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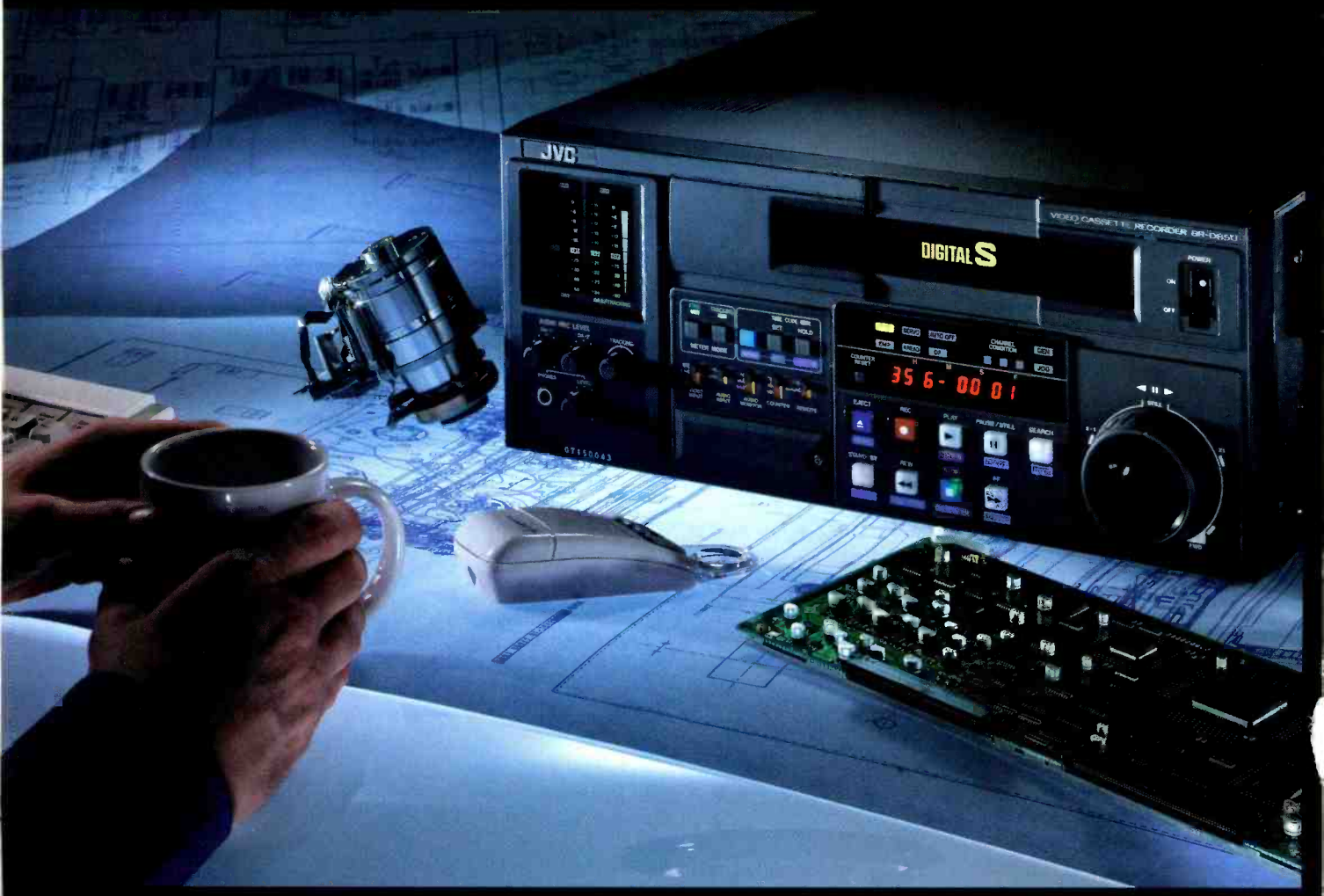

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BROADCAST® ENGINEERING
July 1997
Volume 39, Number 7

features

columns

departments

ON THE COVER: The expansion to DTV has broadcasters scrambling for solutions to antenna and tower issues, while still maintaining coverage areas. The image depicts separate digital and analog signals transmitted from two stacked JAMPRO antennas: a JTW-UHF traveling wave and JTC-VHF spiral. Photos and compositing by Douglas Schwartz, Sterling Communications, Santa Clara, CA, and Rick Der Photography, San Francisco, CA.

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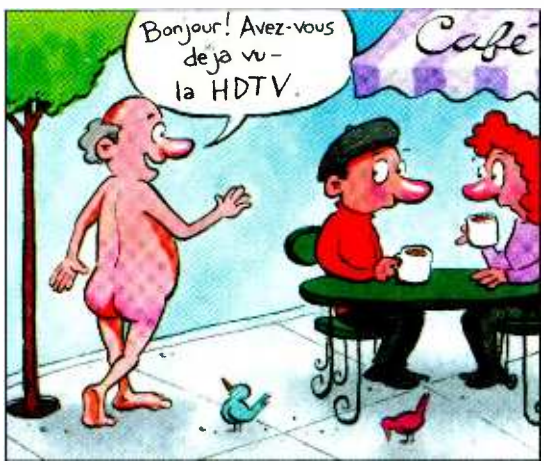
The naked truth

I recently returned from a 10-day trip to scenic Montreux, Switzerland, for the 20th International Television Symposium. For those of you who've not been fortunate enough to visit there, two words describe the locale, *absolutely beautiful*.

Nestled next to Lake Geneva (that's Lac Lemán to you French-speaking types) with the French Alps on the west, the Swiss Alps on the east, it couldn't be more beautiful. As a runner, I always enjoy running through new areas. And running along the lake from Montreux to Villeneuve or to Vevey is tough to beat.



However, interspersed with my scenic jogs, I did manage to attend several of the symposium's sessions. The convention marked the first head-to-head comparison of the American ATSC and European DVB digital broadcasting systems. With proponents lined up on both sides, there were clear differences in both technology and the agendas inherent in the two systems.

The clear contrast between the two systems was not in image quality, it would take a real pair of 'golden eyes' to see any, but in their respective political implementations. CBS's Joe Flaherty led the session by promoting the advantages of ATSC *and* HDTV. There was never any doubt where he was going with his presentation. He drew a line in the sand; digital television should mean HDTV, not multichannel.

His EBU counterpart, Dr. George Waters, was equally firm in his presentation and viewpoint that DVB was equal to the challenge of HDTV images, but that multichannel was currently the way for Europe.

The gloves stayed on throughout the three-hour, hothouse session. And, no one's ear was bitten off. However, it was evident that each side saw a lot at stake and wasn't willing to give any ground. You can expect a lot more posturing from both sides as they try to recruit other countries to adopt their respective technologies.

Although it's expected that the ATSC system will be implemented in a variety of countries, it's less clear whether those countries will choose to emphasize HD or multichannel. We all know the technology will do both, but the economies of scale won't benefit users nearly as much if a clear direction isn't taken.

What this means, is that U.S. broadcasters will have to keep their options open. Building an infrastructure that emphasizes one technology over the other could even limit your revenue potential. Worse, it could result in expensive rebuilds, which no one can afford. So much for the show's tech-talk.

Then there was the naked man. As I was leaving the "Great Modulation debate" (boy! what a snoozer), I walked through the Montreux Palace lobby. I noticed that the guy just in front of me had no trousers on. He had on a suit jacket, shirt, shoes and underwear, but no trousers. He walked out the hotel's front door, and as he stood in the valet parking area, he began taking off the remainder of his clothes. This goofball removed his coat, shirt, shoes and finally his underwear. Then, leaving his clothes in a neat pile, he began to calmly walk down the sidewalk passing bistros filled with diners and patrons. I guess the session was just too much for him.

Brad Dick

Brad Dick, editor

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letters to the editor

"Granny Factor" garners rave reviews

I read your editorial on the "Granny Factor." It is right on the money. Since the FCC's announcement about HDTV, I've had many of the same thoughts. Speaking as a broadcast engineer, it's going to be a major expense and engineering nightmare. Virtually all existing equipment will have to be scrapped. Just who's going to pay for that?

From the consumer's end, the big question I don't hear addressed (except in your editorial) is where is the demand for HDTV? It offers improved picture quality for movies and sporting events, especially with the improved aspect ratio, but do all of us really need that improved quality? My 83-year-old mother watches a couple of soap operas, the occasional talk show and the news. She didn't want my 32-inch Trinitron. She certainly doesn't need HDTV. I'm into electronic wizardry and gadgets, but I'm not convinced I need HDTV either.

I'm not even sure the average consumer will be able to tell the difference. After all, the marketplace opted for VHS over the superior picture quality of Beta. Back in the days before NRSC, most listeners couldn't tell the "superior" FM audio over AM's "inferior" audio, especially if the station was broadcasting in C-Quam.

I agree with your editorial position on this 100%.

BEN BASS

Good editorial! Right on the money.

RANDY HOFFNER

I agree with you again . . . and I don't know if this administration is the source or what, but you're certainly finding some good material these days.

BILL SEPMEIER

Loved the last 'graph in your "Granny Factor" editorial this month . . . . Keep up the great writing!

TERRY BAUN, CPBE

Bravo! I've believed for years that forcing DTV on the terrestrial broadcast world was a mistake. Please don't stop bringing this to the industry's attention.

ED BOK
FOND DU LAC, WI

The switch

Regarding the May 1997 issue, p. 105. The photo caption reads, "At La Chapelle studios in Belgium, a Euphonix CS2000 provides digital control of analog audio signals."

Well, let's see . . . the service tech has fingers, hence, the "digital control" aspect . . . he's adjusting them new-fangled rotary pots (although they look a tad sharp. . .).

The console offers pretty good service access (lift 'er up on the rack, Joe . . .).

One comment about the studio facility, though, wouldn't it be a mite hard to do a decent audio mix with that air compressor chuffing away in the background?

So, tell the truth, do you have a sister publication called Farm Equipment News *that has a caption like "Flemgelders Service Shop is typical of modern-day farm service facilities . . ." while the picture is of a large table-like device with buttons, knobs, sliders and flashing lights?*

You brightened my day.

BRAD SHERVINGTON
TECHNICAL INSTRUCTOR
PROGRAM BROADCAST SERVICES
CBC TELEVISION NETWORK, TORONTO

You're right on target Brad. Intertec does have a publication called *Grounds Maintenance* devoted to lawn care. Seems a slip of the 'ol mouse dropped out the correct photo from Euphonix (see photo below) and inserted a nifty one of a reel mower on a lift (the mower is used to cut the grass on golf courses) on p. 105 in our magazine. Sorry Euphonix and La Chapelle. ■

At La Chapelle studios in Belgium, a Euphonix CS2000 provides digital control of analog audio signals.

Send your thoughts to the editor at
CompuServe 74672,3124
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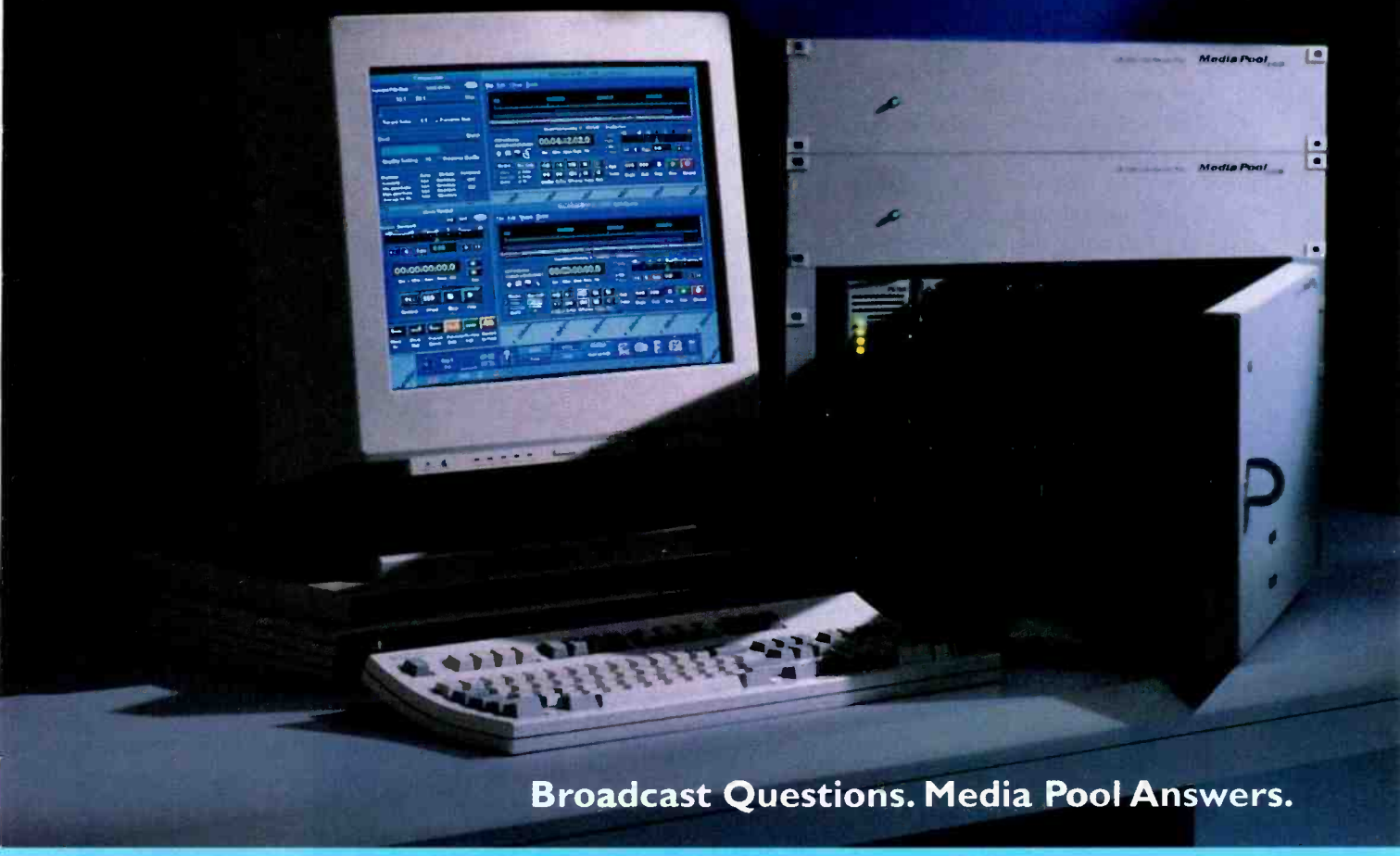

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Circle (12) on Free Info Card

news

By Dawn Hightower, senior associate editor

FCC power cap has broadcasters in a bind

The FCC's decision to impose a 1MW cap on transmission power levels and a 50kW floor is causing major disputes over the ATV rollout. UHF broadcasters aren't happy with the decision and are threatening to pursue legal action to stop the rollout if the commission doesn't reconsider. The dispute is between UHF and VHF broadcasters because UHF broadcasters are worried that the 13dB power difference will affect their digital signals by more powerful VHF broadcasters who are duplicating their analog coverage areas.

During the two-year period of the imposed power limits, field measurements should indicate whether the levels for a particular broadcaster need to be raised or lowered.

Microsoft has its sights on CBS

In yet another possible takeover, Microsoft has its sights on a bid for CBS. Apparently, Seagram, owner of Universal Studios, is also interested in purchasing CBS, but could be held back by foreign ownership restrictions and another planned purchase by the company. Westinghouse Electric Corporation, owner of CBS, is planning to split the company's industrial holdings from its entertainment business. If Microsoft purchases CBS, its deal with MSNBC cable news partnership with General Electric's NBC would end. And, if CBS is bought by Microsoft, it will give the company additional distribution power and a source of entertainment content, as well as a say in setting computer-friendly standards for upcoming digital TV technology.

Bill Gates

Zenith seizes initiative with TV buyer assurance program

Zenith Electronics Corporation is offering the "Ultimate Cutting-Edge Pledge" to consumers. It's a revolutionary buyer assurance program to allay consumer fears that the TV sets purchased now will be obsolete when digital TV broadcasting begins late next year.

The plan pledges that consumers may trade in any large-screen Zenith TV set purchased between Aug. 1 and Dec. 31 of this year, and apply the original purchase price toward a new Zenith digital high-definition TV set, which will be introduced late next year. The trade-in offer is available on all Zenith TV sets from 32- to 60-inch screen sizes, and is good on Zenith HDTVs purchased from authorized Zenith dealers through Dec. 31, 1999.

A coupon for a $100 rebate on a digital converter box also will be offered to consumers who purchase large-screen Zenith TV sets between Aug. 1 and Dec. 31 of this year. The converter box is planned for 1999 and will translate digital TV signals into analog signals for today's TV sets.

The Zenith pledge is to raise public interest and educate consumers to the fact that TV sets today most likely will not become obsolete and will continue to receive analog broadcasts until 2006, and they will accept cable, satellite, VCR and DVD signals for years after that. With the addition of a converter box, those sets will also receive digital TV broadcasts.

The DVB shootout at Montreux

For the first time, the DVB Project in Europe and the ATSC DTV standard in the United States were demonstrated side by side during the ITVS Symposium in Montreux. Both of the systems were shown in the high-definition TV format, which is contained in both standards.

Joseph A. Flaherty, senior vice president, technology for CBS, in referring to the standards-setting process, said, "It's the end of the beginning and the beginning of an era — the digital TV and HDTV era."

Joseph A. Flaherty

According to George Waters, recently retired as director of the technical department of the EBU, the demonstration was not meant to be a shootout between the two systems, although some comparisons, such as modulation with relation to portable and mobile receivers, will be inevitable. Waters pointed out that for fixed antennas and receivers, there aren't any differences in quality, the only difference will be in the 50Hz and 60Hz frame rates, and that won't mean much in the future because the receivers will upgrade it.

The DVB demo brought together the Advanced Digital Television Technologies Project (ADTT), Thomson Multimedia (France), Harris (UK), Independent Television Commission (UK), News Digital Systems (NDS—UK) and Radiotelevisione Italiana (RAI — Italy). ■

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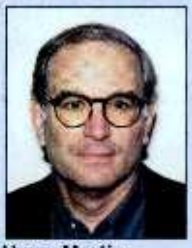
Circle (13) on Free Info Card

By Harry C. Martin and Andrew Kersting

Hundt to leave FCC — Quello and Chong replacements nominated

FCC chairman Reed Hundt notified the White House that he intends to resign when a successor is appointed. His announcement came two days after President Clinton nominated FCC general counsel William Kennard as the Democratic appointee to replace James Quello, and House Commerce Committee economist Herald Furchtgott-Roth for the Republican seat previously held by Andrew Barrett.


Harry Martin

Likely candidates for Hundt's replacement are ex-FCC general counsel William Kennard, commissioner Susan Ness, Kathleen Wallman, staff chief at the National Economic Council, and Ralph Everett, ex-counsel and Democratic staff director to the Commerce Committee.

Another possibility is the Justice Department's Michael Powell, who was recommended by Senate Commerce Committee chairman John McCain (R-AZ), to take the Republican seat formerly held by Rachelle Chong. Any further action regarding Hundt's replacement will not be taken until later this summer or early fall.

Debate continues on ownership and attribution rules

In May, NTIA director Larry Irving sent a letter to chairman Hundt stating that relaxing the TV ownership limits would be premature. Irving noted that even with the minor relaxation of the TV ownership rules, the average number of stations owned by each of the 10 largest group owners has doubled to 14, and their average audience reach has grown from 15.85% to 22.28%. Irving claimed that granting DTV licenses would only exacerbate the problem because each licensee will own analog and digital licenses. Irving also asserted that relaxing the attribution rules would be equally detrimental because the FCC lacks sufficient information regarding the number and effect of LMAs and JSAs.

Although there is some question concerning whether Irving accurately articulated the administration's position, there is little doubt that he would have made such a statement without White House approval.

Commissioner Ness views LMAs as nothing more than an attempt to circumvent the duopoly rule. She advocates a two-tier approach to any waivers of the duopoly rule. The first tier would involve a presumptive waiver for new or failing stations. It's unclear, however, how a station that was failing prior to entering an LMA, but now is profitable, would be considered in her calculus. The second tier would involve a case-by-case waiver analysis, which would include consideration of the public-interest benefits, but place a heavy burden upon the proponent. ■

Harry Martin and Andrew Kersting are attorneys with Fletcher, Heald & Hildreth, PLC., Rosslyn, VA.

Proposal to eliminate newspaper-broadcast cross-ownership ban

Senator McCain has introduced legislation that would lift the ban on common ownership of a daily newspaper and either a radio or TV station in the same market. Although the bill is not clear, removal of the ban apparently also would apply in cases where the common owner is the licensee of a radio and TV station in the same market.

