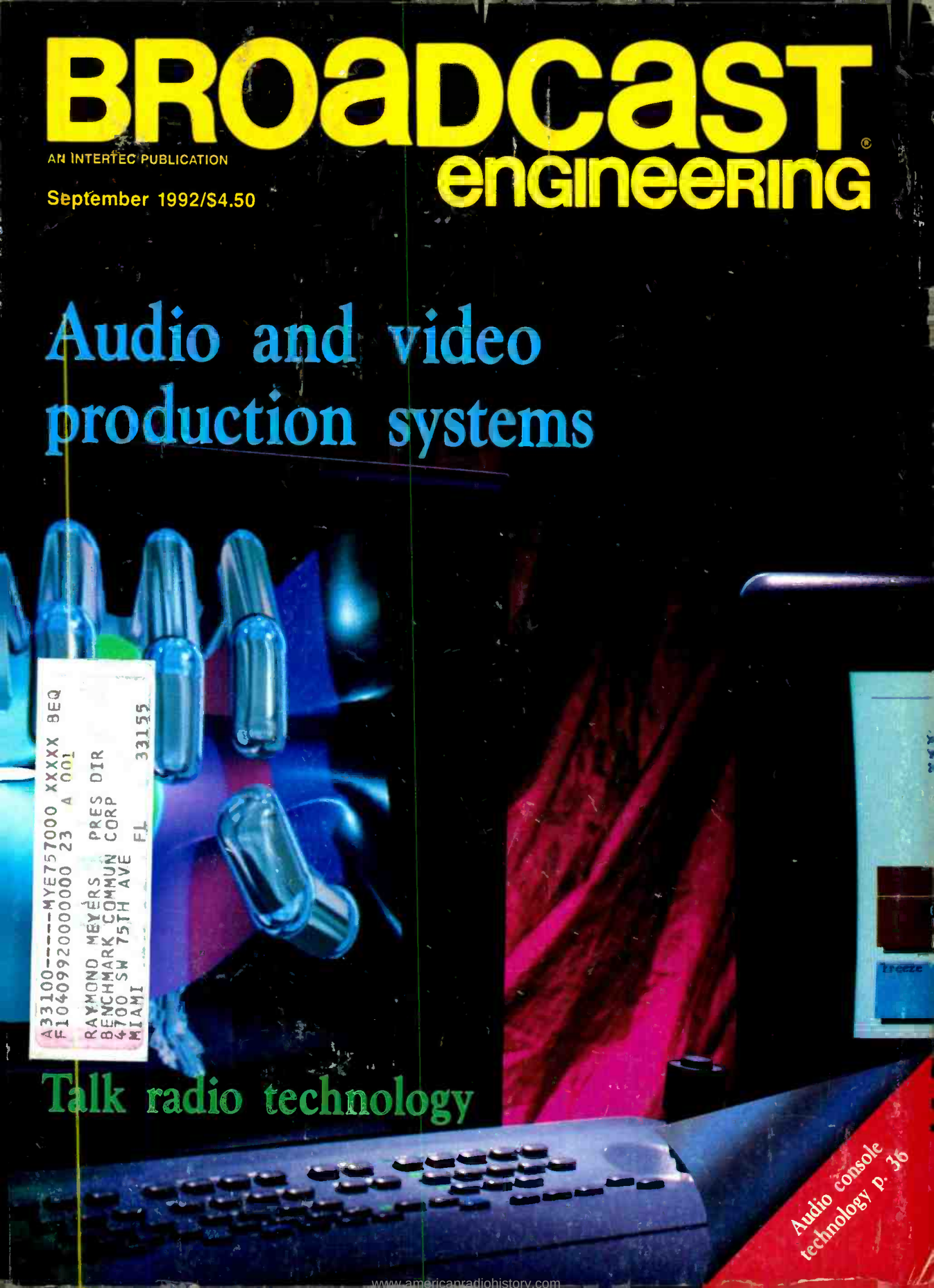
BROADCAST ENGINEERING

AN INTERTEC PUBLICATION

September 1992/$4.50

Audio and video production systems



Talk radio technology

Audio console technology p. 36

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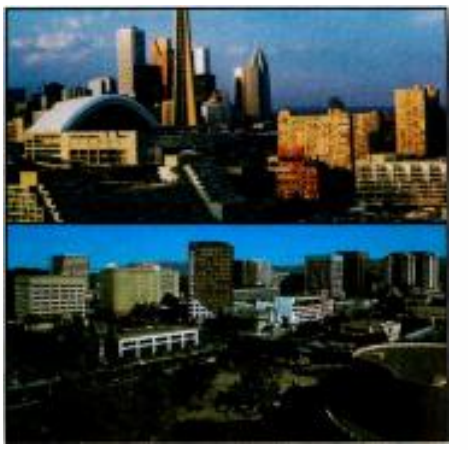

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DEPARTMENTS:

FEATURES:

OTHER FEATURES:

ON THE COVER

Powerful desktop-size production equipment is now capable of effects that used to require racks of space. (Cover credit: photography by Douglas Schwartz Photography; image composed on a Pinnacle Prizm Dveator.)

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News

By Dawn Hightower, senior associate editor

Broadcasters want to extend HDTV transition

The National Association of Broadcasters (NAB) asked the Federal Communications Commission (FCC) to be more flexible with its HDTV development plan. It called the current financing and construction schedule "unrealistic for many stations and many markets."

The NAB has told regulators that the schedule does not allow for a market-driven rollout of this technology.

NAB said it embraces the FCC's goals for the swift implementation of HDTV, but the commission should take into account that HDTV's transition costs could be enormous. For example, transmission equipment for HDTV will likely be $1-2 million per station; another $10-12 million might have to be spent on production equipment to produce local programming.

NAB feels that a longer transition period is needed to allow broadcasters more time to finance their equipment purchases. NAB has asked the FCC to amend the financial qualification requirement, showing that HDTV financing is progressing, rather than committed. NAB notes this measure is necessary because capital financing for many TV stations is difficult to obtain.

Under the current FCC scheme, HDTV equipment costs will be more or less the same for stations with revenues of $5 million as for stations with revenues of $50 million.

NAB asked the FCC to defer or extend its HDTV deadlines to allow for a staggered, more market-driven transition to HDTV. This measure will allow larger stations to take the lead in their equipment purchases. As large stations begin to make their HDTV investments, equipment costs should go down, making subsequent purchases more affordable for medium and small TV stations.

United Airlines has agreement with Sky Radio

United Airlines has signed a contract with USA Today Sky Radio to offer its live, satellite-delivered audio service on United's entire domestic audio-equipped fleet.

Beginning this summer, USA Today Sky Radio became available on select Boeing 757 and 737 aircraft in United Airline's fleet, providing live, around-the-clock news, business updates, play-by-play sports and weather forecasts. The programming is broadcast from USA Today Sky Radio's headquarters near Washington, DC.

United's entire domestic audio-equipped fleet is expected to be equipped with USA Today Sky Radio by the end of 1993.

USA Today Sky Radio plans to launch a second audio channel this fall, which will be a 24-hour all-sports channel.

Slate of officers is announced

The SBE nominating committee has submitted a list of candidates for officers and directors of the society. The membership will vote on these candidates this month, with the results to be announced during the annual membership meeting at the SBE National Convention in San Jose, CA, Oct. 15.

The proposed slate is: president, Richard Farquhar, Columbus, OH; vice president, Chuck Kelly, Quincy, IL; secretary, Marvin Born, Columbus, OH; treasurer, Robert Goza, Beaufort, MO.

Board of directors are: Phil Aaland, Los Angeles; David Carr, Houston; Dane Ericksen, San Francisco; Keith Kintner, Los Angeles; Ed Miller, Cleveland; Robert Reymont, Mesa, AZ; and Martin Sandberg, Dallas.

VOA expands coverage to Central Africa

The Voice of America (VOA) has begun construction of a relay station on the Atlantic island of Sao Tome to improve VOA coverage of West and Central Africa.

The station is expected to begin 100kW medium-wave service in March 1993, and will broadcast programs from VOA's African service in English, French, Hausa and Portuguese. The project also includes the installation of four 100kW short-wave transmitters and a 600kW medium-wave transmitter, which is scheduled for completion in 1995.

The construction of the station on Sao Tome is the second stage of VOA's replacement of four 100kW short-wave transmitters near VOA's medium-wave station in Botswana in southern Africa. Further enhancement of VOA's coverage to Africa will be made in late 1993, when another relay station in Morocco will come on-line.

■

BROADCAST engineering

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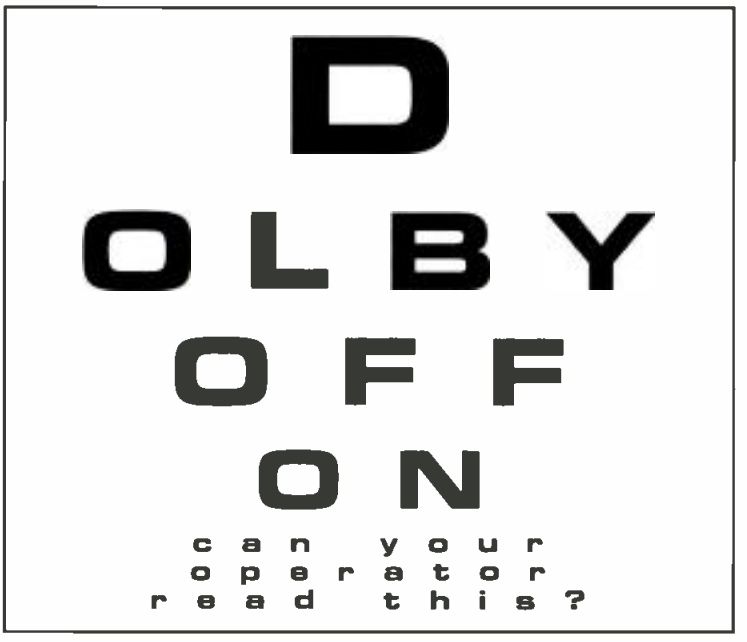
Editorial

Asleep at the wheel

I recently received a letter from a reader describing what he believes to be a common problem with TV audio. The problem centers on the misuse of the Dolby noise-reduction system with videotape playback. It seems that many tape operators are unaware of the need to switch *off* the tape machine's Dolby decoder before playing back non-encoded tapes. The letter notes:

"As you know, Dolby is a 2-stage system that compresses audio before recording and expands it upon playback, thereby reducing tape noise. Therefore, for the audio integrity to be maintained, audio that is played back through Dolby decoding equipment must have first been recorded through the same process.



Unfortunately, this crucial recording/playback relationship is routinely overlooked or ignored by TV audio engineers. Audio that has not been Dolby encoded is often played back through the machine's Dolby decoder circuitry — resulting in a choked, suppressed and muffled sonic quality. When this occurs, speech becomes less intelligible, and the music becomes dull and lifeless. Low-level audio material (such as background music and crowd sounds) is, under these conditions, expanded to such an extent that it is sometimes unintelligible. A related problem occurs when playback levels into the Dolby decoders do not match the original record levels. Playing back audio into the decoders at a level lower than the original record level also results in sonic dulling. These effects are not subtle.

I bring this problem of the misuse of Dolby noise-reduction technology to your attention not to denigrate TV broadcasters but to perform a public service. The broadcasts of ABC, CBS, NBC, CNN, HBO, Cinemax, VH-1, MTV, BET and local TV stations are regularly marred by the practice of playing back through a Dolby decoder, audio that was not Dolby encoded."

After receiving the letter, I contacted Dolby officials, who confirmed the issue as a too-common problem. The error stems from videotape operators not properly setting up their tape machines prior to playback. Fortunately, the solution to the problem is relatively easy and painless.

First, all of your tape operators should be trained properly on how to set the machine for proper playback for encoded and non-encoded tapes. Although there *should* be a Dolby level-set tone at the tape's head, operators must not rely on the presence of a tone as the singular deciding factor. They should be able to *hear* when the tape machine's decoder switch is in the wrong position. Also, be sure they know how to recognize the difference between a Dolby level-set tone and a slate tone.

Second, make certain your tapes and boxes are properly labeled. Stickers are available from Dolby Laboratories to make identification of encoded tapes easy and foolproof.

Finally, when using Dolby encoding, be sure to place a level-set tone at the head. Also note on the box label how the playback levels should be set.

Don't let your operators fall asleep at the wheel when setting up tapes. Noise reduction is a wonderful technology, but only if it's used properly.

Brad Dick,
editor

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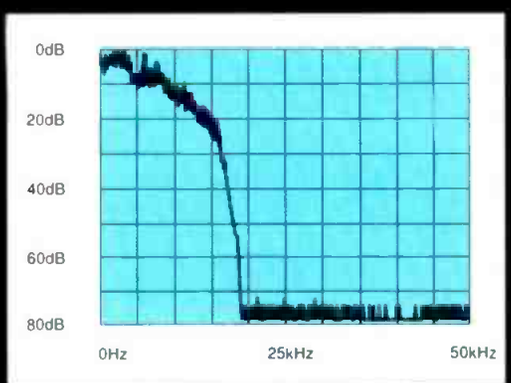

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Circle (6) on Reply Card

FCC Update

Telcos offer video services

By Harry C. Martin

In July, the FCC amended its rules to allow local telephone companies to offer video dial-tone services, including TV programming and 2-way interactive services.

Related initiatives include:

- Recommending to Congress that it repeal the telco-cable cross-ownership ban (Section 613[b] of the Communications Act), so telcos could provide TV programming directly as well as on a common-carrier basis.
- Proposing that the rural exemption to telco-cable cross-ownership be amended to permit telcos to provide video programming directly to their customers in areas with less than 10,000 people. The rural exemption is applicable to places of fewer than 2,500 people.
- Permitting telcos to have up to a 5% interest in video programming entities.

Under the new rules, local telephone companies may provide video dial tone to the public consistent with the existing regulatory framework for non-video enhanced services and subject to the following additional requirements:

- The commission is prohibiting local phone companies from purchasing existing cable facilities in their service areas for the purpose of providing video dial tone. However, the commission will continue to permit phone companies to acquire existing cable physical plant for the purpose of leasing those facilities back to the cable operator.
- Local phone companies wishing to offer video dial tone must make available to multiple service providers, on a non-discriminatory common-carrier basis, a basic platform that will deliver video programming and other services to end-users.
- Local phone companies will be permitted to provide additional enhanced and non-common-carrier services to customers of the common-carrier platform.
- The commission will apply existing safeguards against anti-competitive conduct, and will assess whether additional safeguards would serve the public interest in the context of specific video dial-tone service proposals.
- The commission will review its rules and regulatory framework beginning in three years.

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

Annual user fees specified

In August, the FCC sent to Congress a schedule of proposed annual user fees to cover the costs of the mass media regulatory activities. (See Table 1.)

CLASS	NO. OF LICENSES	ANNUAL FEE ($)
Clear-channel AMs	77	550
Regional unlimited time AMs	1,776	125
Local unlimited time AMs	1,018	125
Daytime or limited time AMs	2,081	125
Class C, C1, C2 or B FMs	2,268	550
Class A, B1, C3 or D FMs	2,439	125
VHF-TV, top-50 markets	176	4,000
UHF-TV, top-50 markets	506	2,000
UHF-TV, markets 51-150 & VHF-TV, markets above 150	340	1,000
UHF-TV, markets above 150	100	500
LPTV/TV translators/TV boosters	7,449	125
Broadcast auxiliaries	50,000	125
CARS stations	2,192	175
Cable systems	—	225 per 100 subscribers

Table 1. Schedule of proposed annual user fees to cover the costs of the FCC's mass media regulatory activities.

FCC cancels silent AM stations

Through a separate Show Cause and Hearing Designation Order, the FCC is moving to cancel the licenses of AM radio stations that have been off the air without authority for extended periods of time. In each case, the commission was unable to communicate with the licensee, or the licensee failed to respond to at least one official letter of inquiry concerning the station's silent status.

In moving against the first 10 silent stations, the agency granted authority to its Mass Media Bureau to issue and release similar orders in future silent station cases.

FOB spot-checks AM spectrum use

Earlier this year, the Field Operations Bureau (FOB) measured the signal characteristics of 174 randomly selected AM stations to determine compliance with Section 73.44 of the commission's rules, which limits how much spectrum AM stations can use. In July, the FOB completed analysis of its survey data and found that 94% of the stations were preventing transmissions of unwanted signals.

However, 11 stations had signals that exceeded the limits imposed by Section 73.44. The rules specifying AM signal characteristics were adopted in April 1989, and were modeled after standards established by the National Radio Systems Committee (NRSC).

Hard look FM processing relaxed

The commission has relaxed its "hard look" approach to processing commercial FM applications. Under the more liberalized approach, the applicant may amend to correct data errors and omissions during the initial 30-day amendment-as-of-right period. Good cause showings are not required during this 30-day period. A second amendment window will close at the end of the 30-day period specified in any FCC staff deficiency letter to the applicant.

Amendments during this second stage will be limited to those making the traditional showing of good cause or those that correct tender or acceptance defects. After this second-stage window closes, there will be no further opportunity for amendment without a showing of good cause. Applications with uncorrected tender or acceptance defects remaining at this stage will be dismissed. ■

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Circle (7) on Reply Card

Strictly TV

Pan to the left

By Curtis Chan

Imagine that it's Super Bowl Sunday 1996. You are sitting in your favorite chair enjoying the game. It's fourth down and 20, and your team is going to attempt a field goal. The TV screen shows a wide shot from the sidelines. You want to know what the coach is doing. No problem. You pick up the remote control, tilting the joystick to swing the view from the players to the bench, where the coach stands. Then, you pan again to capture the band and the benched players' expressions as the ball is kicked — field goal!

As you sit back, you wonder how you ever got along without this added function on your remote control, when only a few years earlier (1992), it was a research project at Bellcore (Bell Communications Research). The process is dubbed *electronic panning*, and was invented by Lanny Smoot, director of multimedia communications systems research. Now, instead of the picture image being confined by the edges of your TV screen, your view is limited only by your imagination. With electronic panning you become the director.

An overview

Bellcore's experimental camera system, together with a high-speed communications network, will allow an unlimited number of people in separate locations to view a scene from an infinite number of directions. The electronic panning camera incorporates Bellcore-created technology that allows users to visually scan a remote scene while the camera and lens remain stationary. A variety of interfaces allow the viewer to electronically move the picture they are viewing to the left or right, beyond what is normally shown on the screen.

With one interface, viewers touch the TV picture to control the angle of view. Another interface uses an infrared control unit. A third interface locks onto physical movement of a selected object on the scene and automatically tracks it.

Tying the system together

The system operates simultaneously with a communications link connected to the central switching office to let the electronic controller know what to feed down the signal path, based on the viewer's selection. At the central switching office, a card that ties to the subscriber's phone line receives commands from the viewer and sends compressed video information back down the line, all in real time.

Your view is now limited only by your imagination. With electronic panning, you become the director.

The bandwidth of the system must accommodate, at the least, VCR-quality TV signals, data and (possibly) voice information. Because of the uniqueness of this interactive system and the potential of the multitude of on-line subscribers, on-air and cable use are unlikely in the short term, or until fiber or an interactive on-air transmission-viewer communications link becomes cost-effective and widespread. This leaves the ubiquitous tried-and-true standby, copper-based telephone networks, as the most practical medium.

