple AMs and FMs in the same market. With this regulatory change, many operators who otherwise would have expanded into new markets were forced to expand in existing markets as a protective strategy. This strategy was based on the perception that even a successful stand-alone operation could have a tough time surviving in a market dominated by duopoly pairings. Some operators are trading markets to achieve their duopoly objectives.

Staff engineers are a thing of the past.

Figure 2 illustrates the impact that duopolies have already had on the radio industry. In 1992, 34% of radio broadcast station sales activity was already duopoly related, and the majority of 1993 activity thus far appears to be in duopolies. By Sept. 1 of this year, there were 284 duopoly and 162 LMA consolidations involving a total of 1,193 stations. That equates to *12.1%* of all commercial stations in the United States.

Coping skills

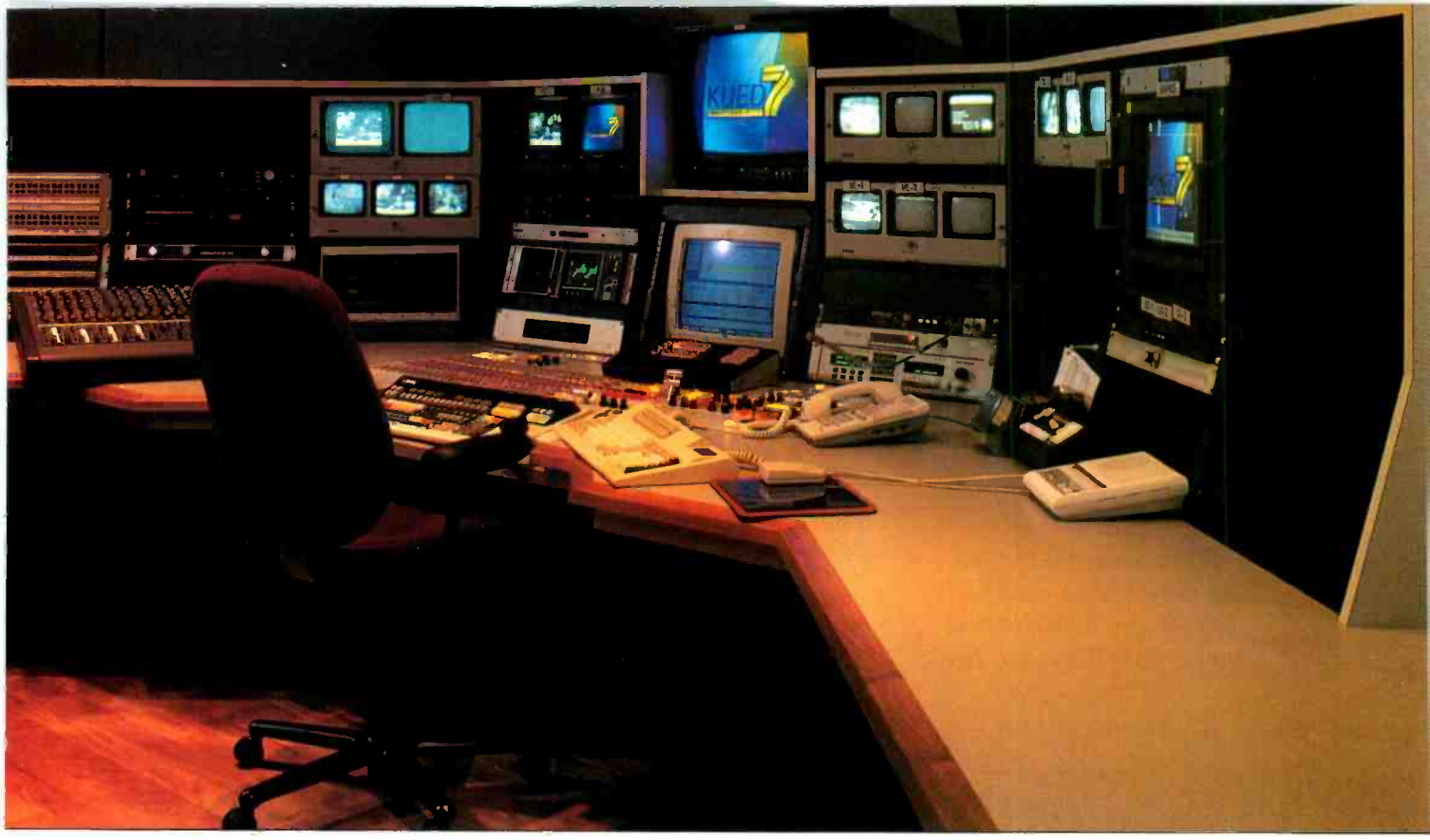
It is clear that this trend will continue. The first key point for technical managers to understand is that you cannot run from duopolies. Moving to another station will just forestall the inevitable. Managers must learn to cope with the possibility of a merger. That means engineering a personal business plan the same way you would design a transmitter or studio layout. Begin with a clear understanding of the available resources, and put it all together in the most advantageous way.

Owners/operators entering into a duopoly acquisition usually fund the deal on the basis of immediate cost savings and long-term competitive advantages. Lenders generally discount the long-term gain and place heavy emphasis on immediate cash flow improvement. This puts great pressure on the operator to reduce costs. It is not a simple lust for profit, but a necessary element to fund the deal. Funding the deal may be key to keeping the company alive.

Proactive response to an impending duopoly is infinitely better than a reactive approach

This is important to understand because the cost-cutting nature of consolidation deals often generates hard feelings, and emotional responses to the changes can get in the way of rational thinking. Many engineers have even attempted to negotiate salary increases for taking on additional workload. Given the maximum cost-reduction goal of typical consolidation plans, this is not realistic and could not be more ill-timed. The first focus should be on survival. Many "irreplaceable" engineers are out there, scrambling for contract work today.

Owners and GMs are vulnerable at this stage and are appreciative of department



STS CONSOLES AT KUED-TV

The new Dolores Doré Eccles Broadcast Center, located on the University of Utah campus, is home to the University's Media Services Department which includes KUED-TV (7), PBS affiliate; KUER-FM (90), NPR affiliate; KULC-TV (9); and EDNET (Utah's statewide microwave system).

This comprehensive facility, known as one of the "crown jewels" in the PBS system, comprises 66,000 square feet, and houses two sizable TV studios, one radio studio, three radio production rooms, three television editing rooms, and on-air control rooms for KUED/7, KUER-FM/90, KULC/9, and EDNET. In addition, audio and video libraries, a multimedia facility, computer graphics room, teleconference room, telecommunications switching center, satellite communications, set and equipment storage facilities, student and staff training areas plus staff offices are conveniently located in the Dolores Doré Eccles Center.

The University's Media Services Department chose Skaggs Telecommunications Service, Inc. (STS) to supply the elaborate electronic furniture/enclosure requirements for the new facility. STS custom-designed and built consoles are located in each of the studios, edit suites, production rooms and on-air control rooms. Matching storage units and workstations were also provided as specified. Additionally, more than sixty 8' equipment racks were supplied.

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heads with a "can do" attitude. So, if your GM or the owner comes to you and confides that a duopoly is in the works, and that your company is the acquiring party, your initial response may have a great impact on your future. It is time to pledge cooperation and ingenuity, not dwell on the negatives. You are not going to stop the duopoly, so it becomes a question of how much you want to be a part of the station's future. A positive and dedicated attitude may help position you as one of the key players in the plan — someone the GM and owner can trust and rely on.

Virtually everyone involved in a duopoly takes on additional responsibility, including technical managers.

Duopoly engineering

Duopoly facility mergers often present a myriad of technical challenges ranging from combining studios and offices to establishing new STL paths. Everybody will want everything done immediately. The GM will be absorbed with reorganizing the sales and marketing effort. Having an aggressive, positive and competent person to oversee all of the operational and logistical details (as well as assuring FCC compliance) is invaluable. The chief engineer is best equipped to handle these matters. This can be a good opportunity to show what you can do at a time when a "take charge" attitude is greatly appreciated.

Operating expense reduction resulting from duopolies is averaging 11%, with most of the savings coming from staff reductions. Herein lies the next key point for technical managers: Staff engineers are a thing of the past. The stronger chief will probably be retained, and the assistants will be let go. There is no point in fighting this because the staff reductions may already have been committed to. Your initial reaction may be to rationalize the current total engineering staff size, but unless there are some onerous directional AM maintenance requirements, one chief for the combo is the norm. Virtually everybody involved in a duopoly takes on more responsibility, including technical managers. If you feel put upon, visit the traffic department.

A major objective of the merger is to reduce the number of employees on the payroll. Plan to use outside contract engineers on an hourly or daily basis to keep things manageable. The overhead on full-time employees makes them 20% to 30% more expensive than their salary would suggest. They also are on-site all the time and are rarely 100% productive. Chief engineers may find that a few hours of outside help allows them to cover all the bases with less management burden than a full-time staff requires.

Another area that engineers can excel in is property management. Duopoly mergers will almost always bring additional transmitter sites to the enterprise, and there is typically a soon-to-be-vacant studio/office location to be divested. Review the property situation with the GM and learn what the company's plans are. You may find that the financial strategy assumes that unneeded property will be sold or subleased, but no action has yet taken place. This means that somebody has to manage that effort; the GM likely will be thrilled to delegate that task.

As soon as a real estate broker is selected, he will actually do most of the work, but the station must have a primary contact for the agent. Once again, the chief engineer is in an excellent position to handle this. Although it does not require too much time, it broadens your business management scope and allows the GM more time to focus on revenue development, which is in everyone's best interest. Go over leases carefully, and be sure to understand every detail. Don't be afraid to ask the real estate broker to explain anything you do not completely understand. They generally are quite expert in these matters and are an excellent learning resource.

The chief engineer of the acquiring station is in the best position to survive and perhaps benefit from a duopoly, but what about the other folks: the chief of the acquired station and the assistant engineers at both stations? For the displaced technical talent, attitude is again the key to survival. The engineers and technicians who are best at their craft and easiest to work with will get the outside contract work. That option may be the only economic bridge to a future full-time opening somewhere. Nobody wants to deal with a bitter personality under the best of circumstances, and in a duopoly everyone is under pressure. A "victim" mentality can destroy you. The technically inept and emotionally ugly are the easiest people to say goodbye to and forget about.

The technically inept and emotionally ugly are the easiest people to say goodbye to and forget about.

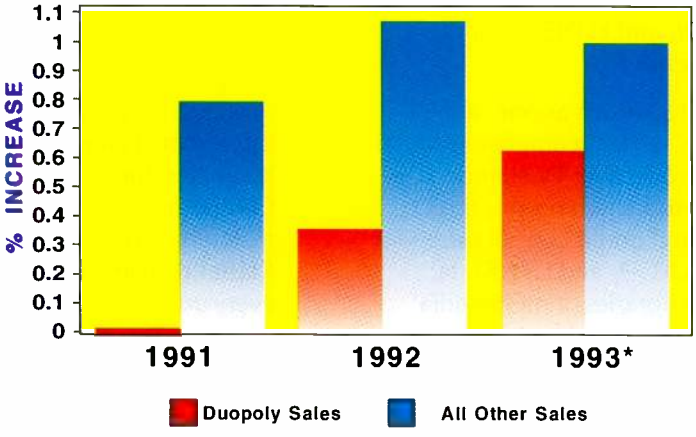

Figure 2. *Duopoly vs. standard station sales activity in the past three years (1991-1993).*

Much of what has been covered here involves asking for, and perhaps competing for, more responsibility. This may be a difficult proposition for an already overburdened technical manager, but it is what it takes to survive and prosper in the post-duopoly environment. Most industries are moving to streamlined management teams, and broadcasting is no exception. Multifaceted business generalists with a technical or marketing specialty will be in great demand. Is it all worth it? Well, in this age of defense cutbacks and uncertain manufacturing growth, radio broadcasting is still one of the most stable businesses. The industry has endured a painful down cycle. Technical managers who are able to adapt and expand their horizons will be well-positioned to improve their status and earnings as industry momentum builds. For many, the duopoly era represents a unique window of opportunity. ■

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Planning for an HDTV future

It's not too early to start your station's HDTV conversion process.

By William R. Ellis

The Bottom Line

Recent estimates place the cost of converting a TV station to HDTV at more than a million dollars, and that is just for pass-through operation. Raising this kind of capital is a frightful thought to station owners. Meanwhile, the station's NTSC transmission chain will continue to require improvement and replacement that will serve it for at least another decade. Careful planning and purchasing can allow many of these current improvements to buy down eventual HDTV conversion costs.

$

Many broadcasters are considering the upcoming conversion to HDTV and wondering where the money is going to come from to convert their stations to this important new technology.

The FCC has given stations a minimum of six years to plan for this conversion — three years to apply plus three years to construct and place the HDTV facility into operation. (As currently defined, such operation requires only network pass-through capability.) The 6-year clock will start when the FCC finalizes standards for HDTV, which is now expected in late 1993 or early 1994.

Whether HDTV comes to your station six or seven years from now is not important. What is important is that HDTV is in your future, and if you do not start planning today, you most assuredly will become a victim of it tomorrow.

Precedents

The most recent model for a new technology that was adopted by most TV stations is MTS stereo audio. Here is an example of how proper planning minimized the cost impact of that transition at one station.

In 1983, the engineering department of KOZK-TV, Springfield, MO, put together a proposal to convert to MTS stereo, at a cost of more than $70,000. In 1985, a revision of the same proposal showed a cost of approximately $40,000. In 1989, when the station finally implemented stereo operation, the conversion cost was only $4,290.

This significant cost reduction can be largely attributed to proper planning. Between 1983 and 1989 every piece of equipment that went into the audio chain was stereo capable.

Replacement cycles

Today, there are still many uncertainties about HDTV. For example, no transmission standard has been established, and channel allocations are still in draft form. Furthermore, these new channels are only allocated to *markets*, not matched to existing stations. Nevertheless, some conversion planning can be done at stations now, and any new equipment purchased in the meantime must be examined to assure its HDTV compatibility.

Again, KOZK-TV provides an example. KOZK's antenna needed replacement, so the station arranged with an antenna manufacturer to supply a dual-channel, tangentially fired panel antenna, which allows multiplexed operation of the present NTSC channel with an eventual second (HDTV) channel. Although the panel antenna is a good wideband radiator, it could not be designed to transmit all five HDTV channels allocated to the Springfield market, plus KOZK's current NTSC operation on Channel 21. The station made an educated guess at its HDTV channel by process of elimination. Only two of the five HDTV channels were compatible with the station's present lengths

Continued on page 86

Ellis is vice president for engineering at KOZK-TV/KOZJ-TV, Springfield/Joplin, MO.

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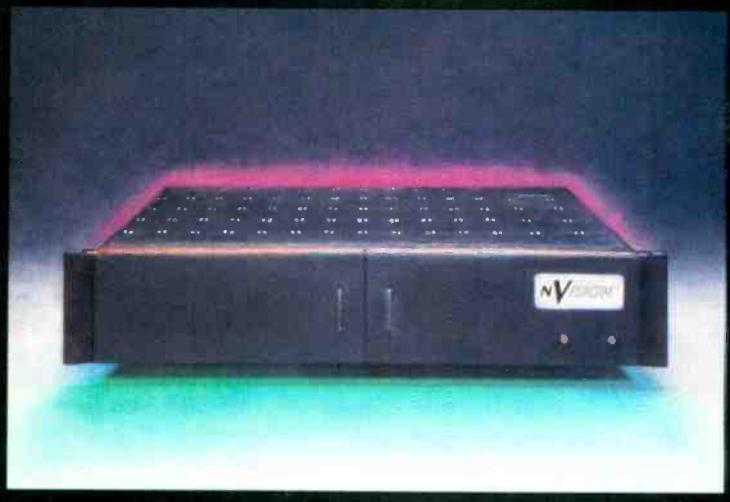

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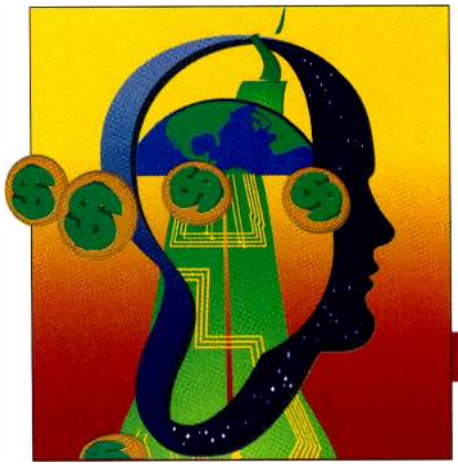

Broadcast, cable and production salaries move upward.

By Brad Dick, editor

The Bottom Line

In today's competitive environment, there is no room for wasted effort — or money. The same can be said about salaries. Good engineering and operations talent costs money, sometimes a lot of money. Even so, the successful (and profitable) facilities recognize that an investment in good people always pays off. Nevertheless, the right information will help managers better understand the salaries being paid for broadcast, cable and production personnel. Armed with this information, you will be better able to retain those people who are critical to your profitable bottom line.