McCain called the existing cross-ownership prohibition "one of the most archaic provisions remaining in telecommunications law," noting that the provision dates from a time when there was a realistic fear that common control of print and broadcast media in the same community could result in the public receiving only one viewpoint on important issues. Since that time, however, the number of media outlets has expanded dramatically to include numerous cable channels, DBS and the Internet, even in the smallest of markets.

The introduction of McCain's bill followed the FCC's denial of Tribune Company's request for a permanent waiver of the cross-ownership rule to permit it to own WDZL (TV), Miami, and the Fort Lauderdale Sun-Sentinel. The commission's decision came as part of its review of the Tribune's acquisition of Renaissance.

Although the proposed legislation may provide significant public-interest benefits in certain circumstances, the bill is likely to face strong opposition from Senator Ernest Hollings (D-SC), who was successful in preventing further relaxation of the cross-ownership rules under the Telecommunications Act of 1996. ■

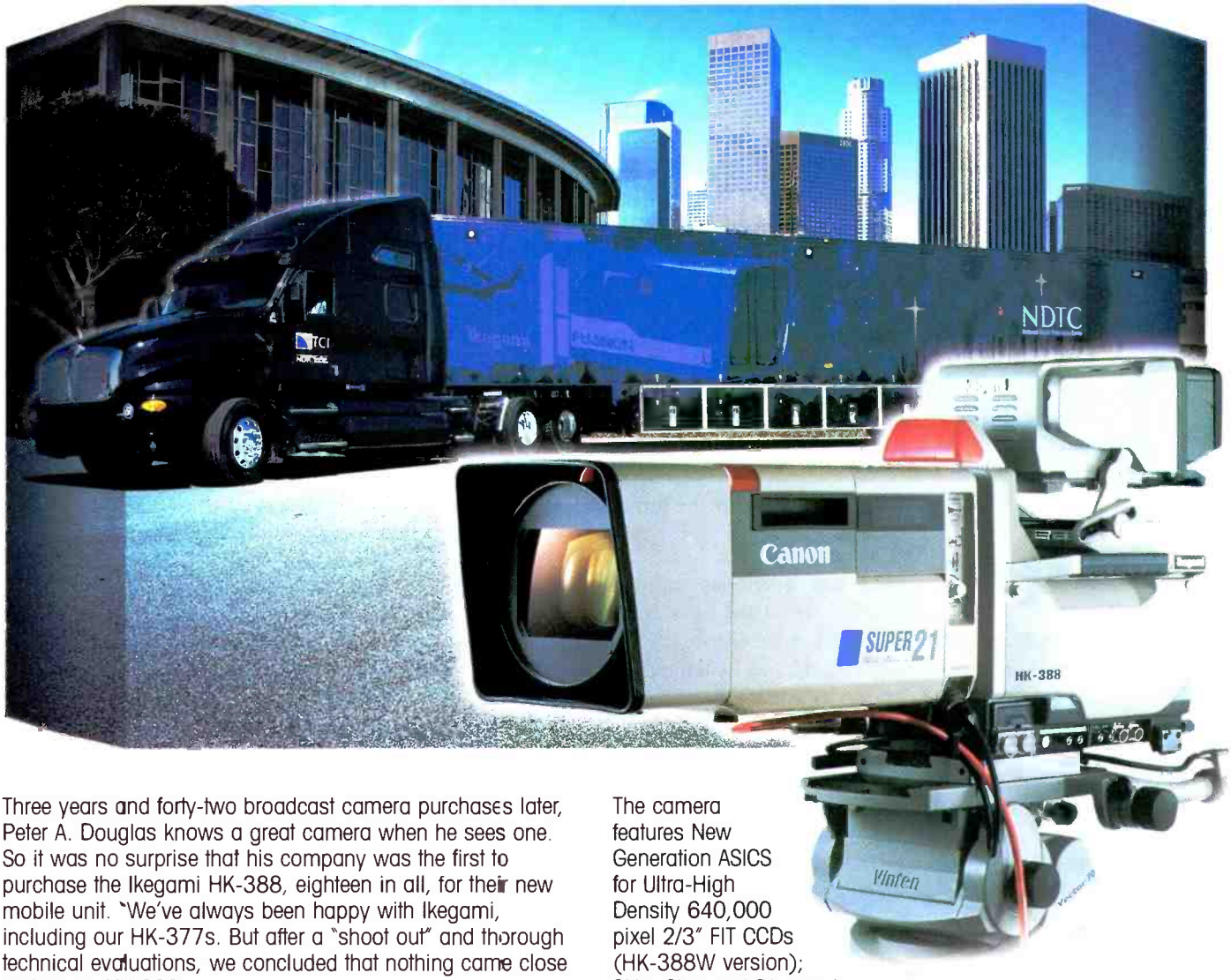
dateline

TV stations in Illinois and Wisconsin must file their renewal applications on or before Aug. 1, 1997. Commercial TV stations in the following states must file their annual ownership reports on or before Aug. 1: California, Illinois, North Carolina, South Carolina, and Wisconsin.

Tower owners in Florida and Indiana must register their structures between Aug. 1 and Sept. 30, 1997.

"Of All The Ikegami Cameras We've Owned, The HK-388 Is The Best."

Peter A. Douglas, Vice President Operations & Engineering, National Digital Television Center



Three years and forty-two broadcast camera purchases later, Peter A. Douglas knows a great camera when he sees one. So it was no surprise that his company was the first to purchase the Ikegami HK-388, eighteen in all, for their new mobile unit. "We've always been happy with Ikegami, including our HK-377s. But after a "shoot out" and thorough technical evaluations, we concluded that nothing came close to the new HK-388s.

"The camera performs beyond expectation, holding resolution and colorimetry even in very low and "colorful" lighting conditions. Skin Detail (an Emmy-winning feature) is also a must with our customers who demand this important Ikegami advantage. All in all, we could not have found a better camera or a better manufacturer to deal with."

The Ultra-wideband HK-388 and HK-388P hand-held companion are full digital cameras that combine Ikegami's vast studio experience with today's digital technology. Switchable 16:9/4:3 models are available.

The camera features New Generation ASICS for Ultra-High Density 640,000 pixel 2/3" FIT CCDs (HK-388W version); Skin, Slim and Diagonal Detail; Ultra-wideband Component Triax Transmission System, Optional Digital Fiber and Interface for RGB Triax; Analog and Serial Digital Component Outputs; a modulation depth of 80% at 5mHz; Sensitivity of f8, 2000 Lux; and a S/N ratio of 62dB.

"Our HK-388s consistently perform beyond our expectations. That's saying a lot."

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By Jerry Whitaker

The ins and outs of ATM

ATM is more than just a way to get cash on the weekend. It's also a high-speed protocol that holds promise for the future of video communications.

Asynchronous transfer mode (ATM) is a technology based on high-speed packet switching that can support professional video/audio and other complex multimedia applications. ATM is capable of data rates of up to 622Mb/s.

Jerry Whitaker

At the present time, ATM is primarily directed at telco-type applications. Interfacility video transfers over ATM can be expensive and complex. Despite these limitations, there is a great deal of interest in ATM technology and great promise for the future.

The basics

ATM was developed in the early 1980s by Bell Labs as a backbone switching and transportation protocol. It's a high-speed, integrated multiplexing and switching technology that transmits information using fixed-length cells in a connection-oriented manner. Physical interfaces for the user-network interface (UNI) of 155.52Mb/s and 622.08Mb/s provide integrated support for high-speed information transfers and various communications modes, such as circuit and packet modes and constant, variable or burst bit-rate communications.

These capabilities lead to four basic types of service classes of interest to video users[1]:

1. *Constant bit rate* (CBR), which emulates a leased line service, with fixed network delay.
2. *Variable bit rate* (VBR), which allows for bursts of data up to a pre-defined peak cell rate.
3. *Available bit rate* (ABR), in which capacity is negotiated with the network to fill capacity gaps.
4. *Unspecified bit rate* (UBR), which provides unnegotiated use of available network capacity.

These tiers of service are designed to maximize the traffic capabilities of the network. As illustrated in Figure 1, the CBR datastreams are fixed and constant with time. The VBR and ABR systems vary as shown. The bandwidth of the UBR class of service is a function of whatever network capacity is left over after all other users have claimed their stake to the bandwidth. Not surprisingly, CBR is usually the most-expensive class of service and UBR is the least expensive.

One of the reasons ATM is attractive for video applications is that the transport of video and audio fits nicely into the established ATM service classes. For example, consider the following applications:

- *Real-time video*, which demands real-time transmission for scene capture, storage, processing and relay, fits well into the CBR service class.
- *Non-real-time video*, such as recording and editing from servers, distributing edited masters and other operations that can be considered essentially off-line, can use the ABR service.
- *Machine control and file transfer*, such as sending still clips from one facility to another, find the VBR service attractive.

ATM is growing and maturing rapidly. It has already been implemented in many industries, deployed by customers who anticipate such advantages as:

- Enabling high-bandwidth applications, including desktop video, digital libraries and real-time image transfer.
- Coexistence of different types of traffic on a single network platform to reduce the transport and operations costs.
- Long-term network scalability and architectural stability.

In addition, ATM has been used in local and wide area networks. It can support a

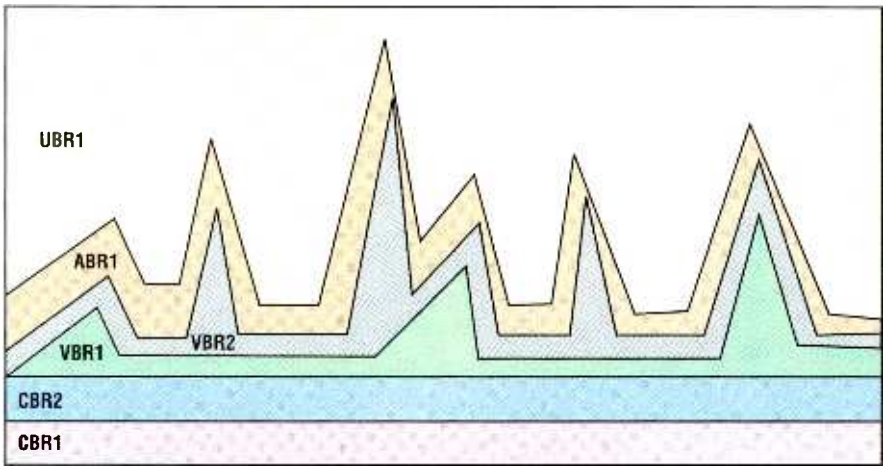


Figure 1. The typical packing of an internodal ATM trunk.

variety of high-layer protocols and will cope with future network speeds of gigabits per second.

The cell structure

It's worthwhile to explore the ATM channel format in some detail because its features are the key to the usefulness of ATM for video. ATM channels are represented by a set of fixed-size cells and are identified through the channel indicator in the cell header[2]. The ATM cell has two basic parts: the header (five bytes) and the payload (48 bytes). This structure is shown in Figure 2. ATM switching is performed on a cell-by-cell basis, based on the routing information contained in the cell header.

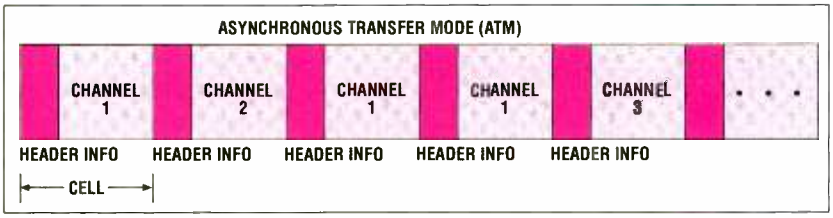


Figure 2. The ATM cell format.

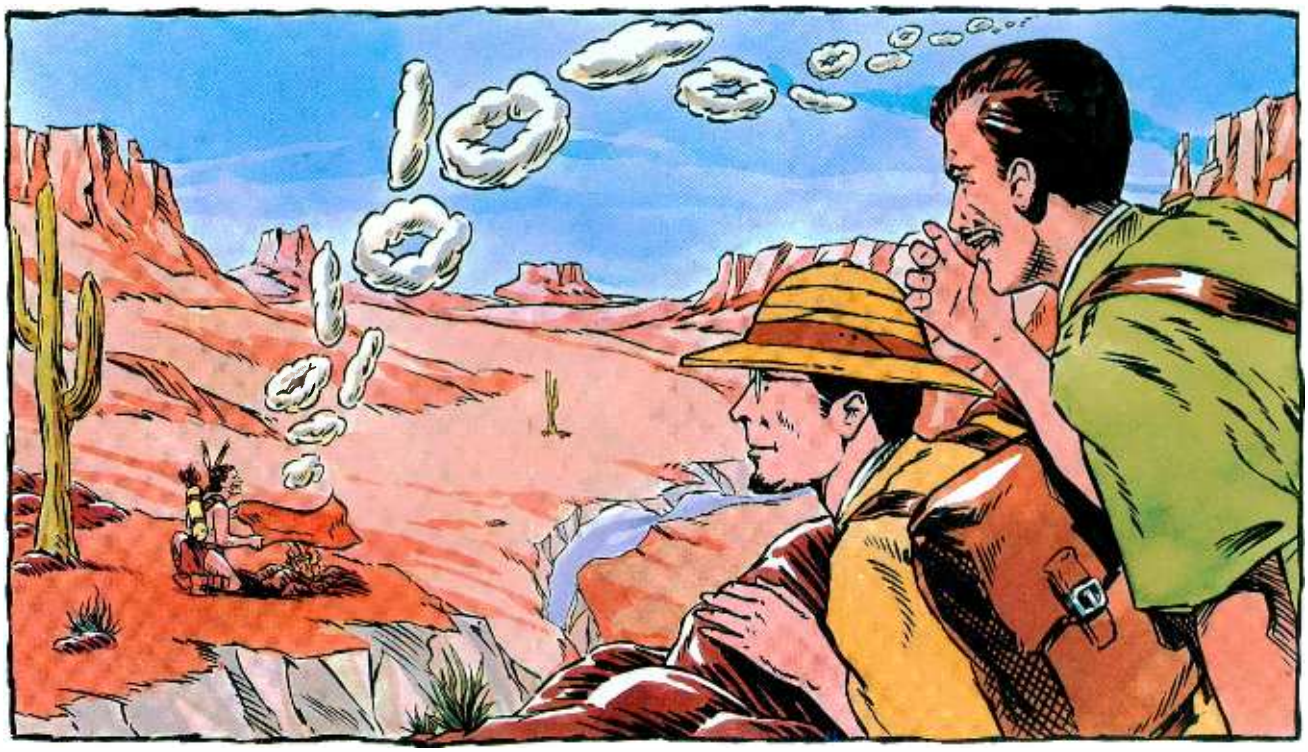
Because the main function of the ATM layer is to provide fast multiplexing and routing for data transfer based on information included in the header, this element of the protocol includes information not only for routing but also fields to indicate the type of information contained in the cell payload. Other data is included in the header to perform the following support functions:

- assist in controlling the flow of traffic at the UNI;
- establish priority for the cell; and
- facilitate header error control and cell delineation functions.

One key feature of ATM is that the cells can be independently labeled and transmitted on demand. This allows facility bandwidth to be allocated as needed, without the fixed hierarchical channel rates required by other network protocols. The connections supported are either permanent or semi-permanent and do not require call control, real-time bandwidth management and processing capabilities, hence, the flexibility of ATM for video/multimedia applications.

Using ATM for broadcasting

Although ATM has been around for some years, it's still in its infancy with regard to video applications in general, and TV broadcasting in particular. Generally speaking, ATM begins to look attractive today from a



"LOOK WILCOX, THE DIGITAL COMMUNICATIONS TREND IS CATCHING ON EVERYWHERE," WHISPERED SNELL.

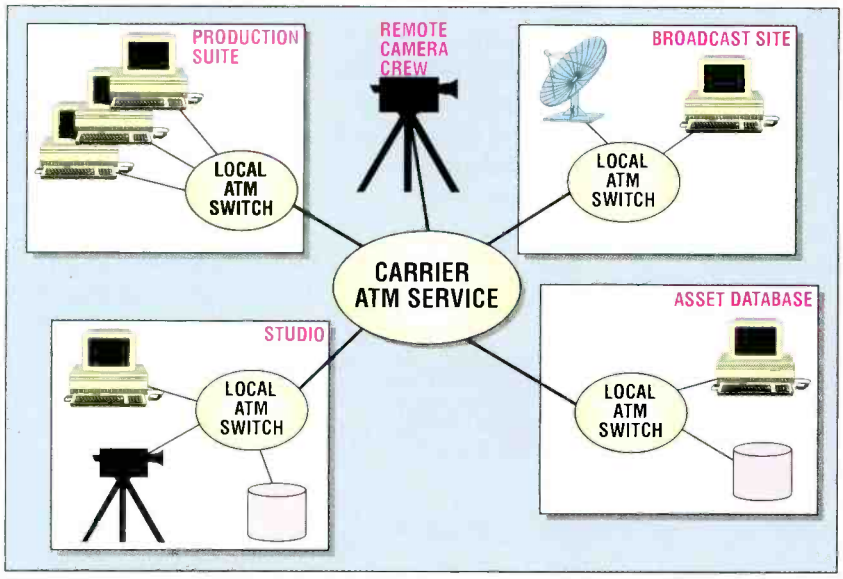


Figure 3. The concept of a virtual studio via ATM.

interconnected via ATM. This concept is illustrated in Figure 3. Note that feeds from the remote camera crew and studio are routed to a production suite, which also has access to an asset database. The finished product is then transported to the broadcast facility, where it's transmitted to viewers. Each of these five sites could be separated by many blocks or by hundreds of miles.

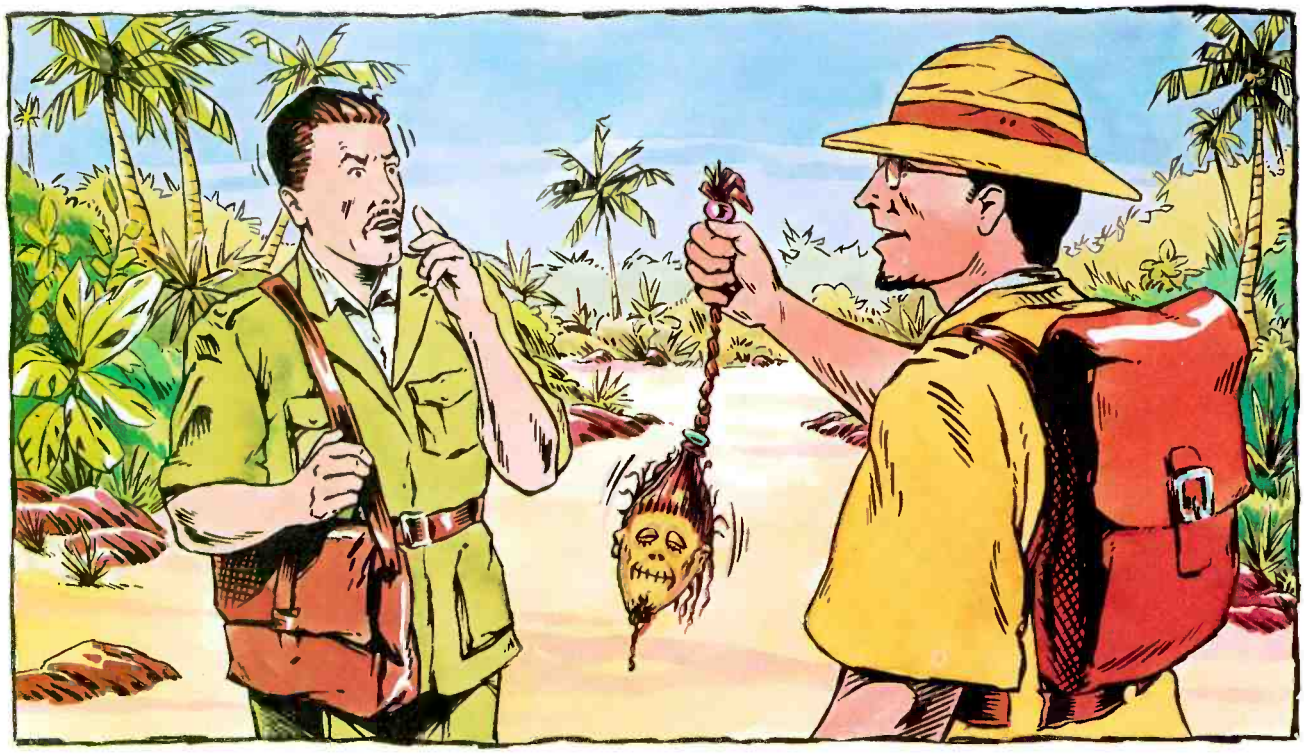
These exciting capabilities are some of the primary reasons for the interest in ATM on the part of the video industry. Stay tuned. It's coming to a node near you. ■