VCR-quality television, voice and data can be sent simultaneously over a single copper telephone line. The proposed asymmetrical digital subscriber line (ADSL) technology with digital processing can expand the transmission capacity of current copper-based networks. Processing raises weak transmissions to acceptable levels with VLSI devices, instead of expensive computers.

The ADSL technology is proposed primarily for the customer loop — that part of the telecommunications network that links residence and business customers to the central switching office. The reasoning is that fiber currently does not link the vast majority of telephone subscribers. ADSL is not meant to take the place of fiber-optic networks, whose bandwidth will be able to provide services, such as multimedia communications and HDTV, which copper-based networks cannot handle. ADSL can provide enough capacity for customers to receive VCR quality along with a regular phone call. ADSL will probably use real time compression of video signals to 1.5Mbit/s.

Other uses

The electronic panning system, connected to a high-speed telecommunications infrastructure, could find applications in classrooms and the workplace, as well as enhancing leisure-time activities. One business application of electronic panning is enhancement of desktop videoconferencing. Viewers could adjust their screen to see the speaker and people on the sides, as well as for a greater sense of being there. This could allow company executives to interact more closely with large groups of employees at satellite offices.

In tele-education, where the teacher instructs class over long distances, videoconferencing has already demonstrated the potential for distance learning, but it lacks a strong feeling of personal interaction between student and teacher. Electronic panning allows virtual one-on-one communication. An electronic panning camera in the classroom can automatically follow the teacher. The student may choose to see other areas of the classroom as well.

If this electronic panning system gets off the ground, it could mean a much different perspective and approach to television of the future. It would allow an unlimited number of people in separate locations to view a scene from an infinite number of viewing angles. Without major changes to current technology, this enhancement to TV viewing will bypass broadcasters and cable operators at the outset. For the phone companies, it will bring a new complexity to the systems already in place, requiring extended 2-way links combined with intermittent network use of standard telephone calling.

Chan is a principal of Curtis Chan and Associates, Fullerton, CA.

Acknowledgment: We would like to thank Lanny Smoot, director of multimedia communications systems research, and Paul Shumate, division manager of distribution network technology research, Bellcore, Piscataway, NJ, for their assistance. ■

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re: Radio

Transcoding transgressions

By Skip Pizzi, technical editor

Emotional reactions aside, audio data compression may indeed have a beneficial impact on society. The relatively small amounts of audible degradation that these *perceptual coding* algorithms seem to impart is a small price to pay for the opportunities they allow, digital radio broadcasting among them. (See "Digital Audio Data Compression," February 1992.)

But these advantages may prove to be such systems' undoing. Data compression's seductive and widely applicable nature virtually guarantees its frequent appearance in the professional and consumer audio environments of the future.

This implies that an audio signal will likely pass through *several generations* of one or more compression algorithms between its original recording and its eventual playback by the end-user. This process is referred to as *transcoding* or *tandem coding*. Such a cycling process occurs even if a standard digital audio interface (for example, AES/EBU or SPDIF) is used between devices.

Transcoding paradigms

Although most listeners agree that the aural quality of today's best data compression algorithms is good, such claims are typically based on hearing audio passed through a compression system only *once*. What happens when the once-compressed and reconstructed signal is transcoded a second time? A fourth time? A tenth time?

Such high transcoding orders are not extreme considerations. It's conceivable that audio in a typical news story of the near future might experience data compression in its field acquisition, in rough-edit transfer, upon transmission via telco, in post-production, during distribution to a network of stations, on those stations' STLs, on the digital radio broadcast system, and finally on the consumer's digital recording device.

At each of these transcoding stages, bit-rate reduced audio data is reconstructed to approximate the original 16-bit linear PCM, and then recompressed. Whether this iterative process produces any significant additive loss demands thorough investigation, which is now under way.

Knowing that bit-rate reduction algorithms exploit the *spectral masking* phenomenon of human hearing for the bulk of their data reduction, you might expect that an algorithm's masking accuracy breaks down after multiple transcodings, and the noise or distortion associated with low-resolution coding becomes audible.

Interestingly, for most systems, this is *not* the case. Instead, the most noticeable degradation that transcoding can cause occurs in the *time domain*. Remember that these algorithms must continually analyze the spectrum of the audio signal to determine what masking will take place, thereby informing their bit-reallocation processes. But a spectrum is not defined instantaneously — it can only be determined by examining the recent history of the signal and analyzing the *rate of change* between successive amplitude values (or successive samples, in the digital world). So to obtain information about the current audio spectrum, a contiguous group of audio samples is collected in a buffer (or *window*), then evaluated and processed as a whole.

Data compressors thereby sacrifice time-domain resolution to obtain frequency domain resolution, and the resulting time-domain distortion is indeed an additive function when repeatedly applied. Transcoding increases temporal resolution loss to the point where time-domain distortion may become clearly audible. When heard, most listeners characterize these artifacts as decidedly unsubtle, sounding like fast flanging or chorusing effects. Transient attacks may also sound softened, splattered or even "reversed" (ramped). Temporal resolution loss causes a coherent original transient to be spread over a longer period of time.

This presents an interesting paradox: Digital audio, the technology that took time-domain distortion *away* from storage media, is now introducing it to transmission media.

Trade-offs and solutions

How much of this temporal distortion occurs on each pass is highly dependent on an algorithm's window size. The two general classes of perceptual coders, *subband* and *transform*, require extremely different window sizes. Subband coders need only determine the general spectral *vicinity* of a particular piece of audio data before sending it off for bit reallocation, so short windows are used. Transform coders, on the other hand, must determine a fairly detailed, full spectrum from each block of audio data, so windows are longer. (Some recent transform designs incorporate *variable* windowing, which adaptively switches to a shorter window when transient energy is present; other coder variants combine elements of both transform and subband designs.)

There is also the issue of manufacturing cost, which in some cases favors the longer-window systems. Finally, systems that perform well at the higher broadcast data rates (128kbit/s and up) may not be the ones that sound best at the lower telco rates (64kbit/s and below). So there seems to be no single, ideal, one-size-fits-all approach. This is why *multiple levels* of standardization have been proposed (such as ISO/MPEG Layers I, II and III).

Nevertheless, given enough transcoding generations, it can be argued that *any* system will exhibit temporal artifacts (although problems will become evident on some systems in fewer passes than others). Therefore, the ultimate solution to the transcoding dilemma requires the establishment of a *compressed digital audio interface* standard. A few control bits in a frame-header could inform adaptive multirate decoders of the compression algorithm currently in use (if any). This would allow the audio signal path and pedigree to retain originally compressed data, and eliminate the repeated reconstruction and recompression of transcoding. It might also allow greater reductions in bandwidth and hardware costs. Incidentally, this is the paradigm currently under consideration for HDTV transmission — compress *once* at the start of the chain, and keep it that way until the signal is viewed by the end-user. Let's hope the digital audio industry realizes the value of this approach before it's too late.

■

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Part 1

Management for Engineers

Dealing with difficult employees

Understanding the difficult employee

By Judith E.A. Perkinson

"How many times do I have to explain this to you?" "What part of no don't you understand?" "Excuses, excuses — what does it take to get the job done?"

Do you ever think of saying these kinds of things to a fellow employee? Sometimes, it's difficult to work with certain people. But when the difficult person is your employee, then that person isn't just an annoyance, he is your responsibility.

Although there are many ways of dealing with a difficult employee, some methods are better than others. Ignoring the problem is usually unsuccessful. Firing the person may solve the problem, but it is not always possible to do so. More important, difficult employees are often valuable because of their skills, knowledge and experience. Smart managers search for ways to turn a problem employee into a productive worker. The process begins with understanding difficult employees.

What is a difficult employee?

Not all difficult people are difficult employees. Just because you have a personality conflict with someone doesn't make that person a problem. A difficult employee is someone who does not perform a job satisfactorily, creates problems with or for the rest of the workers on the job, and/or prevents others from performing their job.

It is important to understand that not all people who present problems to you as a manager are trying to be a problem. There are many reasons why a worker may seem to be difficult. First, identify the nature of the conflict involving the difficult employee. Next, remove the obstacles that may be inhibiting successful job performance, or limit the influence the worker has on the total effectiveness of the staff.

Different strokes

Learn to handle problem employees by recognizing the types of workers who prove to be difficult to supervisors. Most difficult employees fall into one of two categories.

Perkinson is a senior member of The Calumet Group, Inc., Hammond, IN.

- *Category 1.* These are employees who may have a problem they aren't quite sure how to resolve. They want to do a good job, but have a deficiency that prevents them from performing their job successfully. These deficiencies include:
  1. lack of information.
  2. lack of equipment or materials.
  3. time problems.
  4. lack of skills or understanding.

The first step in dealing with difficult employees is to commit to giving each difficult worker a chance to change.

All of these deficiencies probably can be overcome. And when they are, the employee may be able to better perform his duties. Furthermore, the employee most likely will approach his job with greater enthusiasm, because he feels he has been treated fairly and compassionately. Perceptive managers will determine these deficiencies and offer the employee the necessary resources to do a good job.

- *Category 2.* These are people who are not performing well and don't really want to change. Resolving this situation is more difficult. Use the same approach for this type of employee as you would with those who fall under category 1.

Building a supervisory standard

All managers should have a standard approach to dealing with difficult employees. This approach should be defined and used consistently. An inconsistent and/or uneven supervisory reward-and-punishment system can make difficult employees out of good employees, allow difficult employees to go unchecked and diminish the manager's leadership capabilities.

Begin your supervisory standard with the assumption that your workers want to do a good job. By doing so, you create a positive atmosphere and project a sense of fairness. Starting with this assumption will probably automatically divide your employees into the two categories discussed earlier. This effort also will enable you to take the necessary actions to deal with a category 2 employee.

Communication is the key

You are not a mind reader, and neither are your employees. Nothing is clear until it is communicated. As a supervisor, you are responsible for communication. Effective employee improvement requires a clear communication system. Just saying something is not enough. Remember the following when you are dealing with employees:

1. People do not always pay attention when you speak.
2. Just because people say they understand doesn't mean they necessarily do.
3. Saying the same thing over and over (and loudly) does not ensure the listener will understand.

To make sure that you communicate your needs and concerns about an employee's performance, attitude or behavior, develop an approach to communication.

You approach should be as nonthreatening as possible. An employee who is called in by the boss to discuss a problem concerning his performance is bound to feel anxious. Therefore, it is important that you provide employees with a framework that gives them the opportunity to solve the problem.

It is difficult for most people to admit they have deficiencies, because it is tantamount to admitting failure. That is why it is critical that you, as a supervisor, communicate clearly that the process is not designed to accuse, condemn and punish, but to make the employee more successful.

Thus, the first step in dealing with difficult employees is to commit to giving each difficult worker a chance to change. Without this chance, the relationship between you and your employee is almost certain to be combative and unproductive.

Next month, we will examine the 5-step employee improvement process. ■

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Part 2

Circuits

AC power basics

3-phase power

By Roy Trumbull

In 3-phase (or *polyphase*) power transmission, each of the three transmission lines is 120 electrical degrees away from its two partners. When 3-phase voltage is rectified, the DC value never drops to 0V, because of the overlapping waveforms on the three conductors. The resulting raw ripple of a 3-phase, full-wave rectifier is 360Hz, which requires less filtering than the 120Hz of single-phase rectification. (Single-phase power *does* dip to 0V.) For this reason, transmitters rated 5kW and higher are nearly always wired for 3-phase power.

The most common customer connection for 3-phase power is called the *wye*, in which one end of the winding for each phase is tied to a common point to form a neutral. (See Figure 1a.) This creates the situation called *3-phase/4-wire*, a common industrial utility interface.

Role of the neutral

If the load is perfectly balanced (i.e., current supplied by each phase is equal), no current flows in the neutral. However, this condition rarely occurs, and the neutral conductor often carries current, thereby compensating for load imbalances between phases.

The neutral also provides a path for the removal of harmonic currents generated in the load, as is often the case when switching power supplies are involved. To better handle these demands, today's trends dictate that the wire diameter of the neutral should be twice that of the current-carrying wires. (In the past, the neutral had been sized the same as, or smaller than, the hot conductors.)

Derivation of values

In a typical 3-phase/4-wire (wye) system, the voltage between any phase and neutral will measure 120V. But what is E_{LINE}, the voltage between one phase and another? As in Part 1 (see August's "Troubleshooting" column), trigonometry holds the solution. Consider an isosceles triangle (see Figure 1b) in which two sides (AN and BN) are each 120V, and the included angle ($\angle$ANB) is 120°. The remaining side (AB) is the unknown voltage. The two remaining angles are each 30°.

Although there are several ways to proceed, my preference is to bisect the 120° angle to form two equal 30°-60°-90° right triangles (ARN and BRN), in which the hypotenuse (AN or BN) is the given value of 120V. The base of each right triangle (AR or BR), which is half of the unknown voltage, can be solved as x = 120(cos30°), or 120(0.866) = 104. E_{LINE} (AB) is therefore 2(104) = 208V.

If we assume the case of *unity power factor* (see Part 1 of this series), the total power in a 3-phase circuit is P_{TOT} = $3E_{PHASE}I_{PHASE}$, or simply the sum of the power from each phase. However, we normally think of circuit power in terms of *line* voltage. In the wye configuration, E_{PHASE} equals $E_{LINE}/\sqrt{3}$, and I_{PHASE} is the same as I_{LINE}. Therefore, substitution provides $P_{TOT} = 3(E_{LINE}/\sqrt{3})I_{LINE} = \sqrt{3}E_{LINE}I_{LINE}$.

A less common customer-side arrangement supplies power in the *delta* configuration, where one winding simply connects to the next, forming a triangle. (See Figure 1c.) Here, *current* between lines share the 120° phase relationships that *voltage* between lines held in the wye configuration. Therefore, for a balanced load in delta, $I_{LINE} = \sqrt{3}I_{PHASE}$, while $E_{LINE} = E_{PHASE}$. The formula for P_{TOT} is the same as in wye.

To account for power factor (the angle between E_{PHASE} and I_{PHASE} in wye and delta), the complete formula in either configuration becomes:
$P_{TOT} = 1.732E_{LINE}I_{LINE}\cos\Theta$.

A final note: Single-phase power is distributed at a delta site through a wye transformer, to provide a neutral and to split the load between phases. Some high-voltage equipment (such as a transmitter) may be equipped with 3-phase delta primaries, however. Careful observation of phase rotation is important when wiring these devices. Although the power supply will create DC in any event, a wiring error on a 3-phase blower motor will make it run *backward*. Simply swapping any two of the three leads will correct the rotation.

If the load is perfectly balanced, no current flows in the neutral. However, this condition rarely occurs.

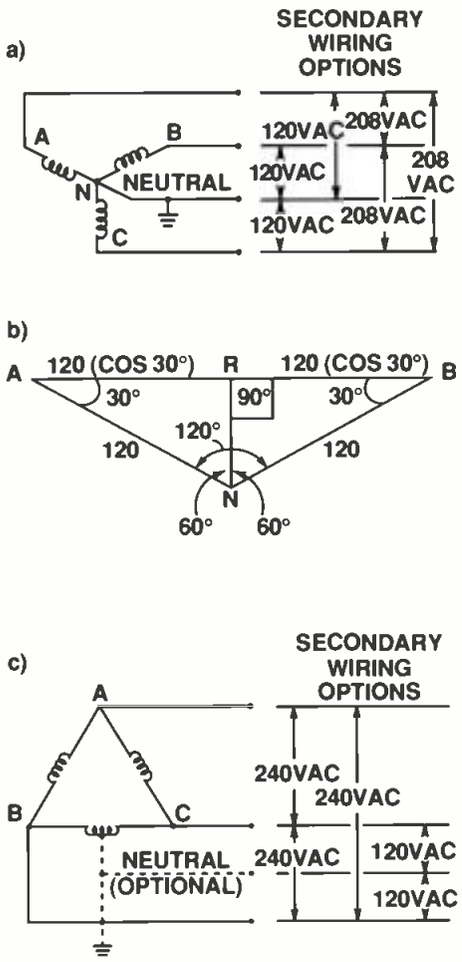

Figure 1. In (a), the wye configuration for 3-phase/4-wire power interfacing is shown. In (b), the trigonometric equivalents are presented, while (c) shows the delta configuration.

Trumbull is assistant chief engineer for KRON-TV, San Francisco.

Further reading

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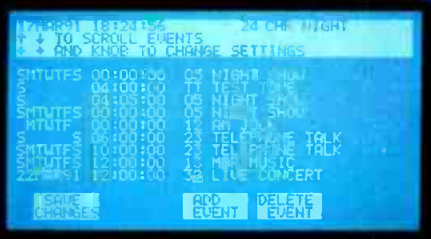

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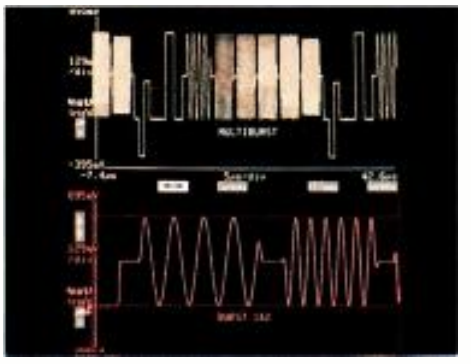
Part 1

Troubleshooting



Maintaining telephone systems

Cracking the closet door

By Steve Church

It's amazing how many broadcast engineers take on the heavy iron and high RF of the transmitter shack without a moment's hesitation, but turn into a quivering mass at the prospect of entering the dreaded *phone closet*. Such anxiety is probably the result of a lack of knowledge.

This column begins a 6-part series exploring some important parts of the phone system: PBXs, key systems, digital phone systems, TI bridges, Switched-56 and ISDN. The focus in all of these areas will be on practical tips for real world phone-closet troubleshooting.

It has been more than a decade since the end of Ma Bell's all-encompassing jurisdiction over the station telephone system. Yet, we still call the phone service repairman when there's a problem. Many engineers think it's the one area in the station that somebody else has to worry about. So why should the broadcast engineer bother to learn about the phone system? Here are a few reasons:

- *It's another way to endear yourself to the GM.* In these days of shrinking engineering staffs and budgets, it makes sense to enhance the department's value in any way possible. Many engineers have gone this route with computer equipment, and have found a satisfying pay-off. Phone equipment repair service is generally extremely expensive, so there is a significant and visible monetary reward for doing some of this work in-house.

- *Occasional necessity.* What do you do when the PBX goes down just before your highly rated evening sports talk show goes on the air? Your phone service provider may be terrific, but usually all you'll get when you call at 8 p.m. is a recording.

- *Curiosity.* You really do want to know how everything in the building works, don't you? Isn't this what motivated you to join the engineering ranks in the first place?

- *Improved audio interfacing.* A better understanding of the entire phone system helps you do a better job with the part of it that you *have* to deal with: telephone interfacing for on-air use.

Church is president of Telos Systems, Cleveland, OH.

A look inside the closet

An important feature of the phone system is the big piece of plywood *backboard* on the wall, covered with standard-issue telco 66 punch-blocks and other intriguing pieces. It might look intimidating, but certainly no more so than your studio installation looks to the telco crew. Just as with studio wiring, each phone installation is unique, but there is a common pattern.