Once again, it is time to take an in-depth look at that most personal of issues — salaries. For many, there is the ever-present feeling that we are not earning as much as the other guy. Often, the issue of salaries is much more than a curiosity; in some cases, it is a matter of survival.

There are two ways to know whether your current salary is competitive. First, try to get a different job. If other companies offer you more, then your current salary is probably too low. Armed with the information contained here, you will be in a better position to negotiate a better deal with your current employer. If, upon making a few calls, you find that your package is better than similar positions, at least you will know enough to keep quiet.

The second — and much more accurate — way to compare salaries is through detailed research. Such a process is time-consuming and expensive. Fortunately, *Broadcast Engineering* magazine does the work for you. The results of our efforts are contained in the annual salary survey. Enough of the preliminaries; it is time to get down to the important stuff.

Cable and post-production salaries

This year, in addition to the comprehensive analysis of broadcast salaries, new data is provided for our *non-broadcast* readers. In addition to the traditional broadcast salary results, the same complete data is provided for our cable and post-production readers.

This year's survey continues a practice begun last year of reporting salaries by specific job title. Engineering salaries are divided into three reports by job title: engineering management, chief engineers and staff engineers. These categories make it easy and accurate to compare your salary against those in similar positions. Now for this year's results:

Tables explained

The survey results are summarized in eight tables. Detailed information appears in these tables about each position, by major category, job title, industry and, for broadcast, market size.

Table 1 provides a median value profile of reader responses from all categories. For instance, the executive management category includes titles for TV, cable and production facility managers. This category includes such titles as CEO, president, owner, general manager, station director and VP/general manager. For comparison, radio responses are not included in this table. See the radio-specific tables for comparative data.

Engineering management

The median estimated salary for engineering managers in television is $58,333. Radio engineering managers earn approximately $20,000 less. The top 50 market TV engineering managers' median salary was $68,333. (See Table 2.)

Radio salaries, not surprising, are lower than comparative position TV salaries. Measured over all markets, the median radio salary is $39,167. The top 50 market salary here is almost $20,000 higher at $57,500. The median broadcast engineer-

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TABLE 1. MEDIAN VALUES FOR ALL CATEGORIES

CATEGORY	EXECUTIVE MANAGEMENT			BROADCAST ENGINEERS		NON-BROADCAST ENGINEERS		STAFF ENGINEERS			OPERATIONS		
	Broadcast	Cable	Production	VP/Dir.	CE	Cable	Production	Broadcast	Cable	Production	Broadcast	Cable	Production
Salary	$56,667	$47,500	$58,333	$39,571	$34,931	$39,999	$46,250	$34,625	$34,999	$36,250	$33,542	$30,556	$36,818
Received increase	48.4%	66.7%	42.1%	76.9%	74.4%	84.4%	63.4%	74.3%	85.2%	63.6%	72.5%	80.4%	70.9%
Amount of increase	4.3%	5.0%	10.0%	4.0%	4.0%	5.0%	5.0%	3.5%	5.0%	5.0%	4.0%	5.0%	5.0%
Years in job	6	5	8	5	7	4	7	10	4	4.5	5	4	4.8
Years in industry	20	15	15	25	20	12	20	18	9.5	10	14.8	10	13
Free-lance	21.%	51.5%	65.8%	23.1%	37.8%	48.9%	61.0%	40.7%	38.9%	59.1%	44.4%	53.6%	54.5%
College graduate	70.3%	48.5%	57.9%	46.1%	26.7%	40.0%	53.6%	24.5%	48.2%	38.6%	69.8%	60.7%	78.2%
Age, years	48	42	43	48	45	38	44	42	36	36	39	34	38

ing management salary in the below top 50 market salary is a little more than $32,000.

Chief engineers

For television, chief engineers received a 1.1% increase in salary, bringing it to $39,571. As expected, this is somewhat dependent upon the market size. Top 50 market chief engineers saw a 2% increase, bringing their salaries to $51,000. The below top 50 market chief engineer salary is now $32,500.

Radio chief engineers saw higher percentage increases, but the base salary

TABLE 2. BROADCAST ENGINEERING MANAGEMENT SALARIES

BASE = All RESPONDENTS	TOTAL TV	TV TOP 50	TV BELOW TOP	RADIO TOTAL	RADIO TOP 50	RADIO BELOW TOP
Less than $15,000	0.0%	0.0%	0.0%	13.6%	9.7%	17.1%
$15,000 to $24,999	0.0%	0.0%	0.0%	10.6%	3.2%	17.1%
$25,000 to $34,999	0.0%	0.0%	0.0%	18.2%	12.9%	22.9%
$35,000 to $49,000	30.8%	13.0%	56.3%	24.2%	9.7%	37.1%
$50,000 to $74,000	46.2%	47.8%	43.8%	21.2%	38.7%	5.7%
$75,000 or more	23.1%	39.1%	0.0%	12.1%	25.8%	0.0%
Estimated median	$58,333	$68,333	NA	$39,167	$57,500	$32,500

also is lower than for television. Measured over all markets, radio chiefs saw a 5.8% increase, bringing their salary to $31,333. Top 50 market engineers have much higher salaries. They saw a 4.3% increase, bringing their salaries to $43,333. The below top 50 market chief engineer salary is $25,595. (See Table 3.)

Staff engineers

Broadcast engineering staff salaries are summarized in Table 4. TV staff engineering positions reported healthy gains. With a 12.1% increase, that salary moved from $30,893 to almost $35,000. The top 50 market staff engineering salary rose 4.8% to $42,917.

Measured over all markets, radio staff engineering salaries rose less than 1%, from $22,727 to $22,941. The government's retroactive tax increase will more than eat up this small difference.

Operator salaries

Measured over all markets, TV operator salaries rose nicely by 12.2% to $33,542. Salaries in the top 50 markets grew by 3.7% to $42,000.

Over all markets, radio operators salaries grew by the same percentage as for television, 12.2%. The median salary increased from $22,273 to $24,999. See Table 5 for the results for operator salaries.

Cable and production results

For the first time, the *BE* salary survey includes detailed information on salaries paid in cable and production facilities. (See Table 7.)

Cable executives earn approximately $4,000 more than their production house counterparts. However, they also earn approximately $8,000 less than their counterparts in television.

Note that VP/director of engineering and chief engineers have been combined into one category for the cable and production categories. These jobs are separated in the broadcast tables.

Across the board, production facility salaries are higher than those paid in cable installations. Cable engineering managers earned a little more than CEs in television, but almost $20,000 less than a TV vice president of engineering and approximately $6,000 less than those in production.

When it comes to staff engineering positions, production houses pay the most. There, they earn 3.5% more than cable staff engineers and 4.6% more than their counterparts in broadcast.

The SBE difference

The SBE certification difference continues to be evident. See Table 8. Over all markets and all engineering positions, SBE-certified engineers earn almost $5,000 (14.5%) more than their non-certified counterparts.

You can check the percentage differences as I did, but the difference is not small change. Certified engineering salaries are from 7% to 26% higher than non-certified salaries measured over all markets and positions. Those differences are something to consider when your local SBE chapter announces certification exams.

Where to now?

This year's responses to the statement "Please comment on the trends, problems, opportunities in the broadcast, cable and production industries brought hundreds of replies.

In years past, the tone in the responses ranged from angry to unprintable. Traditionally, the FCC was blamed for everything from competition to defective radios. It was often stated much like this: "The industry is going to hell in a hand basket."

Even with the premise that it is easier to complain than look for opportunity, the overall slant of comments about the ind-

TABLE 3. BROADCAST CHIEF ENGINEER SALARIES

BASE = All RESPONDENTS	TOTAL TV	TV TOP 50	TV BELOW TOP	RADIO TOTAL	RADIO TOP 50	RADIO BELOW TOP
Less than $15,000	0.6%	2.2%	0.0%	11.7%	2.5%	18.3%
$15,000 to $24,999	5.8%	2.2%	7.1%	21.9%	11.0%	29.7%
$25,000 to $34,999	25.0%	8.7%	31.9%	24.7%	14.7%	31.9%
$35,000 to $49,000	42.4%	34.8%	45.2%	27.8%	41.7%	17.9%
$50,000 to $74,000	25.6%	50.0%	16.7%	11.2%	23.9%	2.2%
$75,000 or more	0.6%	2.2%	0.0%	2.6%	6.1%	0.0%
Estimated median	$39,571	$51,000	$37,679	$31,333	$43,333	$25,595

TABLE 4 BROADCAST STAFF ENGINEER SALARIES

BASE = All RESPONDENTS	TOTAL TV	TV TOP 50	TV BELOW TOP	RADIO TOTAL	RADIO TOP 50	RADIO BELOW TOP
Less than $15,000	2.9%	1.6%	4.3%	23.2%	14.9%	32.8%
$15,000 to $24,999	17.4%	4.8%	31.0%	32.8%	32.8%	32.8%
$25,000 to $34,999	31.1%	20.8%	42.2%	20.8%	17.9%	24.1%
$35,000 to $49,000	29.0%	36.8%	20.7%	14.4%	20.9%	6.9%
$50,000 to $74,000	15.8%	29.6%	0.9%	8.8%	13.4%	3.4%
$75,000 or more	3.7%	6.4%	0.9%	0.0%	0.0%	0.0%
Estimated median	$34,625	$44,999	$28,542	$22,941	$25,429	$19,167

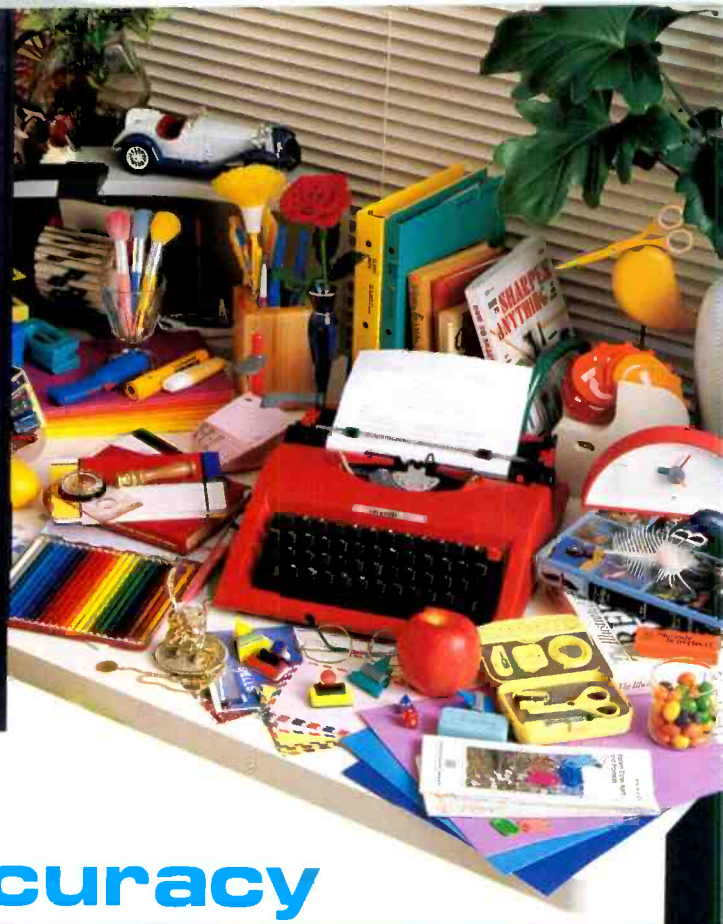
TABLE 5. BROADCAST OPERATOR SALARIES

BASE = All RESPONDENTS	TOTAL TV	TV TOP 50	TV BELOW TOP	RADIO TOTAL	RADIO TOP 50	RADIO BELOW TOP
Less than $15,000	2.8%	1.5%	4.0%	17.8%	9.5%	23.1%
$15,000 to $24,999	19.7%	9.0%	29.3%	32.7%	26.2%	36.9%
$25,000 to $34,999	32.4%	25.4%	38.7%	33.6%	31.0%	35.4%
$35,000 to $49,000	28.9%	34.3%	24.0%	9.3%	16.7%	4.6%
$50,000 to $74,000	12.7%	22.4%	4.0%	4.7%	11.9%	0.0%
$75,000 or more	3.5%	7.5%	0.0%	1.9%	4.8%	0.0%
Estimated median	$33,542	$42,000	$29,063	$24,999	$29,286	$23,235

TABLE 6. BROADCAST EXECUTIVE/GENERAL MANAGEMENT SALARIES

BASE = All RESPONDENTS	TOTAL TV	TV TOP 50	TV BELOW TOP	RADIO TOTAL	RADIO TOP 50	RADIO BELOW TOP
Less than $15,000	4.7%	0.0%	7.5%	7.4%	7.3%	7.4%
$15,000 to $24,999	1.6%	0.0%	2.5%	14.7%	12.2%	15.8%
$25,000 to $34,999	9.4%	12.5%	7.5%	27.2%	17.1%	31.6%
$35,000 to $49,000	29.7%	16.7%	37.5%	27.9%	39.0%	23.2%
$50,000 to $74,000	25.0%	29.2%	22.5%	14.0%	4.9%	17.9%
$75,000 or more	29.7%	41.7%	22.5%	8.8%	19.5%	4.2%
Estimated median	$56,667	$64,999	$48,571	$35,333	$41,000	$33,667

Continued on page 86



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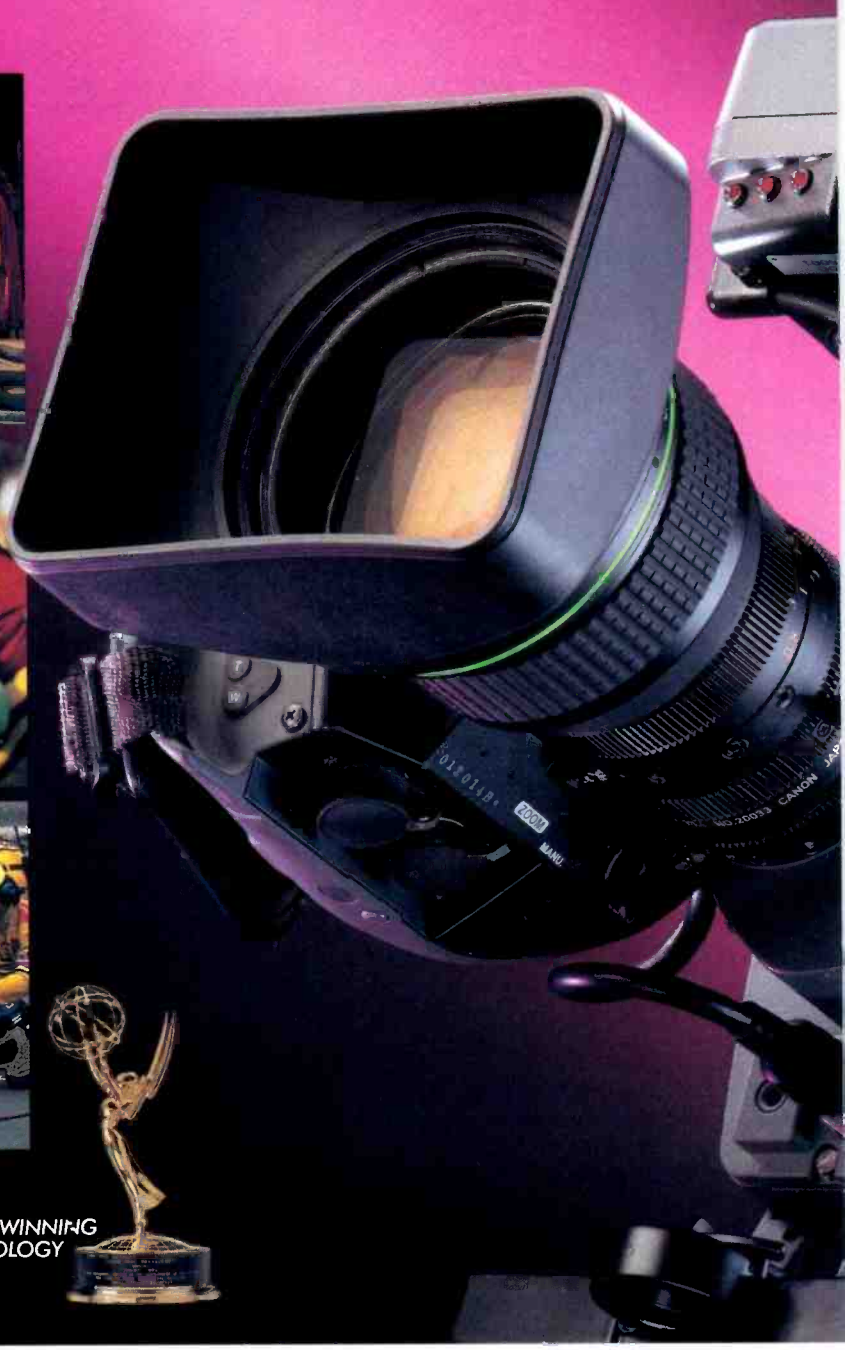

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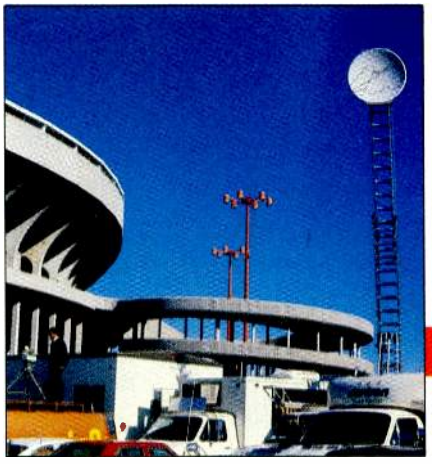

New technology brings dramatic improvement.