Jerry Whitaker is a consulting editor for Broadcast Engineering *magazine.*

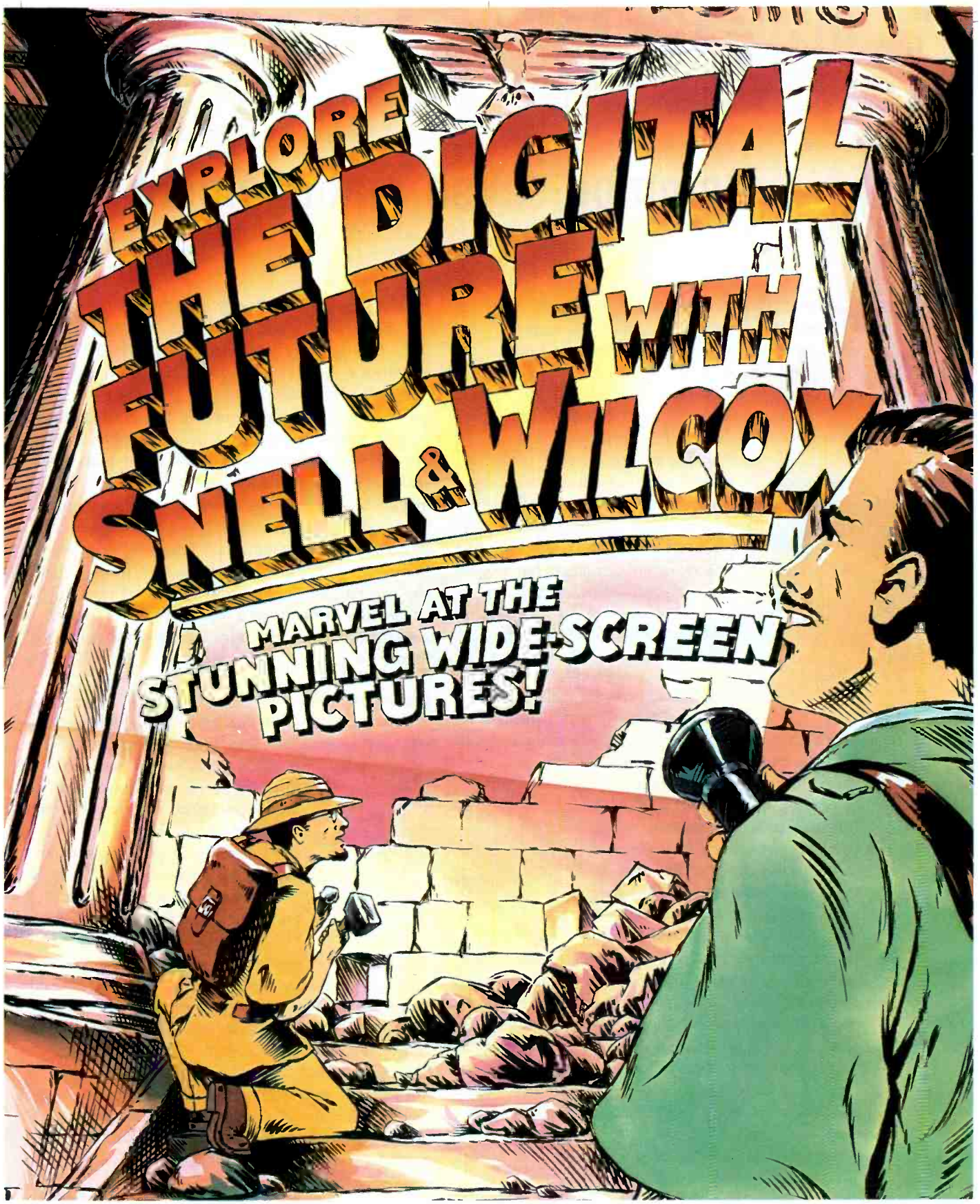
cost standpoint for point-to-point service over 50 miles in distance or for multiple-site connectivity.

When additional network capacity and video interface systems are available and more cost-effective, it's reasonable to consider building a virtual studio where production elements can be physically separated and

References:
1. *Piercy, John, "ATM Networked Video: Moving from Leased-Lines to Packetized Transmission," Proceedings of the Transition to Digital Conference, Intertec Publishing, Overland Park, KS, 1996.*
2. *WU, Tsong-Ho, "Network Switching Concepts," in The Electronics Handbook, J.C. Whitaker ed., CRC Press, Boca Raton, FL. p. 1,513, 1996.*



"CLEARLY THE RESULT OF AN EARLY EXPERIMENT IN COMPRESSION..." MUSED WILCOX.



SNELL & WILCOX

Engineering with Vision

Circle (7) on Free Info Card

By La Dora Morrill

Common-sense management

Even in this state-of-the-art world, the needs of good personnel are as *personal* as they were a century ago. Serious study and research began in the workplace around 1900. It was 1924, however, before concrete evidence was produced by Western Electric's Hawthorne Works in Cicero, IL, that good interpersonal relationships improved morale and boosted productivity.

La Dora Morrill

The idea was based on common sense; treat people well and they will work well for you. Experiments have been done with other factors within the work environment, but few result in increased production.

Rediscovering old-fashioned principles

In today's work environments, management experts are rediscovering — and applying — the principles of focusing attention on employees. Keep in mind that your staff are people just like you . . . supporting themselves and most likely a family. Respect your staff. Make them feel important frequently enough that it becomes a habit. *Communicate*. Listen to your staff's ideas. Let them know you respect their opinions, intelligence and knowledge. A staff with high self-esteem will be receptive to constructive criticism when it is necessary.

According to Randolph P. Harrison, a San Francisco communications consultant, communication is the process in which people become more common, more alike in terms of attitudes, beliefs, behaviors and values than they were before. Keep your staff informed about the business — explain the effect when they make mistakes and the effect when they do a good job.

"Supervision is 90% encouragement." said Tom Watson, Sr., president of International Business Machines Corporation. "Take just a few minutes out of your day to write somebody a note or to give them a sincere compliment. I'm not talking about false massaging of someone's ego. Find something good because everyone has something good about them. Before long, you will be amazed at the effect you can have on the lives of other people."

Supervision is 90% encouragement.

If your staff are not working up to your expectations, perhaps they only need guidance and a clearer knowledge of what is expected of them. I recall the time a few years ago when my promotion to office manager was for the purpose of firing a fellow employee. Before accepting, I made the terms of my promotion — other than firing this individual — clear with my young, egotistical and eccentric boss. Then I met with the middle-aged employee in question. She was intelligent and energetic, with a sincere desire to do her job well, but admittedly had little experience in her assigned position. I supplied her with the guidance she needed from my own well-stocked reservoir of experience. She became a valued employee instead of a statistic. In fact, the boss then become concerned that she might quit.

Moving on

If, after consultation and guidance, a staff member will not or cannot meet the requirements of the position, termination or transfer is in order. A transfer should be to an area more suited to the talents that the employee possesses.

If transfer isn't possible, termination is the only solution. Termination is necessary for the employee's good and that of the other staff members. If possible, suggest a business or type of work better suited to the employee's talents.

Monday is the best day to terminate. Effects of firing a staff member upon the other employees — good or bad — can be dealt with immediately and through the rest of the week, if necessary.

Negative feelings and actions have no place within a business. Anger, yelling and lack of composure are neither necessary nor professional behavior for anyone and should not be tolerated or exhibited. A real manager sets an example for employees with a sense of humor, efficient work and an air of respect. To quote Paul Harvey, "Lead by example, anything else is pushing." ■

La Dora Morrill has been active in the business world for more than 40 years as a manager and a consultant. She lives in Littleton, CO.

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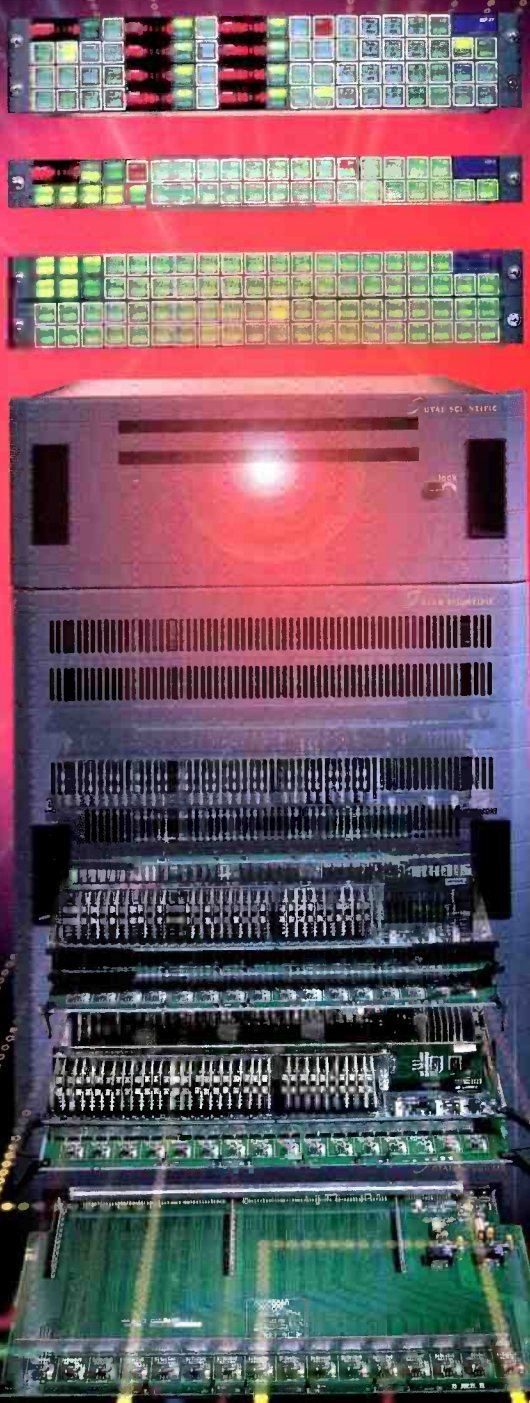

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Circle (8) on Free Info Card

Brad Gilmer

Selecting a network topology, part 2

Let's review some of last month's basic concepts behind computer networks:

• Networks often grow in unplanned ways, which can lead to performance problems.

• Several kinds of networks are in use today, but 10Base-T networks are the most prevalent. Characteristics of 10Base-T networks include low cost, unshielded twisted-pair wiring, 10Mb speed limit with a practical throughput of about 6Mb to 8Mb and the use of RJ-45 connectors.

Brad Gilmer

• Layered standards, such as the open systems model (OSM) allow you to change certain components of a network without having to change everything. For example, you can change system wiring from coax to unshielded twisted pair without having to change the network driver software.

• The conventional Ethernet network. When one person talks everyone else can hear the conversation. If two people talk at the same time, no one can understand what is being said. In a computer network, when one computer talks, everyone else listens in to see if the message is for them. When two computers talk at the same time, you get a collision. Collisions are a fact of life in the network world. The two computers detect that there has been a collision, back off a random amount of time and try again. Usually, this fixes the problem. However, when too many computers are connected to a single network segment, the network can become saturated. If collisions become the norm, communications are delayed significantly.

This month, we'll focus on the last point, describing how to avoid the computer equivalent of gridlock.

Topology for small systems

You can easily design a small network around a single hub or *concentrator*. Each computer on the network has a *home run* back to the concentrator, which provides buffering and interconnection between the computers.

This installation is fine as long as the number of users is low enough that the network isn't saturated. How many users is too many? Ten users on a single segment in a pier-to-pier network is a good limit. On larger systems with file servers, stay below 50 users per segment. If you put more users than that on a segment, you can saturate the network, bringing things to a crawl.

Most concentrator manufacturers allow you to chain one to another using either 10Base-T or higher-speed interconnects (100Base-T or FDDI). This allows you to increase the number of users connected to your network. Chaining concentrators may seem like the logical step in building a bigger system, but remember, everyone is still listening to the same network segment. As the size of the network grows, the traffic on this one-segment system will too.

Segmenting your network

The core concept behind segmentation is that networks may have many separate segments, allowing network traffic to move from one segment to another when the addressee isn't on the local segment. Using an intercom anaology, it's typical to find intercoms that support multiple buses. One bus may be assigned to the studio crew, cameras and technical director. Another bus may be set up for the remote truck and engineering. There may be another bus that is used exclusively between the producer, director and technical director. Why was this multiple bus system developed for intercoms? To avoid collisions and to pool common users who might want to be involved in the same conversation.

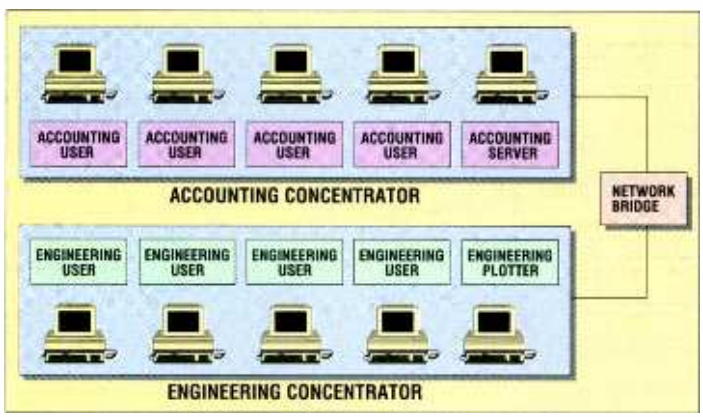

Figure 1. Segmented network.

Continued on page 104

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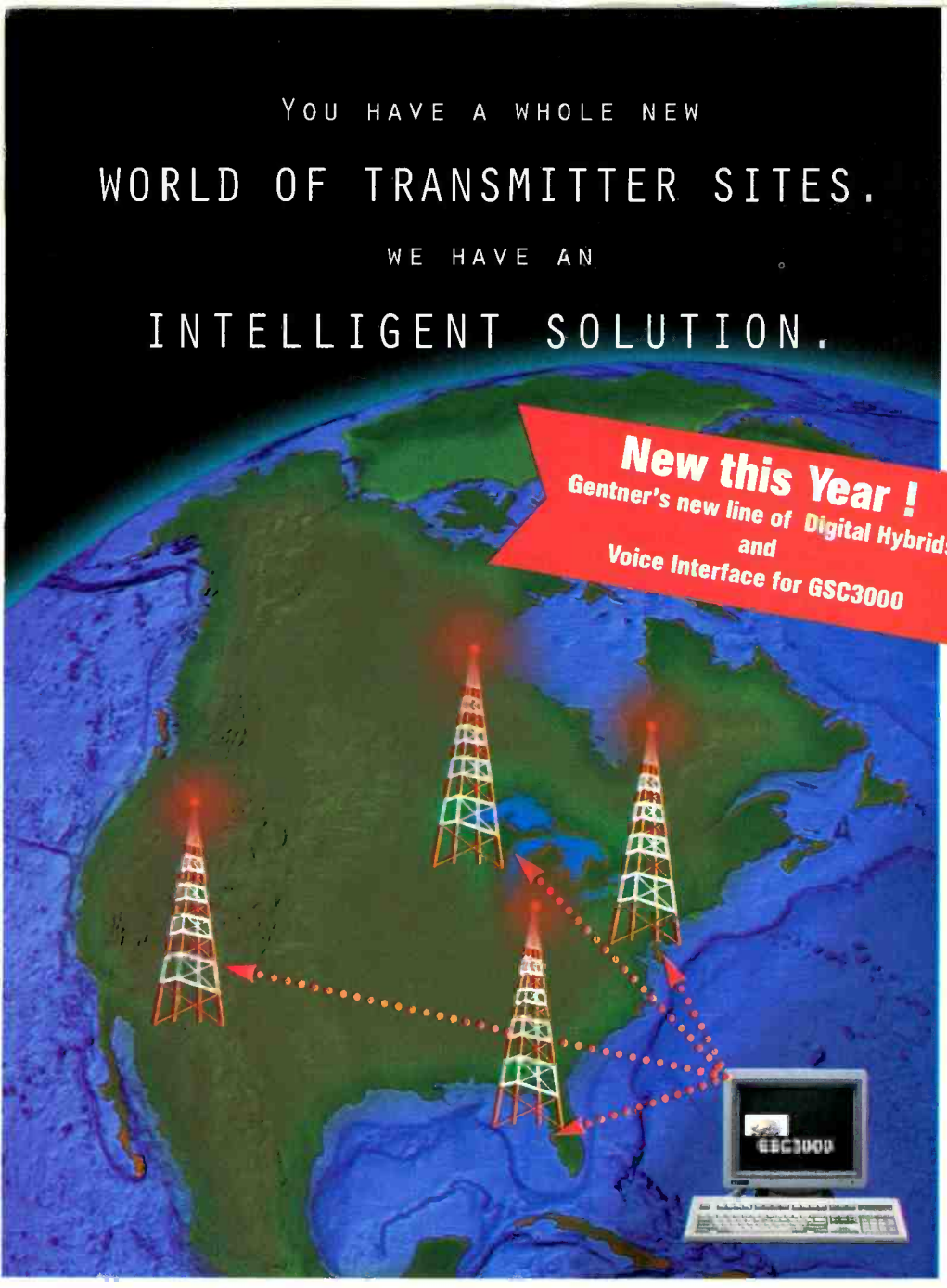

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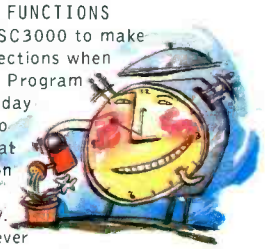

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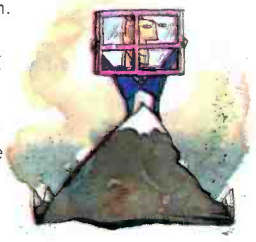

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By John Boudreau and Tom Krajecki

Unraveling the mysteries of wireless mic operation

Are there really mysteries of wireless microphone operation that can't be solved? Not if you take a unified approach to interference and problems of frequency coordination.

Identifying the enemy

The single greatest common denominator in all wireless applications and accompanying potential problems, is identifying the source of interference. Actually, interference basically arrives from only two sources: either outside of your working environment or inside of your environment. Approach both types of interference as a whole, and you'll learn to quickly identify and then rid yourself of them for good.

There are three commonly occurring symptoms associated with the use of wireless systems. Leading this threesome are dropouts. Dropouts occur when signals don't reliably reach the receiver. The length and duration of dropouts within a specific transmission vary according to the amount and type of interference encountered. Next, are the loathsome swishing sounds, which are typically accompanied by hum, static, buzz and distortion. Operating range is often shortened too. Last, but not to be forgotten in this devil-begotten bunch, is when your wireless receiver actually picks up someone else's signal. Depending upon what you pick up, this can be just embarrassing or downright mortifying.

Locating the enemy

Having defined the symptoms, let's now identify the causes for these interfering evils. Outside of the normally short-range working environment, there is essentially one great cause for interference — broadcast TV signals. These UHF and VHF signals can plague you like a hungry swarm of locusts hell-bent on ruining wireless reception. Although the interference can be maddening, it is also easy to remedy. Simply apply some avoidance therapy.

The best way to evade this enemy is to use a frequency-agile wireless system. Simply identify the TV channels in use in a given area, then select a different frequency for your wireless microphones.

Multipath and noise sources

Now let's move into the working environment and identify some of the problematic factors there. The key factor in interference-free operation here is frequency coordination. Put plain and simple, regardless of whether you find yourself working within the media circus surrounding a championship NBA game or a regional college sporting event, someone had better be coordinating the wireless frequencies being used by all.

If you don't know, find out what frequencies are already occupied by others, including local broadcasters of TV signals. A portable scanner can be helpful in determining whether there is activity on the frequencies you plan to use. One hint though. Be sure you perform the scanning check on site *and at the same time* of your proposed work. Checking the operating channel at 9 a.m. isn't of much use if you're planning to broadcast at 9 p.m. You'd be surprised at how activity varies throughout the day. (*Editor's note:* One good source of local frequencies being used by broadcasters and others in any area is the Society of Broadcast Engineers. Call 317-253-1640 for help in identifying the local person assigned to your area.)

Even if you have a clear channel on which to operate, multipath is always a potential problem. Multipath is simply a case where the transmitted signal arrives at the receiver from two or more paths. If the transmitted signals travel over different paths (due to reflections from surrounding objects or buildings), they will arrive at the receiver antenna at different times. This causes the signals to either add or subtract in a time-variant manner. The resulting phase cancellation can be disastrous to any wireless broadcast.

Multipath interference is generally more common in non-diversity systems, which use only a single antenna as opposed to dual-antenna designs of a diversity wireless system. The key here is to be sure that the receiver's antennas are mounted in different physical locations.

If there is any general philosophy of approach in dealing with the problems outlined above, it is to take a holistic approach. Be prepared for anything. Fortunately, once problems are identified, the mystery is over. All that's left is applying the correct solution. ■

John Boudreau is an applications engineer and wireless specialist at Shure Brothers Inc. Tom Krajecki is one of Shure's broadcast specialists.

For more information, a copy of Shure Brothers Inc. booklet on "Selection and Operation of Wireless Microphone Systems" is available by calling 800-257-4873.