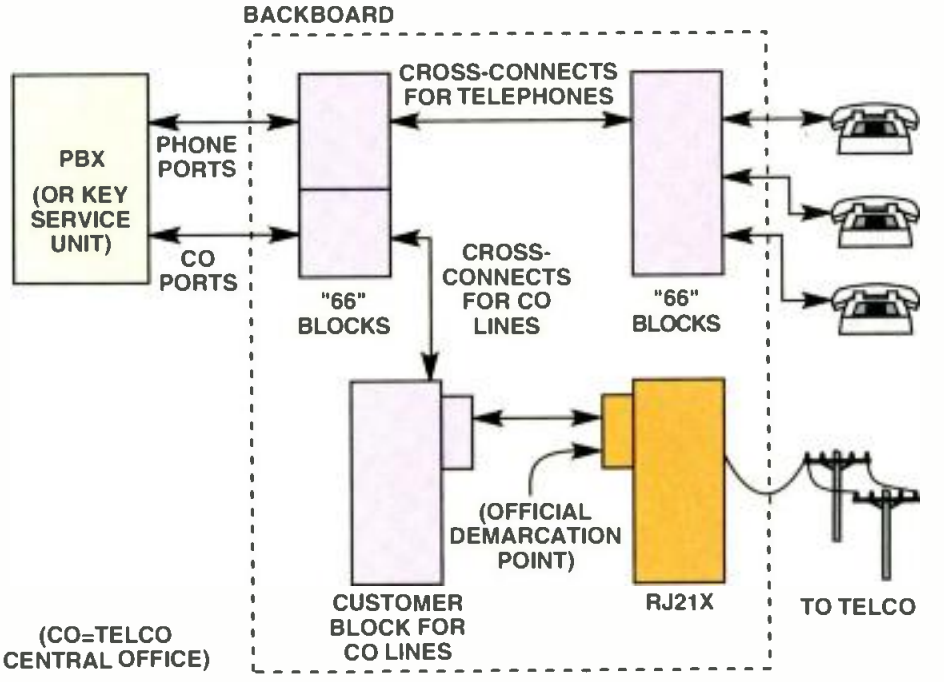


Figure 1. *Basic layout of a typical phone closet backboard.*

A well-crafted backboard will have areas devoted to three simple functions:

1. The connections for all of the telephone sets. These blocks will be where all of the local wiring leading to the station's phone instruments will terminate. They will probably be labeled by extension number.

2. The interface to the PBX or key system. This includes input connections for the telco lines and outputs ultimately bound for the phone sets. Some special auxiliary functions may also be located somewhere, such as an input for music-on-hold or an output for paging.

3. The incoming lines from the telco central office (CO). Lines arriving from the CO will go first to a special block with an orange-colored cover and a female 50-pin blue-ribbon jack fitted to one side. This block is owned by the phone company, and you are not supposed to disturb it.

Connector wiring follows a sequence labeled on or near the block. This configuration is called an RJ21X and serves as the official demarcation point between telco and customer property. The block will usually have bridging clips on each line, allowing telco technicians to isolate problems to either their lines or your customer-provided equipment (CPE). The RJ21X will usually connect directly to another block via a mating 50-pin plug. This is the point where all of your equipment meets with the outside world.

Next month, we'll come out of the closet and study some rules of the telco troubleshooting game. ■

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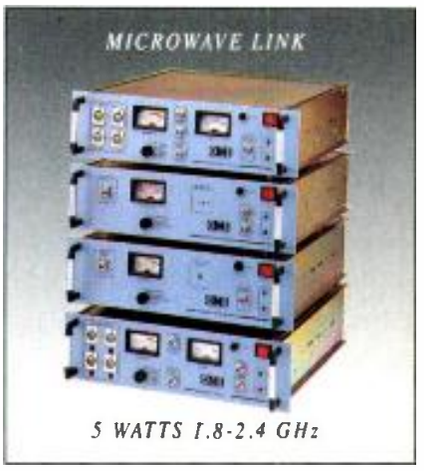

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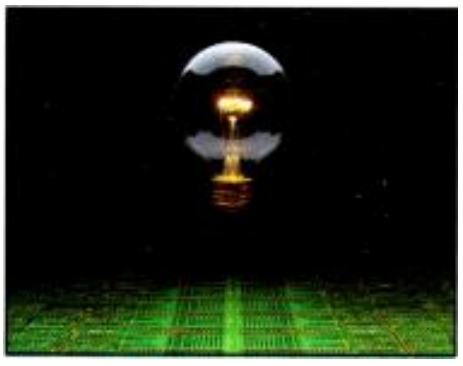

By Michael Arbuthnot

Digital Component Technology (DCT), an integrated video production system recently introduced by Ampex, has important implications for the post-production industry and its interface with broadcasting. Broadcasters will, no doubt, take more time to contemplate the advantages of this digital component system, but post-production facilities will find immediate effects as the trend toward improved picture quality and effects continues.

Tape handling

The speed, gentleness and accuracy of tape handling is one area of particular interest to post-production. Speed is a key to the DCT 700d transport. It can accelerate from standstill to 60× play speed in one second, recue a 30-second spot in 1.5 seconds and rewind a 30-minute spot tape in 30 seconds. The transport accepts three sizes of cartridges with a maximum play time of more than three hours to accommodate an entire feature-length film.

The tape-handling characteristics of the transport are especially important because of the thin media (13 micron) and the narrowness of the signal tracks. Speed is also a major concern from a business standpoint for post facilities, because it helps engender an atmosphere of enhanced creativity by providing clients with more time to make more choices.

The development of the 19mm transport uses a design technology based on reliability (the VPR-3 philosophy), which has been widely accepted in TV production. In the new transport, users will find a combination of familiar and new design features. For example, the gas-film technology of the VPR-3 for tape handling feeds compressed air through laser drilled holes in the tape guides. The tape rides on a layer of air and thus reduces friction.

Transport characteristics

In terms of new technology, more than 100 newly designed application-specific circuits (ASICs) have been implemented. These devices permit an overall reduction in drive size, weight and power consumption. The system uses a direct-coupled, pinch roller-less capstan, which essentially functions as the primary controller device for all transport control functions: play, rewind and the like. The advantage of this approach is the elimination of the potential for tension variations between reels and the tape damage to which torque-type transport systems are prone. At the same time, this arrangement improves the speed characteristics of the transport and provides for virtually instantaneous transport mode transitions.

Arbuthnot is new products development manager, Ampex Systems Corporation, Redwood City, CA.

Speed is a key to the DCT 700d transport.

A factor that has always been of major concern with new recording formats is that of *interchange*. Interchangeability is addressed with a separate stainless steel guide band around the scanner. This is a change from the design of transports for existing recording formats. The guide is usually crafted of aluminum and is often milled onto the scanner assembly itself. As signal track widths become considerably narrower in the new digital formats, it was necessary to take extra steps to ensure long-term interchangeability in this format and allow interchange compatibility for the life of the scanner.

Another concept that provides gentler tape handling concerns guides along the tape path. The number of guides along the overall path was purposely kept to a minimum, particularly for those that make direct contact with the magnetic surface. Because the edges of recording tape are prone to damage, edge guiding was avoided except where necessary. Four of the guides closest to the scanner are designed with tilt and height adjustments to facilitate transport alignment.

Tape loading

From a tape's standpoint, loading and threading of tape through the path is one of the most critical processes of system operation. For that reason, two modes are in use. One is a coplanar mode. The transport is operational, but the tape is not wrapped around the scanner. With this mode, the operator is able to search and cue material based on time-code information without having the videotape placed in contact with the video heads. This reduces wear and tear on the video heads considerably.

For the second mode, the tape is fully threaded and makes contact with the scanner. In this mode, the transport operates at full speed while cuing. Pictures can be viewed during shuttle operation. Mode selection is controlled by a "ready" selector button in the on or off position.

Computer analysis

All stages of the tape path geometry have been precisely plotted with a special analysis program using a series of orthographic dimensional projections. The end result is a tape path system that is patented and is independent of format, tape width, scanner diameter or wrap angle. As such, the geometry may be applied to future applications beyond this format.

Of all the parts in a recording transport, the video heads are the most vulnerable. Considering the amount of use and abuse that a transport receives in post-production, this design provides for field-replaceable heads. All six are easily replaced by the technical staff at the facility in a matter of minutes. This feature reduces the downtime related to head failures.

Other features include 525/625-line switchability to meet the needs of facilities dealing in multiple standards and eliminate the need for multiple systems. A 3.5-inch floppy disk drive accommodates future software updates.

The cost of time

Many post-production clients want a quality product, but they also want the money they spend to be as productive as possible. Any expense that can be trimmed without degrading the project adds to profitability and repeat business. The cost of the more mundane functions of tape rewinding, fast forwarding and cuing in the DCT transport has been reduced without endangering the medium. ■

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With its hugely successful DN-970 and DN-950 CD Cart™ Players, Denon helped make CDs the broadcast media of choice. Given the success of these industry-standard players, there were only two things Denon could do: 1. Make a CD Cart player that is smaller, faster, smarter and better; 2. Make a pro CD player that is *not* a Cart player. Denon did both.

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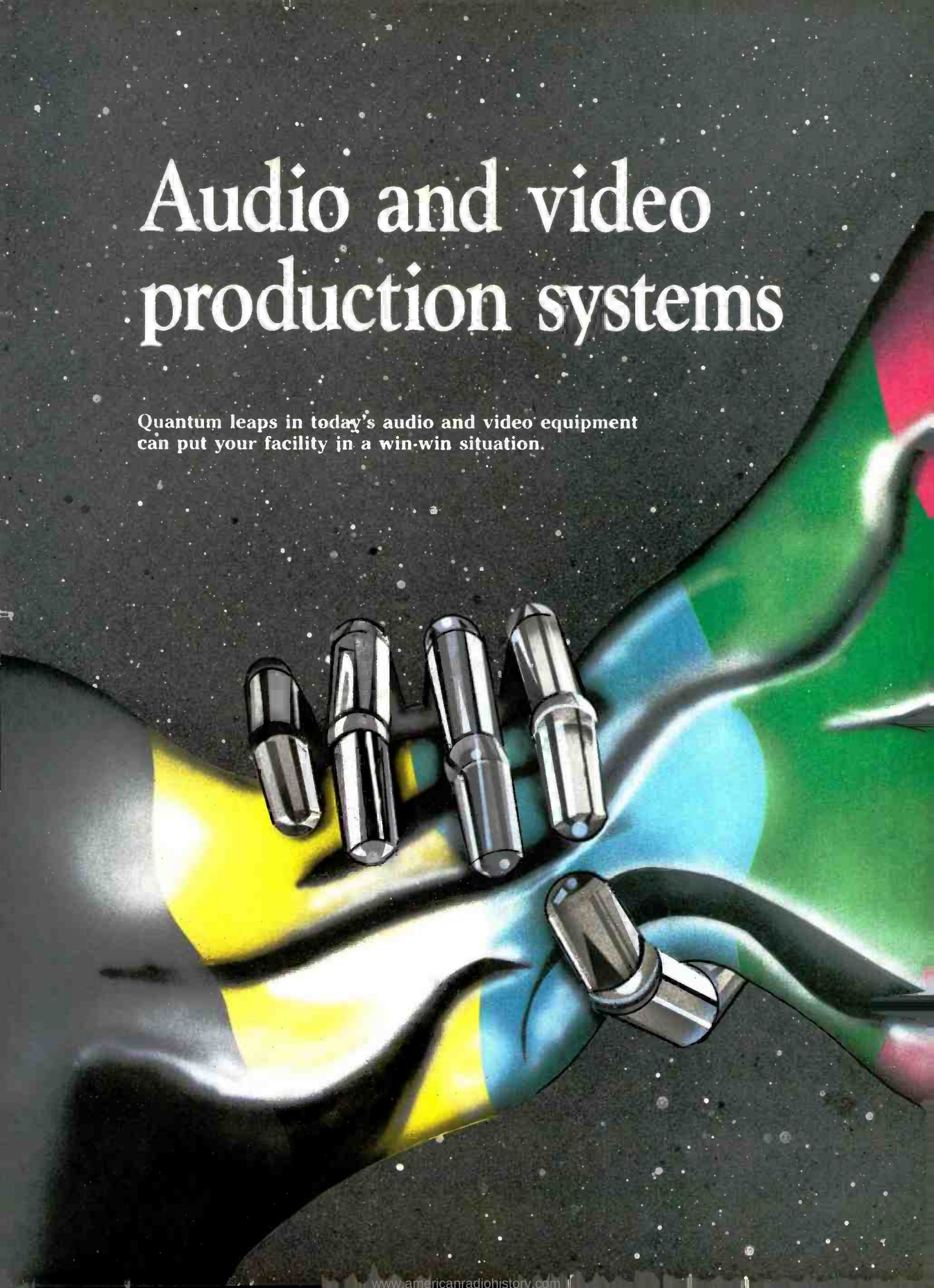
Audio and video production systems

Quantum leaps in today's audio and video equipment can put your facility in a win-win situation.



A few years ago, I was rummaging through a TV studio storage room at the university where I worked. Among the typical castaways of old cables, racks, trays and 16-inch turntables was an old chroma-key system. The device occupied more than two racks of space and required I don't know how many tubes. Today, cameras and recorders have been integrated into single systems that only weigh about a pound.

The same quantum leap in features and size reduction has occurred with most of our modern feature-laden production equipment. This, combined with its cost-effectiveness, has produced a win-win situation for production staffs. Where it used to require racks of hardware (and lots of money) to provide graphic, paint and animation capabilities, today all of these features and more are housed in video production systems that can reside on a desktop.

I recently was treated to a firsthand example of the power of such equipment. Although I consider myself fairly competent with computers, I'm by no means artistic. Yet, within a few hours, I was able to create some basic images and simple movements that impressed even me. So what if my efforts were far short of being airworthy — the experiment reaffirmed the tremendous power and user-friendly capability of today's video equipment.

Audio production equipment has enjoyed similar dramatic enhancements. The features and capabilities of a digitally based console would have been unheard of (if you could have afforded them) just a few years ago. Automation, digital inputs and outputs, and reconfiguration at the press of a button are now commonly available features.

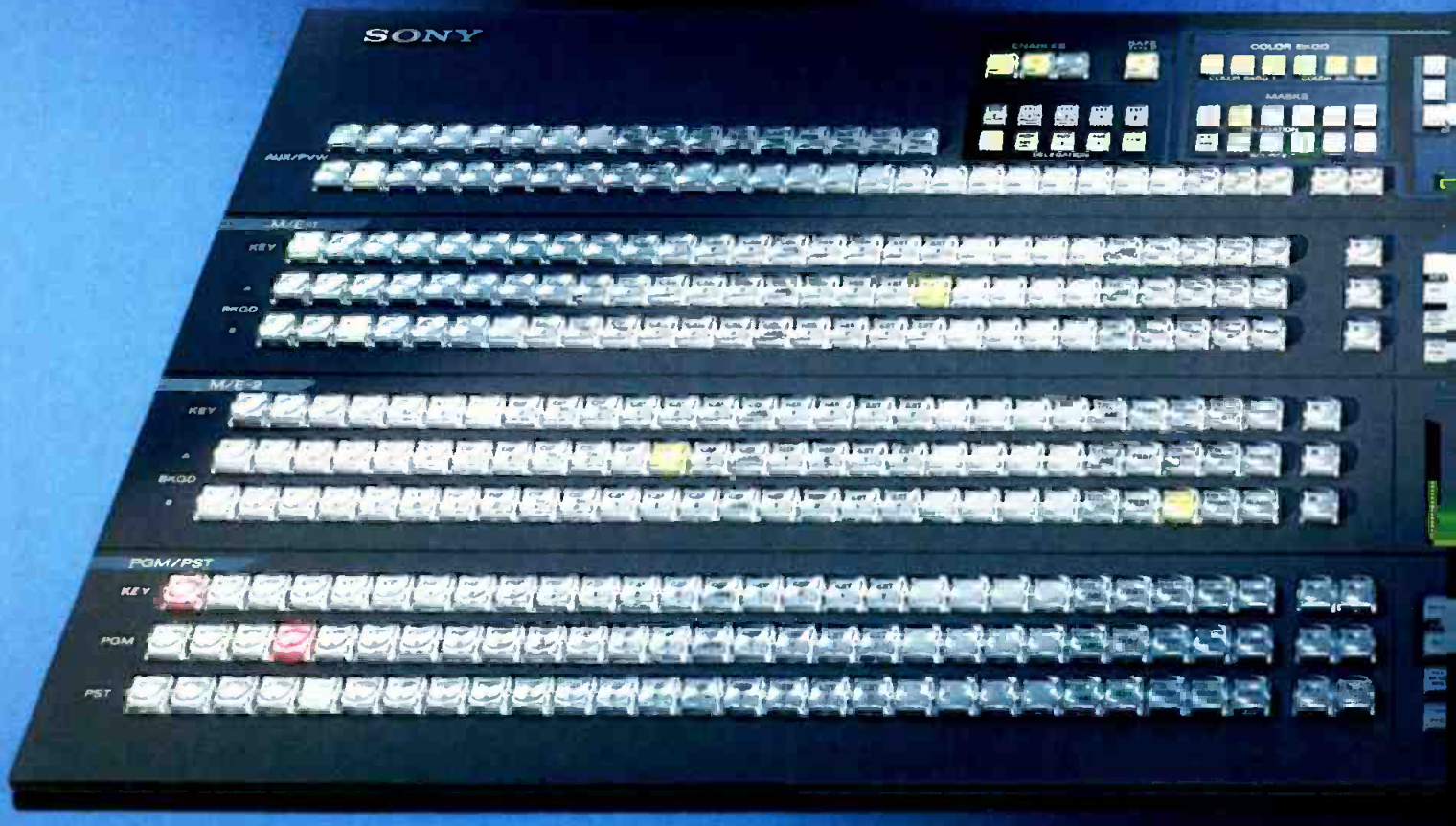
One result of this technological revolution is that producing audio and video programming has never been easier — or more fun. A more important result is that higher-quality programming is created — and costs less to produce.

If you haven't yet considered carefully the advantages provided by today's audio and video production systems, don't wait any longer. The chance to outdistance your competition may be as close as your production room, provided it's equipped with the kinds of technology described in this month's issue of *Broadcast Engineering*.

Brad Dick

Brad Dick,
editor

With Sony's digital switcher and effe



If you're still hesitant about switching to digital, then you probably haven't experienced Sony's DVS-8000 Digital Switcher and the DME-5000 Digital Effects System.

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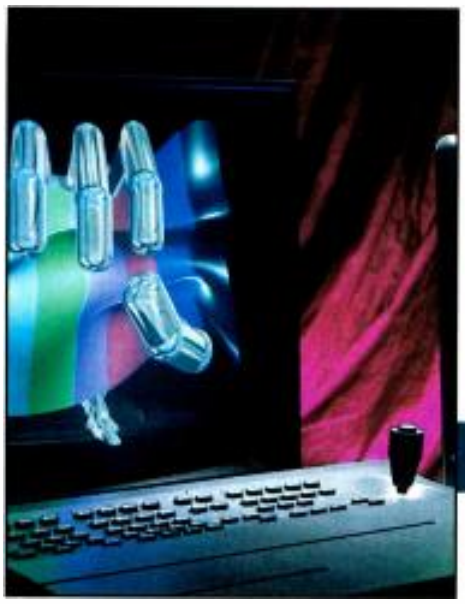

Shopping for a DTV system

Explore your options before jumping on the DTV bandwagon.