By Curtis Chan

The Bottom Line

Camera technology has benefited from the digital revolution. CCDs and DSP technology have reduced operation and maintenance costs. These cost reductions, combined with improved signal quality, have led broadcasters to ask "Can I afford to keep the old?," not "Can I afford new?"

$

ENG camera shoots used to be like planning a family outing. Along with the extra personnel, battery packs, microphones, lines running everywhere and the talent, the camera operator had to worry about camera setup. With the onset of the camcorder or dockable ENG cameras and a little help from the digital age, the 2- to 5-person crews dropped to one camera operator and the talent. Manual camera setups became a thing of the past.

Today's camera technology has something for everyone, whether you are looking at upgrading your EFP/ENG camera or simply wanting to see what is new. The most significant advances in camera technology come in the form of CCD and DSP technology.

CCD and DSP benefits

The benefits of using CCDs and DSP are overwhelming. Today's CCD cameras are a considerable improvement over tubes. CCDs have near-perfect permanent registration and uniform focus from corner to corner. Despite higher sensitivity and better signal-to-noise, CCDs are not susceptible to image burn. Also, advances in DSP and VLSI technology, coupled with recent progress in battery development, have resulted in cameras with better image quality and greater portability and maintainability than their predecessors.

DSP implementation has improved the state-of-the-art in ENG camera technology. Some of DSP's advantages are easier or fully automatic setups, drift-free operation, higher reliability and a centralized control panel. Other advantages include setup memory and recall, simplified camera matching, improved chroma detail and the ability to implement complex algorithms to suppress picture artifacts. Thus, cameras are lighter, smaller, consume less power and attain higher performance levels than their earlier counterparts.

JVC model KY-27.

One major benefit of DSP cameras is the minimal routine maintenance required. By eliminating many conventional components that were affected by temperature, humidity, pollution and vibration, many of the routine adjustments have

Chan is the principal of Chan & Associates, a marketing consulting service for audio, broadcast and post-production, Fullerton, CA.

Author's note: Thanks to BTS, JVC, Sony, Panasonic, Ikegami, Hitachi and Thomson Broadcast for their help with this article.

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been eliminated as well. This results in higher camera stability and reliability in all working conditions.

Fault diagnostics

Even in the most reliable cameras, Murphy's Law prevails. Because of this, camera manufacturers have included fault diagnostics in their arsenal. In the battle against downtime, DSP has made significant inroads in fault diagnostics and preventive maintenance.

Cameras from BTS, Hitachi, Panasonic, Ikegami, Sony, Thomson Broadcast and JVC all have some form of built-in fault diagnostic functions. These functions detect failures in real time and during auto setup modes and provide a character

Sony model BVW-400A with external recorder.

display of the results in the viewfinder screen. In most cases, parameter windows can be accessed by pushing a combination of buttons and subsequently inputting values. The parameters tested include power line voltage, CPU section, and the control values for auto setup.

Fault diagnostics and the requirement to reduce operator error and setup time have resulted in easier setups. DSP makes setup easy for the operator and engineer. Mechanical alignment has been reduced by as much as two-thirds. With DSP, camera setups have become semi-automated.

Camera setups have also become easier with smaller adjustment windows and fewer adjustment variables. Many of these fine-tuning attributes have been burned into silicon to make setups faster. Not only have extensive user setup fields been eliminated, which also reduces cost, but end-users tend to stick with the defaults. Consequently, manufacturers have reduced numerous setup macros into just a few menus.

Today's DSP cameras have three layers of memory for reference, verification and instant recall. The settings are usually stored in EPROM, so readjustment is unnecessary. The camera operator can instantly determine the state of the camera by looking at the alphanumeric readout in the viewfinder or outputting it to a monitor. If any parameters need adjustment, instant changes can be made to memory. The operator can even compare the old setups with the new and make changes accordingly. With the newer cameras, even the factory presets can be changed and users can burn in their own settings.

Auto modes

In addition to the benefits of easier setups, another bonus comes in the form of auto-shooting modes, which are becoming popular in some ENG/EFP camera lines. Several companies have adopted these features. Although the names are different, the function is the same. For example, JVC has several automation features, such as variable scan view, enhanced automatic level control (ALC), full-time auto white and full auto shooting. The enhanced ALC allows continuous automatic shooting in all light levels, without the

BTS model LDK-9D.

16:9 cameras have arrived

By Greg Pine

The world's first deliverable 16:9/4:3 switchable broadcast CCD camera, the LDK-91/69 CCD multirole camera, is now available from BTS. More than 20 of the cameras, featuring frame transfer (FT) technology, have been delivered to customers in Europe. NTSC models will be available in 1994.

The key to its switchability is the new FT-11 CCD sensor, which provides 600,000 elements in 16:9 and 450,000 in 4:3 mode. The sensor uses the same technology as the FT-5SR sensors currently installed in BTS LDK-9 and 9P cameras, and it features advanced technology, including continuous black balance and black shading. Because of FT architecture, the FT-11 sensors have no vertical smear under any operating condition.

A switch on the side of the camera instantly switches from 4:3 to 16:9. When switching modes, the operator does not need to re-establish shots, because shot centering is not affected. Videographers can line up their shots and shoot in both formats if dual-format shooting is required.

One operating parameter common to all 16:9 switchable imaging sensors is that care must be taken in framing wide-angle shots. When switching to 4:3, you will notice that the sensor area used for extrapolating the information is reduced by 25% on both sides of the shot. Videographers preparing for the world of 16:9/4:3 need to consider shot framing set preparation and aspect design. This is required to prevent a 4:3 narrow field at wide angle, and coverage for the left and right wings of 16:9 images. This is a well-known problem to cinematographers who shoot for the big screen but who also must frame their shots for the more confining 4:3 little screen.

The FT-11 chip, developed by BTS engineers and Philips' Eindhoven (Netherlands) Laboratories, benefited from the pioneering research and development that went into the company's high-definition TV CCD sensor. It has 2.2 million active pixels and uses an advanced version of the FT technology.

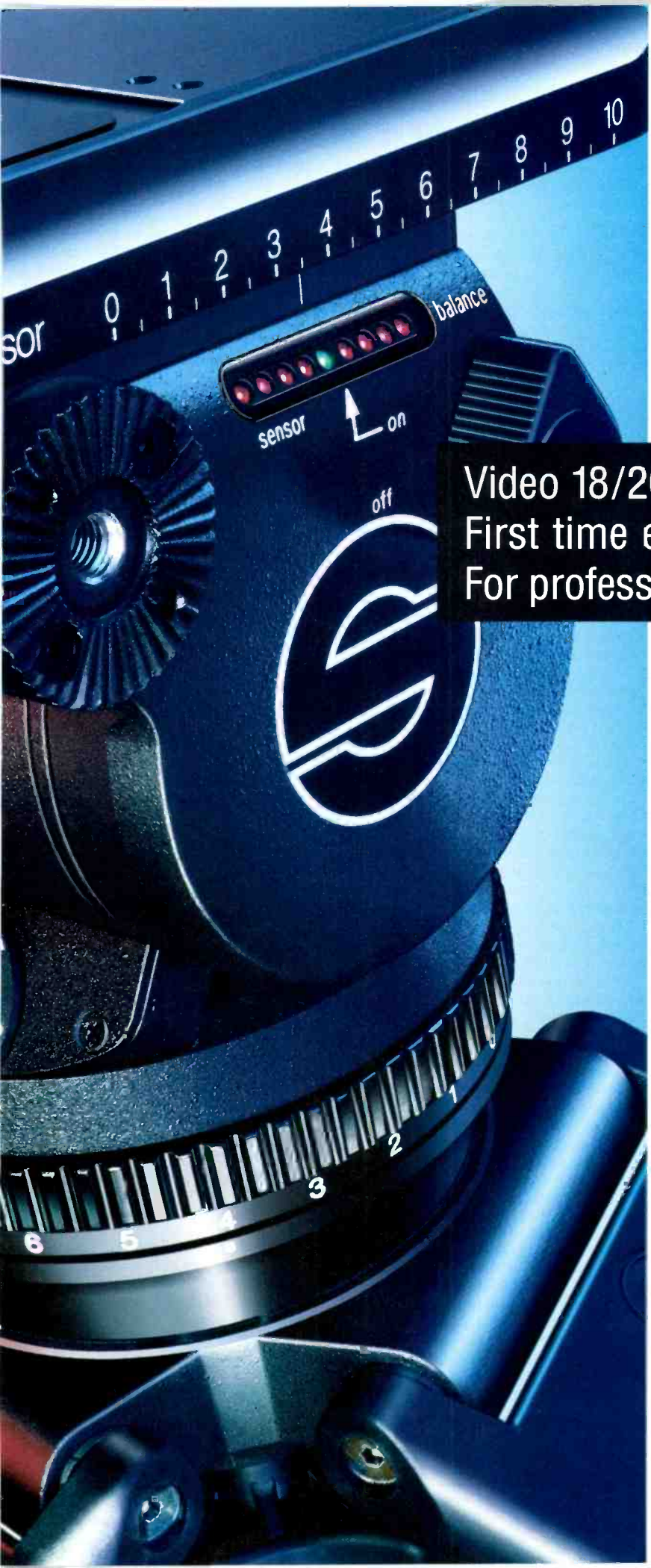
Currently, widescreen video is a reality only in Europe, where there have been regularly scheduled 16:9 transmissions since 1992. U.S. widescreen production is expected to begin in earnest in the next few years, as soon as the FCC's final HDTV ruling is announced.

In Hollywood, major film-produced TV series have been put on notice by studio management to shoot episodes in normal 4:3 aspect ratio, but to create protection shots for re-editing to accommodate possible programming releases in 16:9. No one knows precisely when this might take place, nor what the distribution medium will be. The techniques needed to shoot dual-ratio are extremely important to protect the artistic integrity of the production, yet satisfy the technological advance of 16:9 video.

The problems presented by 16:9 shooting are well-known to transfer houses. The major artistic problem is what to include and what to leave out in resizing from 16:9 to 4:3. Currently, the problem is solved by pan and scan on a telecine. Tomorrow's audiences will probably not have the patience for that crude form of on-the-fly editing.

The availability of these cameras offers a platform from which videographers, directors of photography, producers and directors can create products now for the oncoming widescreen market and from which they can educate themselves and their colleagues about this significant change in their medium.

Pine is business unit manager, cameras, for BTS, Simi Valley, CA.



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need to switch gain setting or insert an ND filter.

In addition to variable gain, the ALC also incorporates an extended electronic iris (EEI) with a continuously variable shutter. This makes it possible for automatic shooting from dark rooms to bright outdoors without any picture interruption or intervention by the camera operator. DSP also has allowed the ALC to have an aperture priority mode, whereby you can select an iris opening and the camera will automatically achieve the desired video level.

Sony has automatic iris control, auto black to maintain balance at high gain levels and white balance with dual white balance memories for each of the four filter wheel positions. Not to be outdone, Hitachi also offers several automatic modes, including auto knee to compress extreme highlights and prevent white clipping, auto iris to control exposure, six auto white balance memories, and iris auto close that closes the lens iris to protect the hiselvicon tube anytime the camera is not in use.

Camera matching is not as much an art form as it is meticulous in its execution.

Cameras are lighter, smaller, consume less power and attain higher performance levels than their earlier counterparts.

With analog cameras, internal tweaks, such as knee and slope, meant adjusting trim pots, which are not the most stable methods available for keeping parameters set. Compound this with the fact that the scene must be viewed and a decision made about which setting is preferred. Adjustments must then be made to the other cameras to match. In an analog camera, when white balance is adjusted, the red and blue gains are automatically adjusted to match the green channel, and its memory setting is kept in the form of a charge on a capacitor or battery. In a DSP camera, settings are burned into PROMs and checked automatically.

Increasing sensitivity

One of the challenges facing camera manufacturers is how to increase the amount of light falling onto each of the photoconductive elements of a CCD. In the case of a single CCD pixel, about one-third is taken up by the light-sensitive area, with the remaining two-thirds taken up by other elements, such as the vertical shift registers, transfer gates, control

Continued on page 62

Choosing the best lens

By Evan Krachman

All too often, when purchasing an ENG camera, the buyer treats the lens as an afterthought. As a result, the camera may be state-of-the-art, but the lens ends up being something less. Following are guidelines for selecting the right lens for an ENG/EFP camera, regardless of the manufacturer.

What you get out of your camera is only as good as what you put into it, and that goes double for the lens. If you purchase a state-of-the-art camera and put a low-cost lens on it, the picture quality will not be much better than what you get from a camera costing thousands of dollars less. If you purchase a moderately priced camera with a good lens, the results will rival those of a much more expensive camera. Do not lose sight of the importance of lens choice.

Do you need broadcast quality? Although that term has been widely used by many manufacturers, the line between broadcast and industrial video equipment is getting thinner each year. More broadcast stations are turning to industrial cameras. Look for these features and characteristics in a broadcast lens:

- built-in high-quality extender
- precise and superquiet servo motor with adjustable zoom speed
- the finest glass elements available
- high and flat MTF (sharpness)
- lightweight, compact, rugged design
- low-light capability (with f-stop of 1.7), critical for field work

Features, accessories and budget

Ask yourself these questions when choosing a lens:

1. *What special features do I need?*

Whatever you do not really need, forget. You can save money by purchasing a lens that does not have built-in focus motors or internal focus. Most lens manufacturers offer models with just the basic features.

2. *What accessories do I need?*

The most important accessory and the best insurance policy is a sky light or UV filter. These filters can prevent damage to the front element, which is the most costly part of the lens to replace. Other useful accessories include close-up filters, wide-angle converters and teleconverters that increase flexibility without breaking the bank.

3. *How much should I budget?*

In the early days of broadcast television, a zoom lens cost $30,000 to $40,000. Today, the cost of a good broadcast lens ranges from $6,000 to $8,000. Depending on the application, plan on spending more for a longer focal length lens or a specialty optic, such as a superwide. Budget at least $6,000 to $8,000 for a normal focal length lens with a built-in extender. Sometimes manufacturers and dealers have demo sales. Keep your eyes peeled and call around to find a good deal.

4. *What about the dual-purpose option?*

As ENG cameras have improved, the appeal for studio applications has increased. Production facilities and smaller TV stations can benefit by using them. ENG cameras can be easily adapted to studio use by adding a 5-inch monitor to the camera and using a rear lens control kit. The control kit provides manual focus control and electronic control over the servo zoom. Most manufacturers sell pistol grips that can be attached to a camera lens. These grips can be used in the studio with simple demand clamp adapters that attach to the tripod pan bar. If you need precise zoom control for studio use, pick the pan bar-type zoom control; it is accurate and smooth. All manufacturers have this option available.

Performance

After the research is done and you have decided on several lenses that can fill the bill, it is time for a test. Be sure to use the same camera to avoid any variables in the results.

Shoot inside and outside. Shoot trees, people, buildings and cars and look for the following:

1. *Color purity.* How close to the real thing does the picture look? Shoot a colorful object, such as a vibrant flower. A good lens will capture accurate colors true to life and also will make the colors pure and vibrant. A lower quality lens will not capture the color as accurately.
2. *Edge sharpness.* Check the edges of the subjects you are shooting and compare sharpness and edge definition.
3. *Lens resolution.* With a lens resolution chart, measure sharpness, using a high-quality monitor to view results.
4. *Look and feel.* Put the camera and lens together and feel the combination. What feels right and looks right will make your decision easier. Pick a lens that is light and compact. Ask friends in the industry about their experiences and call manufacturers to ask about service and loaner lenses if you need one during a repair.

Choosing the right lens is as important as choosing the right camera. Careful analysis of needs vs. budget can easily get you in the ballpark. In the end, real-world performance is important. Check out and compare lenses before the final decision. Then you can ensure getting the best lens for your application.

➡ *For more information on lenses, circle (315) on Reply Card.*

Krachman is a sales specialist for Nikon Electronic Imaging, Melville, NY.

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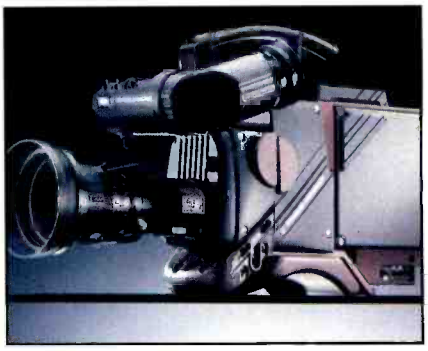
lines and channel stops.

Cameras, such as Hitachi's FP-C10 or the Z-one-B and JVC's KY-27, attempt to resolve this through the use of a microlens. The lens is mounted over each pixel and is used to redirect light into the CCD's photo sensor area to increase sensitivity.