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Circle (15) on Free Info Card

By Steven Blumenfeld and Mark Dillon

Is video ready for IP?

Is video ready for Internet Protocol (IP) is the question that we have only just begun to seriously investigate. Sure there is Real Video from Progressive Networks, Streamworks from Xing, VDO from VDO.net and a host of other companies vying for the mantle of video on the net. These companies, while on the cutting edge of the technology, have not come to grips with the central ideas of video over the net.

Mark Dillon and Steven M. Blumenfeld

Recently, we have seen Netshow and the new Real Video player add video hot spotting, which starts to show the promise of video over IP. If we look at this seriously, these new endeavors can be seen as an alternative to a cable-based interactive TV facility that was all the rage two or three years ago. While the software allows many of the same features as ITV, current video over IP is not real video no matter what the computer guys call it.

Bandwidth hungry

I know we are working with low bit rates, but the quality of what people are calling video today is unacceptable. Have you watched any of these Internet TV feeds? They are typically quarter-screen with 15fps displays. I, for one, do not call this television, and I do not believe that our customers will either.

Having been in the video encoding business from the beginning, I know we can do better. It is time to turn our attentions from the transport and player issues to encoding issues. First, in order to make video over IP work, we have to assume the bandwidth will be available in the near future. ADSL and cable modems are a reality today, and large-scale deployment is already happening. Video is bandwidth hungry. However, as demand for this IP video goes up, the bandwidth will be built. With a twist to the famous line from *Field of Dreams,* let them come and we will build it. This ideology can be seen in our own company, GTE, with the just concluded acquisition of the Internet pioneer-BBN and the purchase of 24 fibers to carry voice, video and data around the United States.

Keys to quality encoding

Back to encoding, we've learned a lot of tricks over the last 10 years. Starting with the early black-and-white encoding of UVlow to today's MPEG-2. An important key remains — for the best-quality compression, you must start with the highest-quality material possible. This usually means film to digital transfers or digital masters.

Content providers must also consider how their material will be distributed. Understand the limits of the technology and create or shoot accordingly. Spend time experimenting with various filtering techniques to create interesting effects. In the early days of encoding, we actually adjusted the quantization tables to get the desired results. These days, encoding systems adjust the quan tables automatically or provide a selection of fixed tables.

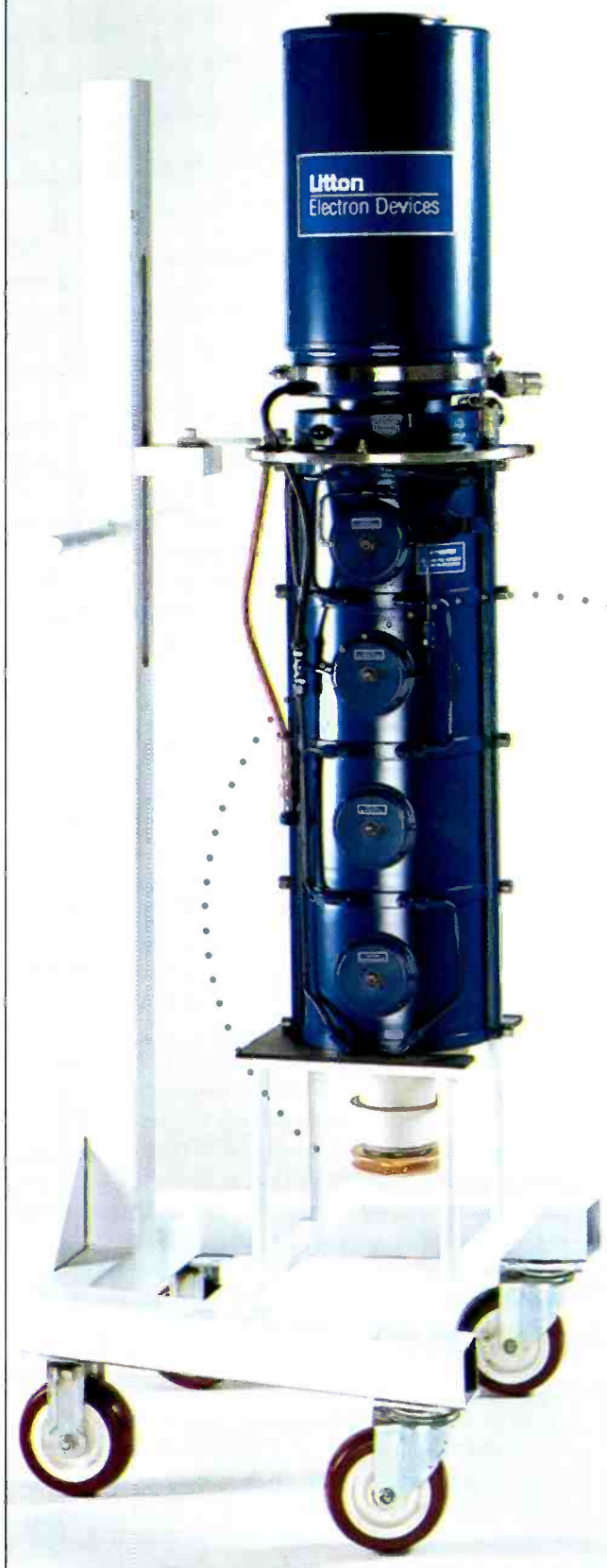
Learn from the experts. See what pioneers in the encoding business like Digital Outpost (www.dop.com), Laser Pacific and Pacific Ocean Post (www.virtualize.com) have done. They have spent many hours and dollars putting together the people and equipment to create excellent compressed video.

So what does all this have to do with whether video is ready for IP? Well, in order to make our customers excited about "watching" video over the Internet, we must make it like television with something extra. That something extra is accessibility. Given enough bandwidth, accessibility will make the promise of video on demand a reality. I am not necessarily talking about those hit movies that are supposedly going to replace Blockbuster but the self-help and how-to videos. As you probably know, there are more of these types of videos created than movies.

Imagine a 20-minute video about how to fix your sink. Your spouse has been asking you to fix that leak for the last month. You have been putting it off because you are not a plumber, you're a video engineer (besides, you don't want to admit that you don't know how). With IP video, you grab your coffee, retire to your home office and log on to the Internet. There you access www.fixit.com and find the sink section. You soon learn all you need to do for a minimal price and are on your way to becoming a self-made plumber.

Video, given the right amount of bandwidth and the proper content, will soon be ready for the Internet — mark my words. ■

Steven Blumenfeld is general manager for GTE Internet Television, and Mark Dillon is vice president, on-line services with GTE, Carlsbad, CA.



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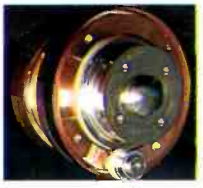

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Circle (16) on Free Info Card

By Louis Libin

The process pushes on

The ball is officially rolling and DTV is well on its way. The FCC announced the allocation and assignment of mostly UHF channels for DTV and all channels will be equally accessible on the DTV receiver. Most DTV channels will have coverage comparable to their NTSC population coverage and from a service area perspective, most channels are equally valuable.


Louis Libin

The first of the DTV stations (non-experimental) are on their way to completion. But of course, there are issues that remain unresolved.

Yet to be seen

One issue that still needs to be covered is the propagation differences between VHF and UHF. These differences have not been fully explored and documented to determine exact replication. We need to debunk the theory that UHF broadcasting is only reliable as a line-of-site service; recent experiments have shown that UHF signals can be captured many miles past the radio horizon.

Adjacent-channel issues must be resolved prior to full station implementation. Only full-power adjacent-channel testing will tell us for sure how well the system can withstand the various adjacent-channel operations scenarios. For example, do stations have to be exactly co-located or is nearby co-location sufficient for interference-free operation?

The exact replication figures of population served and service area will have to be studied carefully as the digital service is rolled out. The differences posed by the channel numbers, your new assignment vs. your market competitors can, in most cases, be mitigated by the new technologies and your own facility implementation.

Room for change

There must be ways for stations to change as technology and time permit. Some stations may desire a move, a minor modification in power or even a change in their assigned channel number. Broadcasters recognize the need for fine-tuning plans on a local basis to accommodate stations that cannot co-locate, wish to move their facilities or desire other facility changes.

Even channel changes between stations are possible if the result is not additional interference to another station. It is understood that in congested markets, these changes become more complicated, because even one change could involve many other stations moving channels. In all likelihood, there will be an industry committee formed to develop guidelines for pre- and post-adoption facility changes.

The digital future

If the House Commerce Committee has its way, broadcasters who launch digital TV service may be able to hang on to their current analog channels far beyond 2006. But the administration is pushing language that would require broadcasters and other spectrum users who did not pay for their spectrum at an auction to pay fees to cover any shortfall.

Zenith has said the first HDTV sets may cost as much as $7,000.

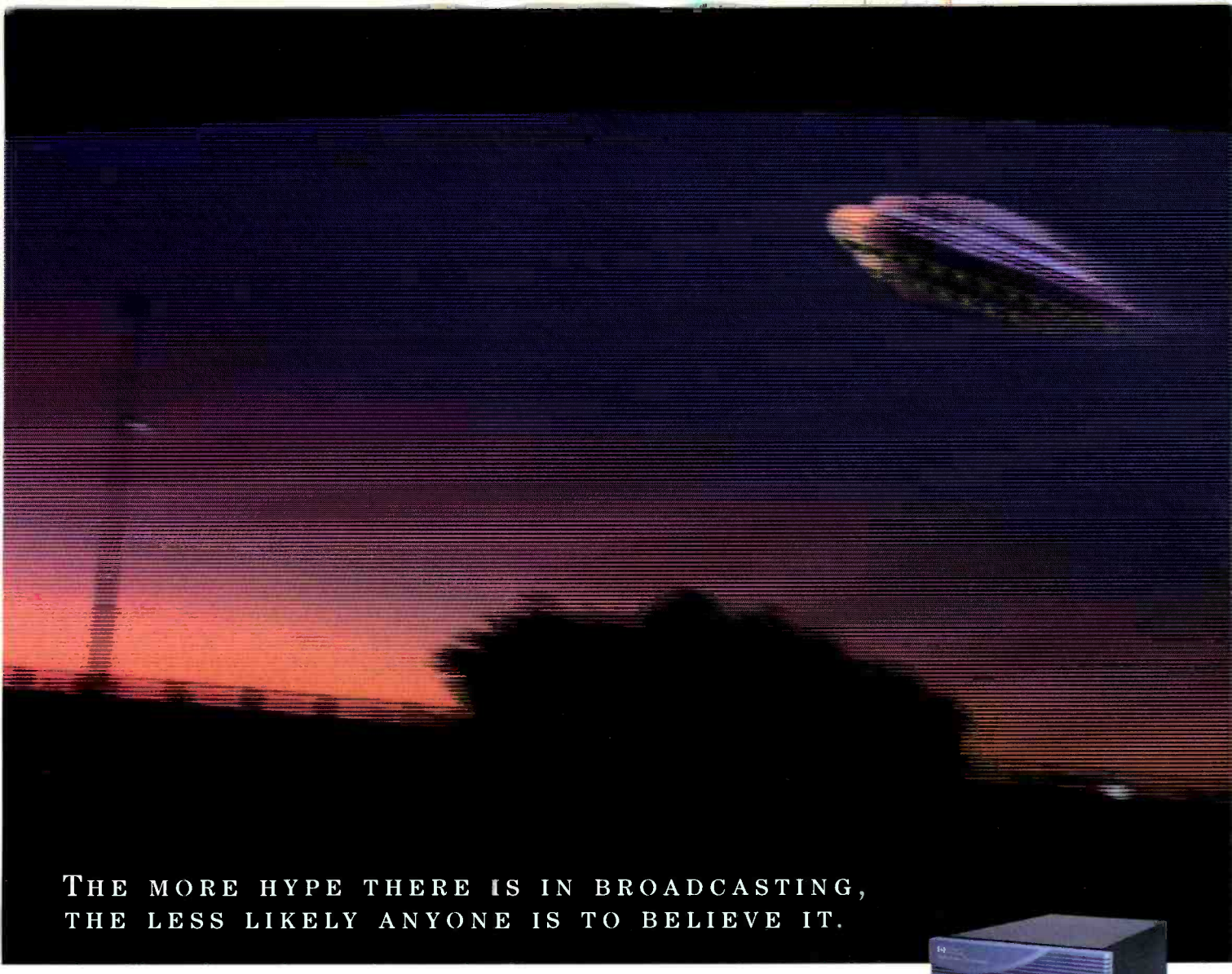
Clearly, digital TV sets will be offered as early as the beginning of 1998, but at a price premium measured in thousands of dollars (Zenith has said the first HDTV sets may cost as much as $7,000). And there is currently little interest from set makers in the set-top box, which could slow its adoption.

We need to plan from past experience. Based on the transitions to color and then stereo television in the United States, and the change from 405-line black-and-white to 625-line color television in the United Kingdom, experience indicates that a 10- to 15-year time frame for the public to move from the old technology to the new technology may not be sufficient.

Also, in many areas, new towers are needed before stations can begin broadcasts. Unfortunately, zoning regulations and community backlash against new towers are prevalent.

It is vital that we continue to solve these issues as we move closer to implementation. Broadcasters should continue to comment to the FCC, but bear in mind that most broadcasters agree with the basic allotment/assignment principles adopted by the commission. Everyone will need to support the process if the technology is to become a success for North America. ■

Louis Libin is a broadcast/FCC consultant in New York and Washington.



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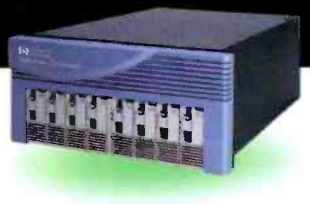

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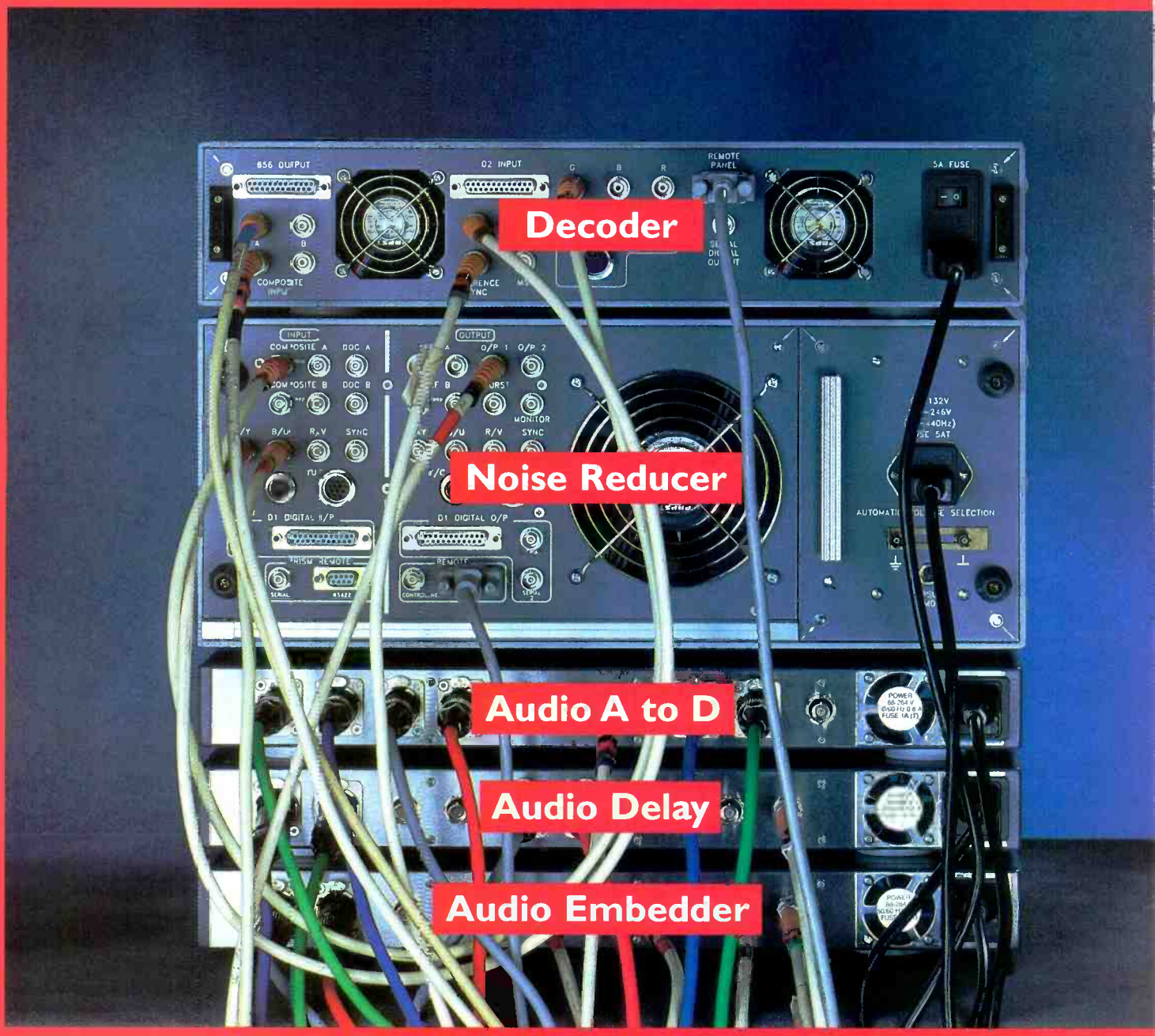

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By Ken Freed

V-chip technology ready for implementation

Implementation of the V-chip by analog cable and broadcast systems faces more political than technical hurdles as the technology evolves into a more advanced parental control solution for digital television. According to the 1996 Telecommunications Act, all TV sets sold in the United States after February 1998 must contain a V-chip, which can block out shows with selected ratings. The FCC, however, has not fixed the "real" compliance date for TV manufacturers because the commission has been waiting for the TV industry, specifically the broadcast networks, to develop an acceptable system of rating programs.


Ken Freed

The rating system finally announced (as strongly influenced by the motion-picture industry as the screen aspect ratio of HDTV) calls for six rating levels that essentially break down into age categories. A cross-section of parental, educational and other interests have condemned the new rating system as too vague, instead demanding explicit content information about a program's level of violence, nudity and adult language. In response to this criticism, a more detailed rating system was announced late last month.

V-chip conception

The Canadian inventor of the V-chip, Tim Collings, sides with those who want a more precise rating system. "I would hate to see the technology underutilized," he says, "because that would be an injustice to the capabilities of the technology, as well a dismissal of what parents have wanted for years."

A professor of engineering science at Simon Fraser University in British Columbia, Collings invented the V-chip after a 1989 shooting at an engineering school in Montreal. Reports that the killer was an addicted fan of combat videos and action TV shows prompted Collings to speculate on how explicit advisory labels could be used for TV shows. And so he conceived the V-chip, which leverages a TV operation's closed-captioning system to carry in-band data about program content.

By 1992, with technical assistance from his university colleagues, guided by research on parental preferences, Collings developed a prototype microprocessor chip that could scan the VBI every few seconds to read a four-character code and compare the data to the pre-selected access codes retained in the chip's 4k of RAM. Frank Lewis at Autograph helped write the on-screen user interface, and Bob Henson at Link Electronics provided the prototype data-insertion hardware.

After the prototype was demonstrated to the Canadian government, Shaw Cable agreed to fund a pilot project, which ran in Edmonton from 1993 to 1994. Rogers Cable then tested the V-chip system in Toronto and Vancouver. Subsequent V-chip tests in the United States included cable systems in Buffalo and Seattle, plus tests by several cable channels. "Because cable is mostly funded by subscriber fees," Collings observes, "they generally have been more supportive than broadcasters, whose revenues are very sensitive to Nielsen ratings."

The interim solution

Right now, there's no need to insert V-chip coding into your cable or broadcast transmissions until chip-equipped TV sets and set-tops come to the marketplace. When that time arrives, use the computer connected to your closed-captioning encoder to insert program title and ratings data into the analog VBI or digital datastream of any program not already coded before arrival. The source of the video does not matter. V-chip program information can be pre-coded weeks or months in advance, depending on the workstation memory. Auto-sync the clock to make sure the V-chip data is encoded into the outbound signal in real time.

Whenever a V-chip in the home encounters a proscribed code, the chip blocks out the entire program with explanatory text appearing on the screen. Scene-by-scene V-chip blocking of analog content can be done now, but tests have shown that the method is confusing to viewers. Single-scene blocking interrupts the storyline too much for most viewers, and viewers never knew how long to wait for the program to return.

For now, the V-chip is ready for implementation only on analog systems. As digital television enters homes, and when every data packet can carry a V-chip code in the header, Collings expects parents will gain the ability to use the remote control to select an adult version of a show and then almost seamlessly shift to a softer version if their kids walk into the room. That's why he sees analog implementation as an interim solution. ■

Ken Freed is a technical writer specializing in cable and interactive television, and is based in Denver.