By Ed Dwyer

The Bottom Line

Some said it couldn't be done, but today, PC-based systems have taken over many traditional functions in broadcast and production facilities. Although these PC platforms are often expanded beyond typical off-the-shelf units, personal computers can form the basis for automation and editing control. Much smaller than earlier computer-based equipment, these integrated products offer capabilities that exceed traditional systems. Welcome desktop video (DTV) as a contender in today's communications and production environment. But look closely at possible directions before you leap onto the DTV bandwagon.

$

Dwyer is vice president of sales and marketing for Matrox Electronic Systems, Quebec, Canada.

Today's video post-production studios require a variety of interconnected, discrete components. Those components typically include a video switcher, an editor, digital video effects units, time base correctors, a character generator, a master sync generator, an audio mixer and, of course, videotape recorders. Paint and animation equipment are usually installed in a separate suite. Needless to say, a well-equipped studio can be expensive to rent or own.

Recently, a number of integrated PC-based desktop video (DTV) systems have been introduced by companies outside the traditional video industry. The low prices and rich feature sets of these products are attracting much attention from corporate video producers, post-production houses and broadcasters. Some industry experts predict that DTV systems could replace conventional video equipment in many but the highest-end studios. Given the number of in-house video producers and the total amount of video produced, tremendous future growth is likely.

PCs for production

However, as is the case with traditional equipment, the specifications and limitations of PC-based DTV systems vary widely. Selecting the right system and the right vendor can be a considerable task, so be sure to thoroughly evaluate each product. And because hardware and software technologies are evolving so rapidly, a look at the planned upgrades also is necessary.

The following set of questions was developed from hundreds of recent contacts asking about the capabilities of desktop systems and how they compare with traditional equipment. Use these questions to obtain a good first-pass evaluation of any DTV system you may be considering:

1. Will the system be used for off-line or on-line production?

Deciding between an off-line or on-line system is a critical first step in pursuing desktop video operation. Off-line systems in a post-production facility can boost capacity without incurring the expense of adding a video production suite. Several PC-based desktop video systems on the market are off-line editors, which produce an edit decision list (EDL) rather than video. The raw video footage and EDL then must be taken to a post-production studio for final editing and printing to tape.

However, in a corporate or small post-production environment, an off-line system does not solve the problem of bringing the video production process completely in-house at an affordable price. Until recently, on-line broadcast-quality, PC-based DTV systems were unavailable, because the analog circuitry found in video switchers and related components is incompatible with the electrically noisy PC environment.

The availability of low-cost, single-chip digital video decoder and encoder devices is one of the technological breakthroughs

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This desktop video package consists of an EISA-bus PC and a set of five plug-in cards. The proprietary software for hardware resource management runs under the Microsoft Windows 3.1 operating system.

needed to successfully design an all-digital video processor operating in the YUV 4:2:2 domain within the PC.

2. Which of today's video input formats — composite, Y/C, analog component, D-1, D-2, D-3 and RGB — are supported?

High-production value video requires high-quality videotape machines and video processing equipment. Furthermore, multiple dubs are often required. Most post-production suites are wired for composite video, but newer installations may include Y/C (S-VHS) or analog component (Y, R–Y, B–Y) formats. Some studios have RGB equipment whose output is subsequently encoded into one of the signal formats. The quality of Y/C or analog component systems is similar, and both provide wider color bandwidth than composite systems.

Recently, a number of low-cost, high-quality decks for industrial use (S-VHS) and professional applications (such as Betacam SP and MII EH) were introduced. All include Y/C I/O interfacing. At a minimum, a DTV system should support Y/C. Analog component support may be desirable with many older professional recorders.

Presently, digital VTRs are extremely expensive. When the price of these machines drops, you might find a future optional or an upgrade of a digital interface valuable for use in a CCIR 601 system.

3. Is the switcher capable of A/B or A/B/C roll operation? What transitions are available? What is the quality of the transitions? Is the switcher symmetrical?

The video switcher is the heart of every DTV system. Many DTV systems have two switcher buses for A/B roll editing, while others have a 3-bus switcher that permits A/B/C roll editing. The switcher prioritizes the selected three video inputs, video background and graphics in a process called *video compositing*. The video layers are then keyed and mixed to produce the video output.

Video mixing may be simple *cuts only*, or it can be more complex transitions between video layers. The standard transi-

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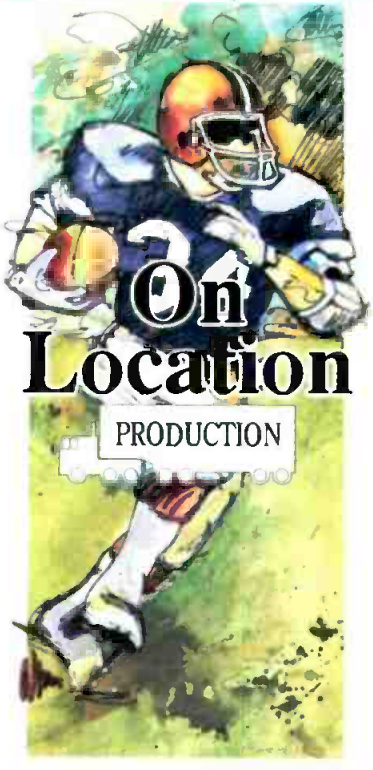

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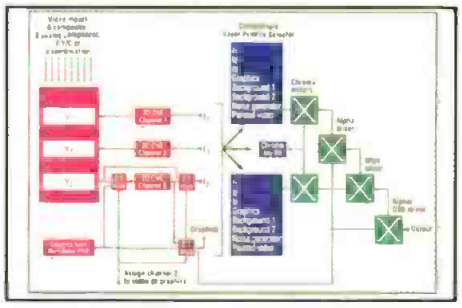

Some DTV systems simulate the 3-bus video switching architecture scheme common to traditional TV production environments.

tions include wipes, slides, pushes and dissolves in various patterns that may or may not have special border features. In addition, the duration of transitions can be programmed. High-quality transitions look smooth at all speeds. Transitions may be implemented in hardware or software. Keep in mind that new transitions can easily be added in software-based systems.

Multilayer video images with eye-catching transitions and video effects are essential to the production of high-quality, high-impact, effective video. An A/B roll system is an absolute minimum requirement, and A/B/C/ roll is highly desirable in a DTV system. Furthermore, the transitions and keying should work identically or symmetrically between all video layers. (Many DTV systems are not symmetrical.)

4. Do the systems include features, such as inserts and match frame editing?

Editing video is an interactive process where a sequence of edits and/or effects is set up and then previewed until the desired results are achieved. Therefore, insert and match frame edits are two important system features to look for in DTV equipment.

Insert edits involve trimming a video clip to be inserted or dropped into the tape to an exact number of frames, and then inserting the clip into the exact position on the finished tape.

A match frame editor simplifies the process of setting up complex transitions or effects by enabling each video source to be independently cued to the exact frame where the transition or effect should start. Once the edit point is chosen, the video clips are marked on the storyboard to facilitate the correct placement.

5. Do the digital video effects capabilities include features, such as 2-D, 3-D and video-in-a-window or picture-in-picture?

In a conventional studio, a single-channel DVE unit is generally contained in a stand-alone box. Several important 2-D effects features are infinite scaling of video-in-a-window (also called infinite image compression and expansion) and image inversion about the horizontal and vertical axes. Other effects, such as strobes, polarization and mosaics, are also common.

Look for a system that allows three channels of 2-D effects to be connected to the input of the switcher. With this architecture, you can set up three live video windows moving in time over a solid background. A live video foreground with two live sources within a video window, with a wipe applied between the two layers in the video window, also is possible. Flying logos on a black background can be created by using a combination of interpolation with time of a scaled video window and continuous image inversion. The logo is then keyed using the luminance keyer. These capabilities are accessed through a keyframe editor menu that sets the start and end frame parameters.

Today, 3-D effects are commonplace. A 3-D DVE unit performs image warping effects, such as page turns and wrapping of images around 3-D objects. It is normally connected to the input of the third switcher bus in an A/B/C roll system.

In some systems, 2-D and 3-D effects can be created by loading video into a graphics frame buffer and using the PC CPU to compute new images. Unfortunately, these effects are seldom performed in real time.

6. Do the keying facilities include luminance, chrominance and alpha channel functions?

Keying of video is an important function that can be described as the process of separating a live video foreground picture from a solid blue background. However, special circuitry is required to implement a linear chroma-keyer. High-quality keying of graphics over live video (for example, titling) is another important function. This process is often referred to as *alpha blending*. But once again, special circuitry is required.

7. Does the system contain a graphics frame buffer? What paint, animation and titling software packages are available?

Computer-generated still images, animations and high-impact titles are found in many video productions. Numerous third-party software packages may be used. These packages require a 32-bit high-resolution graphics frame buffer (eight bits each for R, G and B, and an 8-bit alpha channel) and are optimized for video applications.

8. What character generator capability is offered?

The process of adding titles to video has traditionally been performed by a dedicated character generator. Most DTV systems include some titling capability at user-electable rates. Important features to look for in a titler include the ability to scroll

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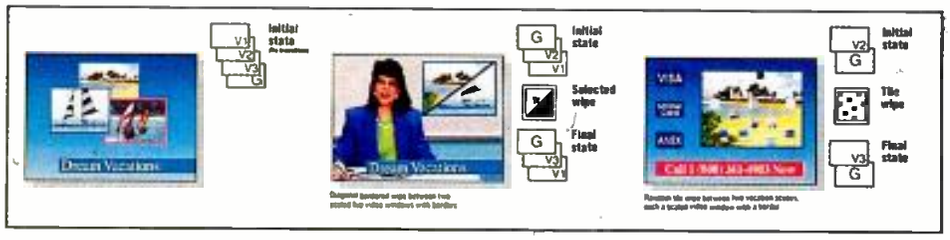

The steps of multilevel video compositing.

or crawl the titles, and key the titles over live video with full anti-aliasing of the character edges. High-quality titles are a function of the titling software and the graphics frame buffer architecture (that is, the alpha channel blending). Characters may be sized on a scan line basis, colored with a color gradient or transparency, and outlined with offset, dropped shadow or color edging.

9. Does the system support analog or digital audio processing and, if so, at what quality?

In some DTV systems, no audio capability exists. Thus, a separate audio mixing unit is required. For high-quality production, the DTV system should support split editing between the video and sound, and even between multiple sound channels. Synchronizing audio on a frame-accurate basis from two or three inputs with frame-accurate digital audio from the PC hard disk gives great flexibility in audio production. Digital audio clips are placed on an audio time line in the storyboard menu in the same manner as video. Audio-follow-video is another convenient feature you should look for when purchasing a DTV system.

10. Is the editing interface character- or picture-based?

Today, dozens of video editing systems are available. They are broadly divided into two categories: character-based or picture-based systems. Picture-based editors use icons to represent video, graphics and audio clips. These use frame-accurate time lines or storyboards to arrange the clips and to set up video and audio transitions. You can probably learn interfaces within several hours. Many potential users are already working with PCs, and the interface is intuitive because it generally matches the scripting process. (The basic concept was first developed by the BBC, where the objective was to enable the general public to make video presentations.) Furthermore, the ability to work with non-drop frame and drop frame materials is essential.

11. What video transports are supported? Is that support direct or is a third-party interface used?

An A/B/C roll system has four video transports — three in play mode and one for recording. These machines must be controlled on a frame-accurate basis. Look for systems that have an integrated 9-pin serial deck control, which is a feature found on the most recent generation of S-VHS and Betacam SP equipment. With the existing base of older machines in use, a third-party *LAN* facility will permit convenient control of many different VTRs. Decks with RS-232 or Control L inputs do not yet support frame-accurate control.

12. What is the level of video quality?

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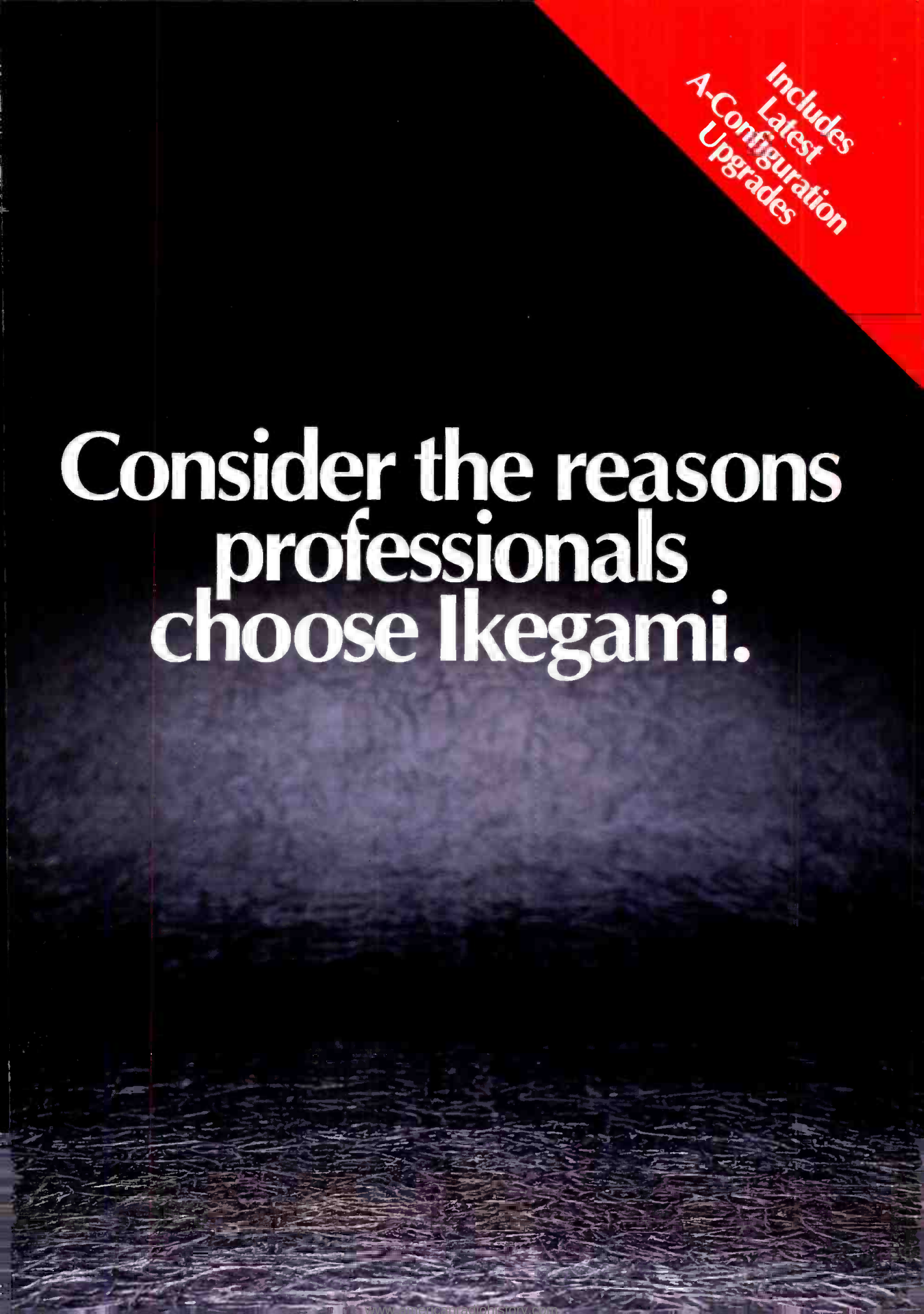

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- List Price: $2,030.

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- RES: 700 TVL
- SENS: f8.0, 2000 Lux
- SNR 62dB Typical
- 400,000 Pixels
- Hyper Gain: +30db
- Continuously Variable Electronic Shutter
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HL-43 ⅓" 3-Chip IT CCD
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- Compatible with HK-343
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HK-355PA, ⅓" 3-Chip FIT CCD
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- 400,000 Pixels
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- 400,000 pixels
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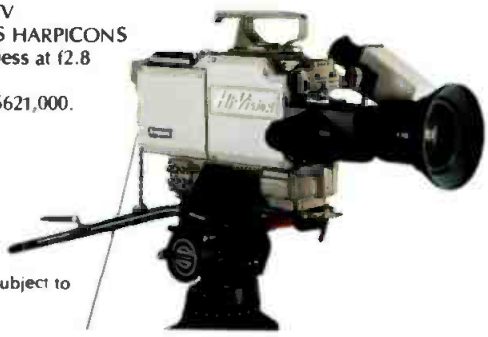

LK-33, 3-D 6-Chip ½" FIT CCD
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30-Series monitor, available in 20", TM20-30RH feature 900 TVL.

20-Series monitors, available in 14", TM14-20RH (shown below) and 20", TM20-20RH feature 700 TVL.

Live video windows with borders moving across a graphic background add interest. A new window moves in as the old one moves off the screen.

Three factors that have the greatest impact on video quality are the type of video used (Y/C, analog component), the quality of the video decoder and encoder units, and the processing of video within the system (fully digital vs. partial digital). Systems with a single chip performing encoding, decoding and processing of all video in the YUV 4:2:2 domain now exist, based on custom-design ASIC devices.

Not all DTV systems are designed to be upgraded. When selecting a system, it is important to consider expansion capability in terms of upgrades that will boost productivity (such as non-linear editing) and upgrades for video processing (such as 3-D effects). Video processing is often software-based, which means that software upgrades must be considered.

One architecture that is field upgradable permits PC cards or components to communicate over a digital video bus. When it's time for new components to be added, the cards are plugged into the PC and a longer video bus connector is installed.

13. Is third-party software support available?

Various DTV vendors have taken different approaches to third-party software, ranging from a closed system, in which all software is provided by the vendor, to the fully open system. The open system concept can attract a large number of third-party applications that complement the basic system.

A frame-accurate storyboard is used to build a print-to-tape file.

DTV and you

If these questions have been answered to your satisfaction, the next step is to attend a hands-on demonstration of the equipment you think will best serve your applications. A good demonstration will probably take one to two hours. Don't let yourself be talked into just looking at a prepared demo tape. Many demo tapes are not representative of typical uses, and they may not address system deficiencies for obvious reasons.

PC-based DTV systems are relatively new products on the market. Some offer amazing performance when compared with traditional video components. If you think your needs can be met through desktop video, compare the various system features and architectures with those of traditional studios. Eventually, you'll find a system that will do the job.

➡ *For more information on DTV systems, circle Reader Service Number 300.*

■

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RS-232C interfaces have been added to key VHS and S-VHS VCRs to extend their applications in edit environments.The new EnHanced Series MII has a forward-looking 16:9 video capability built-in, and includes a Studio VTR with a Digital Output for interfacing to CCIR 601 or D-3 composite digital domains. D-3 VTRs now have a Digital Format Converter, so D-3 can work easily with component digital sources or destinations.

Thus, it should come as no surprise that when Panasonic debuts its half-inch 4:2:2 recording system in 1993, it will play back D-3 recorded tapes in composite *or* component.