To further improve sensitivity, JVC's LoLux technology combines approximately 24dB of electrical gain with a system for mixing adjacent pixels together, which increases the sensitivity another 6dB without noise. Because noise between adjacent pixels is random, this system further reduces it by another 3dB, allowing shooting down to a level as low as 2 lux for 100 video units with full color reproduction.

Panasonic model WV-F700.



Thomson Broadcast model 1657.

Harpicon and hiselvicon

The battle for higher sensitivity cameras has taken another step forward with the introduction of Hitachi's HARP (high-gain avalanche rushing amorphous photo conductor) and hiselvicon technologies. Ikegami also uses the HARP technology in its line of cameras.

The principle of HARP is different from a conventional CCD. A pair of electric charges generated from a photon is accelerated in a high electric field, which continuously generates new pairs of electric charges from atoms constituting the target. A large amount of signal current can be produced by the avalanche multiplication effect. In addition, because the HARP-based target is mainly composed of materials based on amorphous selenium, it has high resolving power and spectral sensitivity attributes suitable for color imaging. Along with its highlight knee characteristics, a picture with a high dynamic range can be obtained.

Hitachi has added the hiselvicon tube to the growing list of innovations for improving sensitivity. Jointly developed by NHK and Hitachi, the hiselvicon tube uses a patented photoconductive film target. Unlike a conventional tube, this technology relies on the avalanche multiplication effect to produce large amounts of signal current from low levels of incident light. The target is composed of materials similar to those used in HARP technology, resulting in sensitivities approximately 30 times higher than available with a saticon tube. This translates into the ability to produce quality pictures in moonlight with the camera set at f1.8, 1 lux and 18dB of gain dialed in. Furthermore, twist field technology optimizes the twist angles of the tube axis and the deflection electrode to reduce beam size and increase resolution of the corners as well as the image center.

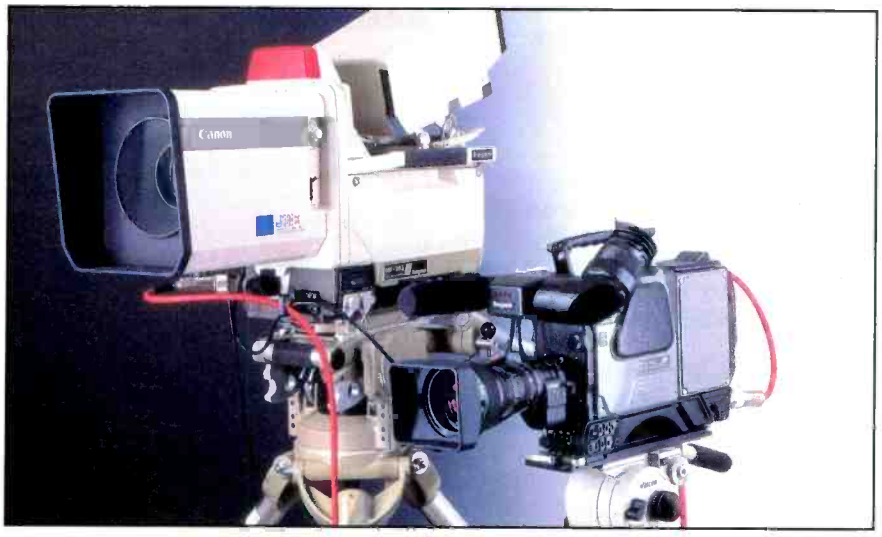
Hyper HAD

The Sony Betacam series uses a Hyper HAD (hole accumulated diode) sensor CCD to get around the sensitivity issue. This new CCD provides sensitivities up to f8.0 at 2,000 lux, thus permit-

ting high-quality pictures to be captured in extremely low light conditions. Vertical smear levels have been reduced to -105dB along with reductions in dark current and fixed pattern noise, ensuring S/N ratios of up to 62dB. This is complemented with DSP to attain up to 30dB of gain and dynamic contrast control for dynamic range of up to 600%.

Other methods

BTS, Ikegami and Panasonic also offer similar solutions using 1/2-inch and 2/3-inch 3-CCD solutions. BTS' LDK series cameras use frame transfer sensors and DSP technology that result in high sensitivity with up to 700 TVL. Ikegami's HK series cameras employ newly developed FIT CCDs with up to 600,000 pixels in its studio line with 900 TVL, 400 vertical TVL and high S/N ratios up to 62dB at f8. Panasonic also came up with impressive specs, using 2/3-inch interline transfer (IT) CCDs. On its 2/3-inch, 400,000 pixel FIT CCD, specs are a modulation factor of 60% at 5MHz (400 TVL vertical, 750 TVL horizontal) and a S/N ratio of 62dB. Using a new securing system, coupled with spectral prisms, provides registration accuracy better than 0.05%. The WV-F700 can produce quality pictures with 4 lux at f1.4 with 24dB of gain.



Ikegami model HK-343 and portable HL-43.

Peltier effect

Another issue that relates to sensitivity and quality of the image is noise and smear. Early on, fixed pattern noise was considered a detriment of CCDs. The increase in sensitivity of the devices generally reduces the dark current characteristics. This, in turn, reduces fixed pattern noise at the output. Recent techniques use thermoelectric cooling for all three channels of the CCD by way of the Peltier effect (absorption of heat at the junction of two unlike metals with current passing) so the fixed pattern noise can be reduced below the detection limit. These thermoelectric cooling devices are installed to maintain temperature along

with a temperature regulator to prevent overcooling and possible condensation.

Electronic shutters

Vertical smear in CCD imaging was another drawback that has been eliminated. The solution is to implement an electronic shutter effect within the CCD structure. Without some type of shutter, charges accumulated by each pixel can change, even as the information is being transferred from the sensing area to the storage area. That change is what causes smear to appear. Electronic shutters with typical ranges from $^1/_{100}$ to $^1/_{2,000}$ of a second enable the operator to obtain sharp, clear pictures with little or no blur even when shooting rapidly moving objects. Newer cameras permit continuous adjustment of the shutter speed in 1H steps to shoot a computer monitor without flicker.

One size fits all

In the wake of modernization, you no longer need to buy a camera for every occasion. With the advancement in DSP and other related technologies, the basic camera platform can "dock" to a variety of tape formats. For instance, several ENG/EFP camera units easily dock to Betacam (SP), MII, Hi8mm, and even S-VHS with the addition of a VTR adapter, which is nothing more than a cosmetic shell. On top of that, there are detachable lenses to fit every occasion, detachable viewfinders, a variety of remote CCUs and the option of going multicore or triax. As an example, Hitachi's Z-one-B/C and FP camera line with adapters can mate to Betacam, MII, Hi8mm and S-VHS. Similarly, JVC's KY-27 also can adapt to S-VHS, Hi8mm and Betacam.

Many of these fine-tuning attributes have been burned into silicon to make setups faster.

Moving forward

DSP and CCD progress have played a significant role in the advancement of camera technology. As we move forward, one of the greatest opportunities for market differentiation for the wide-screen camera will be in local program production, sports coverage, special events and corporate productions. The effect of 16:9 production should not be underestimated. Local widescreen production will involve new approaches to ENG and EFP set designs.

As we move into the era of the all-digital facility, camera technology will continue to improve. At the heart of the advancement will be progress centered on today's core technologies including DSP and CCD developments.

➡ *For more information on ENG/EFP cameras, circle the following numbers on the Reply Card.*

BTS (309)
Hitachi (310)
Ikegami (311)
JVC (308)
Panasonic (312)
Sony (313)
Thomson (314)

■

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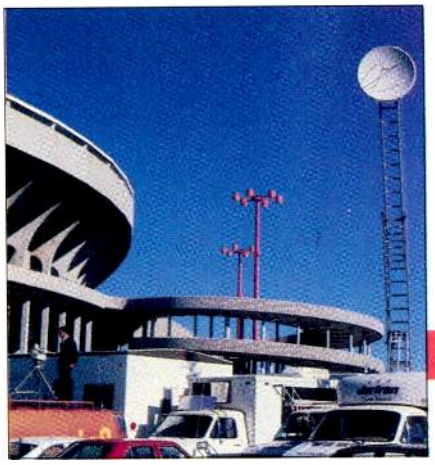
Post-production technology: A perspective



The hardware used in a post-production system has enormous impact on its performance.

By Ken Ellis

The Bottom Line

The processing infrastructure employed by a video production device will have a significant effect on how the system operates. Speed, capacity and quality all are affected. Three basic approaches currently exist: traditional linear systems with stand-alone, "black-box" processors, dedicated random-access devices, and general-purpose (desktop) computers operating with peripheral hardware and video production software. The pros and cons to each approach might not be visible at first glance.

$

Technology is designed to make our life physically easier, yet so often it seems to take revenge by bringing considerable mental anguish. To the concerns over tape formats, compression algorithms, 16:9 widescreen and transmission standards that currently burden broadcast engineers and management is now added the heady prospect of computers in television. After NAB '93, the industry is awash in a sea of marketing buzzwords: multitasking, resolution independence, future-proof technology, open architecture, a cure for the common cold.... Now that the hype has died down, it's worth examining those claims more closely.

The computer as a universal broadcast tool may have sounded attractive to hard-pressed broadcasters. With the prospect of radical change, like the much-heralded advent of high-definition broadcasting, it's easy to look at traditional black-box manufacturers and have little faith in their ability to meet the challenge.

Despite the successful development of dedicated multicapable systems based on random-access digital disk storage since the mid-1980s, traditional broadcast manufacturers have concentrated on new VTR formats and fine-tuning of the linear-architecture technology that goes with them.

Meanwhile, new entrants to the industry continue to press with a third approach; non-linear, computer-based systems, inspired by random-access technology. Such systems are often slow and produce video of less than broadcast quality. In many such systems there is far less flexibility than with true random access. Yet within the confines of off-line shotlisting, it has begun to stir the imagination of broadcasters.

So if we accept that traditional linear "one-black-box-per-function" broadcast technology is too inflexible, and leave dedicated multitasking systems to one side for the moment, is the computer a viable platform to take us into a new era of TV technology? As the restrictions of non-linear appear, computers also present major problems and, like the traditional black box approach, it is the philosophy guiding the technology that provides the source of difficulty.

Ellis is chief operating officer of Quantel, Darien, CT.

Philosophy and performance

Computers are general-purpose systems designed to do nothing specific until software points them in the appropriate direction — a great strength for many business applications, but a fatal weakness in such a specific and demanding field as television, where there is a fast, unrelenting stream of 30 broadcast-quality pictures to process and manipulate every second.

At the desktop end of computing, attempting to compensate with plug-ins and add-ons is an enormous business. But whether the user tries this or simply buys a bigger platform, the basic problem remains unaddressed. Meanwhile, cost and complexity rise. This negates one of the most widely cherished assumptions about computers — that they

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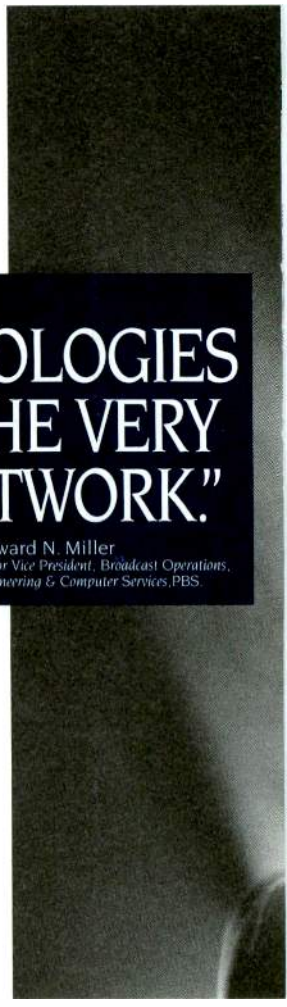
"The video content will be accessed through on-line cart machines utilizing composite digital and an enhanced version of a D-5 component digital tape system. The component digital technology will eventually enable us to record and play back compressed forms of HDTV plus some non-video forms of data.

"When we looked at the alternatives available to us from video manufacturers, it was crucial to understand the direction they were taking—not just the hardware that might meet our current needs. Our decision to select digital composite VTRs was made with reasonable knowledge of where Panasonic was heading with component digital.

"The ability to play back composite digital recordings in the component domain is helpful, to be sure. But our primary interest in a component system is that it be a full bit-rate, 10-bit recording system. That means we can take maximum advantage of the high bit-rate capability of these machines, and consider them for future upgrades to HDTV—as well as for some services that are not video-based at all.

"Currently, we are using some of our D-3 equipment to conduct subjective evaluations of video performance at various compression levels. Using a transparent digital tape system, we introduce no

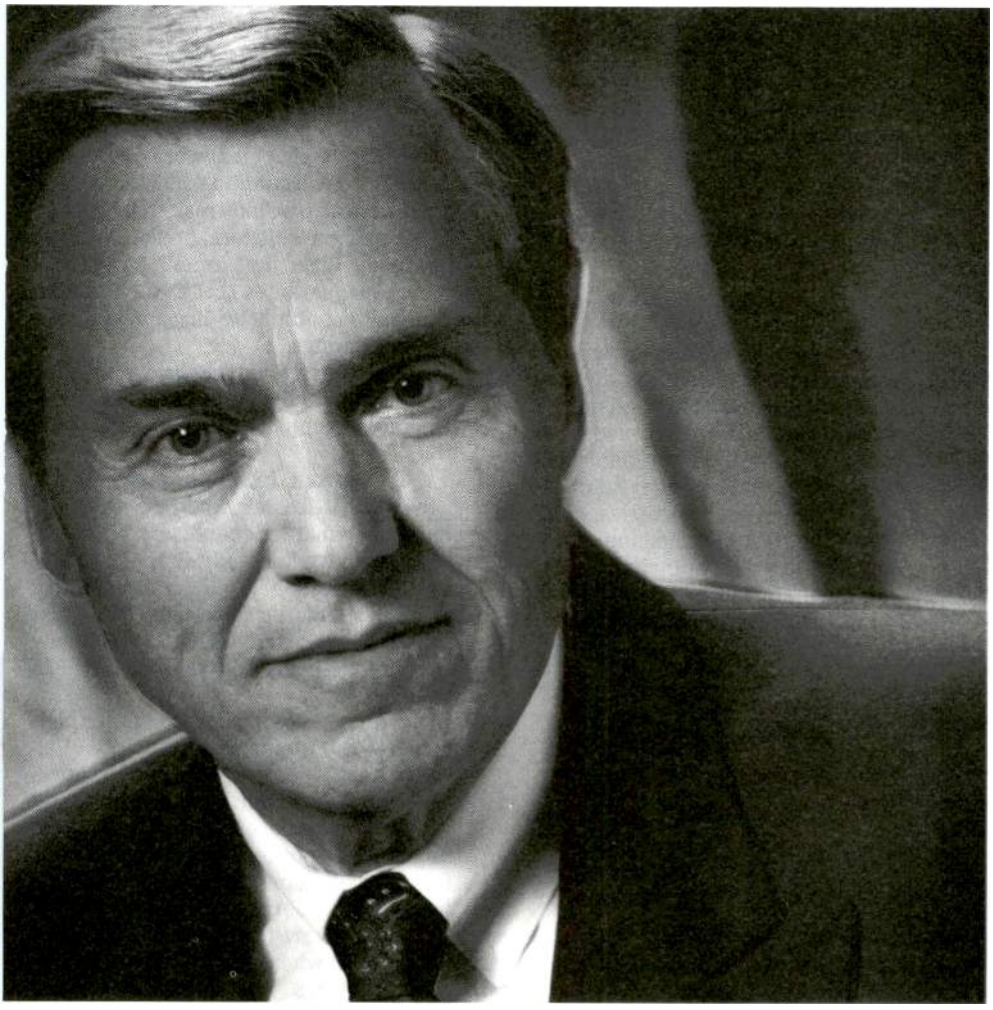


"NEW VIDEO TECHNOLOGIES WILL DETERMINE THE VERY NATURE OF OUR NETWORK."

Howard N. Miller
Senior Vice President, Broadcast Operations, Engineering & Computer Services, PBS.

further degradation in our compression testing; any quality differences are obviously associated with variations in the transmission path, not differences introduced by the recording medium.

"Because of the evolving nature of the television industry, it's unacceptable to have a traditional buyer/seller relationship. Before



we enter into any contract with any company, we emphasize how essential it is for us to collaborate to achieve better results. From our perspective, as new video technologies emerge that will determine the very nature of our network, we must have good working relationships with our equipment suppliers."

Panasonic's strategy offers a simple, combined composite and component digital system that provides all digital solutions for diverse video recording applications through the eventual HDTV era.

Panasonic believes that digital composite and component equipment will continue to co-exist for many years.

We see integrated D-3/D-5 facilities with equipment performing the tasks to which it is best suited.

Howard Miller, Public Broadcasting Service's senior technologist, has been breaking new ground throughout his 35-year engineering career. His current challenge is to fashion computer, video, compression, and transmission technologies into a complete digital signal distribution network for PBS.

It's the industry's visionaries who see a clear path to the future.