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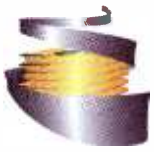

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New frontiers for transmitter technology

The move to DTV has put transmitters center stage.

By Jerry Whitaker

THE BOTTOM LINE:
As stations begin broadcasting digital signals, a variety of changes need to be made in facility infrastructures. One of the most fundamental is the upgrade to a digital transmission system. Choosing among the various technologies can be difficult, because it requires balancing the various long-term vs. short-term costs and maintenance issues. $

With the clock ticking toward the deadlines for DTV service, stations are taking a serious look at transmitter requirements. For the first time in many years, the RF system is taking center stage. RF hardware is at the top of the list for DTV conversion. The STL, transmitter, antenna and tower conversion/upgrade requirements brought on by DTV are considerable; in some cases, the challenge is enormous.

The product offerings demonstrated at the spring NAB convention for this conversion process were covered in some detail in the

Photo: Two engineers look on as WRAL-HD signs on, becoming the nation's first transmitter to transmit digital signals.

June issue of *Broadcast Engineering* and, therefore, will not be covered. Instead, this article examines the basics of power amplification devices, as well as many of the issues surrounding the implementation of digital service.

How much power?

Two parameters determine the basic design of any transmitter: the operating frequency and the power level. For DTV, the frequency has been clearly spelled out; the power parameter, however, deserves — and indeed requires — additional consideration.

The FCC allocation table for DTV lists ERP values that are given in watts rms. Although sometimes referred to as *average power*, this is not always technically correct. The intent was to specify the *true heating power* or rms watts of the total DTV signal averaged over a long period of time.[1] Specifying transmitter power is further complicated by the DTV system's characteristic peak-to-average ratio, which has a significant impact on the required power output rating of the transmitter. For example, assume an FCC UHF DTV ERP allocation of 405kW rms, an antenna power gain of 24 and a transmission line efficiency of 70%. The required DTV transmitter power *Tx* will equal:

$$T_x = \frac{405}{24} \div 0.7 = 24.1\,\text{kW}$$

Because the DTV peak-to-average ratio is four (6dB), the actual DTV transmitter power rating must be 96.4kW (peak). This 4X factor is required to allow sufficient headroom for signal peaks.

Nothing but choices

Having established the operating power and frequency, the fundamental architecture of the transmitter can be set. Three basic technologies are used for high-power TV broadcasting today:

1. *Solid-state* — bipolar, MOSFET, LDMOS, silicon carbide and others.
2. *Grid-based power vacuum tubes* — tetrode, UHF tetrode and Diacrode.
3. Klystron-based UHF devices — conventional klystron, MSDC klystron and IOT/Klystrode.

Each class of device has its strengths and weaknesses. Within each class, additional distinctions also can be made. Sorting out the relative merits of transmitters based on these devices can be a confusing proposition. Certainly, each of the varied approaches works — some better than others. Identifying which system is best for a particular application is made easier when the basic principles of each approach are understood.

Unfortunately, space limitations prevent a detailed examination of all components within the three device classes.

The transmitter room at WHD-TV, the Model HDTV Station in Washington, DC.

We will, instead, touch on the highlights of each group, focusing on the technologies that are considered the leading candidates for DTV applications.

Solid-state devices

Solid-state devices play an increasingly important role in the generation of RF energy. As designers find new ways to improve operating efficiency and remove heat generated during use, the maximum operating power per device continues to increase.

Invariably, parallel amplification is used for solid-state RF systems. (See Figure 1.) Parallel amplification is attractive from several standpoints. First, redundancy is a part of the basic design. If one device or one amplifier fails, the remainder of the system continues to operate. Second, lower-cost devices can be used. It is often less expensive to put two 150W transistors into a circuit than it is to put one 300W device. Third, troubleshooting the system is simplified because an entire RF module can be substituted to return the system to operation.

Solid-state systems are not, however, without their drawbacks. High-power transmitters using vacuum tubes are much simpler in design than comparable solid-state systems. The greater the number of parts, the higher the potential for system failure. It is only fair to point out, however, that failures in a parallel, fault-tolerant transmitter will usually not cause the entire system to fail. Instead, some parameter, typically peak output power, drops when one or more amplifier modules are out of service.

This discussion assumes that the design of the solid-state system is truly fault-tolerant. For a system to provide the benefits of parallel design, power supplies, RF divider and combiner networks, and supervisory/control systems must also be capable of independent operation. Furthermore, hot swapping of defective modules is an important attribute.

The AC-to-RF efficiency of a solid-state transmitter may or may not be any better than a tube transmitter of the same operating power and frequency. Much depends on the type of modulation used and the frequency of operation. Fortunately, the lower average power and duty cycle of the DTV

New frontiers for transmitter technology

signal suggests that a high-efficiency solid-state solution may be possible.[2] The constant signal power of the DTV waveform eliminates one of the biggest problems in NTSC applications of class AB solid-state amplifiers: the continual level changes in the video signal vary the temperature of the class AB amplifier junctions and, thus, their bias points. This, in turn, varies all of the transistor parameters including gain and linearity. Sophisticated adaptive bias circuits have been developed to reduce or eliminate this limitation to class AB operation.

Solid-state amplifiers operating class A do not suffer from such linearity problems, but class A operation can impose a substantial efficiency penalty. Still, many designs use class A because of its simplicity and linearity.

The two primary frontiers for solid-state devices are: 1) power dissipation and 2) improved materials and processes.[3] With regard to the first point, the primary factor in determining the amount of power a given device can handle is the size of the active junctions on the chip. The same power output from a device may also be achieved through the use of several smaller chips in parallel within a single package. This approach, however, can result in unequal currents and uneven distribution of heat. At high power levels, heat management becomes a significant factor in chip design. Specialized layout geometries have been developed to ensure even current distribution throughout the device.

The second frontier is being addressed with technologies, such as LDMOS and silicon carbide (SiC). From the standpoint of power-handling capabilities, there is a point of diminishing returns for a given technology. The two basic semiconductor structures, bipolar and FET, have seen numerous fabrication and implementation enhancements over the years, steadily increasing the maximum operating power and switching speed. Power MOSFET, LDMOS and SiC devices are the by-products of this ongoing effort.

With any new device, or class of devices, economies always come into play. Until a device has reached a stable production point where it can be mass-produced with few rejections, the per device cost is usually high, limiting its real-world applications. For example, if a device can handle more than four times the power of a conventional transistor, the per-device-cost must be less than four times the conventional product to be cost-effective. It is fair to point out in this discussion that the costs of the support circuitry, chassis and heat sink are equally important. If, for example, a SiC device — while still at a cost disadvantage relative to a conventional silicon transistor — requires fewer support elements, then a cost advantage may still be realized.

If it seems that we are focusing more on cost than technology in this discussion, you are right. After a certain point, users really don't care what's inside the box as long as it works. Price — both the initial purchase price and the ongoing operating costs — is what's important.

If increasing the maximum operating power for a given frequency is the primary challenge for solid-state devices, then using the device more efficiently ranks a close second. The only thing better than being able to dissipate more power in a transistor is not generating the waste heat in the first place. The real performance improvements in solid-state transmitter efficiency have not come as a result of simply swapping out a single tube with 200 transistors, but with using the transistors in creative ways so that higher efficiency is achieved and, thus, fewer devices are required.

This process has been dramatically illustrated in AM broadcast transmitters. Solid-state transmitters have taken over that market at all power levels not because of their intrinsic feature set, but because they lend themselves to enormous improvements in operating efficiency. For television, most notably UHF, the march to solid state has been much slower. One of the promises of DTV is that clever amplifier design will lead to similar — albeit less dramatic — improvements in intrinsic operating efficiency.

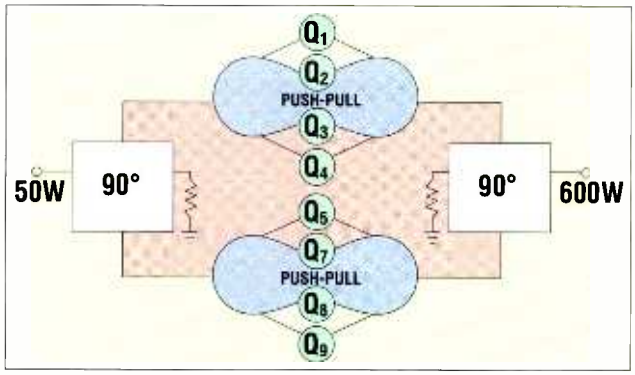

Figure 1. Diagram of a 600W VHF amplifier using eight FETs in a parallel device/parallel module configuration.

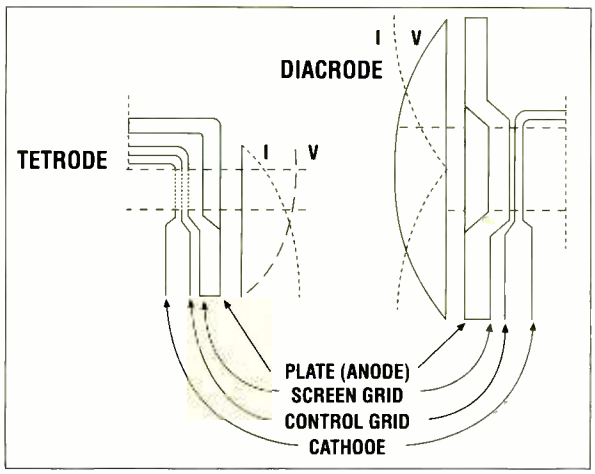

Figure 2. Cutaway view of the tetrode (left) and the Diacrode (right). Note that the RF current peaks above and below the Diacrode center, while on the tetrode there is only one peak at the bottom.

Power-grid devices

Advancements in vacuum-tube technology have permitted the construction of numerous high-power UHF transmitters based on tetrodes.[4] Such devices are attractive for TV applications because they inherently are capable of operat-

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ing in an efficient class AB mode. UHF tetrodes operating at high power levels provide essentially the same specifications, gain and efficiency as tubes operating at lower powers. The anode power supply voltage of the tetrode is much lower than the collector potential of a klystron — or IOT-based system (8kV is common). The tetrode also does not require focusing magnets.

Efficient heat removal is the key to making a UHF tetrode practical at high power levels. Such devices typically use water or vapor-phase cooling. Air cooling can be impractical because of the required fin size. Also, a large blower would be required, reducing the overall transmitter AC-to-RF efficiency.

Another drawback inherent in tetrode operation is that the output circuit of the device appears electrically in series with the input circuit and the load.[2] The parasitic reactance of the tube elements, therefore, is a part of the input and output tuned circuits. It follows that changes in the operating parameters of the tube can affect tuning. More importantly, the series nature of the tetrode places stringent limitations on internal element spacings and the physical size of those elements in order to minimize the electron transit time through the tube vacuum space.

The expected lifetime of a tetrode in UHF service is usually shorter than a klystron of the same power level. Typical lifetimes of 8,000 to 15,000 hours have been reported. Intensive work, however, has led to products that offer higher output powers and extended operating lifetime, while retaining the benefits inherent in tetrode devices.

With regard to DTV application possibilities, the linearity of the tetrode is excellent, and this is a strong point for DTV consideration.[5] Minimal phase distortion and low intermodulation translate to reduced correction requirements for the amplifier.

The Diacrode (Thomson) is a promising adaptation of the high-power UHF tetrode. The operating principle of the Diacrode is basically the same as that of the tetrode. The anode current is modulated by an RF drive voltage applied between the cathode and the power grid. The main difference is in the position of the active zones of the tube in the resonant coaxial circuits, resulting in improved reactive current distribution in the electrodes of the device. Figure 2 compares the conventional tetrode with the Diacrode. The Diacrode includes an electrical extension of the output circuit structure to an external cavity.[6] The small deblocked cavity rests on top of the tubes, as illustrated in Figure 3.

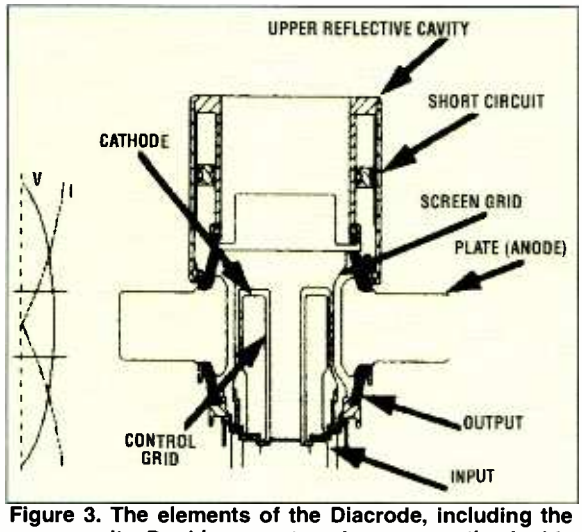

Figure 3. The elements of the Diacrode, including the upper cavity. Double current, and consequently, double power, is achieved with the device because of the current peaks at the top and bottom of the tube, as shown.

The cavity is a quarter-wave transmission line, as measured from the top of the cavity to the vertical center of the tube. The cavity is short-circuited at the top, reflecting an open circuit (current minimum) at the vertical center of the tube and a current maximum at the base of the tube, like the conventional tetrode, and a second current maximum above the tube at the cavity short-circuit.

With two current maximums, the RF power capability of the Diacrode is double that of the equivalent tetrode, while the element voltages remain the same. All other properties and aspects of the Diacrode are basically identical to the TH563 high-power UHF tetrode, upon which the Diacrode is patterned.

Benefits include the availability of robust power output, reduced high-voltage requirements, small size and simple replacement procedures. On the downside, there is little installed service lifetime data at this point because the Diacrode is relatively new to the market. The first Diacrode transmitter was placed on the air in December 1995 (KASY, Channel 50, Albuquerque, NM), running 60kW combined amplification using a single tube. The expected Diacrode lifetime, based on the performance of the Thomson TH563, is 20,000 hours.

Klystron-based devices

The klystron is a *linear-beam* device that overcomes the transit-time limitations of a grid-controlled vacuum tube by accelerating an electron stream to a high velocity before it is modulated.[7] Modulation is accomplished by varying the velocity of the beam, causing the drifting of electrons into *bunches* to produce RF *space current*. One or more cavities reinforce this action at the operating frequency. The output cavity acts as a transformer to couple the high-impedance beam to a low-impedance transmission line. Klystron frequency response is limited by the impedance-bandwidth product of the cavities that may be extended by stagger tuning or by the use of multiple-resonance filter-type cavities.

The klystron is one of the primary means of generating high power at UHF frequencies and above. Output powers for multicavity devices range from a few thousand watts to 10MW or more. The klystron provides high gain and requires little external support circuitry. Mechanically, the klystron is relatively simple. It offers long life and requires minimum routine maintenance. However, in its basic form, it is inefficient. Efficiency improvements can be gained for TV applications through the use of beam pulsing, but still, tremendous amounts of energy must be dissipated as waste heat. Years of developmental research have produced two high-efficiency devices for

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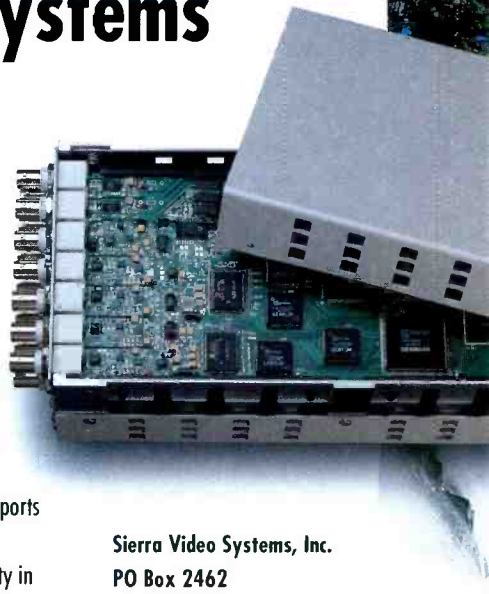

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television use, the *multistage depressed collector* (MSDC) klystron and the *inductive output tube* (IOT), also known as the Klystrode (Varian).

The MSDC device is essentially identical to a standard klystron, except for the collector assembly. Beam reconditioning is achieved by including a *transition region* between the RF interaction circuit and the collector under the influence of a magnetic field. From the electrical standpoint, the more stages of a multistage depressed collector klystron, the better. The trade-off, predictably, is increased complexity and, therefore, increased cost. There is also a point of diminishing returns reached as additional stages are added. A four-stage device was chosen for TV service because of these factors. As additional stages are added above four, the resulting improvement in efficiency is proportionally smaller.

The IOT, on the other hand, is a hybrid between a klystron and a tetrode. The high reliability and power-handling capability of the klystron is due, in part, to the fact that electron beam dissipation takes place in the collector electrode, quite separate from the RF circuitry. The electron dissipation in a tetrode is at the anode and the screen grid, both of which are an inherent part of the RF circuit and must, therefore, be physically small at UHF frequencies. The tetrode has the advantage that modulation is produced directly at the cathode by a grid — a long drift space is not required to produce density modulation. The IOT has a similar advantage over the klystron — high efficiency in a small package.

In the IOT (see Figure 4), the electron beam is formed at the cathode, density modulated with the input RF signals by a grid, and then accelerated through the anode aperture. In its bunched form, the beam drifts through a field-free region and then interacts with the RF field in the output cavity. Power is extracted from the beam in the same way as a klystron. The input circuit resembles a typical UHF power grid tube. The output circuit and collector resemble a klystron.

Because the IOT provides beam power variation during sync pulses (as in a pulsed klystron) and variation of beam power over the active modulating waveform, it is capable of high efficiency. The device provides full-time beam modulation as a result of its inherent structure and class B operation.

A great deal of development has gone into refining the IOT to the point that now, some eight years after the device (a Klystrode) was first placed into commercial service, the IOT has emerged as the technology to beat when it comes to high-power UHF-TV amplifying devices. With the move to DTV, the IOT is particularly attractive because of its good linearity. The IOT provides –60dB or better intermodulation performance in combined 10dB aural/visual service.[2] Tube life data varies depending upon the source, but one estimate puts it in excess of 35,000 hours.[8] Tube cost, relative to the less-expensive Diacrode, is, of course, also a consideration.

The maximum power output available from the IOT (60kW visual-only service) has been an issue in some applications. A new tube, however, has been developed that will produce 55kW visual, plus 5.5kW aural in common amplification.[9] Reported test results indicate that the device (EEV) is capable of delivering peak digital powers in excess of 100kW and could be well-suited to DTV applications. The new tube also incorporates several modifications to improve performance.

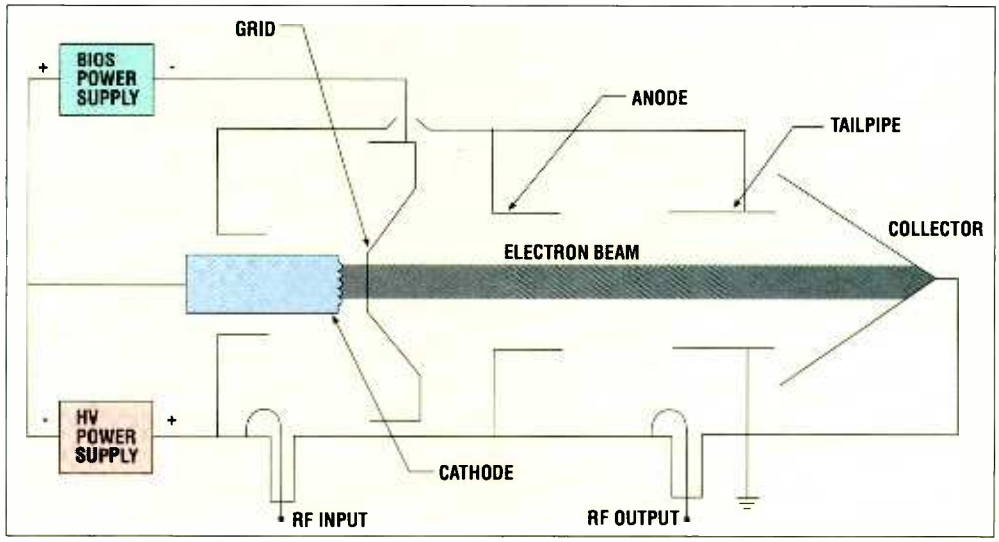

Figure 4. Conceptual diagram of the IOT.

Implementation Issues

The purchase of a new transmitter for DTV operation, or for NTSC use for that matter, is a complicated process that must take into consideration a number of variables. Some of the more important issues include:

- The actual cost of the transmitter, both the initial purchase price and the ongoing maintenance expenses for tubes and other supplies.
- The actual AC-to-RF efficiency, which relates directly to the operating costs. Efficiency numbers for transmitters can be rather confusing. The only number you really care about, however, is how much AC is required to achieve your licensed power output. Those numbers exist; insist on them from the vendor.
- Maintenance issues, the most important of which is the *mean time between failure* (MTBF). Also important is the *mean time to repair* (MTTR), which relates directly to the accessibility of transmitter components and the type of amplifying devices used in the unit.
- Environmental issues, not the least of which is the occupied space needed for the transmitter. The cooling requirements are also important and may, for example, affect the ongoing mainte-

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New frontiers for transmitter technology

nance costs.