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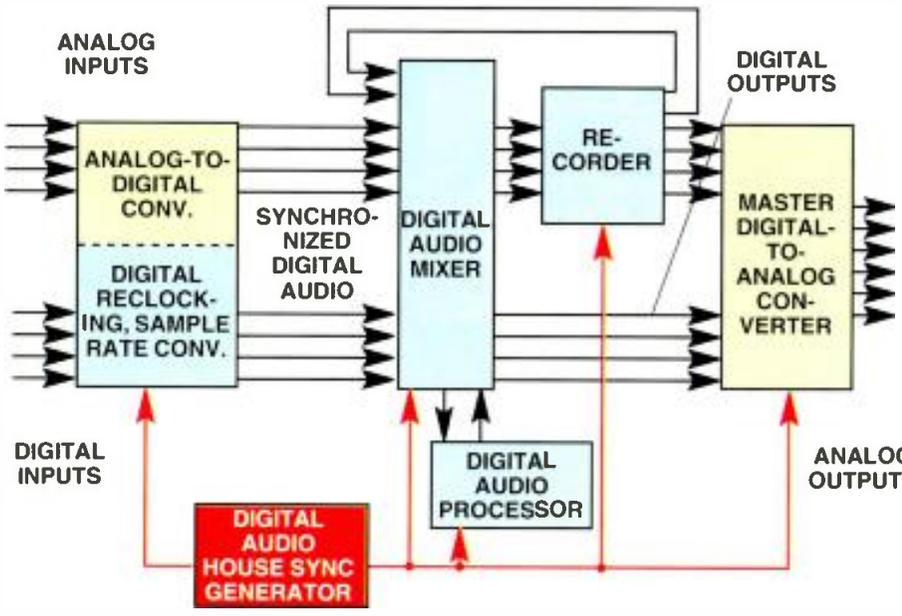

Figure 1. *The fully digital audio mixing suite accepts either analog ar digital audia inputs and converts them to standard, synchranized digital audio signals. All studio operations take place within this domain.*

version is still required.

Therefore, the *digital mixer* — after languishing as a bit of an albatross or niche curiosity throughout the 1980s — is now taking on a new and urgent realism. With this change comes lower costs, as production of a wide range of digital mixing systems grows.

Call us last

Another synergy is also taking place. One of the most expensive and sonically critical components of the digital mixing console is the analog-to-digital (A-to-D) converter. Because a separate, high-quality A-to-D converter is required on each input, a large digital console became extremely expensive while still at the mainframe level, before any truly functional items were even added to the design.

Now, as a greater number of sources are equipped with standard digital audio interfaces, the need for all those A-to-D converters is reduced, and so goes the price of the digital mixer. Because these are transitional times, several manufacturers now offer hybrid consoles that operate digitally, but offer analog *and* digital input modules (or groups). A quick look at their pricing sheets confirms the turnabout — digital inputs cost *less* than analog inputs on digital mixers. (This also presents an incentive to convert other remaining analog devices in the facility.)

Following the tenets of the squeaky wheel theory pays off doubly in this case — as the console becomes the limiting factor (i.e., all other components are already digital), it becomes cheaper to replace because there is no need for costly converters. Ideally, a single analog-to-digital conversion will take place at the start of the process, with a single D-to-A conversion at its end. (See Figure 1.)

Interfacing

Problems of digital audio interconnection are also subsiding as the AES/EBU and IEC 958 (consumer) standards become well-established and better understood. Aiding in this evolution is the recent publication of AES3/1992, the revised standard document for the AES interface, which specifies more of the details of its implementation and sets out three tiers of implementation: minimum, standard and enhanced.

Although digital interfacing will still not be completely trouble-free, these refinements and a growth in its general familiarity will make its usage more common and comfortable among audio professionals. Skills in troubleshooting with these interfaces also must be developed.

Lest we forget, the current "simplicity" of analog audio interfacing is really a complex but *familiar* set of vagaries with even more wide-ranging possibilities for degradation. It, too, has evolved (compare the 600Ω matching of the past to today's bridging configurations) and incorporates a number of different standards (for example, +8dBm, +4dBm, −10dBV, balanced, unbalanced, pin 2 or 3 hot). At present, the reluctance to move more strongly to digital interfacing seems more a case of "the devil you know." As more and more sequential links of the audio chain offer digital I/O, the use of digital interfacing will necessarily increase. Once established, it will likely be shown to offer less problematic results than analog interfacing traditionally has.

Other recent discussions have concerned a broadcast-specific digital audio interface standard, generally centered on a group of broadcast equipment manufacturers. Consensus has not been reached on the application, scope or nature of the format. Nevertheless, some interesting proposals have been made, including the first provisions for a *compressed* digital audio interface standard.

Console control paradigms

As new audio mixing systems develop along diverse paths, it is helpful to categorize them in some way. This allows the user to compare apples to apples, and to associate appropriate products to given applications. Audio mixing systems are dividing along the following lines:

• *Traditional.* Also known as a *hard* design, this is the way all mixing systems were constructed until recently. There are still plenty of applications and users for which only these consoles will do. They maintain a physical hardware module for every input and output, and repeat controls on each module as needed.

• *Assignable.* Although this approach may resemble a traditional console at first glance, it uses an abbreviated design. A few physical hardware modules can control a larger number of actual inputs and outputs. Hardware components are *assigned* to an actual input or output channel when adjustments in its status are required. The channel then retains its status when the controlling hardware module is reassigned somewhere else. Potential space and cost savings may be significant. Direct, immediate access to every console function is not provided, perhaps rendering assignable designs inappropriate for some live broadcasting applications.

• *Virtual.* No actual console hardware exists in these systems, and the operator performs mixing operations by watching a representation of a console on a computer screen. This type of system is most commonly encountered in integrated environments, such as the digital audio workstation, many of which now include mixing operations. Some feel that this is the approach all mixing will take in the future, while others strongly disagree.

The last major change in mixing console control surfaces came when the linear fader replaced the rotary pot. The transition that lies ahead could dwarf that one in its impact. The term *console* may go the way of *tube* and *turntable*, as mixing takes place on something other than an imposing piece of furniture. Once this golden link is forged, new frontiers of audio may be opened to prospectors.

➡ *For more information on new developments in audio consoles, circle Reader Service Number 301.* ■

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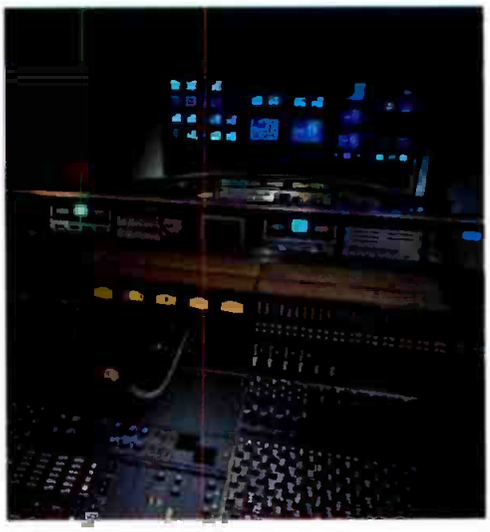

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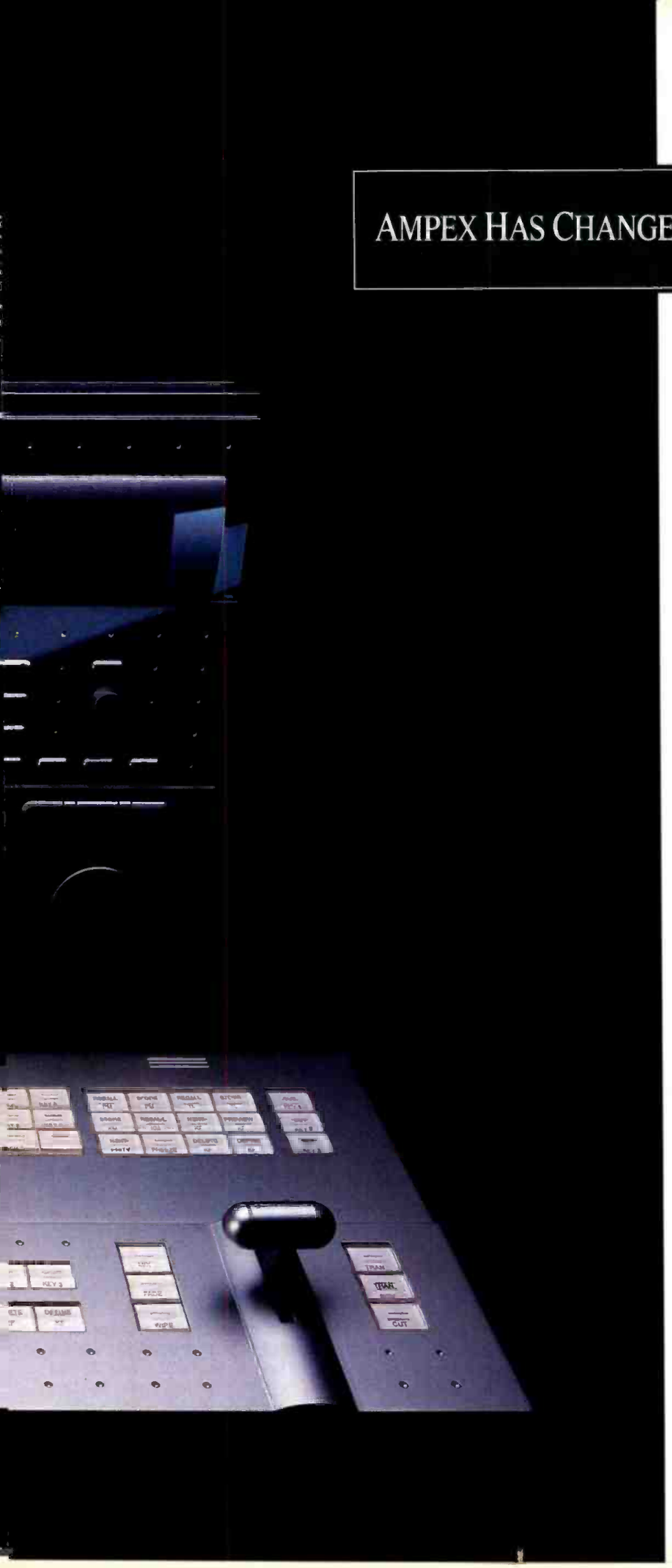

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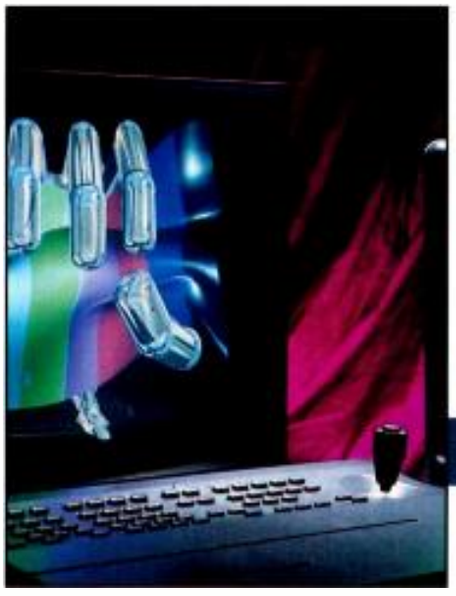

Production suite technology

Find out what technological breakthroughs are on the horizon.

By Curtis Chan

The Bottom Line

Some will argue that black is white while others disagree on hot and cold. In video production suites, "complex is easy" is not entirely untrue either. As new methods of system control become available, the PC is often found to be at the heart of the master. $

Have you ever heard about the world's first digital electronic computer? It had 18,000 vacuum tubes (which ran extremely hot) that required 140kW of AC power. It weighed 50 tons, took up an entire room, cost $1 million and was top secret. Today, a complete equivalent to that computer can be etched into a single silicon chip, and purchased for about $10 at a local computer shop.

Technological ingress

This means that these technological breakthroughs will soon find their way into our industries. The terms videographer, desktop production and integrated video production system are less than a decade old. Now, personal computer-based systems with processing power equaling super minis of the past can be found in low- and mid-ground systems.

In the professional area, digital products have made significant progress in production suite technologies to date. The *all-digital* post facility has officially begun, but it is still years away from full implementation. What's new in current production suite technology is that some hardware alternatives now exist.

Facility planning

For most facilities, changing from an analog or hybrid facility to an all-digital environment is a time consuming and expensive proposition. A well-planned transition from analog to digital will allow for the best use of current and future hardware. Areas of concern focus on flexibility, expansion, routing and distribution, interface and timing.

With the planned implementation of a hybrid or all-digital facility, there should be a plethora of formats to deal with in acquisition, recording/playback and distribution. In this case, industry guidelines should be followed to minimize timing, amplitude or phase discrepancies between the integration of various format systems.

The care and feeding of signals

There are two main ways to distribute audio and video signals in a facility.

- *Analog routers and distribution.* Analog routers couple the source directly to a master routing switcher, which feeds the various destinations. Tape machines in such an installation typically have less than 31m runs. The design uses the master switcher to isolate the various VTRs. If more feeds are required, multiple DAs are placed after the switcher.

The second approach reflects multiple production switchers and a master control switcher. This requires all source units to use DAs to distribute their signals. When designing complex systems with multiple edit suites, source devices may have to feed multiple switchers and routing matrices. In this case, use of auto delay or isophasing DAs can correct errors to 15ns or more. Beyond this range, timed cables (4.9ns/m) may be used. Equalizing DAs are advisable if cable distances exceed 46m of standard 8281 or RG11 coax. Newer DAs can compensate to 1,524m. All feeds entering the switcher/processor must be zero timed. Emphasis will be placed on current digital routing schemes.

- *Digital distribution.* The digital parallel and serial I/O capability is one commonality of the new generation digital VTRs. This facilitates keeping signals in the dig-

Chan is a principal of Curtis Chan and Associates, Fullerton, CA.

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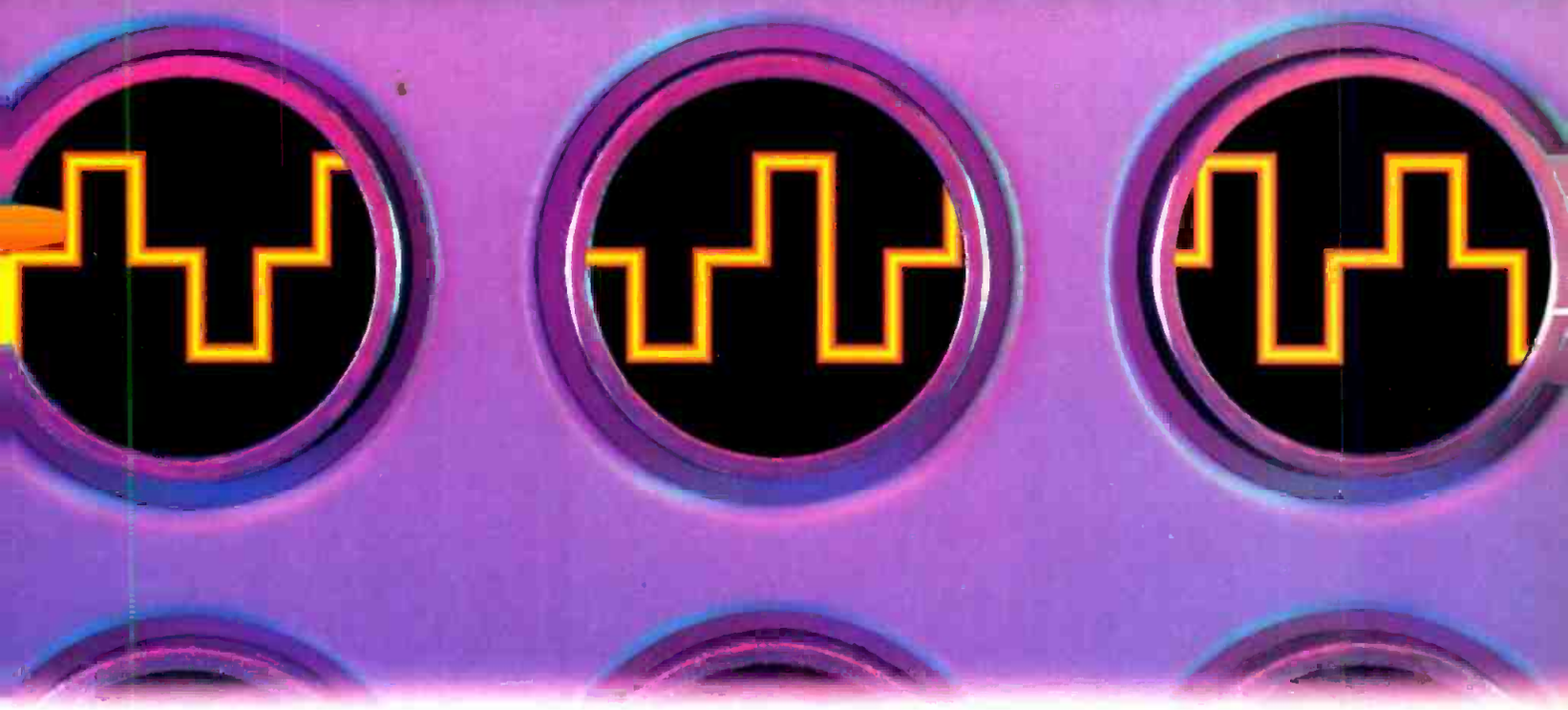

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Hughes Communications' Galaxy I is the nation's leading cable satellite. The illustration above is an artist's conception of how it would appear if viewed from space. When fully deployed, the 1560 pound spacecraft reaches a height of 21 feet, 8 inches, the equivalent of a two story building.

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ital domain to minimize artifacts. Prior to a digital serial standard, the cost of routing had to include overhead for serial-to-parallel and parallel-to-serial conversion. Parallel implementation cables can be up to 50m long, or 300m with proper equalization. Pulse widths may suffer in conversions between ECL and TTL. The use of digital DAs keeps optimal signal integrity.

This points to the importance of serial distribution technologies. With the availability of digital serializers and deserializers, the cost has been significantly reduced, because serial transmission offers an advantage of signal wire, coax or optical fiber distribution. Soon, VLSI technology will replace "black boxes" with a serializer/deserializer chip set integrated into the product. Preferably, the chip set will accommodate the various digital formats and operate between 143Mb/s and 300Mb/s (143Mb/s — NTSC composite, 177Mb/s — PAL composite, 270Mb/s — 4:2:2 component), thereby reducing parts count and cost while adding flexibility.

• *Routing.* The routing system should complement existing and planned upgrades. For example, to route analog composite and component, digital video, time code and audio, a routing matrix may contain segments of 96×128 video, 64×64 time code, 64×64 audio and 48×48 digital video crosspoints. These different levels of routing accommodate multilayering in the digital domain, but still retain flexibility in the analog domain. Many facilities are implementing computer-based systems to track and optimize operations. To dub digitally between machines or to go from analog to digital, software executes the necessary routing decisions in the background, avoiding unnecessary patching. In parallel routers, the number of crosspoints in even a small router would be large. This can be overcome in part by applying crosspoint reduction techniques.

Another technique centers on multistaging routers, which replace a large matrix by several small matrices with a smart controller capable of re-assigning paths to avoid blockages. These techniques result in a reduction in crosspoint count, a reduced physical size and cost savings over their analog counterparts. The latest trend is the integration of the router into the physical switcher.