Panasonic
Broadcast & Television Systems Company

should not only be able to do more things, but do them more cost-effectively.

The dedicated random-access systems in the middle of this dialogue integrate keying, color correction, audio, true random access storage and multiple channels of digital video effects (DVE). Although these are not inexpensive devices, some similarly priced (or even more expensive), high-end, computer-based packages struggle to handle a single layer of video in commercially acceptable time frames. Broadcasters take for granted the ability to deal with full bandwidth video in real time, but computers don't, and the speed difference becomes more dramatic as the sophistication of your manipulation increases.

Nor is software going to help. No matter how cleverly written, it can never compensate for the lack of focused hardware horsepower. It also can impose performance-sapping restrictions of its own. The need to conform to a general-purpose operating system results in more inefficient performance. UNIX, for example, may be excellent for many applications, but it is approaching 20 years old and was never designed to handle the particular demands of video.

One of the key performance questions for any station engineer is what happens when a system refuses to perform? Costly and compulsory service contracts are becoming a contentious part of the computer experience. This is an understandable precaution when software and peripherals from so many potential sources may need to be investigated to get to the root of a problem.

This brings up an important question: Once a computer fault has been found, who takes ultimate responsibility for correcting the problem? Users may be bounced around between suppliers without anything positive being accomplished. Add to this the potential headaches of networking a still-store system, for example. Station engineers must become systems integrators, faced with the challenging task of combining general-purpose terminals, specialized hardware, off-the-shelf software and custom code, in an attempt to achieve reliability and fast, bottleneck-free access.

Despite the drawbacks, computing philosophy is not going to change. Being a jack of all trades (and master of none) is what sells general-purpose platforms. Concentrating on television would dilute that all-around capability and offer manufacturers inadequate return. Enormous effort has gone into disk research, for example. Years of development have increased capacity and dropped size and weight — all useful features in the computer market. Access times, however, remain far too slow for straightforward broadcast use, let alone the true random

A dedicated post-production system in use at Editel Pty in Australia.

access, intensive post-production work. This is because general-purpose computer applications don't require such sustained speed, so CPUs aren't designed for it. Therefore, no significant demand exists to develop such disk capability. Specialized disk management systems are required to avoid this problem, and these come only from dedicated devices.

Future-proofing

The claimed trade-off for computer-based systems' inefficiency is longevity. Computer advocates stress the potential to add different software and peripherals at any stage and hopefully keep them up-to-date. Clearly, the traditional black-box approach has little to offer here, but anyone who has ever owned a computer knows that talk of remaining on the cutting edge is wildly optimistic.

Many mainframe computer owners found themselves saddled with dinosaurs seemingly overnight with the move to

Is the computer a viable platform to take us into a new era of TV technology?

desktop networks. One of the biggest names in desktop models regularly makes its models obsolete in months, not years. (These words are being written on one.) Workstation producers seem to revel in pointing out to prospective customers that something less expensive and slightly more powerful is just around the corner. At low price levels, this is an acceptable risk, but as workstations become more complex and costly in a bid to overcome their inefficiency, the threat of overnight obsolescence has serious financial implications.

It is a danger that comes with the territory. Change is a constant in computing. If a machine is designed for nothing in particular, there's always the elbow room to make it do nothing in particular a little bit better. A frequent promise seems to be "I know it doesn't do quite what you want, but it will do it very soon." *Caveat emptor* applies.

When improvements do come, there's no guarantee that they'll translate well into the real world of broadcasting. The unfocused nature of computer platforms means that development is measured in abstract terms: More MIPS, better clock speeds and the like. The end-user's concern — Can I make better pictures more effectively? — is not directly addressed.

Software developers are, of necessity, more closely in touch with the needs of the broadcast industry, but they are separate companies, independent of hardware manufacturers, and with their own priorities. If there is a new platform or operating system that seems more suitable or more powerful, there is no guarantee that development work on existing user setups will continue. Black-box manufacturers also would argue that because a specialized software house requires relatively little investment to set up, there's no guarantee that it will be stable enough to continue trading and supporting its offerings.

In short, current future-proof claims for computing should be treated with considerable skepticism.

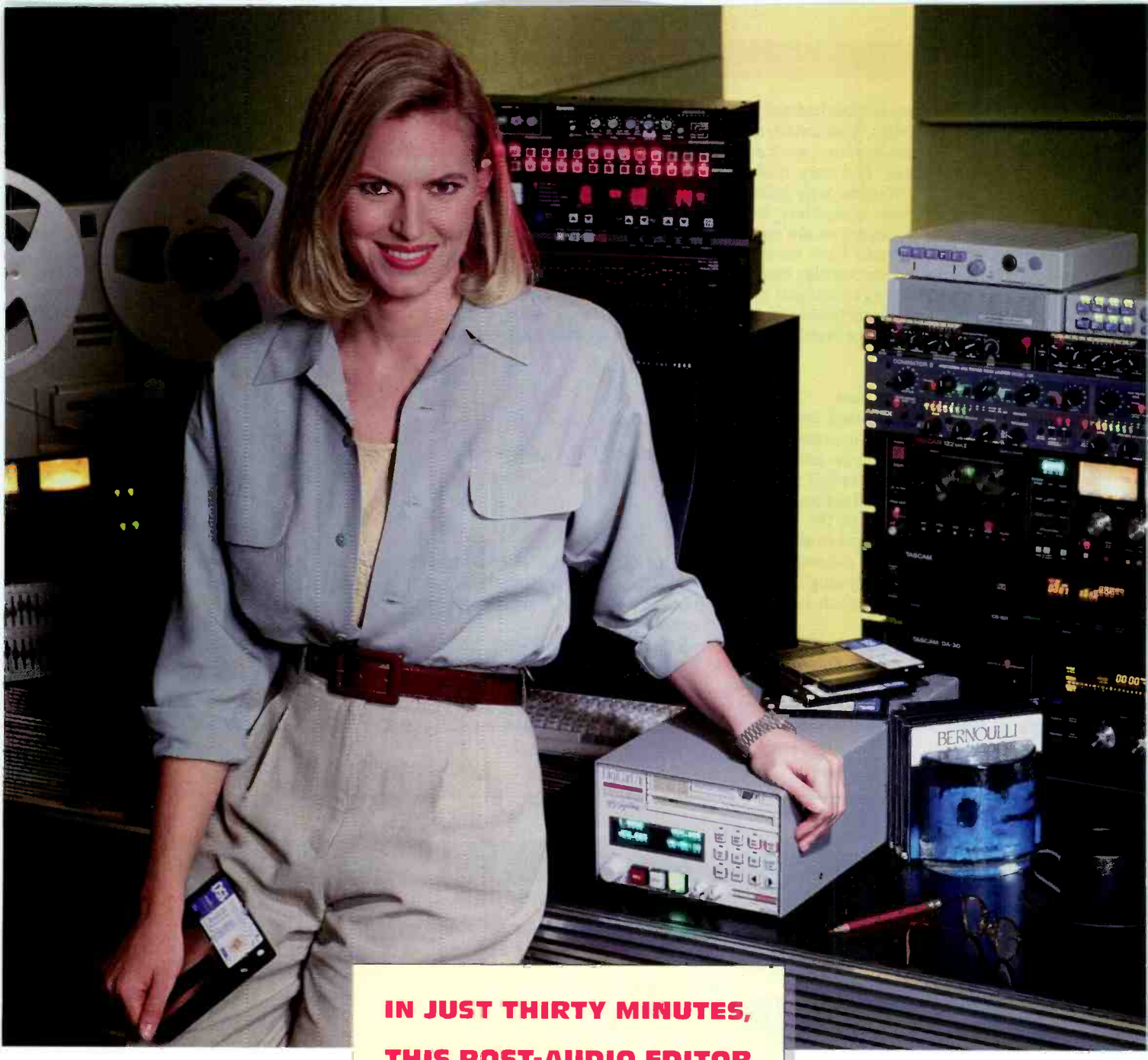
Format independence

Every broadcaster would like the flexibility of format independence. To an extent they have it already. Black-box technology offers 525/625 compatibility through standards conversion, and most CCIR 601 equipment should be relatively simple to software-convert for 525 or 625 widescreen.

One potential appeal of computer platforms is the theoretical capability of altering its file size to handle moving images of any resolution. If the problem of rapid obsolescence can be overlooked, might this not be appropriate technology for a transition period from conventional to high-definition broadcasting?

Computers are inefficient and prone to delays even when processing video resolution pictures. High-definition quadruples the file size, and therefore, the problem. Film magnifies the inefficiency by a factor of more than 16. A computer that barely holds its own in video would virtually grind to a halt when tackling anything more ambitious. Conversely, a system capable of overcoming its own inefficiency at higher resolutions would need to be so colossally powerful that it would make no commercial sense to use it at video resolution. Anything in between wouldn't be particularly usable, or economically viable, for either task.

Nevertheless, computers have deservedly achieved major success and enormous publicity in a number of recent movies. This activity has been primarily



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in computing's long-established niche of 3-D computer graphics, traditionally slow and intensive frame-by-frame work even at video resolution. The only realistic way of getting the job done is by splitting it between numerous computers. Numbers of up to 80 workstations are quoted for the work on *Jurassic Park*, for example. The results are spectacular, but consider the cost, the organizational problems and the overall practicality of splitting work in that way for regular broadcasting operations.

Conclusion

Many of the issues raised here regarding computing in television remain hypothetical. Behind the hype and beyond traditional areas, such as 3-D computer graphics, scheduling and automation, few computers are active in the industry. Longevity, reliability, legal wrangles and, above all, performance conspire to suggest that computing, although different from the black-box approach, is similarly inadequate.

So why the blizzard of computer publicity and debate? Perhaps computers are television's equivalent of the protest vote: A statement of dissatisfaction at the failure of black-box manufacturers to address the developing needs of the industry. Yet they may not be the answer to the problem. Perhaps they present a Utopian vision that some would prefer not to look too closely and spoil the illusion.

In any event, it could be suggested that the ideal broadcast system lies squarely between the two camps, though neither can reach it: One is committed to a kind of technology that only reflects how our industry used to be, and the other is built on technology that was never appropriate for the demands of television in the first place. Here we return to the third option; dedicated multitasking, random-access systems.

Current future-proof claims for computing should be treated with considerable skepticism.

In a changing industry, multitasking systems, not black boxes, are clearly the way ahead, but they have to perform each task with speed, quality and efficiency. That is best performed on dedicated hardware, not general-purpose computers. Systems must harness their processing power effectively, integrating functions seamlessly and presenting them in such a way that the user can extract the best performance from a device. This also requires flexible and powerful software. Finally, systems must have long life and a clear upgrade path without the waste of throwing away existing computer equipment or the inefficiency of bolting on extra black boxes as an afterthought. This implies a vertical integration of hardware and software, carefully controlled and developed from a single source.

Broadcasters and post houses now have the choice of three distinct approaches for every aspect of teleproduction. Time will tell which proves appropriate.

➡ *For more information on post-production systems, circle (318) on Reply Card. Also see "Production Systems Integrated" p. 14 of the BE Buyers Guide*

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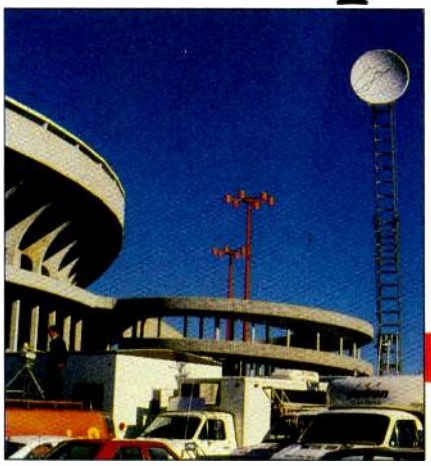
Using wireless microphones



Multichannel wireless microphone systems present some interesting RF challenges.

By Joe Ciaudelli

The Bottom Line

The use of wireless microphones has grown significantly in the past few years, thanks to advances in technology and a trend toward greater mobility in production. The number of wireless mics in use at a given event also has increased. Although six channels constituted a large system in the past, 10 to 30 channels are common today. Systems of this magnitude present an engineering challenge. Careful planning, installation, operation and maintenance are required.

When designing a multichannel wireless microphone system, you'll likely encounter widely varying RF signal levels, intermodulation, frequency spacing problems and spurious transmissions.

Varying RF signal strength occurs mainly because of shadowing, absorption and multipath propagation. Multipath can cause dropouts to occur even at close range to the receiver, especially in indoor applications. Signal-strength variation inside a building can be 40dB or more. RF energy also can be absorbed by nonmetallic objects and result in low field strength. The human body absorbs RF energy quite well, so wireless microphone transmit antennas must be placed correctly to minimize this effect. To minimize shadowing, the receive antenna should be placed at least one wavelength away from any large or metallic object.

These problems are addressed by a diversity receiver. A diversity system is recommended even if only one microphone is in operation. Large multichannel systems are *only* possible with diversity operation. (See "Diversity Reception for Wireless Microphones," January 1993.)

Regarding the choice of UHF (450-952MHz) or VHF (165-216MHz) systems, as a general rule for fixed installations, you'll notice that carefully chosen VHF frequencies are the most economical. For touring work or in an environment already saturated with VHF wireless equipment, you should consider UHF.

Ciaudelli is product manager for professional products at Sennheiser Electronic Corporation, Old Lyme, CT.

Intermodulation

As with any RF transmission system, intermodulation (IM) between wireless microphone systems occurs within nonlinear active components in the receiver or RF amplifier when exposed to strong RF input signals. In multimicrophone wireless systems, intermodulation products grow quickly. The frequency of a new channel should be carefully selected to avoid intermodulation products of the other signals. (See also "2A-B and Other Intermodulation Nightmares," May 1993.)

Wireless microphone systems can be designed to minimize intermodulation. IM rejection is a measure of the RF input threshold before intermodulation occurs. For a well-designed receiver, this specification will be 60dB or greater. The highest quality multichannel receivers feature IM rejection of 80dB.

Another important design feature is *selective filtering*. Filter bandwidth should be as narrow as possible. This can be achieved through the use of helical filters in the first stage of the receiver. Figure 1 shows the response of a third-order helical filter in a modern VHF wireless microphone receiver. Signals 5MHz away from the desired frequency are attenuated by at least 20dB.

Present technology does not allow cost-effective implementation of highly tunable receivers in large multimicrophone systems. The filter bandwidth on this type of receiver has to be wide enough to accept all of the frequencies to which it can be tuned. This wide window is an invitation for unwanted signals to get

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into the receiver and cause intermodulation. A tunable receiver is acceptable as long as the difference between the highest and lowest frequency within its range is only 2MHz or 3MHz, so that helical filters can still be employed. For this reason, a receiver that is fully agile across the entire VHF or UHF wireless microphone spectrum is not available. Therefore, covering the entire band requires several separate receivers. (See Figure 2.)

Despite these precautions, frequency coordination between microphones in the system is still required. Only the third- and fifth-order intermodulation products need to be considered with most equipment. (Others are either out-of-band or too weak to cause problems.) High-quality receivers with IM rejection of 60dB or greater allow only the third-order IM to be considered.

The spectral distance between an IM product and a carrier frequency should be kept to a maximum. A theoretical minimum safe distance can be determined by considering two criteria. First, an intermodulation product should not enter the IF bandwidth of the receiver. Second, the bandwidth of a third-order IM product is three times the bandwidth of the carriers generating it. If full modulation is assumed, then that IM product's bandwidth is three times the maximum frequency deviation of the carriers. Therefore, the minimum safe distance for third-order IM products is three times the maximum carrier deviation plus half the IF bandwidth of the receiver. (Correspondingly, if fifth-order IM products must be considered, they should be assumed to have a bandwidth of five times the maximum deviation of the transmitters.)

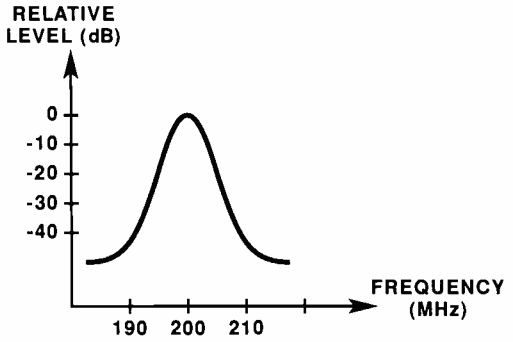

Figure 1. Response curve of a 3-stage helical filter in the first stage of a wireless microphone receiver.

Nevertheless, this is a theoretical ideal. Often, full modulation of the carriers is not achieved, producing IM products of lower bandwidths. The practical minimum safe spacing then becomes a subject of frequent debate. It is generally recommended that third-order IM products fall at least 250kHz from any carrier frequency.

Intermodulation products are not only generated in receivers, but transmit antennas also tend to pick up other signals. When these signals pass in a reverse fashion across the output filter of the transmitter, they are fed to a non-linear component: the output stage transistor. Inverse-square law applies, such that these IM products will increase dramatically as two transmitters approach each other. In practice, bodypack transmitters are less problematic than hand-held wireless microphones because the antennas are typically kept further apart and held close to the body. The situation changes dramatically if several wireless microphones (especially hand-helds) are placed side by side. A highly selective output stage in the transmitter should be incorporated to minimize these problems.