• The availability of sufficient AC power and power of acceptable reliability and regulation at the site.

Each of these issues, and many others, must be given careful consideration before any buying decision is made. It is possible, for example, that upon further examination, the transmitter costing the least to purchase winds up being more expensive than others in the long run because of higher annual operating expenses.

Place your bets

The frontiers of RF design are being stretched with each new generation of products. While not forgetting NTSC, the big focus now is clearly on DTV. Hardware exists today to meet the requirements set forth by the commission. More hardware with more features will follow. It's not a question of whether you will buy a DTV transmitter, but when.

Unfortunately, there are no easy answers when it comes to making a decision on which technology to bet on for your DTV future. As we have seen from the UHF efficiency wars of the past, any technology that makes it to market will work. Some work better in the long run than others. The real threat to your station's future is not choosing the wrong horse to ride, but rather standing on the sidelines and missing the race altogether. ■

Jerry Whitaker is a consulting editor for Broadcast Engineering *magazine.*

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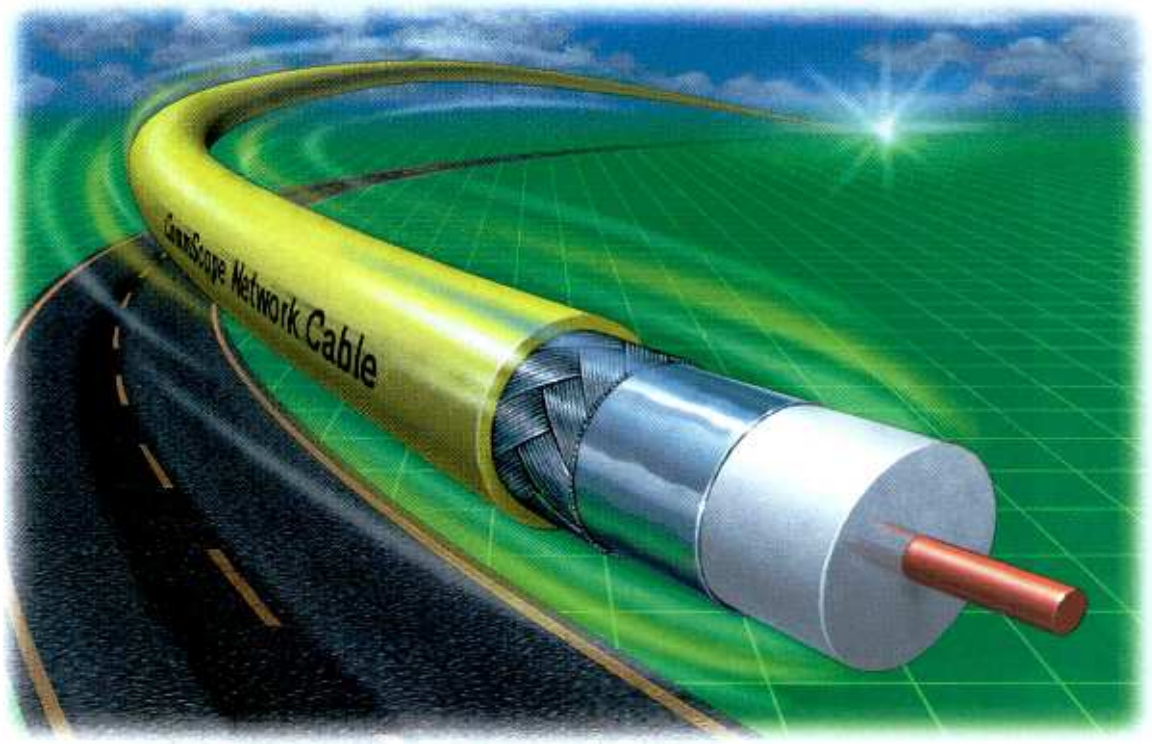

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Choosing an intercom system

Starting at the end points.

By Andrew McHaddad

THE BOTTOM LINE:
Intercoms are the vital link between every point in a production environment. If that link fails, it costs you time and money. So, when considering a new intercom system, a knowledge of what your operators have to do and the intercom technology available to help them do it is a prerequisite to selecting a good solution. $

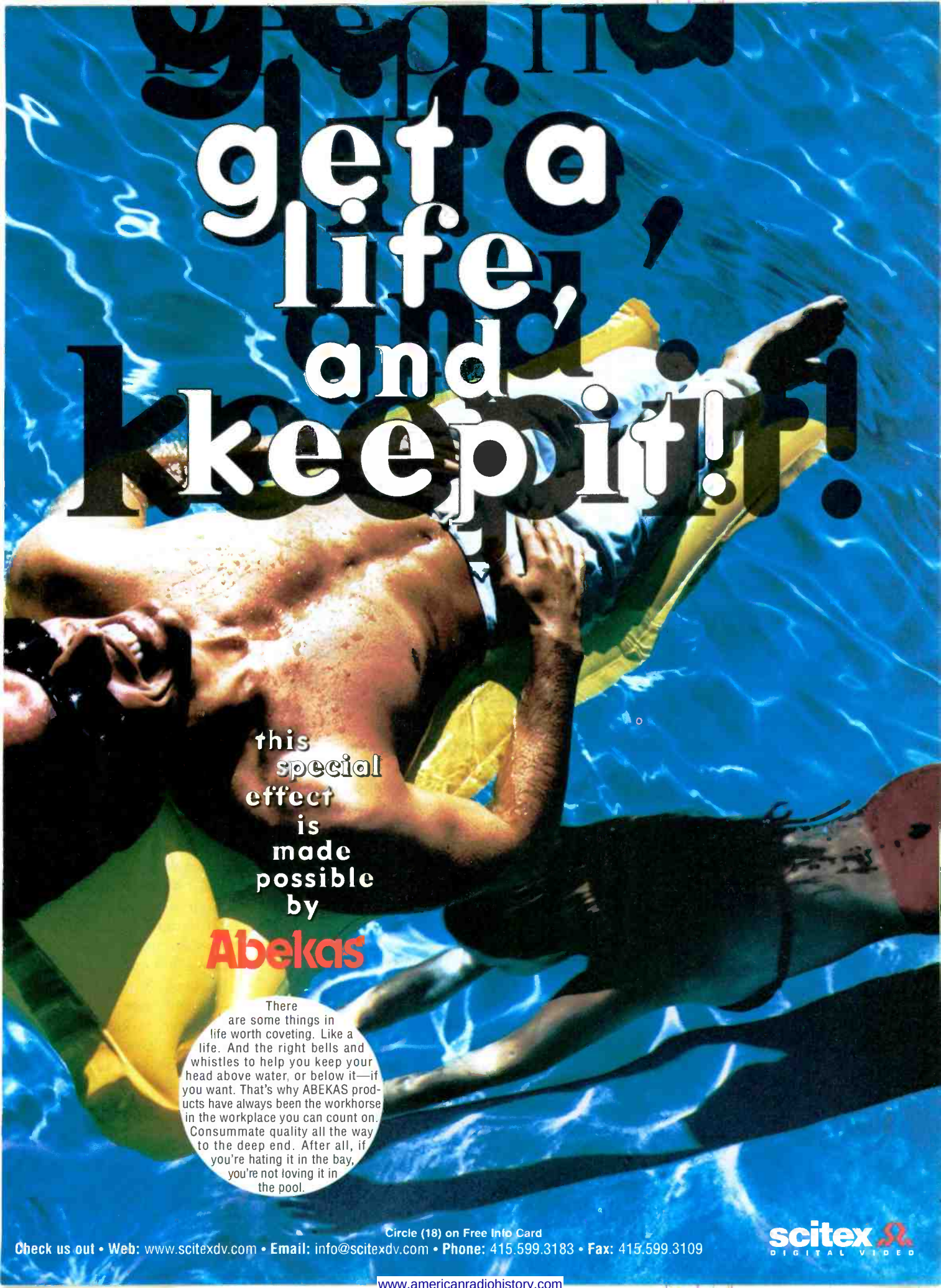
It's easy to underestimate the time and effort it takes to choose an intercom system, because unless you have done it before, the subtleties and requirements of the systems are difficult to identify. An intercom system is a foundational element in a broadcast facility and if the choice is not made early on, other decisions get more confusing. Start early in the overall project with a decision so that other equipment selections will be less complicated to make.

Probably the most important knowledge the system specifier has is an accurate understanding of the operational routine of the facility. This is hard to come by in a new facility or in a facility that is breaking new ground in personnel allocation and job responsibility concepts. It's slightly less daunting to upgrade a current system, because the work habits and operational routines are easier to identify.

The next thing that's necessary to know is that a facility-wide intercom system, be it an SNG truck, news control room, production facility or a network master control, is typically a combination of multiple types of intercom systems, some tied together, some stand alone.

The ability to talk to on-air talent may be a completely separate system from the one that is used by engineering to set up a remote truck incoming feed.

Photo: This TNN remote truck, one of several production units, provides full broadcast capability from around the country for the network's programming.



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Choosing an intercom system

Likewise, the master control operator might have a microphone on the console that simply pages to a speaker in the tape machine room. All of these are examples of intercom systems.

Intercoms can be as simple as two people in different rooms communicating, such as a video editor and a tape operator, or as complicated as a NASA mission control room with users located all over the world. As an intercom system grows in size, so does the need for focused attention from the engineering department.

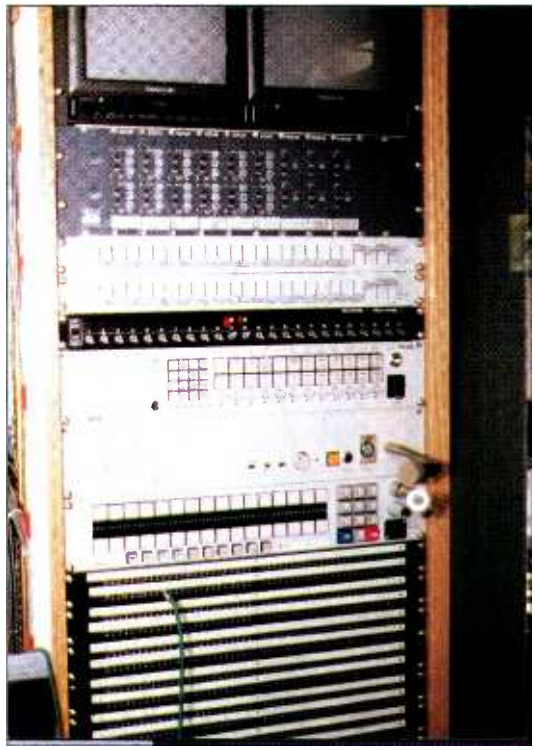
System administrator

Intercom systems are supposed to "just work," like an elevator or a water faucet. They are supporting structures that allow the real work to happen more efficiently. As important as intercoms are to most people, it would be shortsighted to minimize the attention that is required for them to become something that "just works."

If your needs are sophisticated, and especially if computer software programming is involved, it's vital that one person be committed to the task of administration. It's almost impossible to maintain a large or complex system if more than one person can make fundamental changes to the software.

This person typically needn't be an electronics expert, but rather more like a computer network manager. Maintaining proper file names, backup files, entering the changes in a timely manner and communicating in written form the profile of the system to the users are the most important tasks for the administrator. If the administrator is not a member of the regular engineering staff, be sure he or she works closely with the engineering department so there is some personnel redundancy.

Another point to remember is that unlike hardware-based systems, a software-based centralized architecture intercom will live or die on the integrity of the software that defines its nature. Do whatever it takes to assure that the software is what it needs to be.



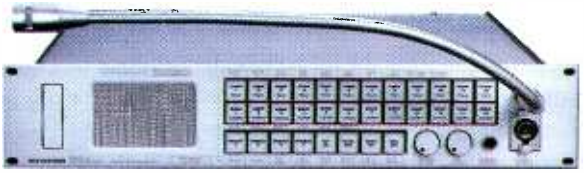
The Nashville Network's remote unit No. 7 allows for routing, interfacing and patching for the RTS/ Telex ADAM and RTS 803 two-wire system.

Reasons to upgrade a system

There are many reasons to upgrade to newer intercom technology. Sometimes, it's simply because the number of users has grown beyond the system's capabilities. Other times, additional functionality is needed. In general, there are some often-heard reasons for installing a better intercom system.

- *Client driven.* "If you had this particular intercom, we could do our show at your facility." Sometimes, a complicated show requires more operators with additional user stations. Or, as the hours of operation within your facility expand, scheduling/ equipment use eliminates the time-sharing that was once possible with the existing system.
- *Having to interface with other new equipment.* "These new cameras won't interface to our current intercom system. If we buy these cameras, we'll have to upgrade our intercom." As the industry races ahead, fueled by new technology, some otherwise acceptable systems will have to change to accommodate the newer stuff.
- *The current system is too small and cannot be expanded due to manufacturing limitations.* "We'll need more intercom stations for the new edit bay, but the manufacturer no longer supports this system. We may need to swap the whole thing out." But don't despair, if the decision is made to upgrade, a system that has come to the end of its useful life need not be completely abandoned. Some of the older items can probably be re-used or interfaced with the new technology.
- *The time and effort spent reconfiguring the current system to meet the needs of regularly scheduled events is too great.* "We have to spend most of our setup day swapping user stations around for this show and then half a day to reset it to normal. This can't continue." As engineering is more and more becoming a free-lance task, especially maintenance engineering, a facility needs to streamline its functionality. Reliability is the name of the game with intercoms. A system that has all the necessary functions all the time is more reliable and consistent than one that is built as the needs arise.

The truck's transmission/QC rack provides centralized and distributed intercom architectures. Shown here are the RTS/ Telex 803 TW master station and KP98-7 ADAM key panel.



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Choosing an intercom system

System architecture

The two most common types of system architectures are *distributed crosspoint* and *centralized crosspoint* (also called a "matrix" or "digital matrix" system).

A distributed crosspoint system embeds the functions of listen and talk on/off to within the user station. The audio from one station to another is distributed to all stations and a user simply decides to add or subtract a particular talk or listen circuit to the rest of the intercom station circuitry. The Telex/RTS TW intercom system is a good example of this architecture. An infinite number of stations all connect to each other on a passive backplane with a three-pin XLR connector or 25-pair cable. There is no need to decide on a system size prior to initial purchase because all infrastructure for adding another station is contained within each station. All the available circuits or channels are brought to each station regardless of the needs of a particular station.

One benefit of this type of design is a high tolerance to catastrophic failure. Because all the crosspoints are contained within the user station, no single failure will effect more than that user. The method of crosspoint control, because it's also contained within the user station, can be as simple as a basic toggle switch.

One limitation of this architecture is that unless modifications are made to the stations, every station will have access to the same circuits. This means there is no ability to force one user to listen to another because there is no control data between the stations, only audio. If a system has 12 circuits and 12 stations, then it would be possible to have dedicated circuits between stations. However, if the system has more than 12 user stations, it would be necessary to instruct the users as to which channels are being monitored by which other users. This design can be cost-effective, both as a price-per-station consideration, but also because it doesn't require the time and effort of software programming that's necessary with a centralized crosspoint architecture.

Centralized crosspoint architecture

This system embeds all the crosspoints of a system into a common chassis. The first thing this system needs is a control path from the user station to the frame to change the state of the crosspoints. Unlike a distributed crosspoint system, you have to decide on how many signals will connect to the frame. These signals can be in the form of a user station, program input, camera CCU intercom connections, satellite links or phone lines. Usually, each user station is connected to a port in the frame with two audio circuits and some format of data connection. The control path from a user station to the frame is typically a serial datastream that is used to update the user station displays. The frame-to-station wiring is simple, typically only three or four pairs are required.

The most important benefit of the centralized crosspoint system is its almost unlimited versatility. Because each station in the system is connected to the frame as an individual input/output and data path, any user station can have a unique, private conversation with any other user in the system. Because of its versatility, this system can function also as an audio monitor mixer for consolidating all aural information into a single headset or speaker.

As with any piece of equipment, the more sophisticated and versatile, the more complicated and confusing it can be to the people who use it and those who must maintain it. It's also important to remember that the individual parts of a system like this are not a system until the profile is activated. In other words, until you program it to do

Intercoms 101

Before we can begin the design phase, let's be sure we understand some commonly used intercom phrases. Some of these terms are ambiguous, which can lead to confusion.

ADMINISTRATOR: The person that maintains the functional integrity of a system.

CONTROL DATA: An electronic information signal that allows an action at one location to effect the function of a device at another location. Some systems embed the control data into a digital audio datastream from one point to another.

CROSSPOINT: A switch in an audio signal path from one point to another that is opened or closed at the request of the user.

CROSSPOINT CONTROL: The method by which the user requests that a crosspoint be opened or closed.

CHANNEL: Most commonly refers to a two-wire path with multiple users on the same wire.

TWO-WIRE: A user station connection scheme whereby the talk and listen for a particular user are on the same wire pair. Each pair of wires can consist of ground/common and a single conductor or in a balanced configuration, a positive and a negative conductor. Usually found in a distributed crosspoint architecture.

FOUR-WIRE: A user station connection scheme whereby the talk and listen audio for a particular user are on two different wires. Usually a balanced audio pair is used for the talk out and a separate pair for the listen input. Signals can be carried in an unbalanced wire set while still being referred to as four-wire. This technique is most commonly found in centralized crosspoint architectures.

PORT: An audio input and output pair with dedicated real-world connections. Works with a four-wire system.

PROFILE: A collection of choices that are applied to the system controller, which define the operational nature of the system. These choices can be made from the system software, a key panel or hardware controllers.

TALK SIGNAL: The post-microphone pre-amplified signal that will be heard by other people.

LISTEN SIGNAL: The signal that emanates from a speaker, earphone or headset earpiece.

USER: A person that talks or listens at their discretion to other individuals using the intercom system.

USER STATION: A device, either rack-mounted or portable, consisting at a minimum of a microphone connector/pre-amplifier with an off/on switch and a speaker with an amplifier/volume control. May also include serial datastream and multiple listen/talk circuits. ■

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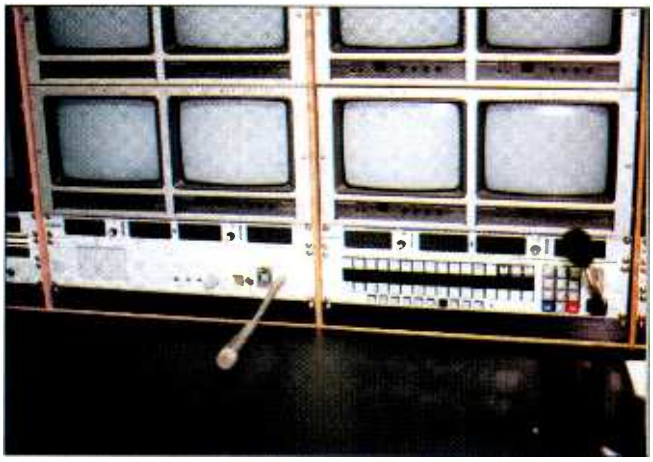
Choosing an intercom system

something, it's an empty shell. A user station can't talk or listen to anything until that station has been programmed to do so by the administrator or qualified user.

Consider cost benefits

The cost structure of the two systems typically means that a centralized crosspoint architecture is more appropriate for a large facility, while the distributed architecture is cost-effective for a smaller facility. The single most expensive component in the centralized architecture is the frame containing the crosspoint circuitry. The individual stations are typically half to one-third the price of an equivalently sophisticated distributed architecture user station. So, if your system needs to be big, it gets expensive to implement a distributed architecture system. Conversely, if the system is small, it gets difficult to amortize the expense of the frame



The 1RU-high powered speakers shown here in the truck's graphics room are used for monitoring the director and producer hot mics.

across only a few stations.

For example, a facility that buys 50 distributed crosspoint stations, costing $6,000 each will spend $300,000 and have limited circuits. That same facility using a centralized architecture will spend $100,000 on a frame and $200,000 on stations at $2,000 each for the same total of $300,000. So, for the same money, you get enormous versatility and an expansion path that is only $2,000 per station.

Not all systems are this big and the numbers can greatly vary. It would be just as unwise to spend $50,000 on a frame to connect eight $2,000 stations together. In this case, it would be better to spend $48,000 on eight $6,000 stations.

These two architectures are not the only choices. There are some that combine features of each, however, the industry trend is to focus on either great versatility and with it low fault tolerance and focused attention or a limited, highly tolerant more consistent system.

Deciding on a system size

Once you've decided on the type of architecture you want,

Continued on page 103

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Keeping digital transparent

Processing a digital signal can have its problems.