• *The switcher center of attention.* Most switchers control two types of devices: field-based devices and devices that provide static recall. However, with digital and computer-based technologies, a new generation of digital disk-based switchers are coming. These switchers provide integrated control over a complete editing or production environment, with capabilities of supervising more than 30 devices, including routers, frame buffers, TBCs, camera robotics, VTRs and ATRs. The switcher control protocol ties external device time lines to the switcher's reference for recalling, previewing and running effects. It delegates functions on the switcher control panel to the peripheral, so control may be partially or completely integrated into the switcher control system. This allows control information to be stored as part of a switcher effect.

In a modern production facility, a monitor room displays control system feedback for the devices in the room. Each has a dedicated control panel, taking up real estate on the console. Aside from the inefficiencies of trolleying back and forth to operate each piece of equipment and the operating curves, there doesn't appear to be a standard for control interfaces. Edit controllers and automation packages often control only a subset of the device's functions. The new switchers feature easily implemented protocols and incorporate the RS-422 interface standard, allowing other manufacturers' devices to be directly controlled from the switcher panel.

The switcher sends out two types of communications: *private* and *multicast*. Private messages are directed from the switcher panel to specific devices, and are unique to those devices. Multicast messages are global commands from the switcher to several devices simultaneously. Return communication takes the form of either a constant update of position and state or menu display from the slave devices. Because menus reside in the processor at the slave device and only differential data is sent over the network once the initial menu is written, real time control of these devices can be realized.

• *TBCs and frame buffers.* If the digital switcher is interfaced to a TBC and a frame buffer bank, additional benefits can be gained. Because the operator has direct control over TBC memory functions via the switcher, its setups are saved directly into the EDL along with the particular edit parameters. The location of the TBC becomes mute, because full control is achieved from the edit bay. This is advantageous when doing projects with large amounts of raw elements. The TBC memory registers can contain the setup for each reel or group of similar scenes. As the switcher triggers the memory register, the need to adjust a VTR for every reel is eliminated.

Combining frame buffers to the switcher further extends the power of the system. With dual frame buffers, graphic elements composited to the switcher output are captured in a buffer and returned as inputs to the switcher for additional layering. Several layering passes through the switcher system with little or no degradation can increase the efficiency over less sophisticated systems. The result can be multiple layers in a single pass, while viewing the final composite in real time.

• *Cache recorders and integrated control*

systems. In the post environment, much time is spent fine-tuning the edit to achieve the right timing. With cache recorders (which can be disk, optical or tape based), a switcher time line effects system eliminates VTR preroll and lock-up times, making "what if" scenarios possible. Because the integrated switcher can directly control devices, effects can be generated that encompass switcher, DVE, still-store, character generator, cache elements and VTR elements off tape. The entire operating environment of the time can be saved as part of the edit and recalled to restore data to all devices, the switcher and cache recorders. The fully integrated switcher/control system remains a

Continued on page 68

Advantages of a digital component video system

By Craig McCartney

For several years, there has been a trend to integrate control functions from different parts of the production suite into a centralized location. For example, an editing controller, under EDL and time code, proceeds to operate the video switcher, audio mixer, keying, transport control, graphics and effects equipment. Editing suites often have represented a collection of analog equipment, not originally purchased or configured for post-production editing, but made to work successfully through various signal and control interfaces.

Some new generation production switchers include integrated effects capabilities through special hardware designs that link the switching and effects equipment directly on a digital bus. The introduction of Digital Component Technology (DCT) represents another step forward. For video post-production, several features of this concept are particularly advantageous:

McCartney is marketing manager for new products/systems with Ampex Systems Corporation, Redwood City, CA.

- It is a fully integrated component system with all video signal processing accomplished in the digital domain.
- Because all video remains in a 4:2:2 environment, there are no cross-color or cross-luminance problems and no loss of image quality.
- No signal generations are lost during keying, ADO or other signal processing.
- The degradation typically caused by the conversion processes from composite analog to digital and then back to composite again is eliminated.
- Multigeneration performance is identical from stage to stage.
- A fully integrated system combines a 19mm tape transport, post-production switcher, edit controller, digital effects system and interconnect functions.
- A switch between 525- and 625-line operation will permit one system to serve multiple standards.

These features produce related benefits for the post-production staff who use DCT. For facility owners, more clients can be offered a higher quality level of video processing — all digital — in less time. That has an immediate impact upon facility revenues.

Video editors will find creativity enhanced when the drawbacks of multigeneration processing are removed. Where a 5-generation limit was generally understood for analog composite technology before substantial signal degradation, components — combined with digital technology — offer an unlimited number of generations. Keying can continue as long as ideas keep flowing.

The engineering staff most likely will find an integrated digital production system simple to organize and implement, and just as easy to maintain. Software upgrades can be accomplished through 3.5-inch floppy drives in the various components of the system. Headroom in such a system should accommodate future advances in technology, such as the proposed 16×9 13.5MHz system, although an interface with existing digital video signal processing using the CCIR-601 international standard is provided.

The highlights of digital component technology can be summed in a few words — speed, accuracy, efficiency and enhanced creativity. Joining these in an integrated production system can only be advantageous to all concerned.

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Talk radio technology

New terms of art for the talk radio renaissance.

By Skip Pizzi, technical editor

The Bottom Line

Although it may seem strange to see the words high fidelity and telephone in the same sentence, the growth of talk radio concurrent with the consumer digital audio revolution challenges radio stations to make telephone audio sound as good as possible. Contrary to the common wisdom, telephone audio is far from a lost cause. There are many techniques and new products that broadcasters can use to optimize talk radio operations at their facilities.

Even though most broadcasters don't think of telephone audio as defining the cutting-edge of studio technology, a number of significant and useful systems have been introduced that can help broadcasters improve their operations in this field. This article will examine some areas where noteworthy innovations have recently appeared.

Developments in delay

Profanity delay systems have been in use for live talk radio programs for many years, starting with the labyrinthine tape delay systems of the 1960s and '70s, and followed by the digital delay lines of the 1980s. With either technology, the typical use of a 7-second delay made the deletion of profanity fairly elementary, but getting back into the delay mode afterward was more cumbersome. Digital delay systems allowed the delay to be "regrown" gradually over a few minutes, but often with audible glitching.

Today's best digital delay systems allow a wide range of delay times to be stepped into place on the air without audible artifacts. This allows the function to be routinely used in establishing the delay at the beginning of each show segment (not just for recovery of delay after a deletion), which is especially helpful to stations that break into talk show segments for network news or the like.

Multihybrid operation

Although a single telephone interface might be sufficient in the newsroom or a production studio, any serious talk radio application requires at least *two* interfaces of equivalent quality in its air studio, and probably more. Today's state-of-the-art in interface design is defined by the *digital hybrid*. (See the related article, "Progress in Telephone Audio Interfacing," pg 60.) These units are not inexpensive ($1,000-$3,000), but talk radio stations that use telephone audio for a significant portion of their daily programming shouldn't balk at paying about what they do for any other audio source in the studio (such as a cart machine, CD player or tape recorder).

Some telephone interfaces now include a measure of manual or automatic audio processing to enhance caller audio quality. If it's not incorporated in the hybrid, *outboard* audio processing can be used. Either way, this can dramatically improve caller intelligibility. Helpful processing includes bandlimiting for reduction of high- and low-frequency out-of-band noise, a bit of equalization to remove excess energy in the 300Hz-1,200Hz region, and some mild compression. Some stations even insert an aural exciter or other subtle effects processing for further enhancement of phone audio.

Each telephone interface also requires its own separate *mix-minus* backfeed, increasing the demands on the studio console's busing (although an outboard programmable routing/mixing system can also be used). This allows callers to hear all the other program elements, including other callers, without getting an echo of their own signals or risking feedback.

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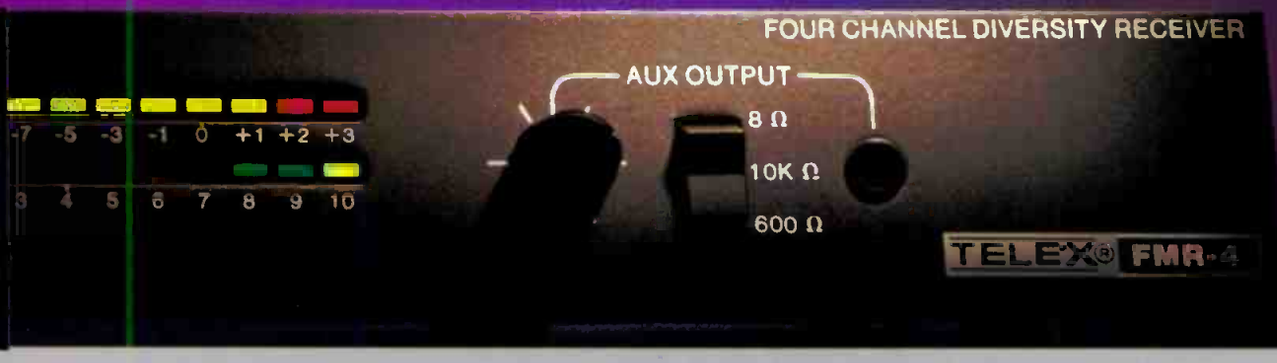

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Progress in telephone audio interfacing

By Steve Church

The state-of-the-art device for interfacing with the analog phone network is a digital hybrid. Audio on that network is travelling in both directions on a single pair of wires, so some way to separate the two paths is required. That's what a hybrid does. If it does so poorly, distortion of the air talent's voice will occur for the following reason: In a broadcast studio, the talent's voice is mixed in the console with the telephone audio. A full 2-way phone conversation's audio will include a distorted and phase-shifted version of the talent's signal along with the caller audio. When the hybrid has insufficient "trans-hybrid loss" (that is, cancellation of talent audio through the hybrid), the resultant talent voice leakage combines with the direct talent feed to the console from the microphone to produce a hollow or tinny quality, because the phase cancellation affects some frequencies more than others. Poor trans-hybrid loss can also create a problem with feedback when the phone

Church is president of Telos Systems, Cleveland.

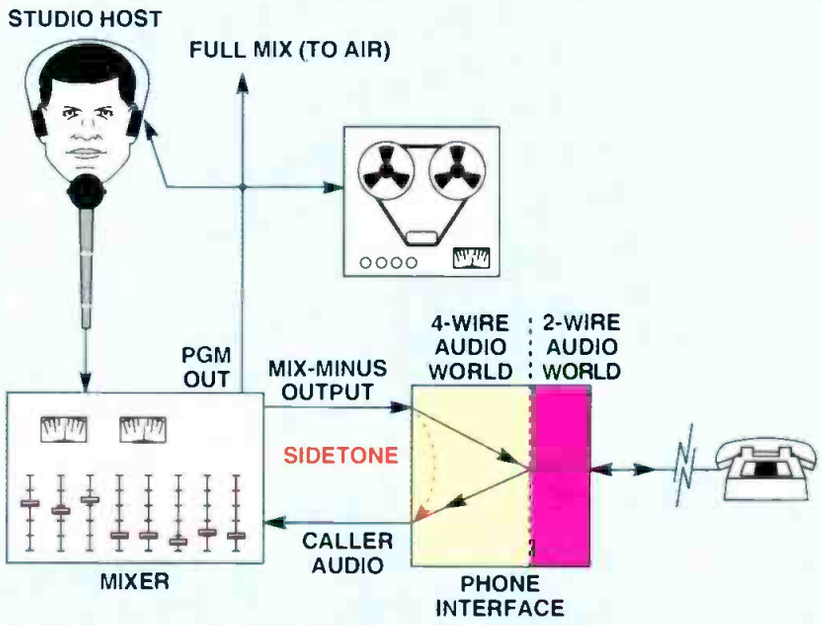
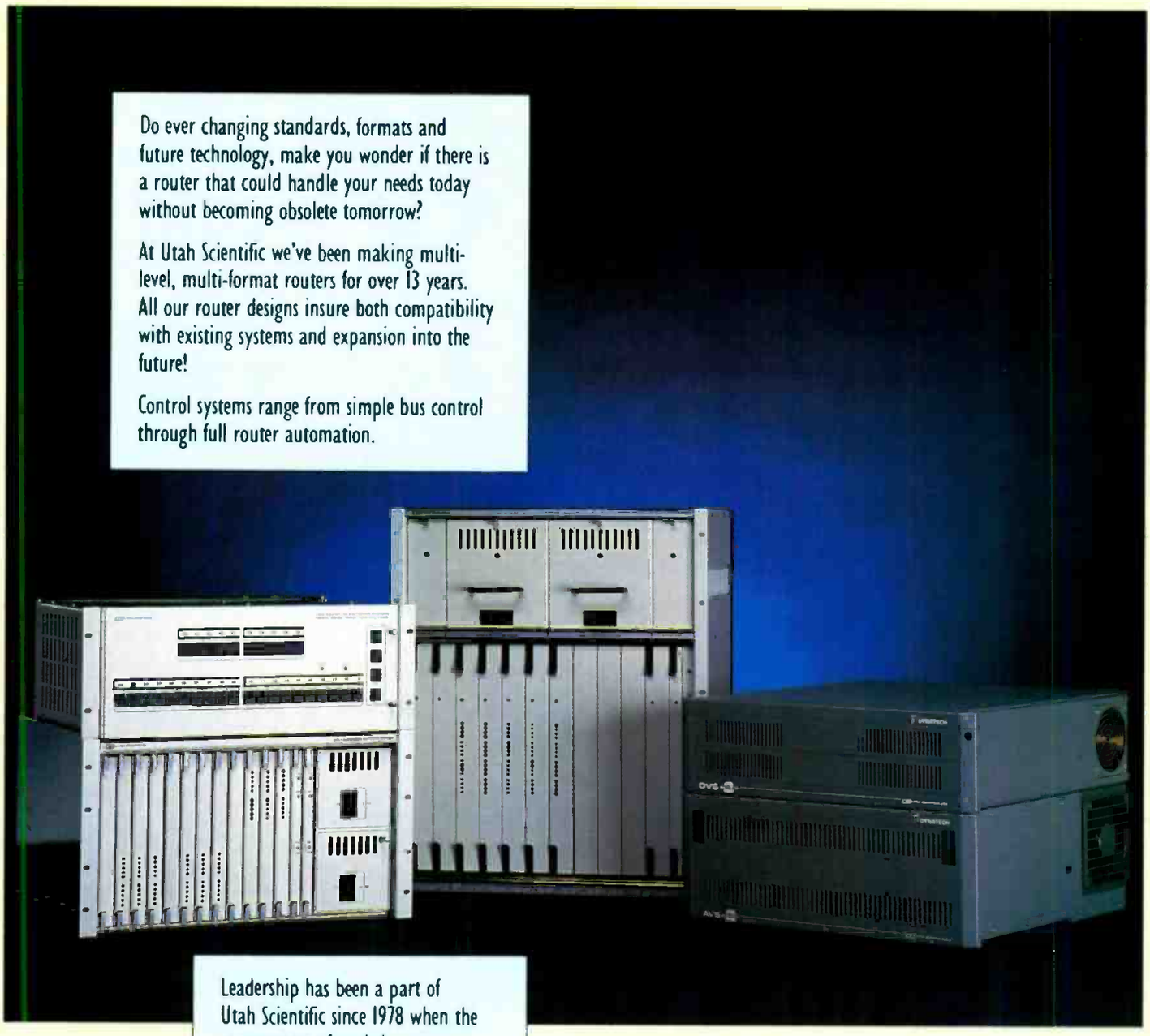


Figure 1. A typical talk radio hardware configuration. The phone interface provides a junction between the bidirectional (2-wire) paths of the telco world and the unidirectional (4-wire) circuitry of the broadcast facility. A measure of the interface's quality is its ability to suppress sidetone leakage of the studio's mix-minus backfeed into the caller-audio output (also known as trans-hybrid loss).

Multi-Level, Multi-Format



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audio must be heard on an open speaker in the studio.

Unlike most analog phone interfaces, today's digital hybrids are also adaptive, in that they automatically tune themselves to each phone line in order to maximize trans-hybrid loss. A convolutional adaptive filter is used to perform the nulling by synthesizing the correct transfer function for the hybrid's balancing network. A feedback loop continuously adapts the filter network to conform to changing line impedance, just as an FM exciter uses a feedback loop in the AFC circuit to maintain consistent frequency. This ensures optimal trans-hybrid loss across the full telephone network passband. When a call is initially established, a digital hybrid typically uses a brief mute/adapt period (about 250ms) to adjust to the phone line before the call goes to air.

Why is all of this necessary? Why can't we just use a simple differential amplifier circuit to subtract the send audio from the phone line signal? Unfortunately, phone lines have complex and erratic impedance vs. frequency characteristics. Loading coils, carrier systems and switching equipment all contribute to impedance anomalies. If studios are downtown near the phone central office (CO), it is possible for the impedance curve to be reasonably smooth. On the other hand, because suburban phone lines are more likely to be distant from the serving CO, and because carrier equipment is more likely to be used, these will generally exhibit the poorest impedance characteristics. That's why an analog hybrid is able to have fairly good performance on some lines, but not on others.

Of course, hybrid problems can be avoided by tapping into a speakerphone, which separates the send and receive audio paths with a bidirectional switch or gate. This can often be annoying to listen to, though. In addition to making line noise more noticeable by its continual disappearance and reappearance, it can also create problematic interaction between the caller and talent voices when they speak simultaneously or nearly so.

Modern digital hybrids include a number of processing functions in addition to the adaptive nulling. These can include send and receive AGC, caller and acoustic ducking and pitch-shifting. The latter is an implementation of the old PA feedback reduction trick, in which send audio is shifted down a few hertz, thus reducing or eliminating feedback.

All of this has become possible as a result of the near incredible advances in achieving real time digital signal processing (DSP) at low cost. This is the same technology that is poised to transform all of telephony — and, likely, all of radio broadcasting.

Music technology meets talk radio

By Paul D. Lehrman

When a talk show is about talk, the audience doesn't need to hear much more than...well, talk. But when the subject is music, it's a lot more interesting when the audience can hear the music that the speakers are discussing.

This is the premise for one new kind of telephone talk show that involves a measure of interactivity previously considered impossible. "What's the Score?" is a call-in quiz show that first aired this May on WGBH-FM in Boston. It challenges listeners to win prizes by answering questions on the air about classical, jazz and Broadway show music.

In the golden age of radio, a program like this would have had its own crackerjack orchestra, whipping out charts and playing a few bars of appropriate music behind each question, but few radio shows today can afford that luxury.

Lehrman is a Boston-based consultant, author, composer and faculty member at the University of Massachusetts in Lowell.

Instead, I was commissioned by the show's producers to come up with a high-technology, low-budget way to simulate that environment when they hired me as musical director for the ...gram.

The approach I selected empl...n of the new and versatile ge...ch can digital synthesizers/samp...unds or electronically create ...ings you play back actual a...an switch be- load into them. M... quickly, and application, the... capacities than tween diff... I selected also has have sign...nable reverb (some- their previously only available ...hal outboard box), allow- ...sical space to be changed ...d easily. Like most of today's ...ynthesizer/samplers, it also ...es everything in stereo, is easy to ...port and sounds convincing in a ...e variety of musical styles.

I use an audio production workstation to assemble and prepare sampled effects, and then load them into the synthesizer via a SCSI port. Additional editing can be done on the synthesizer, and effects can be assigned to individual keys on the synthesizer's piano keyboard for easy cuing during the show. A portable, removable hard drive system also connects directly to the synthesizer to back-up the synthesizer's RAM.