Coordinating multimic systems

Frequency coordination can be extremely complex, and it typically requires an appropriate computer program. For a 6-mic system, 90 third-order IM products have to be considered. For 20 mics, this figure increases to 3,800. The necessary RF bandwidth for linear operation rises exponentially as the number of channels is increased. This function grows even faster if fifth-order products must be considered.

External interference sources, such as TV transmitters, taxi services, police services and digital equipment, also have to be considered. Fortunately, the screening effect of buildings is rather high (30dB to 40dB for VHF carriers). A significant problem can occur, however, when poorly screened digital equipment is working in the same room. These wideband interfering sources can reach all VHF wireless microphone channels. The only real solution to this problem is to replace the poorly screened piece of equipment with a better one.

Channel spacing

In order to have a well-defined channel, operating without crosstalk and with an intermodulation safety gap, a minimum spacing of 300kHz between carrier frequencies should be employed. A wider spacing is preferable, because many receivers often exhibit desensitized input stages in the presence of closely spaced signals. However, caution should be exercised when linking receivers with widely spaced frequencies to a common set of antennas. All active frequencies must be within the bandwidth of the antenna system.

The bandwidth of a third-order IM product is three times the bandwidth of the carriers generating it.

Receivers contain one or two local oscillators (LO) for single or double IF conversion. In most VHF systems, the LO is 10.7MHz below the carrier. A small part of the LO's energy could be radiated via the antenna or via the housing. Although this energy is small, it is not negligible. When the receivers are connected to each other through the antenna system, this potentially interfering frequency will find access to the multiple input stages. This must be considered in the computer program. The difference between two carriers should never be equal to (or even close to) the LO frequency. A safety margin of 200kHz is recommended.

Another related frequency, the *image frequency*, at double the LO frequency, also should be avoided. To minimize this problem, high-quality receivers apply a double screening. Inside an all-metal housing, hermetically sealed metal boxes contain the complete RF circuitry. This technique can reduce spurious emission by 20dB.

Antennas

Two types of antennas are used in wireless microphone equipment: the long, straight whip antenna and the coiled "rubber duck" antenna. The duck antenna is used on VHF transmitters to minimize the length of a whip antenna necessary for ¼-wave tuning in the VHF range. Its tuning also is more critical than a whip.

The tuning is further influenced by close proximity to conductors. On bodypack transmitters, the duck antenna tends to be stiff and rest against the user's body.

Because the human body is largely composed of water and salt, it's a good conductor and could easily detune the duck antenna. Therefore, a whip antenna is recommended for bodypack transmitters. If a duck antenna must be used, bend it slightly so it does not rest against the body. UHF antennas are short enough to allow only whip antennas to be used.

Hand-held transmitters are often designed with their antenna incorporated on a circuit board inside the outer housing. This design is not efficient because the user's hand will absorb some of the radiated energy. Also, it cannot be implemented with a metal housing.

A good *receiver* antenna system also is extremely important. Several types of receiver antennas are available in omnidirectional and directional designs. Omni antennas are more common, but directional antennas are more attractive in areas that are saturated with RF equipment. One example is a theme park, especially if it has outdoor theaters. By carefully aiming these antennas, you can provide RF pickup of the intended stage and reject the potentially interfering signals from other venues at the site.

Directional antennas are larger than omnis and need to be distanced farther from potentially blocking objects. They also cannot be disassembled and neatly packed like omnidirectional antennas. These disadvantages are more pronounced with VHF systems because of their larger size.

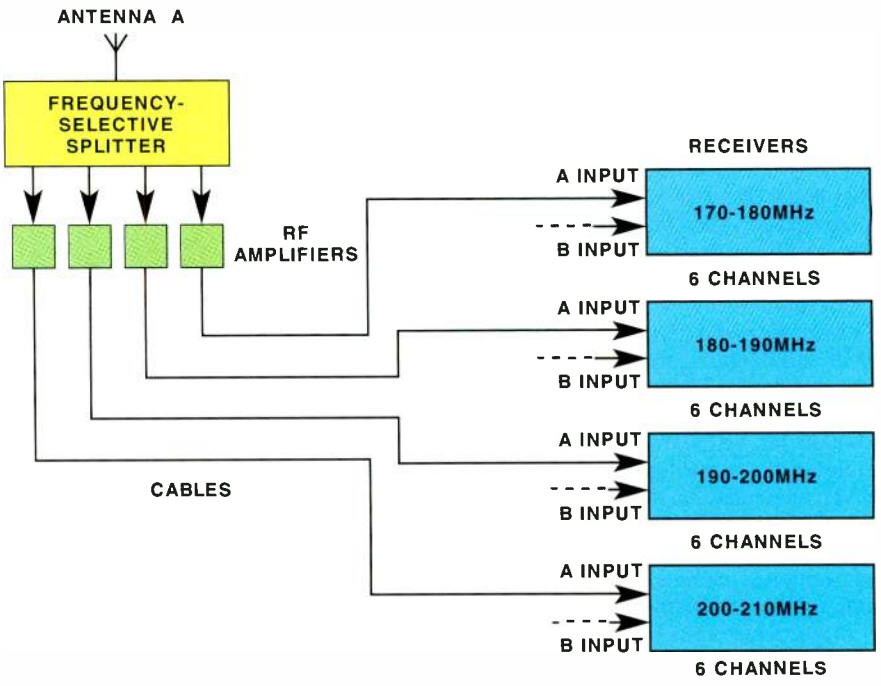

Figure 2. *A multichannel wireless microphone system, showing frequency-selective splitter and multiple narrowband receivers. Only "A" side of diversity antenna system is shown. Another identical antenna, splitter and RF amplifier system feeds "B" input of each receiver.*

Most omni receive antennas are simple 1/4-wave monopoles attached directly to the receiver chassis. A more sophisticated approach uses a remote, ground-plane antenna connected to the receiver by coaxial cable. The ground plane protects the main radial from potentially interfering deflected waves bouncing off the closest large reflective surface, which is usually the floor. If the antenna is mounted from the ceiling, however, it should be turned upside down because the ceiling is more of threat than the floor.

To prevent the receivers from getting unacceptably high input levels, do not place the receiving antenna too close to the transmitters. Receive antennas should generally be positioned at a minimum distance of six meters (20 feet) from the transmitters.

Splitter systems

Several receivers operating within the same frequency range often share one set of antennas. RF splitters are used for this purpose, but these and their associated cabling must not create excessive signal loss. UHF frequencies are attenuated more than VHF frequencies over a given cable length. Where long antenna cables are needed, low-loss cable or an in-line RF amplifier (or both) is recommended. An RF amplification of 10dB is usually sufficient. The goal is only to compensate for losses, not to provide any net gain. Higher amplification invites stray signals to be picked up and can aggravate intermodulation. The amplifier should be positioned near the antenna to obtain the best signal-to-noise ratio. Active splitters also can help in large systems.

For additional security from interference, selective filters should be used in the splitter system. If an RF bandwidth of 40MHz is available for a 24-microphone system, the bandwidth can be divided into four subgroups of 10MHz, thereby splitting the 24 microphone channels into four groups of six. (See Figure 2.) This minimizes coordination problems that involve the entire system, and allows only those within each subgroup to be considered.

Large multichannel wireless microphone systems demand excellent planning, especially in the initial phase, along with strong technical support. If proper attention is paid to the items discussed previously, perfect operation of a system can be guaranteed, even under difficult conditions.

➡ *For more information on wireless microphones, circle (316) on Reply Card. Also see "Microphone Equipment, Wireless," p. 7 of the BE Buyers Guide.*

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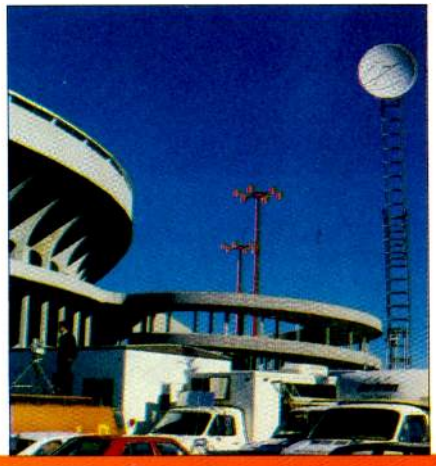


The changes are many in the remote production world, with more to come.

By Steve Kirsch

The Bottom Line

Radio remote broadcasting has undergone such sweeping changes in the past five years, that equipment and signal delivery methods of five years ago more closely resembled those from 1963 than 1993. Some of the most dramatic differences have occurred with advances in digital audio recording, processing and transmission. Within the analog domain, engineering and design developments have resulted in smaller and more versatile equipment, better S/N ratios, and revolutionary mixing techniques.

The changes continue at a rapid pace along radio's front lines — the remote sites. Although nearly every element of remote production has been affected, no area has undergone as much change as the audio storage systems.

Recording, editing and playback of audio has always been essential to field production. In the 1950s and '60s, full-sized reel-to-reel machines were built into rolling racks or flight cases for this purpose. In many instances, the transport and electronics were so cumbersome that they were shipped separately and tethered together with the necessary connecting cables at the remote site. When multiple machines were needed, trucks were hired to haul the equipment around.

Some engineers borrowed from the film industry and purchased over-the-shoulder-type portable reel recorders, whose audio reproduction and speed consistency made them extremely desirable. Their drawbacks included high cost, susceptibility to damage, limits to reel size, and minimal editing capabilities.

Portable cassette tape recorders were able to alleviate some of the bulk as their performance improved through the late 1960s and '70s, but serious professionals would consider their use for voice application only. Tight cuing also remained a problem for on-site playback applications of cassettes.

Through the 1970s and early '80s portable reel recorders with 10.5-inch reel capacity were produced. These devices' specifications matched or exceeded those of their older, larger counterparts.

It wasn't until the late 1980s, with the advent of R-DAT (rotary digital audiotape) recorders, that state-of-the-art reproduction could be achieved outside the studio with equipment that weighed less than three pounds and could run on battery power. Tight cuing and fast, accurate location also was possible with these units, along with long continuous recording times (up to 180 minutes).

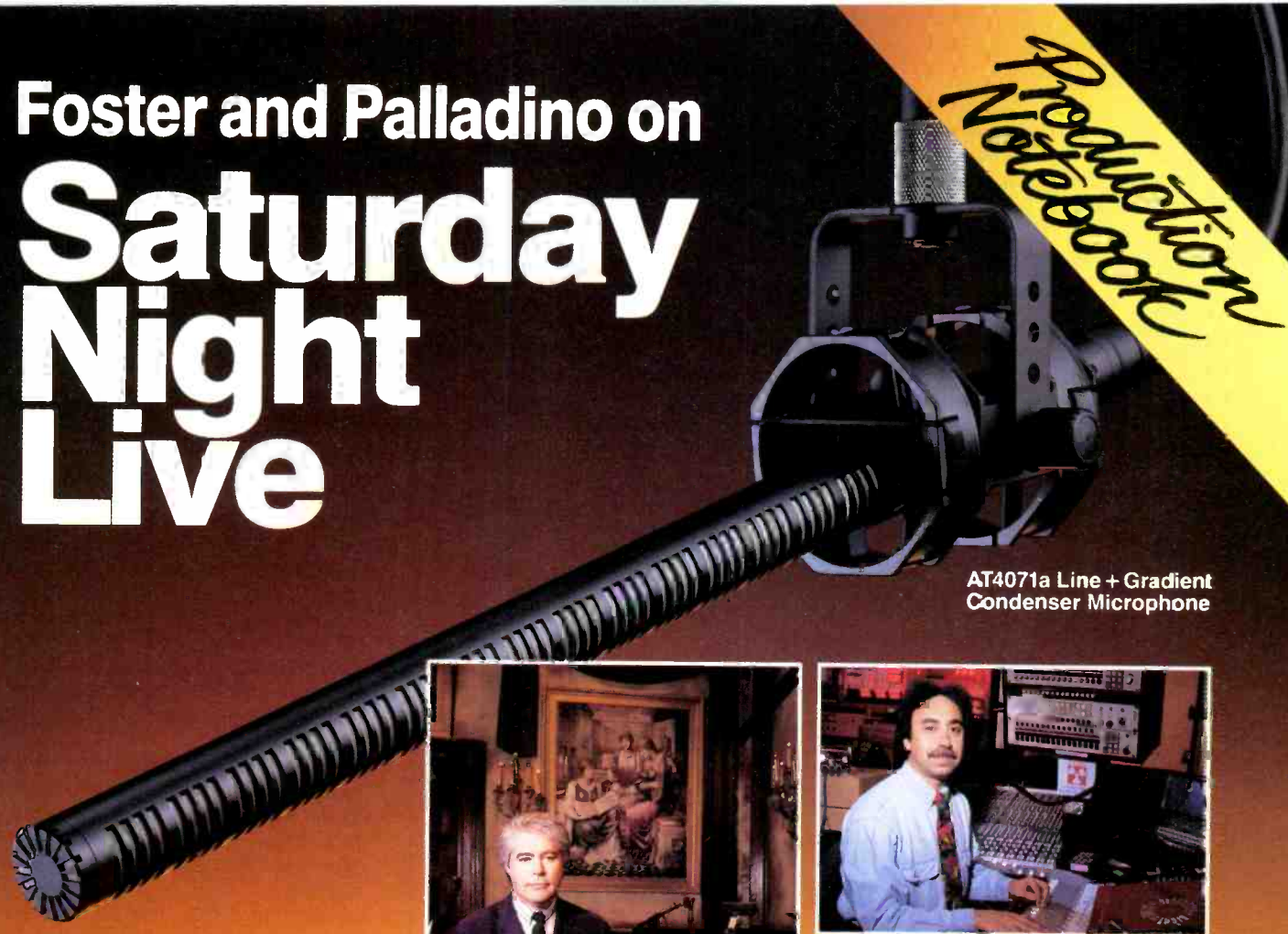
Although clearly an excellent choice for high-quality digital recording and playback on location, DAT has some disadvantages. The VCR-type loading mechanism requires the machine to open the tape cassette, pull the tape from the shell, load it into position around the head drum and place the transport in motion. Once the tape has disappeared into the recorder, there is little the engineer can do to remedy a malfunction without disassembling the unit.

Another problem on most DAT machines is the lack of a provision to monitor the signal off the tape as it is being recorded. A recorder that has not loaded tape properly may appear to be recording normally, but this is not the case. The addition of off-tape monitoring for record verification (read-after-write in digital terms) on some newer machines is welcome. Nevertheless, some experienced radio engineers still recommend carrying a high-quality portable analog cassette recorder for backup while in the field.

Kirsch is proprietor of Silver Lake Audio, a remote broadcast production and equipment rental company in Baldwin, NY.

Foster and Palladino on Saturday Night Live

Production Notebook



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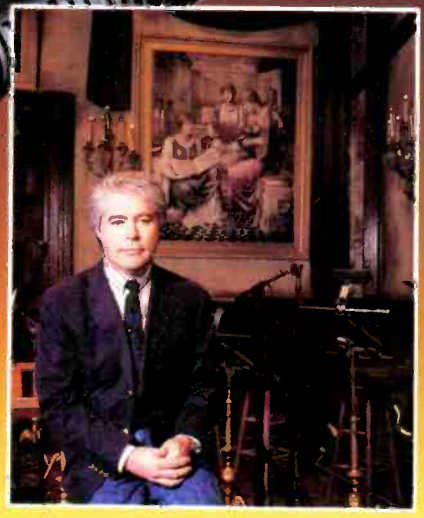

No, Foster and Palladino aren't the latest rock stars or comedy team. Rather, Stacey Foster is the technical audio advisor and Bobby Palladino is the chief audio engineer for this ever-popular and innovative NBC show. Because they have set such high audio standards for this complex program, their thoughts on the microphones they use should be of interest to every video or film audio engineer.

To quote Stacey Foster, "We have used all the world's standards for our shotgun applications. Nothing has approached the performance of the Audio-Technica AT4071a. There really is a dramatic difference. The AT4071a is a lot warmer, has more gain and basically sounds much more natural. It also has an extremely good off-axis response. When we first compared the AT4071a shotgun to what many consider the world standard, we were blown away!

"We couldn't believe there could be such an audible difference between the two. Every engineer immediately wanted to know what we had done to the sound. Obviously, cost is not a determining factor when we select audio products. We want the best that money can buy, but here is an instance when the best – the Audio-Technica AT4071a – also represents an incredible value."

Bobby Palladino explained that the show uses two AT4071a shotguns on booms, and a third wireless AT4071a on a fishpole. While they also use RF body microphones when appropriate, Bobby notes that, "...shotguns provide better dynamic range...and the boom mikes sound as though you are actually in the room."

Because the show is produced live before a studio audience of 300, the microphones must also offer excellent gain before feedback. In addition to a stage foldback system, there is the on-air mix and a house system as well. Bobby Palladino concludes that, "I've really been impressed by the improved performance of our audio product since we switched over to the AT4071a."