By Jim Boston

THE BOTTOM LINE:
Problems such as noise and distortion do not affect digital signals in the same manner that they affect analog signals. Because of this, many assume that digital will be a "problem-free" solution. Although it has eliminated many problems associated with analog, digital has brought with it a few new problems. Keeping digital signals at the highest possible quality level can be done fairly easily, but not without an understanding of how digital signals can be changed as they move from device to device within a facility. $

It has become common today to refer to digital video as data. There is no doubt that in a video stream defined by SMPTE 259M, a significant portion of the bitstream can be devoted to ancillary data. Although slightly less than 10Mb/s are available in composite bitstreams (barely enough for four channels of embedded audio), more than 55Mb/s are available for ancillary data in a component digital stream. That's approximately 20% of the bitstream. Currently, almost all of this auxiliary data is embedded audio.

Video as data

In the serial digital data interface (SDDI) bitstream, all bits are considered data. SDDI is a serial digital signal conforming to SMPTE 259M (270Mb/s) where the active video portion of the bitstream is replaced with data. This data could be of any type, but it's typically MPEG video and audio data. Because 4:2:2P@ML has a data rate of approximately 18Mb/s, and component digital video has approximately 207Mb/s of capacity, either multiple streams of MPEG data or MPEG data at faster than real time can be sent. The SDDI bitstreams can pass through a serial digital interface (SDI) component video path and can even be displayed on an SDI monitor. Although you won't see recognizable video, you will see the datastream

Photo: Digital technology, like that shown in this production control room at DirecTV, is the key to high-quality video and future HDTV/multichannel operation.

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Keeping digital transparent

arrayed on the raster.

The point is that even when "baseband" serial digital component video is the bitstream, it's helpful to think of this stream as all data. In the DSP realm, where video spends more and more of its time, this datastream would often be referred to as a number sequence. Each sample of luminance or chrominance information is just a number representing the original intensity value of a picture in spatial space.

The beauty of digital video is that once the video signal is in the digital domain, these number values should never change, not by one literal "bit." You should be able to send this stream of "numbers" or values on a never-ending journey and not have any change in their value.

Is that really true? Like most sweeping statements, it depends. First, let's describe a scenario that would be a mistake in an analog facility. Take one analog framestore (yes, we all know that internally it's a digital TBC on steroids, but it still has analog ins and outs) as shown in Figure 1:

- First, feed a signal to the frame sync from the output of a router.
- Second, take the framestore's output and run it to the input of an analog router.
- Third, switch the crosspoint feeding the router to the output of the framestore.

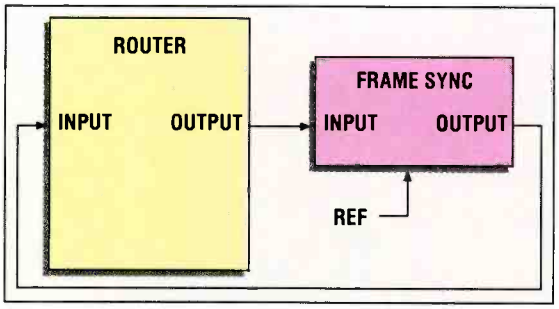

Figure 1. Video feedback occurs when the same signal appears at the input and output of a device, such as a framestore.

What happens? Video feedback, of course. A coherent picture quickly dissolves into a blur and usually pulsates or undulates at some rate based on the overall resonance of the path. Not useful. Let's try the same thing, but with an entirely digital path. What happens when the router crosspoint feeding the frame sync is switched so that the frame sync sees its output? Nothing. A still-frame occurs. The output of the frame sync circulates through the router/frame sync path forever. In fact, you can add many other digital boxes to this path and have the same result. Why? Because the "number sequence" is faithfully being reproduced by each box in the path. In fact, you can keep this bitstream recursively transversing through the frame sync for many days (in a normal "healthy" path) and not see any errors. How would you know if you picked up an error? If it occurs during the active portion of the video, you'll see a "dot" appear in the picture. Once that error is generated, it will continuously circulate with the

"good" data. The longer your bitstream can circulate through your path under test, the more transparent that path is.

This doesn't mean that you could send this digital bitstream through just any infinite path. It's generally believed that as long as a box re-clocks the bitstream at its input or output (or both), then the bitstream has a new "lease on life." Not true. Re-clocking eliminates the higher-frequency accumulated jitter, but not the low-frequency jitter (also called wander). The wander jitter component slowly continues to accumulate until it finds a re-clock circuit it can swamp. It usually takes more than 60 re-clocks before this can happen.

You're probably wondering why this didn't happen with our "framestore" test. Remember what a framestore does — it disassociates input timing and bit rates (along with the accompanying jitter) from the output. A simple re-clock circuit's PLL is actually gen-locked to the recovered clock information in the incoming bitstream. (See Figure 2.) Although a frame sync uses PLL circuitry locked to incoming video to write to RAM and PLL circuitry locked to local reference to read video back out of RAM, the local reference should have little accumulated jitter, while incoming video might have a considerable amount. Imagine what would happen if a sync generator fed a second gen-locked sync generator that fed a third, and so forth. Consider what the tenth sync generator's reaction would be if the first one hiccuped. Thankfully, the potential for this cascaded gen-lock scenario was ended by the introduction of the frame sync in the '70s.

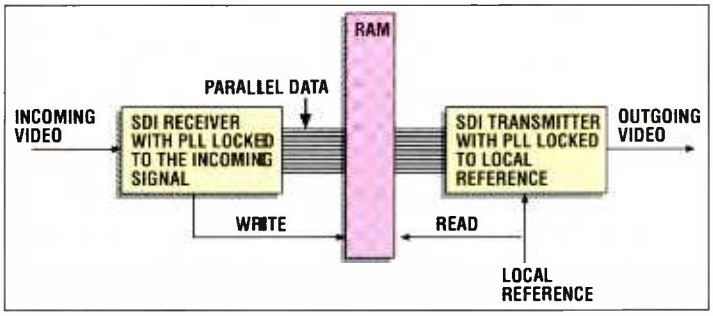

Figure 2. Although the incoming video may have considerable jitter, the outgoing video will have little jitter. This is because the two PLLs are locked to separate references, and the outgoing PLL is locked to a stable local reference.

Problem paths

Now that you can prove that most digital paths are transparent, let's look at some reasons why a path might not be. The first reason is the most obvious and most talked about — compression.

Intraframe (JPEG) and interframe (MPEG) compression schemes are labeled "lossy" for good reason. Anytime a digital video bitstream is converted from the time domain to the frequency domain (which is what the discrete cosine transform does) and then scaled, you've changed the data.

Keeping digital transparent

The actual DCT process isn't lossy in itself, because you can end up with more data than you started with. Hence, the frequency coefficients are scaled to make the small-valued ones go to zero. (For more information, see "Video Compression 101," *BE*, February 1996.)

When the signal is returned to the time domain and then back into the frequency domain of the compressed world, the video data will change some more. If you continually do this, the amount of data change will diminish exponentially, meaning that the fifth or sixth change will be small compared with the first change, with one caveat — if any part of the picture is changed (a key laid on the existing compressed video steam, a wipe added), then the exponential degradation for that area starts over. This is only true if you stay in the digital domain.

If you're going between the analog and digital domains, all bets are off. No D/A or A/D is completely linear or perfectly accurate. Non-linearity breeds unwanted harmonics. Noise is added in each step of the analog domain, followed by quantization noise as you return to the digital domain. Techniques, such as one-bit D/As (used to improve accuracy when converting audio) can't be used for video due to the speeds required.

Compressed video is not the only place where digital video can be changed. It turns out that any domain change introduces video data change. Going from digital component (SMPTE 125M) to digital composite (SMPTE 244M) or vice versa isn't transparent; it has some cost. Just because you're in the digital domain doesn't mean that what Fourier had to say is no longer true. Most approaches to these domain changes involve subsampling, and thus low-pass filtering, and in some cases, interpolation. But it's digital, it shouldn't do that, you say. Yes, DSP techniques, namely when applied to filtering, have made many DVEs/DMEs remarkable when it comes to video quality during complex effects, and DSP has made 28k and now 56k modems possible, but even they can't approximate enough poles when it comes to filtering and making the process completely transparent.

Additionally, if you traverse into the composite domain from the component domain, you no longer have separate luminance and chroma information. Upon re-entering the component realm, you will have some of the luminance in the chroma, and vice versa, traditionally known as cross-modulation. In situations such as this, the analog reference fed to these digital boxes can become important for minimizing artifacts. All boxes should also have the same reference. What should be stressed here is that once you're in a particular domain and stay there, and as long as nothing in the path is broken, your quality shouldn't diminish. Up to now, the main beneficiary of digital operations has been the VTR. The ef-

Continued on page 105

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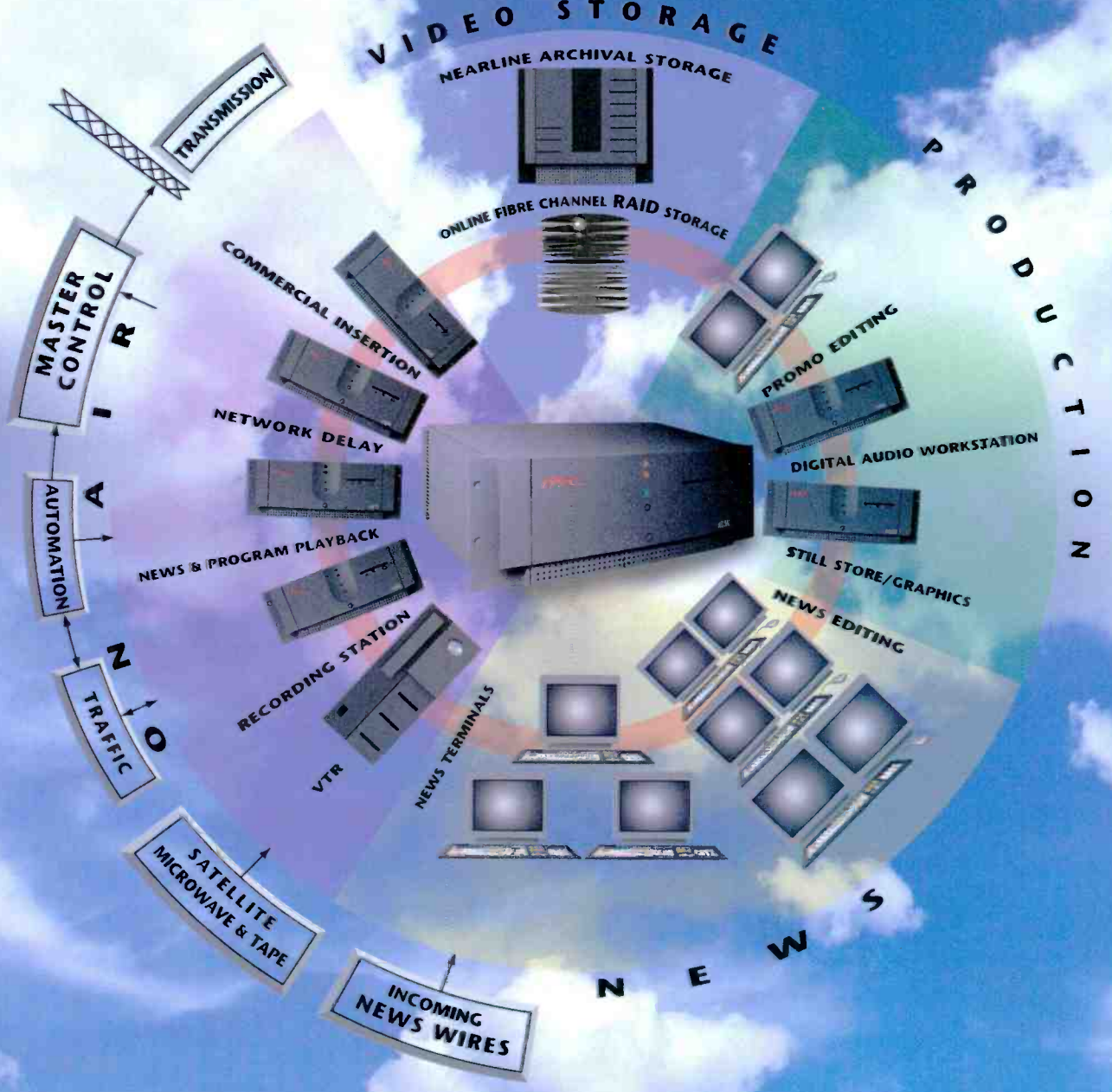

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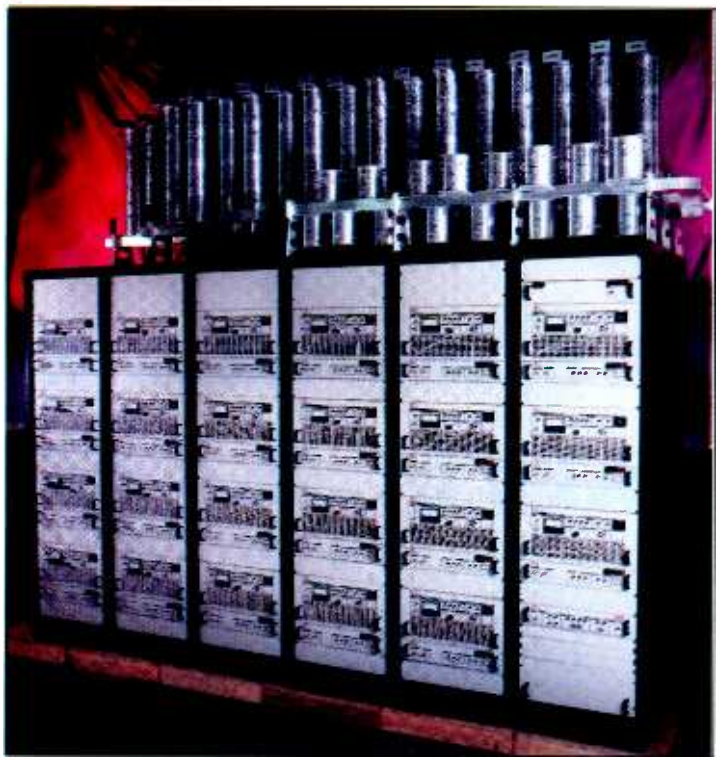
Wireless cable comes of age



Embracing MMDS.

By Ken Freed

THE BOTTOM LINE:
MMDS is becoming a competitive technology to cable and satellite. It allows multiple channels of video to be transmitted from low-power transmitters. These microwave-multipoint-distribution systems and local microwave distribution systems have proven popular in urban settings. And the baby bells have embraced MMDS as a way to quickly and inexpensively get into the cable business without having to run a single foot of cable. $

A decade after the microwave TV industry began to accumulate its current base of one million subscribers in the United States and 5.5 million customers worldwide, a thousand people attended the 1997 Wireless Cable Association (WCA 97) convention in Anaheim, CA, June 23-25, to witness the breakthrough demonstrations of microwave television and data services delivered on two-way multichannel multipoint distribution systems (MMDS).

Generating the most buzz was the rollout of "Pacific Bell TV," a 251-channel digital service in the Los Angeles basin offering 150 commercial video channels, 70 educational video channels and 31 digital audio channels. Received on a small microwave antenna installed atop the Anaheim Convention Center, the signal was routed to a booth on the show floor where the attendees could operate PacBell TV's interactive program guide with parental control functions.

On the data side, the big news at WCA 97 was the 64 QAM wireless cable modem, already deployed for Internet service in places like Washington,

Photo: A digital MMDS transmitter system with digital channel combiner.

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Wireless cable comes of age

DC, and San Jose, CA. Indicating the modem's potential was a multiple-booth demonstration of high-speed, two-way microwave Internet access at 2.3GHz frequency assigned for "flexible use" wireless cable services (WCS).

These MMDS technical advances need to be viewed within a business and political context. "Wireless cable," a term coined by cable TV veteran and microwave TV pioneer Robert Schmidt, struggled for any respectability until several regional Bell operating companies saw the possibilities in adapting cellular telephone architecture for one-way and even two-way video services. Wall Street remains leery of wireless television, but buildouts continue apace as the industry insists that PCS interference problems are resolved.

While telcos like Bell Atlantic have concentrated on hybrid-fiber-coax (HFC) development, microwave television has been embraced by RBOCs like PacBell and the Americast consortium of Ameritech, Bell South, GTE, SBC, SNET and Disney. Bell South already provides analog wireless TV services in New Orleans and recently bought digital MMDS licenses for Atlanta to complement its HFC system in nearby Chamblee, GA. On the political side, as depicted by WCA president Andrew Kreig, wireless cable would seem to be the darling of the FCC. And outgoing FCC chairman Reed Hundt appeared at WCA 97 to recall when he attended the first 1987 WCA conference with his high-school classmate Al Gore.

In a prerecorded interview played for the audience, commissioner Susan Ness recalled the FCC's July 1996 declaratory ruling that permits wireless cable to implement digital video transmissions. She discussed the current FCC rule-making process to permit full two-way digital Internet and telephony operations within the "wireless local loop." Hundt and Ness demurred on questions about specific plans for more spectrum auctions.

A cutting-edge MMDS launch

The Los Angeles digital MMDS system from Pacific Bell Video Services purports to be the most advanced state-of-the art deployment so far. A profile of the system reveals the potential for other locales.

The heart of the PacBell TV system is the digital compression center in east Los Angeles where programming comes in from tapes, satellite, cable and fiber. Its national content sources include standard basic and premium cable channels received on five overlapping 6m antennas with double or triple beam feeds for redundancy. Another bank of four antennas is dedicated to receiving the content for its sports package. The company also has on-site a 4m steerable dish for use as an emergency back-up in case of catastrophic failure and for receiving shows from unusual sources. Content for its near-video-on-demand (NVOD) service arrives on pre-encoded tapes.

Local content arrives from two primary sources. The 70 channels of educational programming mostly come from the 24 LA-area colleges with ITFS licenses that have installed MPEG-2 encoders on their campuses with TS3 fiber links to the PacBell operations center. LA's terrestrial broadcast channels are captured with off-air antennas, but PacBell plans on installing direct fiber feeds from the broadcast stations.

Once received at the PacBell facility, the programming is processed to insert commercials into any local avails and to add such services as closed-captioning, descriptive video or second language dubs. Stereo and surround sound are maintained throughout the process, varying with the source material. All inserts remain transparent to the transmission system.

Most of the material entering the digital compression center arrives in analog format, including the satellite feeds (the exception being the educational content, which is compressed on campus). The analog content is batch encoded at 1:5Mb/s or 1:6Mb/s into MPEG-2 (MP@ML) with a dozen titles per batch. Content for the 40 channels of near-video-on-demand is routed to high-capacity servers for playback every 15 or 30 minutes, depending on the time and the demand.

The MPEG-encoded content passes through a series of four ATM switches that merge multiple bitstreams into one

larger bitstream that goes through a fifth ATM switch before traveling at 1Gb/s over an OC48 fiber to the primary microwave transmitter on Mount Wilson. Another ATM switch at the main transmitter fans out the bitstreams to a remux, which feeds 32 6MHz carriers to microwave antennas co-located on Mount Wilson and Modjeska Peak.

Operating in the range of 2.5GHz to 2.686GHz, the Mount Wilson transmitter covers Los Angeles and also feeds over 48 miles to the Modjeska Peak repeater, which then covers Orange County. The 15W MMDS digital transmitters at both sites each have a line-of-sight range of 25 to 30 miles and can reach 3.2 million households.

MMDS in the home

At the subscriber site, 85% of the households need an innocuous 15dbi to 18dbi flat-panel antenna, only 11 inches square. The other 15% of homes near the outer edges of the coverage area need a slightly larger 21dBi parabolic antenna to clearly receive the MMDS programming. A still larger antenna is recommended for apartment buildings and other MDUs. Pacific Bell claims objections from the homeowners associations have been minimal and that these objections vanish when they see the actual antennas. The telco has not had to officially invoke federal rules overriding local covenants.

Inside the home, a Thomson MMDS set-top box has RF, NTSC and S-VHS outputs with stereo audio. The VCR tuner is controlled from the set-top through an RF adapter, which can activate the recording function based on content selected through the program guide. PacBell's interactive program guide, based on the Tele-TV interface, lets viewers pick between a full-screen program grid or a half-screen grid with barker space. The guide has perpetually updated seven-day program information, each program having a description. A "sort" button allows the viewer to organize display of the 150 channels by categories, such as news, sports, sitcoms, movies and documentaries.

Viewers can change channels with the remote by scanning through the grid, moving an IR cursor to any rectangle in the grid, scrolling through the channels as usual or using a keypad for punching in channel numbers. Whenever a new channel comes up, a transparent banner across the top of the screen can tell the channel's name and number, the current program title and the next program title scheduled on that channel.