The show's producers tell me in advance what musical selections will be required for each program, so I record and orchestrate all possibilities as MIDI files on a computer-based multitrack sequencer. I then use a Hypercard stack to associate each finished MIDI-file music cue with a virtual "button" on the computer screen. This lets me choose randomly during the show from dozens or even hundreds of cues, which the synthesizer will begin to automatically play within milliseconds. I can change volume or tempo on the fly, and stop the music or go to any other cue instantaneously. Meanwhile, sampled sound effects assigned directly to the synthesizer keyboard remain available throughout.

A useful function included in the Hypercard stack is a *freeze* button, which literally pauses and holds a cue in mid-note, similar to the way a conductor would raise his baton to have the orchestra hold onto the notes and stretch them out of tempo while something dramatic was happening. Another button resumes the cue at its original tempo without a break or glitch.

Fooling some of the people

So far, the program has been well received, with most of the audience unaware that a computer and synthesizer are responsible for 95% of the music they are hearing. (Reproducing opera and art songs is still beyond the system's capabilities, but we're working on it.)

The synthesizer is now used for the program's open and close themes, and for the show's musical "puzzles," in which several different musical themes are jumbled in odd contexts, and listeners are challenged to identify them.

This program has demonstrated that listener call-in shows can cover a lot more ground than they used to, and that the technology developed for performance and production applications has something to offer broadcasters as well. An arsenal of inexpensive, user-friendly, fast and highly effective audio tools are available for such interactive programming concepts, redefining the boundaries for call-in show design. They're also a lot of fun to work with. ■

SMPTE show preview

Toronto-bound attendees will find unique vie and technical perspectives at this year's confe

By Dawn Hightower, senior associate editor

This fall, attendees will converge on the Metro Toronto Convention Centre in Toronto, Nov. 10-13, for the 134th SMPTE Technical Conference and Equipment Exhibit. The conference theme, "Images in Motion — The Second Century," will set the scene for the latest in film and video technology.

Many exciting technical areas will be explored in-depth at more than 100 technical paper presentations. Those attendees interested in the future of electronic imaging, film, digital video compression, computers, telecommunications and advanced TV systems will walk away with an earful on these topics.

The latest technology

This year, almost 200 exhibitors will display the latest in film and video equipment. The equipment exhibit will run concurrently with the technical program. The New Technology Room (formerly called the New Product Introduction room) will once again be featured, and will be held on the exhibit floor.

Experience two all-day tutorials

Two all-day tutorials, "Multimedia World" and "The Post Experience," will enhance the conference itinerary on Nov. 9, the day before the conference begins.

"Multimedia World" is geared toward hardware suppliers, applications developers, content creators, publishers and end-users of multimedia. It will cover the process of creating electronic multimedia productions, and demonstrate techniques for bringing together sound, full-motion video, stills, graphics and text. The program will present an overall concept of the technology and its emerging trends, and will provide an overview of the multimedia arena, with discussions devoted to display, processing control and communications. The tutorial also will include a discussion on the many multimedia standards that exist and are under development, including ISO, CCITT and SMPTE standards.

"The Post Experience" will focus on the creative and technical aspects of audio, film and video post-production. Emphasis will be placed on the electronic post-production process. Topics to be covered include film transfer, off-line and on-line editing, color correction, special effects, sound effects, Foley, automatic dialogue, replacement and mixing. In addition, attendees will help assemble a 1-minute segment of a TV show transferred from film to videotape through to editing and final international versioning.

Hands on

In the days following the tutorials, attendees will have a chance to see demonstrations and interact with media integration technology in four hands-on workshops. One session will be offered each day of the conference and will cover multimedia production, teletraining and distance learning, communications and information access and retrieval. These workshops were designed to complement and coordinate with the papers session.

Session highlights

During the 4-day conference, participants in the technical papers session will examine film post-production technologies, film lab environmental issues, large-format film, film production and sound technologies, applied production technologies, electronic post-production and visual effects, compressed video imaging, desktop systems, digital systems, advanced TV systems and TV recording technologies. Tours of local TV facilities will also be on the agenda.

A special papers presentation on media integration will be held concurrently, in addition to the traditional papers program.

The conference will be put into perspective by two diverse speakers. Patrick Watson, chairman of the board of the Canadian Broadcasting Corporation (CBC), w deliver the keynote address. Dave Broadfoot, a Canadian humorist, will address the Honors and Awards Luncheon.

A new addition

Creativity Clinics will be a new feature at the conference. At these sessions, industry experts will offer demonstrations on the creative aspects of motion picture and TV production. Topics expected to be covered include creative lighting techniques, underwater motion imaging and aerial filming.

Take time for the tours

Several excursions will be offered as highlights to the convention program. A tour of the Canadian Broadcasting Corporation's new broadcast center is planned. Participants will be able to view the facility while state-of-the-art equipment is installed. Attendees will also be able to observe the largest indoor TV screen currently in use at the Skydome. A visit to the Cinesphere will let attendees view the largest film format in the world as well as hear several conference presentations that are scheduled to take place there.

What is a convention without the usual social events? This year's social agenda will include the opening reception on Tuesday, Nov. 10. The Honors and Awards Luncheon will be held Tuesday afternoon. The Fellows Luncheon will take place Wednesday, Nov. 11, and the banquet and reception will be held Thursday, Nov. 12. A Partners Program will offer scenic trips to Niagara Falls and the surrounding Toronto area.

Toronto in the fall

If you're Toronto-bound this fall, the 134th SMPTE Technical Conference and Equipment Exhibit will no doubt have much to offer.

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SBE show preview

Do you know the way to San Jose? SBE does.

By Stefanie Kure, associate editor

What better place to explore the future of broadcast technology than the capital of Silicon Valley — San Jose, CA? That's the site of the 1992 SBE National Convention and *Broadcast Engineering* conference scheduled to be held from Wednesday, Oct. 14 to Saturday, Oct 17.

This year's turnout is expected to be quite large, because many members on the West Coast have not had a chance to attend a national convention. Furthermore, the San Jose area has the second largest concentration of membership in the United States.

Pioneering sessions

Building on past successes, this year's show will include a record number of technical sessions and workshops. A total of 45 seminars and panel discussions is planned for the 4-day event.

In addition to examining the current state of the industry on the first day of the conference, other important topics to be explored include facility automation, digital audio broadcasting, FCC regulations and the digital studio. Thursday's afternoon session will feature a special hour-and-a-half emergency broadcast system (EBS) Summit conference. Briefings on WRSAME, ICEBS and EDIS will be presented. SBE has filed comments with the FCC on possible technical improvements to the EBS. This session will examine each of the major players.

On Friday, a "night owl" evening session titled, "SBE Frequency Coordination Committee Update and Open Forum," will be held. Panelists of this presentation will include Howard Fine of the FCC and Gerry Dalton of the NFCC.

If you're in the mood to socialize with fellow broadcasters after attending the sessions, then don't miss Thursday's exhibitor-attendee reception, Friday's ham radio reception and Saturday's reception and banquet. The annual banquet will feature an awards ceremony in recognition of those members who have gone to extraordinary lengths to help promote and support the SBE.

As in past years, the exhibit floor hours will not conflict with the conference presentations. Exhibit hours are scheduled from 10 a.m. to 4 p.m., Friday and Saturday, Oct. 16 and 17.

All conference sessions and exhibits will be held at the San Jose Convention and Cultural Center, located in downtown San Jose.

Ennes engineering workshops

In keeping with tradition, the Ennes Foundation will sponsor a number of manufacturer-conducted workshops on Wednesday, Oct. 14, the day before the conference formally begins. These workshops are designed to give broadcasters specific maintenance and operational instruction on important pieces of equipment. By attending these hands-on sessions, you can learn how to repair, operate and install certain kinds of equipment, polish your technical skills or refine your management abilities. Most of the workshops will last a half day, but some are planned as full-day events.

The workshops tentatively will include lectures and demonstrations on klystrons, power conditioning, HDTV design requirements, video equipment training, how to run a successful contract engineering company, NRSC-2 compliance and BBS systems.

If you plan to attend the Ennes workshops, be sure to note an important addition to the agenda. Sony will present an afternoon seminar on small-format videotape systems, including Betacam, Hi-8 and U-matic. The relative strengths and weaknesses of these acquisition formats will be discussed, along with the operational theory and future trends in small-format videotape. As part of the workshop, a tour of the Sony Sunnyvale facility has tentatively been scheduled.

Paid registrants for the *Broadcast Engineering* conference may attend the workshops, or you may choose to attend the 1-day workshops only. There is an additional fee for the workshops, and seating is limited to 25 people per session.

All sessions begin at 9 a.m., and attendees will receive an Ennes Engineering Workshop certificate upon completion of the sessions.

Loosen up

While you're in San Jose, be sure to take advantage of the many attractions. San Jose is the third largest city on the West Coast, located just 50 miles south of San Francisco and 60 miles north of the Monterey Peninsula. The city is home to the Rosicrucian Egyptian Museum and the Tech Museum of Innovation. The Winchester Mystery House is another famous San Jose landmark.

In addition, SBE will be offering a special 2-day spouse or invited guest program that will provide a scenic tour of San Jose and the surrounding area. The program will feature an extensive tour of San Francisco, San Jose (including the Convention Center, St. Joseph's Cathedral, several museums and the Winchester Mystery House) and Los Gatos.

The 1992 SBE National Convention and *Broadcast Engineering* conference promises to be informative, educational and fun, which are just a few of the reasons why you should attend. See you in San Jose. ■

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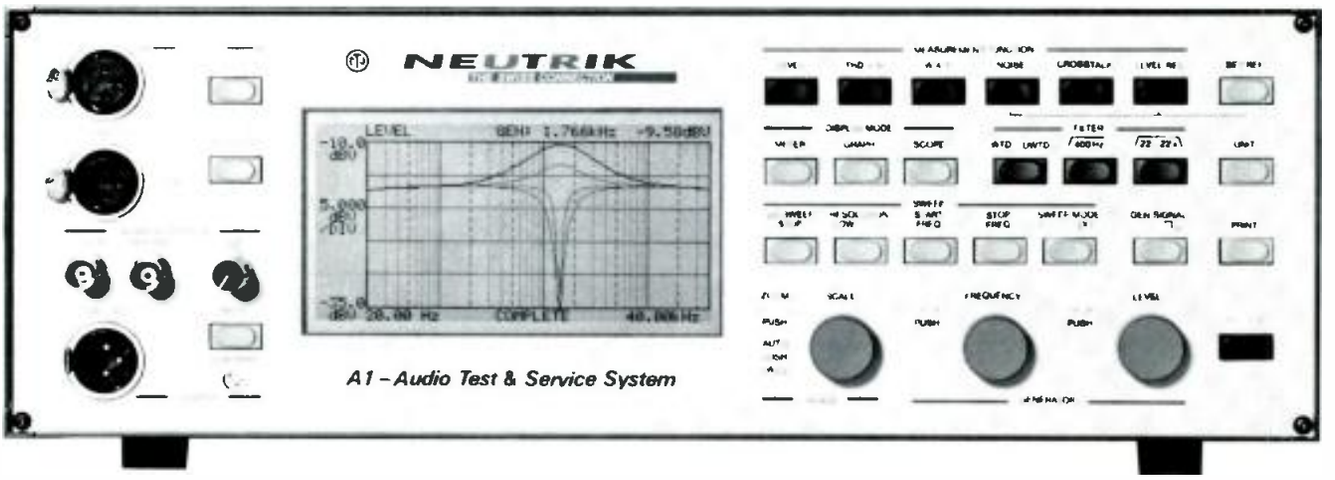

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Circle (42) on Reply Card

A new approach to integrated post-production

By Skip Pizzi, technical editor

For several years, the ultimate incarnation of a digital post-production system has lurked just beyond the next bend. For many post facilities (especially those with an emphasis on the audio side), the fully integrated, fully automated, multiroom, digital audio and video production environment took the form of a holy techno-grail, pursued by many, approached by some, but truly claimed by none.

Now it seems that a few manufacturers are pulling within sight of this elusive goal, and the objective can at last become real for audio post. One such system is *Scenaria* from Solid State Logic.

The system combines a 38-channel, fully automated digital mixer with a 24-track random-access digital recorder. To this it adds full audio editing, and machine control for conventional VTRs. Although impressive, such an array of features is not unique in the highly competitive video post-production marketplace. What distinguishes Scenaria from other systems is the way it works with video, and how it integrates into a multiroom facility.

Video elements are stored on an inboard, random-access video recorder, and integrated to the system with an array of useful and exclusive control features. The instant access to storage that audio workstations have provided is now matched by instant access to synchronized video. Moreover, when audio is edited after prior mixing (to conform to late video edits, for example), automation data is automatically conformed to the edit, and remixing is not required. Audio and video of complete scenes can also be easily inserted or deleted, thereby simplifying the preparation of a program's alternate versions.

Automation covers gain, EQ/filters, pan, compression/limiting, delay and eight auxiliary send levels, operating in snapshot, dynamic (time-code-based) or combinational modes. Automated routing is also provided, handling AES/EBU digital audio, analog audio and RS-232/422 control channels.

This system fulfills much of the promise of a truly integrated post-production system.

The system incorporates virtual and hard control surfaces, with eight assignable moving faders for channel gain and banks of LED-encircled rotary pots for other functions. Alphanumeric LED title bars over faders and pot banks identify the track name/number to which each device is currently assigned.

The upload/download time problems that workstation users often confront are minimized through the incorporation of magneto-optical work drives and the networking of additional off-line/prelay workstations (to which Scenaria serves as a mothership). Multiple Scenaria stations can also be networked.

Although not for the small budget, this system fulfills much of the promise of a truly integrated post-production system, providing remarkable speed, quality and organizational benefits. Scenaria's functional merging of a large and flexible digital mixer, random-access multitrack digital audio storage, extensive editing capabilities, comprehensive machine control, highly integrated random-access video storage, automated routing, and multi-user networking on a real world, reliable platform breaks new ground in post-production technology.

Continued from page 52

future goal, but significant strides have brought this potential closer.

Babes in Toyland

The production suite of today may use technology from the personal computer industry. The idea of non-linear and linear editing is relatively new, especially in regard to the many ways this technology is executed. Many basic off-line systems based on a PC platform use integrated proprietary software and codes, but the menus and features emulate typical CMX styles of editing. More advanced systems offer non-linear-based functionality, where editing is done by the cut, copy and paste methodology.

Newer systems offer enhanced video resolutions to 720×480 pixels. The obvious advantages are that these systems offer full 30-frame capability and random-access to 24 hours of source footage via optical disk. Numerous manufacturers include the ability to link digital audio multitrack hard disk recorders to the system. Immediate benefits are multitrack operation, EDL upload and download capability, real time punch-in, overdubs and track copying and sweetening in the digital domain. For spot or feature work, there is the benefit of storing large amounts of sound effects that can be cataloged and brought up and placed in real time.

Another new front is the desktop video production studio. One company offers a total system package in an EISA PC capable of A/B/C roll, 4:2:2 digital video effects and digital audio mixing, starting at approximately $10,000. This type of system offers multilevel mix effects and transitions to five layers of video and graphics simultaneously. The system may include three 2-D DVE channels, luminance and chroma-keyers, 32-bit graphics with alpha channel, titling, soft graphics and title keyers, three TBCs and complete VTR machine control, as well as a 6-channel stereo digital audio mixer.

Editor's note: An example of the new breed of sophisticated production suite equipment is described in the related article, "A New Approach to Integrated Post-Production," above.

➡ *For more information on production suite systems, circle Reader Service Number 303.* ■

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Station to Station

TTU-60 multiplex conversion

By Steve A. Rowell

If you own an RCA TTU-60 transmitter that was purchased without the klystron patching option, it was designed to work only one way. The visual output is a combination of two 30kW klystron final amplifiers, and the aural is a single 30kW klystron amplifier. If one of the three tubes fails during prime time, changing the tube will cost you viewers and air time.

With planning and a little RF work, you can modify the transmitter to work as a single-ended 24kW transmitter.

Redundancy is the reason

Most transmitter sites have redundancy — two microwave transmitters, two microwave receivers, two exciters and even backup IPAs. If you have a TTU-60, that's where the backup ends. No provision has been made for the failure of a tube except to change it. With the loss of one visual tube, the transmitter will continue to work at one-quarter power. The reject loads were originally rated to allow this operation, but it puts them at their maximum rating. Aging, contaminated oil or fatigue could cause them to fail under these conditions.

If the aural tube fails, there is a provision to divert the aural drive to the second visual amplifier. However, it is not possible without RF patching.

Rowell is assistant chief engineer at WOFL-TV, Lake Mary, FL.

Start with the RF

The RF modification is simple, but adapting it to your site may take some planning. Break the two connections to the input of the combiner or diplexer, bring those connections to a patch panel, and then make a single run to the output patch panel so that either of the two visual tubes can be put directly into the antenna. The installation will require one 4-port $6^1/_8$-inch patch panel, one 7-port $3^1/_8$-inch patch panel, and enough line and elbows to complete the installation.

When planning, be careful to maintain the quarter-wave relationship that exists between the two visual tubes. This is done by keeping the new lines of equal length.

Run multiplexed

After the installation of the RF system, the transmitter can be brought up in a multiplex mode. First, configure the exciter to run multiplexed, by which it adds the aural carrier to the visual carrier. Second, lower the drive to the transmitter so that the single tube used in this configuration will come up at 80% power. Third, pull the shorting bars on the two tubes not in use. Finally, change the $3^1/_8$-inch patch to put the working tube on the air and change the $6^1/_8$-inch patch to put the same tube into the antenna input.

This sounds like a lot of work, but it will allow you to return to 40% power quickly. The only other alternative is to leave the air and change a klystron, which takes from one to three hours.

A few precautions

When a transmitter is run in the multiplexed mode, it may create intermodulation products in the transmission. Holding the power level to 80% of the single-tube amplifier output and maintaining the visual-to-aural ratio will cut down on these unwanted signals. The SAW filter will attenuate the skirts, but there will be no RF system to minimize harmonics.

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Although these spurs will not noticeably degrade picture or sound, they may create excessive harmonic radiation. Spurs also may be generated by the combination of visual and aural signals. Spurious signals are most likely to occur at 4.50MHz and 3.58MHz below the visual carrier, and 7.16MHz and 9.00MHz above the visual carrier.

These signals may create interference on channels near your coverage area. Therefore, it is wise to examine the RF feed to the antenna, noting any harmonics that exceed −60dB. If any are found, the licensee should request authority from the FCC to continue operation.