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Circle (46) on Reply Card

Playing back from DAT into live programming is not without its problems. Although the indexing feature enables precise cuing with relative ease, there is often a delay between the time the play button is depressed and the audio begins.

Many think that DAT is a temporary format, soon to be replaced by something more permanent and reliable. Recordable CDs may be the answer, and although the recorders have dropped in price substantially, blank disks are still quite expensive ($30 to $40 per hour). Optical technology also doesn't lend itself well to portable use when recording, because of its sensitivity to shock or motion.

Still other formats in this constantly changing area have emerged within the last year or so. The Mini Disc (MD) recorder uses magneto-optical storage as opposed to conventional CD laser technology. The Digital Compact Cassette (DCC) offers digital recording on a magnetic tape format quite similar to conventional analog cassette, using a backward-compatible recorder that can also play back analog cassettes. Finally, the Non-Tracking (NT, or "Scoopman") format provides up to two hours of recording (one hour uninterrupted) on a postage-stamp-sized cassette, using a microcassette recorder with long battery life. These systems have been designed primarily for consumer use and haven't had a major effect on the pro market (although NT has begun to penetrate radio news departments and the surveillance industry). (See *BE*'s February 1993 issue for more on all of these new formats.)

Automatic mixers

Portable mixers have been a staple of the remote kit since the days of vacuum tubes. Changes in this area have primarily involved reductions in size and weight, because even the early models performed the desired functions and could operate on batteries when necessary. Of course, audio quality (primarily S/N and distortion) also has improved incrementally, as have overall I/O capacity and monitoring flexibility.

Mix engineers have always faced problems when mixing multiple microphones in the field. Results have depended on how well microphones were selected and placed and how skillfully gain-riding was applied.

When more than one microphone is open at a time at different distances from a sound source, comb filtering occurs. Because the sound does not arrive at each mic at precisely the same time, the signals are not in phase. When the outputs from the mics are mixed together, they produce a signal that is spectrally distorted from that of a single open microphone. The only way to prevent this degradation is to have only the microphone that is closest to the sound source be active. This is an impossible task for anyone to accomplish perfectly in a broadcast involving a spontaneous conversation between two or more people.

Through the years, several "automatic" microphone mixers were introduced, including some portable models. These systems open and close microphones based on level detection at each input, similar to the operation of multiple noise gates. Most of these systems were designed for sound reinforcement use (where they also can improve gain-before-feedback performance), but recent advances have optimized automatic microphone mixing for broadcast.

These newer designs can differentiate between voice and constant ambient room noise, preventing it from inadvertently activating a channel in the presence of a noisy air conditioner, for example. Multiple units can be linked together, providing automatic mixing for hundreds

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of microphones. Most systems allow the automatic function to be manually overridden. A helpful improvement for broadcast use is the "last mic stays on" feature, which leaves the last microphone to be used open until another microphone is activated. This avoids the loss of room tone experienced in earlier systems when no one was speaking and all mics were shut down.

Engineers will find that using such an automatic mixer for a multimicrophone event (other than music mixing) can result in overall improvement of audio quality. At the same time, the mixer can be used automatically or in the traditional manual mode.

Delivering the signal

When the government ordered the AT&T divestiture in the 1980s, one consequence involved the resulting smaller telcos charging exorbitant rates for equalized broadcast lines. Others simply stopped offering the services altogether.

An alternative to dedicated lines and satellite backhauling emerged in the mid-1980s. A dual-line telephone frequency extender delivers 5kHz audio through the use of two standard dial-up phone lines. Always available within a few days, dial-up lines offer a twofold advantage. A remote can be scheduled on short notice, and the price in most areas, including installation, is reasonable. Later, frequency extenders were improved to include use of a third dial-up line, enabling users to achieve an 8kHz frequency response.

One expense that must be considered when using frequency extenders is the cost of the telephone calls. Depending on the location of the remote, the time of day and the length of broadcast, this can become quite expensive.

The latest developments in delivering remote audio involve digital telephone lines. With the appropriate hardware, these circuits can produce up to 20kHz performance, in stereo, for a fraction of the cost of either satellite backhaul or conventional program circuits.

The hardware consists of a 2-part configuration. A codec (COder-DECoder) converts the analog input to a digitally processed signal. A data service unit (DSU) or terminal adapter (TA) interfaces the codec with the digital line. The frequency response and features of the system vary among codecs. The most common and least expensive is called CCITT G.722, which delivers 7.5kHz mono in a duplex configuration, allowing simultaneous transmission from the remote site to the studio and return audio from the studio back to the remote. More expensive codecs offer wider frequency response and more advanced features. Not all codecs use the same digital processing techniques. Be sure that the codecs at each end of the transmission are compatible.

Unfortunately, there is no standard among individual telephone companies for digital lines. Basically, three types of services are offered:

1. *Digital data service* (DDS) is a dedicated digital circuit between two points. Various data rates are available.
2. *Switched-56* is a dial-up digital line. It has a number assigned to it just like a standard telephone line.
3. *Integrated services digital network* (ISDN) also is a dial-up digital line. It has a number assigned to it just like a standard telephone line.

In order to use digital services for remote backhaul, you must first determine which services are offered in the originating and terminating sites. Once this has been accomplished, you simply place an order with the local telco(s) for installation. The installation time varies from company to company, but allow at least two weeks in most cases. Once the lines are installed, the hardware designed for that particular service must be obtained. Usually, the codec will remain the same, and the DSU or TA will be the component that varies.

Current telco plans call for ISDN to eventually become the standard phone system throughout the country. Doing remote broadcasts then will be almost as simple as making a phone call, with high fidelity audio transmission available at an affordable price.

The broadcast industry finds itself about halfway through a period of cataclysmic change. Digital and analog technologies must coexist during this time, and skill in both areas is required among broadcast technologists to steer a clear path through the transitional period. One inevitable result will be easier, cheaper and better remote broadcasts.

Acknowledgment: Thanks to Michael Pettersen and Davida Rochman at Shure Brothers, Evanston, IL, for their help in producing this article.

For more information on radio remote production equipment, circle (317) on Reply Card. Also see "Audio Digital Coders, Decoders; Mixers, Portable; Recorders, Digital and Telephone Bandwidth Extenders," pp. 6-12 of the BE Buyers Guide.

■

Our competition is making a lot of noise about their wireless. Trouble is, their wireless make a lot of noise too.

Experience the Nady 950 UHF. The first quiet multichannel UHF wireless.

Fact: Due to problems inherent to UHF technology, like phase noise and residual frequency modulation, UHF wireless systems tend to be noisy.

Fact: Other companies offer high end UHF wireless systems that are 5-10 dB noisier than their VHF systems, and VHF systems that are 10-30 dB noisier than any Nady.

Fact: Some companies that do offer a quiet UHF system don't advertise how they make it quiet: by sacrificing headroom. So you're asked to accept less critical performance—to choose between noise and clipping.

Fact: Nady devoted extensive R&D to testing, simulating and modifying our UHF systems. Our engineers utilized circuit modeling and analog simulation software to optimize our design and compensate for manufacturing tolerances and variations in device parameters.

Fact: Nady engineers achieved the first truly quiet RF link for UHF wireless. The Nady 950's proprietary components and circuitry yield radio link carriers that are up to 20 dB quieter than any other UHF system. And Nady's specialized companding noise reduction delivers the best dynamic range—and headroom— in wireless today.

Fact: The Nady 950 features state of the art frequency synthesis. With several ten channel models in the 490-950 MHz range, and a 40 channel version in the 800 MHz range. Plus exclusive hiss mute circuitry, which maintains audio quality as the transmitter moves toward the outside limits of operating range. Variable bass boost. Balanced and unbalanced output. Switchable 115/220 and DC power. Available frequency bands for worldwide use.

Fact: You could pay a lot more for a UHF wireless system, and get a lot more noise. So choose the Nady 950 UHF.

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Circle (50) on Reply Card

TABLE 7. CABLE AND PRODUCTION FACILITY SALARIES

BASE = NON-BROADCAST RESPONDENTS	EXECUTIVE/GENERAL MANAGEMENT			VP/DIR. & CHIEF ENGINEERS			STAFF ENGINEER			OPERATIONS MANAGEMENT		
	Subtotal	Cable	Proud.	Subtotal	Cable	Proud.	Subtable	Cable	Proud.	Subtotal	Cable	Proud.
Less than $15,000	11.3%	9.1%	13.2%	1.2%	2.2%	0.0%	4.1%	3.78	4.5%	3.6%	3.6%	3.6%
$15,000 to $24,999	0.0%	0.0%	0.0%	4.7%	6.7%	2.4%	12.2%	11.1%	13.6%	23.4%	32.1%	14.5%
$25,000 to $34,000	18.3%	15.2%	21.1%	30.2%	37.8%	22.0%	31.6%	35.2%	27.3%	27.0%	28.6%	34.5%
$35,000 to $49,000	28.2%	30.3%	26.3%	31.4%	29.8%	34.1%	32.7%	33.3%	31.8%	30.6%	26.8%	34.5%
$50,000 to $74,000	26.8%	21.2%	31.6%	19.8%	15.6%	24.4%	15.3%	14.8%	15.9%	14.4%	8.9%	20.0%
$74,000 or more	15.5%	24.2%	7.9%	12.8%	8.9%	17.1%	4.1%	1.9%	6.8%	0.9%	0.0%	1.8%
Estimated median	$44,999	$47,500	$43,750	$42,692	$39,999	$46,250	$35,667	$34,999	$36,250	$33,571	$30,556	$36,818

TABLE 8. TECHNICAL SALARIES: SBE-CERTIFIED VS. NON-CERTIFIED

JOB CATEGORY	ALL MARKETS			TV ONLY			RADIO ONLY		
	Certified	Non-certified	Salary difference	Certified	Non-certified	Salary Difference	Certified	Non-Certified	Salary Difference
VP/Dir. Engineering	$53,750	$42,500	$11,250	NA	NA	NA	$53,333	$31,250	$22,083
Chief Engineers	$37,708	$33,772	$3,936	$$42,143	$39,000	$3,143	$35,357	$29,750	$5,607
Staff Engineers	$32,917	$30,676	$2,241	$35,909	$34,167	$1,742	$24,268	$22,000	$2,268
All Engineers	$37,841	$33,061	$4,780	$39,792	$37,766	$2,026	$35,500	$28,190	$7,310

ustry's problems began to change about two years ago. Now more readers see the challenges as opportunities.

Readers saw HDTV, DBS and cable as venues to explore. That complaint about automation being an evil disguised as new technology has passed. Readers know that automation is here to stay.

The future

It's an encouraging sign to see the technical community recognizing that computers and technology are opportunities rather than obstacles.

As broadcast, cable and production facilities strive to carve their niche out of the program delivery and production process, forward-thinking and qualified technical managers will become more important to profit-producing companies. Those looking forward are less likely to trip than those looking behind. Which direction are you looking? ■

Research statement: The 1993 Salary Survey was conducted by the Intertec Corporate Marketing Research Department. A total of 4,450 questionnaires were mailed to domestic *BE* readers in the broadcast and non-broadcast field. The individuals were selected on an nth name basis. As of Aug. 12, 1993, a total of 1,850 usable questionnaires were received. The effective response rate was 42%. The data in this report is based on the responses in those questionnaires.

Editors note: The complete results of the 1993 Salary Survey are available in bound form of more than 120 pages. The data is displayed in tabular and graphical form for easy evaluation. Copies are available for $75 each. Call Renee Hambleton at 913-967-1732 for more information.

Planning for an HDTV future (continued from page 46)

of transmission line. One of those two remaining HDTV channels presented some incompatible distortions in the pattern because of tower effect. A single option remained, which KOZK currently assumes for planning purposes will be its HDTV channel.

Compatible interim purchases

Regarding transmission line incompatibilities, interim replacement hardware might eliminate this issue. At least one transmission line manufacturer is developing a rigid line system with joints that are electronically transparent to all UHF frequencies. Updating an existing line with these joints could cost a station 50% to 60% of the price of a whole new line, so the line's overall condition will guide a station toward either wideband joint replacement or full line replacement. In either case, if you are currently broadcasting in the UHF TV band and must replace or improve your existing line soon, make sure it will cover all channels in the UHF band so you will not be restricted as to which HDTV channel you must use. (Remember, that in a few [generally UHF-only NTSC] TV markets, HDTV channels have been allocated in the VHF band, so these recommendations will not apply in all cases.)

Compatible transmitter replacement before HDTV conversion also is a possibility. In KOZK's case, the existing transmitter will be replaced next year by a completely redundant dual transmitter. The immediate advantage is reliability, but the long-range bonus is the ability to split the transmitter, using one half for standard NTSC transmission and the other for HDTV transmission. Both would be multiplexed into the existing wideband transmission line and antenna.

Although this will require reducing NTSC power by half to be able to use the existing antenna and transmission line, the station has operated at half power when a klystron was lost, and no one could see a difference. Evidently, a 3dB loss of field strength is negligible and tolerable.

At least four transmitter manufacturers have HDTV-compatible transmitters either on the market or ready to be introduced. If you must buy a new transmitter today, make sure it will serve your needs into the HDTV future. (Transmitters are considered to have a 17- to 20-year amortization.)

HDTV broadcasting is a large investment, considering the total dollars required to make the conversion. If a station starts planning now and makes equipment purchases during the next six to seven years of only HDTV-compatible hardware, the picture may not look so ominous. The future starts today. ■

New Products

Lenses
By Fujinon
• **Ah24X7ESM:** for ⅔-inch cameras; uses proprietary floating group lens assembly, which effectively controls coma and field curvature; features Electron Beam Coatings.
• **Sh24X5.3ESM:** same as Ah24X7ESM, but for ½-inch cameras.

Circle (350) on Reply Card

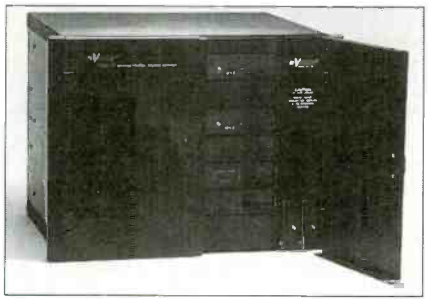
Digital audio processors
By Sabine
• **ADF-1200 and ADF-2400**: single-channel and dual mono/stereo workstations; functions include 12- or 24-band digital parametric filtering, digital shelving filters, digital delay, noise gate, multiple configurations storable in memory, and password; also include 31-band real time analysis; automatically detect acoustical feedback and precisely determine its frequency.

Circle (351) on Reply Card

Encoder/decoder
By Broadcast Video Systems
• **VBI-232**: designed to plug directly into a Leitch Video or Grass Valley Group DA frame; provides an economical method of transmitting and receiving RS-232 data and control information via the VBI of a composite video signal; available in the FR3 ½-rack-width frame with power supply for stand-alone operation; features include 2,400 baud using one line in VBI, 4,800 baud using two lines in VBI, biphase data, transparent insertion into and transparent recovery from loop-through video; EDC protected; 1.35-2.7MHz data frequency; all connections via existing DA frame BNCs; onboard jumper determines encoder or decoder mode; optional relay card provides eight on-off functions.

Circle (353) on Reply Card

Machine control routing switch
By NVision
• **NV3128 series**: designed for routing the machine control data, which allows for the remote operation of multiple VTRs, R-DATs, editors and other machines that conform to the EIA RS-422-A data standard; 8-RU chassis may be configured for control of 64 or 128 machines.



Circle (352) on Reply Card

Precision plug-in transcoder
By Broadcast Video Systems
• **YC700**: designed to plug directly into a Leitch Video or Grass Valley Group DA frame; provides economical solution for converting S-VHS and Hi8 to Betacam or

New Products

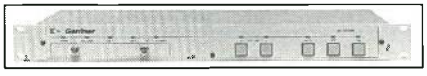
MII format, plus RGBS; available in FR 3½-rack-width frame with power supply for stand-alone operation; features include clamped inputs; onboard jumpers for either Y, R-Y, B-Y or RGB output; card edge hue, saturation and Y level controls; regenerated sync and blanking; high-stability four quadrant demodulators; sync may be added to any of the RGB outputs.

Circle (354) on Reply Card

Digital telephone hybrids

By Gentner

• **G2500 and G3200**: hybrids use DSP technology to auto null to the telephone line; in the G2500, the echo canceller is used to automatically generate a mix-minus feed to the caller; with the G3200, the audio that is sent over studio speakers and picked up by mics is digitally removed from the hybrid's send path; both hybrids provide auto answer/disconnect, automatic re-nulling on new line selection, receive mute, RS-232 control and an echo suppressor; G3200 provides automatic mixing of up to three microphones, and a 3W power amplifier with speaker binding posts and front-panel control.



Circle (358) on Reply Card

Warning beacons

By EG&G Electro-Optics

• **FlashGuard**: FAA approved; narrow-beam optics eliminate the need for a Fresnel lens; narrow vertical beam width is half that of conventional beacons; smaller beacon size results in 30% less wind-loading, less stress on the tower and less vulnerability to storm damage; separate power supply; 2-year warranty; AC or 24VDC power options; available in two models: FG-2000 (white strobe or long burst flashing red beacon) and FG-3000 (fully integrated dual red/white beacon).