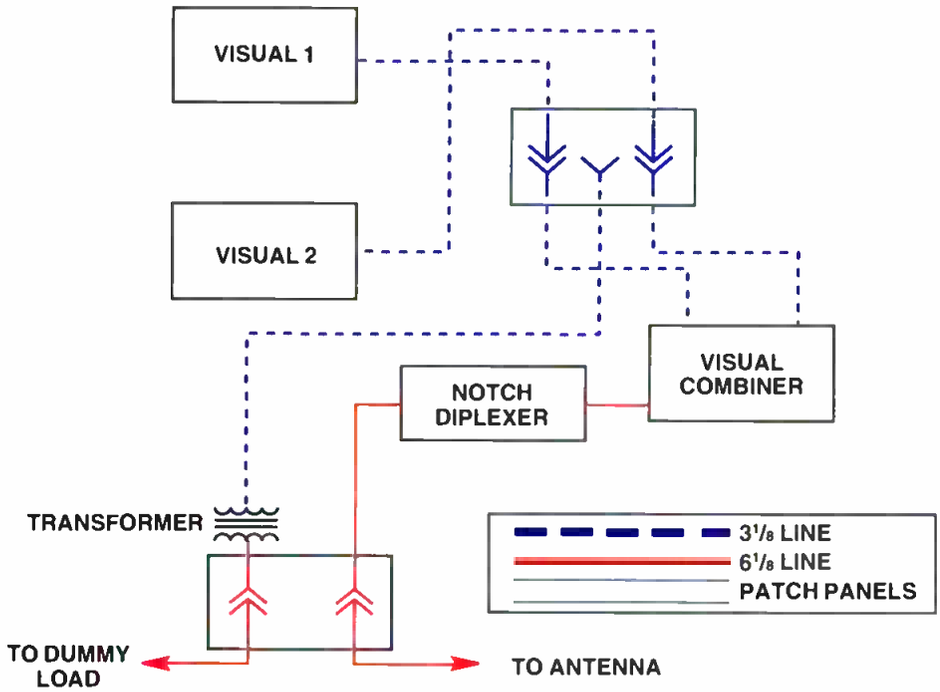


Figure 1. Completed modification will provide this routing. Either visual tube can now be put directly into the antenna.

Added features

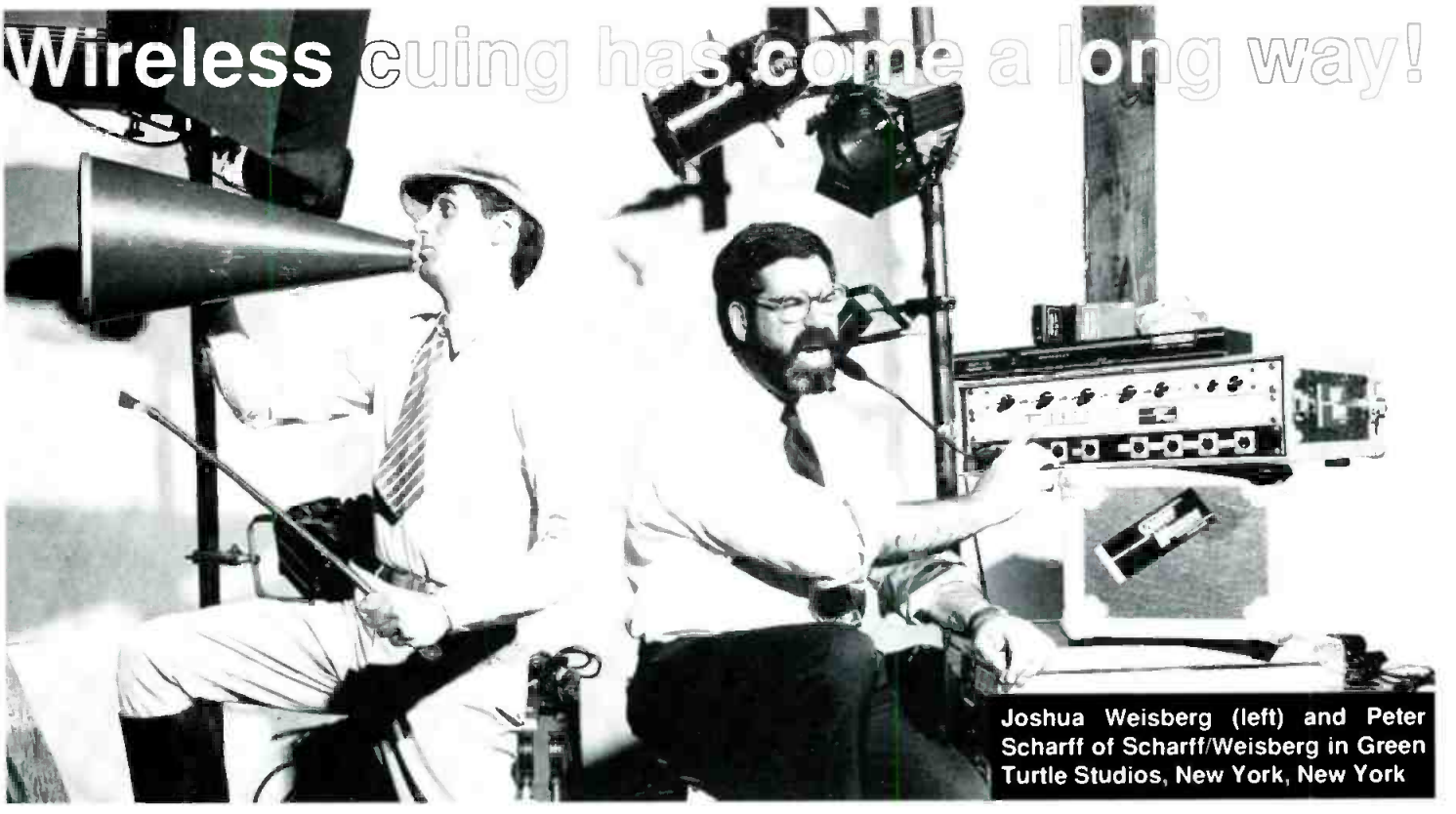
One benefit of this arrangement is the single testing of each amplifier. Each tube can be run single-ended into the dummy load. This will allow you to tune each tube separately and calibrate each cavity output power meter to reflect the actual power produced by the tube.

The ability to bypass your RF combining and filtering networks and still stay on the air is another advantage of this modification.

Cost vs. need

This project involves the purchase of two patch panels, RF plumbing and labor, all of which can add up to approximately $26,000. This investment allows you to return to the air (at 40% power) within 20 minutes after a tube failure. In a market where cable penetration is extensive, 40% power may cover the ADI and deliver an acceptable signal to most of the cable systems. Most importantly, this system gives the engineering staff time to think. Once you determine that a tube needs replacement, you can immediately return to the air, and then make plans to order a new tube or install a spare one at the most convenient and appropriate time.

Editor's note: The modifications listed in the article represent the opinions of the author, and are not necessarily endorsed by *Broadcast Engineering* magazine or the manufacturer. ■



Joshua Weisberg (left) and Peter Scharff of Scharff/Weisberg in Green Turtle Studios, New York, New York

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Vega's new wireless Interrupt Fold Back system, the IFB-12, is today's means of talent cuing in the studio, in the field, or wherever else you require simplex communications to a virtually undetectable miniature receiver. The system operates in the 174-216 MHz VHF high band and utilizes companding to make this the best sounding wireless IFB system on the market.

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The factory-matched system is available on any of more than 1600 stock frequencies and can be coordinated with any other wireless microphone systems you may be operating. The PL-2 receiver's multiple RF and IF tuning stages and outstanding sensitivity and selectivity make the IFB-12 *the* wireless talent cuing system for the professional.

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New Products

Studio audio
By Right Coast Recording
• **LRM-2 monitors:** high-resolution systems with 2-way mid-field design; pentagonal graduated-density, low resonance enclosure reduces internal standing wave effects, edge diffraction.

Circle (394) on Reply Card

Audio editor enhancements
By Solid State Logic
• **SoundScreen software Ver. 4.1:** revision for digital audio-for-video editor; extended operation includes multiple input recording, audio clip hold, selective backup/restore to MO disks, serial VTR emulation.
• **SoundNet Ver. 2.0:** enhanced software for multi-user networking system; functions include Print a Directory, expanded off-line directory to 32 off-line MO disks; selective backup/restore for archive facility.

Circle (395) on Reply Card

Maintenance products
By Tech Spray
• **Envi-Ro-Tech products:** HFC-free sprays include the Duster (1671) and Freeze Spray (1672); contains no chlorofluorocarbons in the spray propellant.

Circle (396) on Reply Card

Digital audio product
By WavePhor
• **AUDIO 2000:** 4:1 digital audio compression system with dynamic encoding process; converts two channels of analog stereo audio to digital datastream; 20kHz bandwidth with 352kHz clock rate; requires 25% of transmission bandwidth normally required; models available for 15kHz, 7.5kHz and 3kHz channel requirements.

Circle (402) on Reply Card

Data reference
By WEKA
• **Modern IC Databook:** 1,000-page, loose-leaf reference contains extensive substitution lists of equivalent ICs; data sheets for devices with index by function and part number.

Circle (403) on Reply Card

Audio processor
By NTP Elektronik A/S
• **Type 179-500:** adaptive pre-emphasis limiter with de-esser function; retains high subjective audio level with minimal coloration of the program material.
• **Type 477-500:** digital true peak program meter (PPM); mode display combines familiar analog type PPM indication using 10ms integration time with digital peak level meter like DAT systems using zero integration time.

Circle (387) on Reply Card

Specialized camera support
By Optical & Textile Ltd./OpTex
• **Poolside tracking system:** combines Panther dolly with OpTex Radamec-EPO remote head; permits camera operator to track action above, at and below water surface; motorized center column, Sony CCD camera and periscope with 4:1 zoom facility operable from 75m distance.

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SONY

Reference material

By Perma Power Electronics

• **"Guide to Power Protection:"** 8-page catalog includes discussion of power problems, solutions; covers surge suppression, voltage regulation, UPS systems.

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Titler enhancements

By AVS Broadcast

• **PC Utopia:** titler with link to a PC for live updating of data, creation of additional text; designed for sports scores, election returns, rapidly changing program text; full FloatingPoint facilities include designing event-specific template pages.

• **601 Option:** digital output and key signal; provides direct feeds digital mixers in all-digital edit suites; integral digital keyer inserts overlay titles on digital backgrounds.

• **Basys interface:** for Newsroom network; implements fast-moving text changes for live news.

Circle (358) on Reply Card

Portable lighting

By Broadcast Marketing International

• **Kobold ENG 200:** compact lighting kit; 30V battery belt or 110VAC supply; light can be hand-held, attached to camera or light stand; dimmer control varies output by 50%; 8:1 spot:flood ratio.

Circle (362) on Reply Card

Power conditioning

By Best Power Technology

• **Citadel systems:** ferroresonant power conditioning products for 110VA to 1.8kVA loads; full-range voltage regulation; noise and harmonic filtering; 250:1 attenuation protects against lightning, spikes, surges.

Circle (360) on Reply Card

SMT maintenance

By Pat Dooley Company

• **PD-900 desoldering tool:** for through-hold and surface-mount applications; conforms to ESD standards; usable with all size SMT devices; available with air-operated vacuum pump or portable electric motor pump.

Circle (392) on Reply Card

RF measurement equipment

By Bird Electronic Corporation

• **4304A THRULINE:** broadband, directional wattmeter; single-element measures 5W to 500W levels of signals from 25MHz to 1GHz; ±7% of full scale accuracy to 800MHz; forward and reflected indications; supplied UHF connectors may be changed to N, TNC, BNC and others.

Circle (361) on Reply Card

FO distribution

By FOCS

• **PDRS Premise Distribution Rack System:** interconnection, patching equipment for up to 72 fiber-optic conductors; supports all standard connectors; for 19- or 23-inch relay racks.

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Industry Briefs

BUSINESS SCENE

Dynatech Video Group, Madison, WI, held its first Dynatech Digital Seminar July 30-31 at Magno's Video Stage in New York.

The seminar, the first in an ongoing series of such events, was designed to help keep the film and TV production professional up-to-date on the latest developments in digital technology.

Roland Pro Audio/Video, Los Angeles, has sold a DM-80 multitrack hard disk recorder to WQCD-FM, New York.

Broadcast Electronics, Quincy, IL, was awarded a contract by National Transcommunications, Winchester, England, to supply all of the high-power FM transmitters to the United Kingdom's first national commercial radio network.

Vega, El Monte, CA, delivered more than 25 UHF wireless systems to NBC, New York, for use at the Summer Olympics in Barcelona, Spain.

Pinnacle Systems' (Los Gatos, CA) DVEator was used to perform 3-D transitions between live and prerecorded footage at the 27th annual Academy of Country Music Awards, April 29.

Vinten Broadcast, Towaco, NJ, has installed a Microswift TV camera robotic system at WRGB-TV, Schenectady, NY, which is the oldest TV station in the United States.

GEC-Marconi, Chelmsford, England, has received an order from the BBC, London, for four solid-state UHF TV transmitters.

In addition, Nozema, the Dutch-based company responsible for supplying TV transmitters in the Netherlands, has purchased a solid-state UHF TV transmitter.

Louth Automation, Menlo Park, CA, has secured a contract to provide Fox Tape, a division of Fox, with an ADC-100 automation system.

Solid State Logic (SSL), Oxford, England, has installed two ScreenSound digital audio-for-video editing/mixing systems at The Mix Place, New York.

SSL has also received orders for Scenaria, a complete digital soundtrack production system, from Producer's Color, Detroit; Avenue Edit, Chicago; Saunders & Gordon, London; the Tape Gallery, London; Voss AG, Dusseldorf; and four facilities in Japan.

Sony, Montvale, NJ, has received an order from DRDO-TV, Colorado Springs, CO, for 10 DVR 20 D-2 composite digital videotape recorders.

Quantel, Darien, CT, has delivered two Picturebox Twin and one Picturebox Single still-store systems to KOMO-TV 4, Seattle.

Symetrix, Seattle, has sold a 572 SPL computer to Muzak for installation at the Moreno Valley Mall, Riverside, CA.

In addition, producer Brian Ahern has added a Symetrix 564E quad expander gate to his Enactron remote truck.

Benchmark, Syracuse, NY, has delivered 500 mono DAs to ABC, New York, to help ABC rebuild Central Switching, the heart of its network production hub in Manhattan.

Shure Brothers, Evanston, IL, has been named as a finalist in the Rochester Institute of Technology/USA Today Quality Cup Competition for Individuals and Teams.

A 10-person team involved in the manufacturing of Shure's world standard SM57 and SM58 microphones was selected as one of 16 finalists from a field of 432 entries.

In addition, Shure received the International Television Association 1992 Technical Achievement Award for its FP410 portable automatic mixer.

VGV has relocated it headquarters. The address is 2400 N.E. Waldo Road, Gainesville, FL 32609; phone 904-372-0270; fax 904-378-5320.

Video Solutions, Wakefield, MA, has taken on product responsibility in New York City and upstate New York for Flori-Cal Systems, Colorgraphics, Dynatech, Delta Products and Camplex Systems.

Television Technology Corporation (TTC), Louisville, CO, was listed in the top 20 of the Rocky Mountain News 1992 Top 100 Colorado Companies. TTC received the Most Improved Award for climbing 75 spots from number 94 in 1991 to number 19 in 1992.

Vinten Broadcast has relocated its southern sales office. The address is 10208 N.W. 47th St., Sunrise, FL 33351; phone 305-572-4344; fax 305-572-4565.

Microwave Radio Corporation (MRC), Chelmsford, MA, has opened a European sales office in Hitchen, Hertfordshire, United Kingdom.

Cycle Sat, Forest City, IA, has opened an office and service center in Chicago. The address is Suite 2025, 541 N. Fairbanks Court, Chicago, IL 60611; phone 312-670-5100; fax 312-670-0008.

Comark's (Colmar, PA) 60kW IOT-equipped UHF transmitter has been chosen by the FCC Advisory Committee on Advanced Television Service and the Field Testing Task Force of the Systems Sub-Committee Test and Evaluation Working Party for the field test project for use in the HDTV test facility under development.

Lindquist Robinson Marketing, Nyack, NY, has been named as the advertising agency for Rosco Laboratories.

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SR. BENCH TECHNICIAN Growing Telecommunications Company in Minneapolis area seeks a Sr. Bench Tech with 7-10 yrs. Experience in VHS, ¾, Betacam, Tube & CCD Cameras, 1", D2, AUDIO, System Inlegration. Ability to troubleshoot to component level. Salary commensurate with experience. Full benefits package, travel-relocation included.

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TV MAINTENANCE ENGINEER: Needed in Gulf Coast Vacation Market. Must be a highly motivated and versatile individual who is a team player. Must have 3-5 years experience repairing ¾", M-2 1" tape equipment and other ENG and studio equipment. FCC General Class License required. Send resume to A. Dallas, WJHG-TV, P.O. Box 2349, Panama City, Florida, 32402 EOE. 9-92-2t

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TELEVISION MAINTENANCE ENGINEER for public TV. Repair/adjust studio and/or transmitter equipment. Assist in construction of new equipment or the modification of existing facilities. Must demonstrate extensive knowledge in theory of operation of TV broadcast equipment. FCC Radiotelephone Operator License, General Class, or other certification and background in digital troubleshooting required. Resume to: Personnel, WMFE, 11510 East Colonial Drive, Orlando, FL 32817. Deadline 9/30/92. EOE. Minorities and women encouraged to apply. 9-92-1t

EQUIPMENT WANTED

WANTED: USED VIDEO EQUIPMENT. Systems or components. **PRO VIDEO & FILM EQUIPMENT GROUP:** the largest USED equipment dealer in the U.S.A. (214) 869-0011. 4-91-tfn

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Acrodyne Industries, Inc.	65	38	800-523-2596
ADC Telecommunications	49	28	800-726-4266
Ampex (AVSD)	40-41	24	415-367-2011
Ampex Recording Media	11	8	415-367-3809
Antenna Concepts	82	68	916-621-2015
Apogee Electronics	76	20	310-915-1000
Audio Precision	13	9	800-231-7350
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Canare Cable, Inc.	72	55	818-365-2446
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Dolby Labs, Inc.	28	16	415-558-0200
EEV, Inc.	71	49	800-DIA-LEEV
ESE	70	60	310-322-2136
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Midwest Audio	85	39	
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Nikon Electronics Imaging	5	5	800-NIKONUS
NVision, Inc.	69	40	916-265-1000
Odetics, Inc.	9	7	800-243-2001
*OMB Sistemas Electronicos	19	12	347-627-4537
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Orban, Div. of AKG Acoustics	7,17	6,11	510-351-3500
Otari Corp.	3	10	415-341-5900
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Pioneer RVR Division	15	4	201-327-6400
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360 Systems	76	43	818-342-3127

Preview

October...

MANAGING TECHNOLOGY

- **Annual Salary Survey**

A review of the salaries paid to broadcast technical personnel.

- **Software for Production Facility Management**

In an effort to maximize profits, facilities need to keep their equipment and rooms as busy as possible.

- **Video Facility Management Hardware**

What do you get when you marry a broadcast monitor to a microprocessor?

- **Making Money With Technology**

In what has become an increasingly popular topic, we will show how to make money with technology.

- **Contracting for Maintenance Services**

The feature will show technical and business managers how to find qualified technical support and the advantages this approach offers.

- **Studio Camera Update**

A review of the technology used in modern studio cameras.

November...

9TH ANNUAL FACILITY MAINTENANCE REPORT

- **User's Guide to Test Equipment**

- **Maintaining Digital Systems**

A look at the new AES digital testing standard. The standard describes testing procedures and required equipment.

- **Maintaining RF Systems**

Keeping the transmitter and antenna system operating properly is crucial.

- **Equipment Reliability Testing**

With a decreasing amount of technical support, stations must make sure equipment operates reliably.

- **Measuring Camera Performance**

It's now possible to accurately and objectively measure the performance of video cameras.

- **Timing Video Systems**

All video systems rely on timing pulses to frame-synchronize their signals with other signals. The article will show how to adjust video equipment.

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