Circle (355) on Reply Card

Closed-captioning system

By Cheetah Systems

• **CAPtivator Offline**: SMPTE time-code based off-line caption editing package; features soft VTR controls; easy-to-use windowing interface with pull-down menus; extensive context sensitive help; caption positioning through mouse control; can automatically create a computer file from a pre-captioned tape; block cut and paste functions; on-screen caption preview and simulation; multiple encoder/decoder support.

Circle (357) on Reply Card

BUSINESS TODAY

The national television series, BUSINESS TODAY, will explore a broad spectrum of issues in technology, manufacturing and finance. The following will be featured in a show titled, "AUDIO & VIDEO TECHNOLOGY"

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Comsonics Inc.
An employee-owned manufacturing & repair services company specializing in broad-band communication technologies.
800-336-9681

Hughes-JVC Technology Corporation
A technology for the '90s where our brightness keeps you out of the dark.
800-CAL-HJTC

Newton Instrument Company
We Wrote the Book on Telephone Structural Components.
919-575-6426

Audio Processing Technology (APT)
Digital audio compression technology & products for professional transmission & storage applications.
213-463-2963

Abekas Video Systems
Manufacturers of high-value tools for the creation, production and distribution of video images.
415-369-5111

Tune in to "AUDIO & VIDEO TECHNOLOGY"
on the Discovery Transponder, November 17, 1993 at 6:41 a.m. Eastern and Pacific Time!

Circle (62) on Reply Card

WJMK, Inc. 2424 N. Federal Highway, Suite 462, Boca Raton, Florida 33431

New Products

Plug-in acquisition modules
By Tektronix

• **FL series long range plug-ins**: for FiberMaster OTDR; allow telecommunications carriers and suppliers to test extended fiber cable lengths; designed for 1,310nm and 1,550nm single-mode operation; offer reduced noise, improved linearity and increased resolution; available in three configurations: FL1300 (for testing 1,310nm fiber), FL1500 (for testing 1,550nm fiber) and FL1315 (for testing 1,310nm and 1,550nm in a single module).

Circle (365) on Reply Card

Dual-channel processor
By AKG Acoustics

• **296 Spectral Enhancer**: for cleaning up and detailing instruments, vocals and program material in studio or music playback applications; features two independent channels, providing the user with selectable amounts of high-frequency detail enhancement, low-frequency detail enhancement and hiss reduction, with a LED meter to indicate the amount of hiss reduction being employed; U.S. manufactured.

Circle (366) on Reply Card

Multitracker
By Fostex

• **380S**: compact 4-track multitracker; combines a high-performance 4-track cassette recorder with a multitrack, multifunction mixing console that features 12 inputs.

Circle (362) on Reply Card

UHF wireless system
By Nady

• **RW-3**: economical professional multichannel UHF wireless system; features state-of-the-art frequency synthesis, with four user-switchable channels on the receiver and transmitters; includes first truly quiet RF link in UHF wireless; uses Nady's patented companding circuitry to deliver 120dB dynamic range; includes rack compatible, removable front-mounting antennas; hand-held microphone transmitter features a new, all-metal case with a sleekly tapered design; all RW-3 transmitters include a 4-channel selector switch, plus power on/off, audio on/off, level trim adjust and low-battery LED indicator.

Circle (367) on Reply Card

Signal analyzer
By Anritsu Wiltron

• **ME2627B**: digital modulation signal analyzer; 10MHz to 2.7GHz frequency range allows it to test digital cellular and digital cordless telephones; provides $\pi/4$ DQPSK and GMSK modulated signals; flexible enough to change measuring conditions, filter type, sampling points and display; can be used to analyze and measure digital modulation signal parameters; consists of the MF8601A digitizer, MG3633A synthesized signal generator and an engineering workstation with CRT display.

Circle (368) on Reply Card

Hard disk recorder
By Akai

• **DR4d**: economical multitrack hard disk recorder; 4-in/4-out recorder is equipped with superclean 18-bit 64x oversampling

New Products

A/D converters and 18-bit 8x oversampling D/A converters, as well as two channels of digital audio input/output; up to four DR4d units can be chained together to create a 16-track system; seven SCSI hard disks can be used, and overflow recording across multiple disks is supported; optional factory-installed 200Mbyte internal hard disk offers 32 track minutes right out of the box.

Circle (369) on Reply Card

Coaxial cables

By Andrew Corporation

• **Heliax**: ¼-inch superflexible, 50Ω coaxial cables for high-power/plenum application; ideal for equipment room jumpers that must interface with high-power transmitters; 1-inch minimum bend radius allows for easy installation and routing in enclosed areas; feature UL listing and a type CATVP marking; low-loss expanded PTFE dielectric handles 3.5 to 4 times the average power of foam polyethylene at 1,000MHz.

Circle (370) on Reply Card

Flexible electronics cabinet

By Zero East

• **Zero Guardian**: extra duty cabinet for the electronics marketplace; allows for standard to custom-design without added cost or lengthy wait of custom production; available for normal delivery in one to six weeks; can be designed in virtually any size and configuration in either steel or aluminum to solve special equipment packaging requirements; provides equipment protection for a wide range of applications.

Circle (371) on Reply Card

Video compression/decompression daughtercard

By RasterOps

• **MoviePak2**: features full-motion (60 fields per second), real time (30 frames per second), video digitizing and full-screen (640x480) playback from hard disk; snaps onto RasterOps video display adapters to enable users to record, edit and playback Apple QuickTime movies on the desktop; shipped in a 7-inch form factor to work with all Apple Macintosh, Quadra and Centris computers; uses LSI Logic JPEG technology.

Circle (373) on Reply Card

Stereo audio consoles

By LPB

• **7000 series**: 12-channel (model 7012) and 18-channel (model 7018) stereo linear fader consoles; feature modular plug-in electronics behind a unitary front panel, cold contacts, socketed ICs and heavy-duty front-panel switches; also include two inputs per channel, three stereo buses, mono mixdown plug-in for utility bus outputs and a built-in timer.

Circle (372) on Reply Card

Handbook

By Motorola

• **Rectifier Applications Handbook**: revised edition includes latest material on power factor correction, high-frequency applications, Schottky diode theory, surface-mount technology, SPICE modeling and parameter extractions and reliability; written for use by design engineers, engineering students.

Circle (374) on Reply Card ■

Industry Briefs

BUSINESS SCENE

Sony, Montvale, NJ, has provided NBC, New York, with BVP-375 studio cameras, supplemented by BVP-90 hand-held cameras for its studio production requirements. The purchase also incorporates Betacam SP products, including BVW-75 VTRs abd BVW-65 players for NBC's news field acquisition requirements.

Pro-Bel, Dunwoody, GA, has supplied a routing system to Big Shot Productions, Baltimore. In addition, Air Studios, Hampstead, England, has purchased digital audio reference and distribution equipment from Pro-Bel.

JVC, Elmwood Park, NJ, provided a BR-S822 editing recorder for use on the set of the film "The Fugitive."

Ultimatte Corporation, Chatsworth, CA, has supplied a memory head and memory head utilities to Pet Fly Productions for use on a new pilot series called VIPER.

Ultimatte also sold CineFusion software that was used in several summer movies, including "The Last Action Hero," "Cliffhanger," "In the Line of Fire," "Super Mario Brothers," and "Hocus Pocus."

Quest Research & Development, Wichita, KS, has sold a Q-Alert viewer alert system to KWCH-TV, Wichita, KS.

Antenna Technology, Mesa, AZ, has been chosen to provide two Simulsat multibeam satellite earthstations as downlinking antennas for United States Satellite Broadcasting's state-of-the-art Digital Satellite System (DSS) uplinking facility, Oakdale, MN.

Snell & Wilcox, Hampshire, England, has delivered an Alchemist standards converter to the "flying eye hospital," Orbis International, a non-profit organization that combats blindness through education and training.

The converter has been installed on the ORBIS flagship, a converted DC10 aircraft fully equipped as an opthamological teaching hospital.

Quantel, Darien, CT, has installed a second DOMINO (Digital Opticals for Movies) at Digital Magic, Santa Monica, CA.

Sony, Montvale, NJ, has begun shipping Digital Betacam videotape recorders on schedule and will meet all current orders by the end of October.

Pioneer New Media Technologies, Upper Saddle River, NJ, has installed a video wall at Michael Jordon's restaurant, Chicago.

Ampex, Redwood City, CA, has supplied DCT 700d tape drives to Post Perfect, New York, to be used for "The Stand," an 8-hour miniseries based on the novel by Stephen King.

PESA Switching Systems and **Chyron Corporation**, Melville, NY, have been awarded contracts by Sony Systems Integration Division, Montvale, NJ, to provide switching and graphics systems for the DirecTV Castle Rock Broadcast Center.

Otari Corporation, Foster City, CA, has delivered a Series 54 console to the World Wrestling Federation, headquarted in Connecticut. In addition, Jack Van Impe Ministries, Troy, MI, has installed a Concept I console.

AMS Neve, Lancs, England, has sold a SoundField and ST 250 microphone system to Drawmer, West Yorks, England.

Panasonic, Secaucus, NJ, has sold an AJ-D350 D-3 digital studio VTR to Coastal

Industry Briefs

Video Communications, Virginia Beach, VA. Also, WBRE-TV, Scranton, PA, has purchased a pair of WV-F700 3-CCD digital processing color video cameras.

Harris Allied Europe, Cambridge, England, and Yorkshire Coast Radio have teamed up to make Yorshire Coast Radio the first U.K. user of Digilink, the U.S. digital automation system.

ECHOlab, Burlington, MA, and **Editing Technologies Corporation**, Moorpark, CA, have appointed Dixon Representation, Leawood, KS, as manufacturer's representative for the 13 states of the upper midwest.

Pioneer New Media Technologies, Upper Saddle River, NJ, has formed the Broadcast and Professional Group to handle marketing, sales and support for a line of products designed for the broadcast and video production professional, with the Pioneer VDR-V1000 rewritable videodisc recorder at its heart.

Svetlana Electron Devices Manufacturing Corporation, St. Petersburg, Russia, will market its power grid and modulator electron tubes to the United States and other Western countries through Svetlana Electron Devices, Huntsville, AL.

Neutrik, Lakewood, NJ, has acquired Canadian-based Amber, a manufacturer of complimentary instruments for audio test equipment. The new company will be established under the name of Neutrik Instrumentation Inc. (NIS), and will be headquartered in Montreal.

PEOPLE

Greg Laney has been chosen as sales engineer for Apogee Electronics, Santa Monica, CA.

William "Pete" Mountanos, Rahoul K. Seth and **Tom Hooper** have been appointed to positions with Abekas, Redwood City, CA. Mountanos is president and CEO. Seth is executive vice president. Hooper is national sales manager.

Michael Hopkins has been named vice president of sales and marketing for Dotronix, New Brighton, MN.

Albin F. Moschner has been elected president and chief operating officer for Zenith Electronics, Glenview, IL.

Fiorenza Mellas has been named sales director of the graphics products range for Dynatech Video Group's European, African and Middle Eastern Headquarters, Wokingham, Berks, England.

John Leveck has been named Western regional sales manager for Microtime, Bloomfield, CT.

Kevin Prince has been chosen as senior product specialist of the Hal creative digital video compositing system for Quantel, Darien, CT.

Greg McHale has been named vice president of marketing for VideoLogic, Cambridge, MA.

Hendrik Homan has been appointed managing director of AKG Acoustics, Vienna, Austria.

Gray Wong has been chosen as district sales manager of Northern California and Northern Nevada for Richardson Electronics, LaFox, IL.

■

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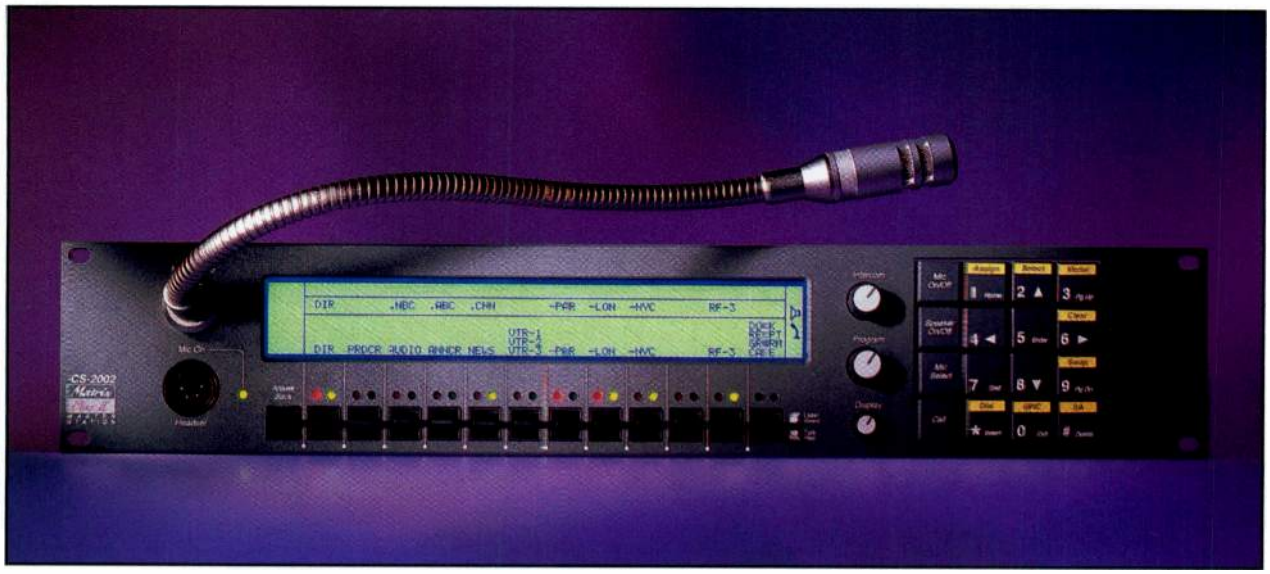

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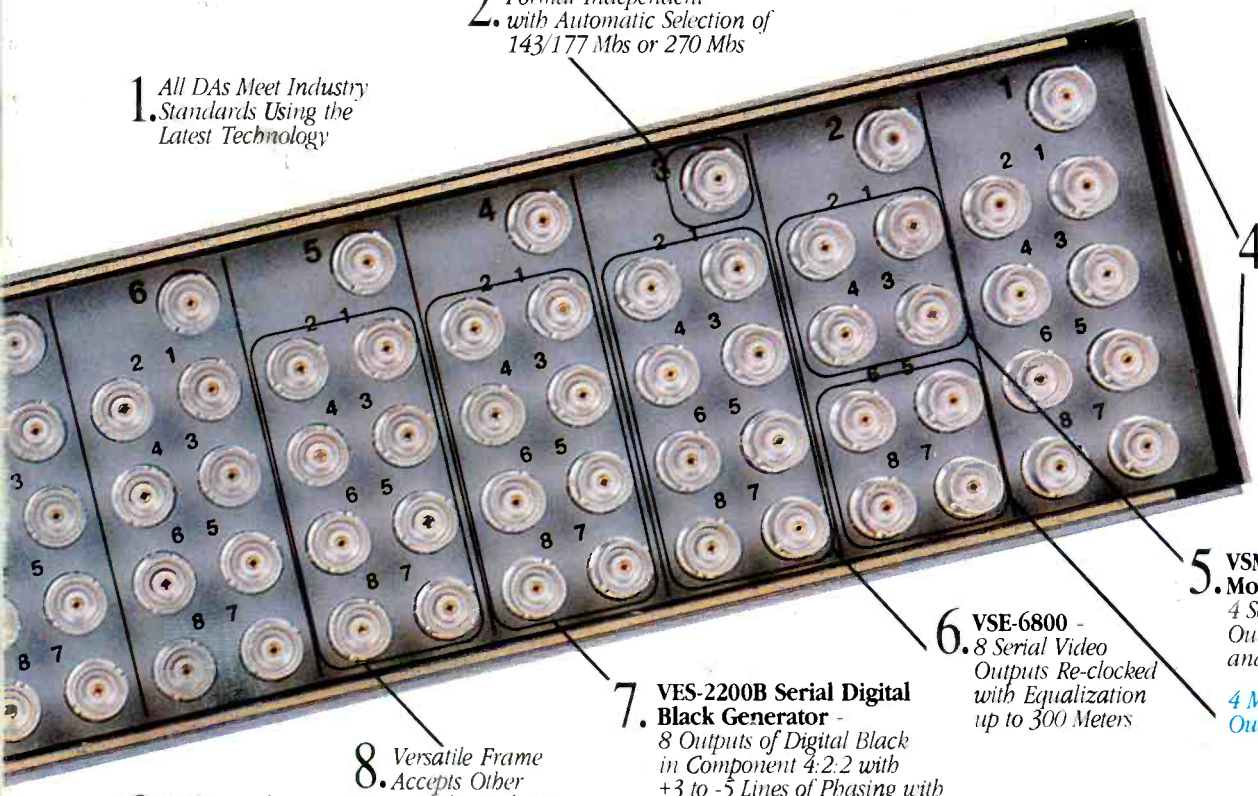

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