Parental control functions in the set-top permit parents to block out programming based on motion picture rating codes. (Once the TV industry settles on a ratings system to use with the V-chip in the television, the box's parental control system may be upgraded in compliance.) The system also supports assignment of a secret PIN to each member of the household. Parents can designate the levels of access accorded to each ID number, selecting a week in advance which programming their children can and cannot watch. Furthermore, parents can fix a dollar limit on how much their children (or themselves) can spend on N-VOD pay-per-view programming.

PacBell is not packaging Internet access with its TV service, but the system has unused capacity that later can be used for data services. Right now, it wants to expand on the 5,000 customers grandfathered into the commercial service from their alpha and beta tests. It plans to keep marketing efforts to a

MMDS telephony

Further illustrating the carriage capacity of the WCS frequencies (let alone the interoperability of equipment from so many different vendors), in another part of the TSI booth was a demonstration of MMDS telephony.

Using an ADC platform originally designed for voice service over HFC, for the show it adapted the system to run downstream in channel H3 (26.74MHz to 80MHz) and upstream within channel MDS 2 (21.56MHz to 62MHz). Only POTS was demonstrated, although the 240-DS0 capacity with a 6MHz channel could handle much more than plain old telephone service, including custom services like caller ID, call-waiting or teleconferencing.

The WCS channel capacity also could conceivably support viewphone service. Video quality could depend on the duplex or multiplex scheme and the capacity of central office switching, most likely using ATM. ■

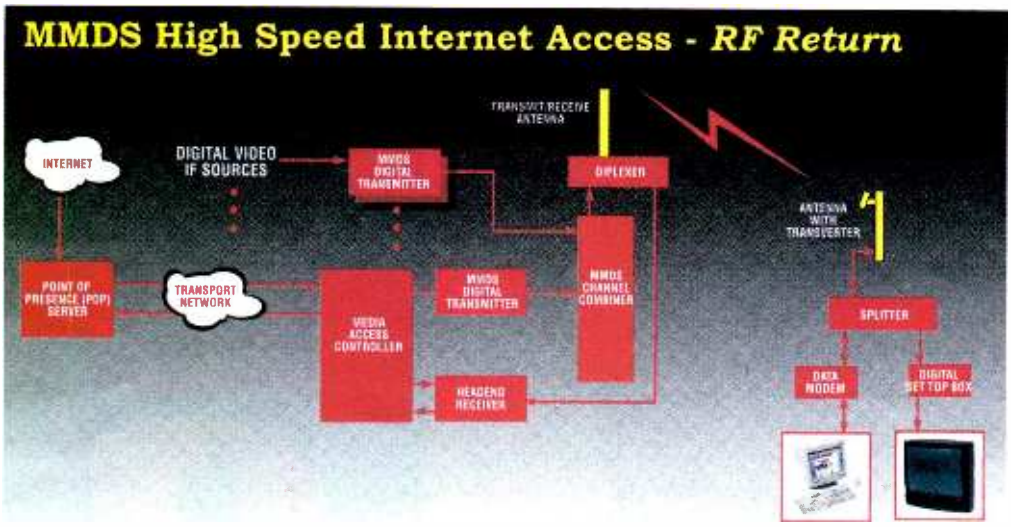
Wireless cable comes of age

minimum until it knows the bugs are out of the system. Even so, the service picked up almost 2,000 new subscribers (at $31.95 per month for the entry-level package) in the first week after its launch at the WCA convention.

Wireless internet service

State-of-the-art microwave data service also was presented at the WCA show. An ad hoc consortium involving ADC/TSI, California Amplifier, Conifer and Pacific Monolithics using Hybrid Networks' wireless cable modems demonstrated microwave's capacity for carriage of video, data and voice transmissions. The internet traffic was carried on the new WCS frequency of 2.3GHz, part of the previously unlicensed WCS spectrum auctioned by the FCC last April 15 for one-way and two-way "flexible use" by wireless cable systems.

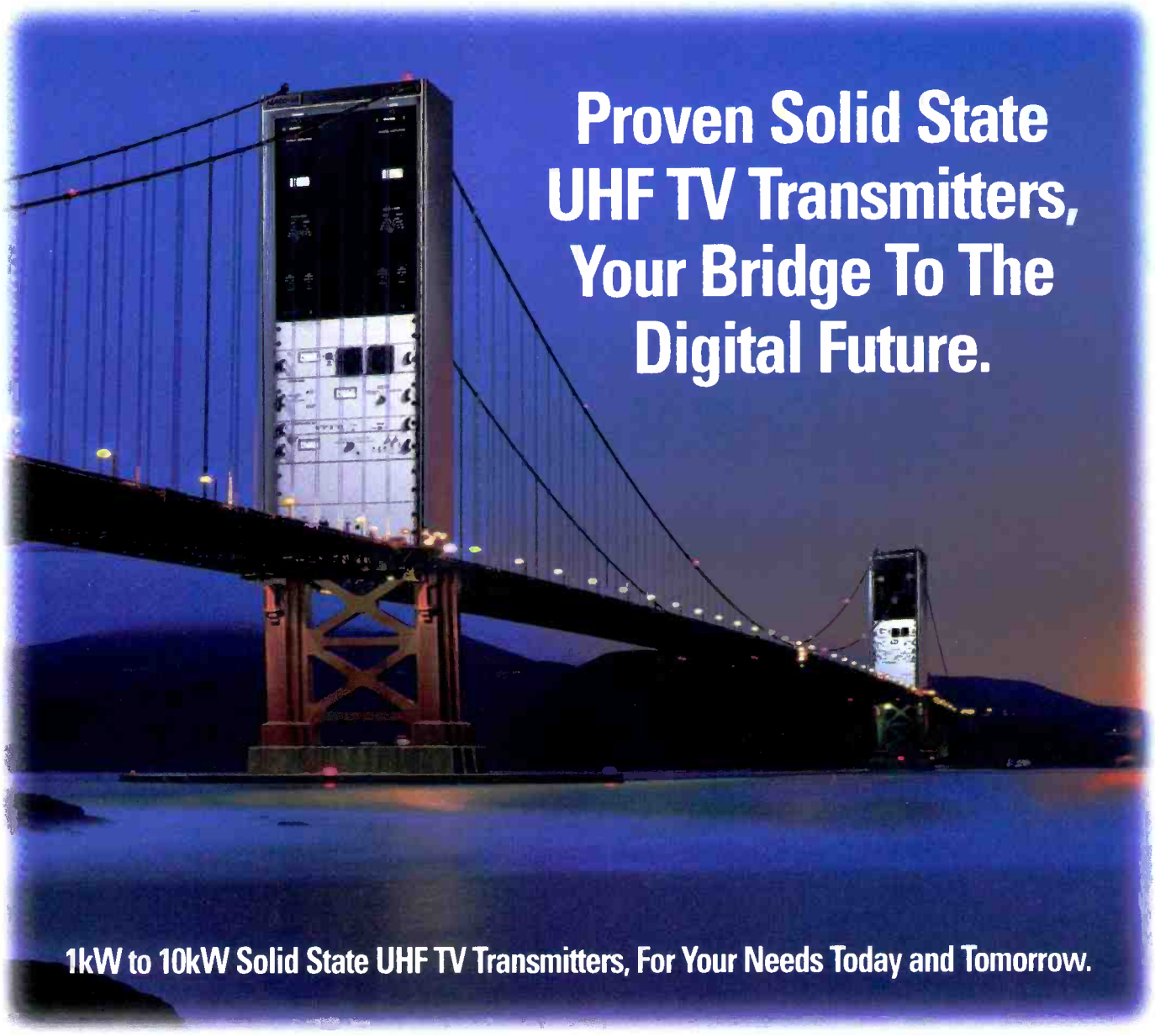
In a special section of the TSI booth, kept apart from the TV set-top and monitor showing PacBell TV, sat the PC-operated head-end modem for downstream data broadcasting to a Hybrid wireless "client cable modem" in each of the five participating booths. The symmetrical modem handled 27Mb/s in both RF channels. Within the WCS frequencies, they used the 6MHz MMDS channel H2 (26.50MHz to 56MHz) for downstream datacasting. For the 6MHz upstream path back to the on-site head-end server, they used channel MDS 2 (21.56MHz to 62MHz).



What happens when a sluggish server on the other side of the planet can't send faster than 300b/s? Said one product manager, "The intent of wireless internet access is to improve bandwidth in the last mile."

The technology is proven and the only barrier to deployment is money, this according to Bob Schmidt, now president of National Digital Network, which recently acquired the first two-way MMDS license for all Argentina. "Until cynics see enough subscribers paying fees for more than plain old video," he said, "you'll have to read the Wall Street Journal like a racing form to see whose running today. Your partners in the morning may be your competitors in the afternoon."

Ken Freed is a technical writer specializing in cable and interactive television, and is based in Denver.



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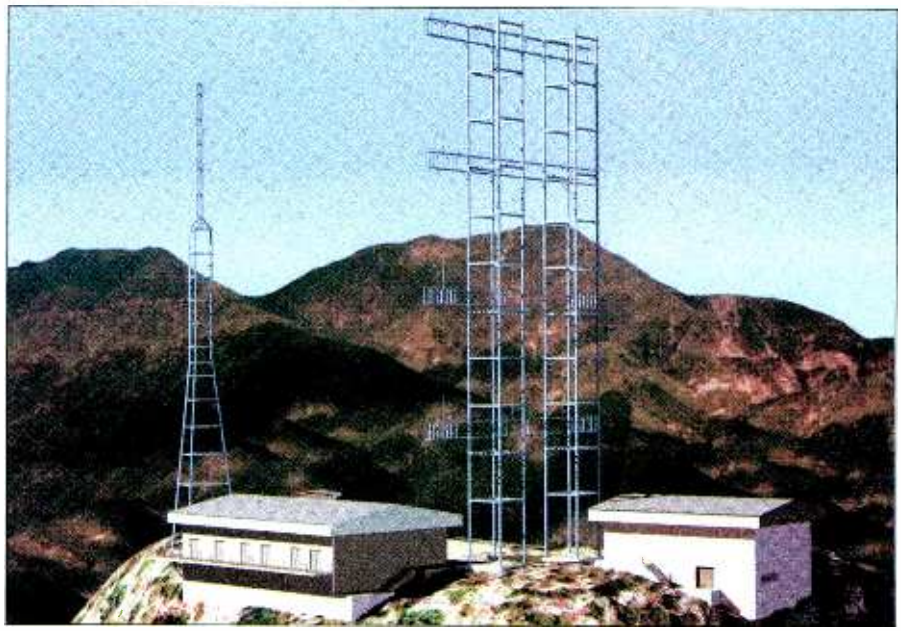
Is your tower ready to go digital?



Preparing for digital begins with the tower.

By John McKay, P.E.

THE BOTTOM LINE:
Three DTV transmission facilities are now operating in the United States, with several others on the way. Is your facility ready for DTV? Here's what you should do *now* to prepare your tower for the new equipment. $

Many engineers have realized that the best way to begin the conversion to DTV is to start with the transmitter facility. Recent estimates by the NAB place this type of conversion cost at less than a million dollars, but could easily rise to two to three million if a new tower has to be built.

The reasoning behind this figure is that the DTV transmission facilities can be put in place before anything else, enabling the station to begin broadcasting a digital signal. Once the DTV transmitter and antenna are in place, the NAB envisions that many stations will then spread the rest of the conversion process (and cost) over several years. This primarily consists of converting the studio systems and equipment to enable the station to produce and edit DTV material.

With this in mind, many broadcasters are now turning their efforts toward establishing a DTV transmission facility. Where do you turn for tower work and what do you need to have done? How can you select a competent consulting engineer to review your tower design? What about

Photo: A computer-generated photo depicting the Lodestar tower facility at Mt. Harvard, CA. When construction is completed later this year, the site will provide a state-of-the-art, multitenant, multipurpose facility for DTV broadcasting and wireless communications in Los Angeles.

a capable tower crew to do your antenna work?

Tower inspections

Now that summer is here, many AM tower owners already know that they have to do a "once-over" on their towers. This might include relamping the lights, repairing any winter damage and clearing away the brush around the base insulator.

What about owners of taller towers? For these facilities, it's time to look at performing a plumb and tension check. This will verify the verticality of the tower and the tension in the guy cables. It's also a good time to see how the antenna and transmission line fared with the ice, snow and winter winds; an inspection of the tower might be called for.

Inspections can be cursory or thorough, depending on your budget and how long it's been since the previous inspection. The EIA/TIA-222 tower code recommends an inspection of guyed towers every three years.

Competent, experienced tower crews or consultants should be used for inspections, because they will know what to look for while climbing the tower. Their primary function should be to look for loose or damaged structural items, observe the degree of corrosion, check the operation of the lighting system, inspect the antenna and record the mast straightness and guy tensions. They should also inspect the transmission line for leaks, bullet holes from the previous hunting season or other types of vandalism and inspect the grounding straps.

The EIA tower code provides a comprehensive list of all the items that should be covered in a complete tower inspection. You can think of this as comparable to your annual physical performed by your family doctor. The inspector should generate a written report, indicating the overall "health" of the tower, including any urgent items that need to be corrected. The report should also indicate if the plumb and tension measurements are out of tolerance. If so, a "P&T" adjustment is required, and this has to be done by a fully equipped tower rigging crew.

Costs for tower inspections can range widely, as with all tower work, because of the various options and tower heights. A heavily loaded 2,000-foot tower with an elevator will cost much more to inspect than a 1,000-foot tower with just a TV antenna. Usually, travel costs and living expenses for the crew are built into the price, so the tower location and access will also be a factor.

For a typical tall tower inspection, a minimum of two inspectors are required just from a safety standpoint. A complete inspection will probably take at least two days, and may run between $10,000 and $15,000. The more complicated the tower is, the longer and, therefore, more expensive the inspection. If your tower is in the 2,000-foot range, you should find out beforehand how the inspector plans to check guy tensions. Smaller-sized cables are usually "pulsed" or "swayed" by hand, the time for pulsing or swaying being measured and used to calculate the tensions

On larger towers, hand pulsing may not be possible due to the size of the cables. The transit intercept method is often applied in this case. This involves sighting along the guy cable and measuring the "sag." The guy tensions can then be calculated from this. In some cases, such as when a tower is equipped with low-frequency guy dampeners, a more direct method is required. This involves rigging the guy cable at the anchor end with jacks and a device to directly measure the tension in the individual cable. Although highly accurate, this is a costly and time-consuming method that will add significantly to the inspection price.

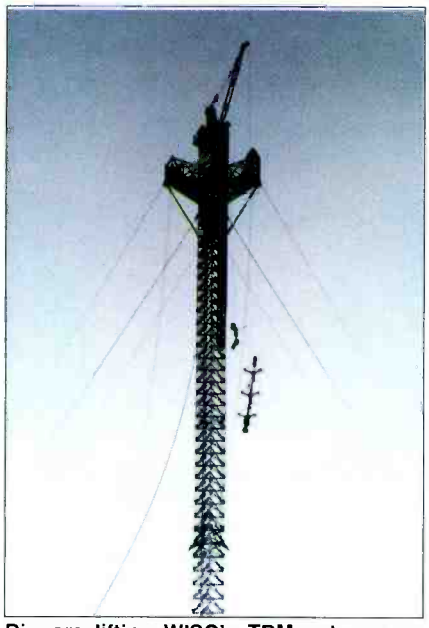
Selecting a consultant and analyzing the tower

Once the inspection is done, a structural engineering analysis should be ordered to see what the tower loading capacity is. (See "Transmission Technology," January 1997.) The newest tower code, version F, is now in force and although it's similar to the previous E standard, many towers that are in service now were designed and built to much earlier standards.

If you're planning to add DTV or other antennas and lines this year, you should have your structure checked against the current code, rather than the original design code. It's also time

Is your tower ready for digital?

to sit down with your broadcast consultant or corporate engineers to finalize your antenna type and elevation, transmission line and transmitter plans. You will need to know this information



Riggers lifting WISC's TDM antenna up the tower in Madison, WI.

for the tower-loading analysis.

Assuming that the inspection phase has been completed, a consultant should be hired to analyze the tower. Your first choice should be the original designer. Some of the larger tower companies have full-fledged engineering design departments. LeBlanc, for example, has more than a dozen engineers on staff that not only design new towers, but can analyze any existing tower, including competitors' structures, provided the tower drawings are available. If the tower is old, or the designer is long gone, look for a consultant or engineering group that specializes in communications structures. Find out what software they use and if it's specifically designed for tower analysis work or general structural analysis. Also, find out if it is a commercially developed product or if it was written in-house. There is nothing wrong with in-house programs, provided they are accurate and use the industry-accepted modeling scheme outlined in the EIA tower code.

Several tower companies today use their own software packages to analyze towers, which is fine. Many companies use commercially developed tower design software to ensure some consistency in results between companies. Ask if a printed output from the tower analysis software is available.

Does the company keep the software analysis on file in case you need to make more changes a few years down the road? This is a lot cheaper than having another consulting engineer input all the modeling data again next time you want to add an antenna. Even if you have a structural consultant who already does this kind of work on an ongoing basis for your company, it may be wise to find out the answers to these questions for your own reference.

Costs of structural analyses can vary widely from consultant to consultant, and even from region to region. A budgetary value for a static tower analysis in accordance with the current EIA code is $3 to $4 per foot of tower height. This will cover a basic structural analysis of the tower, assuming adequate drawings and an up-to-date antenna inventory are available, although the design of reinforcing or modifying may be extra. If no drawings are available, someone will have to inspect the tower and measure each member, which will greatly add to the cost of the analysis.

A plan of action

Once the tower has been analyzed, the results will tell you if there is any reserve capacity left. If not, then no additional antennas or lines can be added to the tower unless reinforcing is installed. In some cases, the tower may be overloaded with just the existing antennas and lines. In this situation, strengthening will be required just to maintain the status quo. If the tower passes the analysis for the existing loading and the latest code, be sure to have a firm concept of what antennas you are proposing to use for DTV.

Have the structural engineer revise his analysis with these new antennas added to the existing load and look at physically what modifications may be required to attach the new antennas. You'll need to know total antenna weight, windload areas and the physi-

TOWER ANALYSIS CHECK LIST

CONSULTANT
- Type of software used?
- Is data kept on file for future reference?
- Engineering consultant only or design/build?
- Can consultant inspect the tower as well?

TOWER OWNER
- Structural tower drawings
- Member sizes and guy cable sizes
- Site layout including anchor radius
- Foundation details
- Up-to-date list of antennas and transmission lines

DTV TOWER ACTION CHECK LIST
- Find original tower designer
- Find original tower fabricator
- Find original tower erector
- Determine new loading requirements
- Collect tower drawings and plans
- Inspect tower
- Tower structural analysis
- Plumb and tension check/adjust
- Modify/reinforce or build new tower?
- Consult with tower company regarding analysis, recommendations and/or antenna installation

TYPICAL TOWER ANALYSIS — COSTS VS. HEIGHT
- 300 feet — $1,200-$1,500
- 1,000 feet — $3,000-$4,000
- 1,500 feet — $4,500-$6,000
- 2,000 feet — $7,500-$8,000

Based on EIA-E code, with complete drawings available, up-to-date antenna inventory. Static analysis only. More costly dynamic analyses may be required under special circumstances, e.g., earthquake, loading conditions, etc. Multiple antenna scenarios will require several concurrent analysis, which will also increase the cost of the analysis.

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Is your tower ready for digital?

cal mounting requirements, including any options you can use to limit the increase in loading. The transmission line details will also be required for the analysis. Rigid transmission line, in particular rectangular waveguide, adds a substantial amount of windload to the tower and requires careful planning with regard to placement inside the tower and hanger attachment. If modifications are required, discuss the results, options and reinforcing with the consultant. Sometimes, site-specific wind- and iceloads can be employed to "save" an otherwise "condemned" tower.

Selecting a tall tower company

Does a new tower have to be built? If additional height and/or capacity is required, and the cost of reinforcing is prohibitive, maybe it's time to build a new tower. In this case, you need to select a few companies to solicit bids from. Look for companies that have a track record of building tall structures that are comparable to your requirements. Look for companies experienced in all aspects of the tower, including engineering, fabrication and erection. A 2,000-foot guyed broadcast tower is a totally different class of structure from a 200-foot self-supporting cellular tower. The type of welding used in the shop is just as important as the method of stacking the tower, and many minor issues can directly affect the quality of the structure.

When reviewing bid submissions, consider the location of the company's resources and offices. If required, how quickly can they mobilize additional field resources? Find out about the facility workload and other factors that may impact your schedule. Some tower fabricators will reserve production time for a premium, others may offer discount pricing if their shop is running at less than full capacity. Also, consider the difficulties in erecting the tower. If you have a complicated site, such as irregular terrain, difficult access (e.g. mountain top) or an existing tower nearby, you'll want to have a clear picture from your selected contractor

Mounting of Channel 4 WTAE antenna atop a modified TF Superturnstile antenna in Pittsburg, PA.

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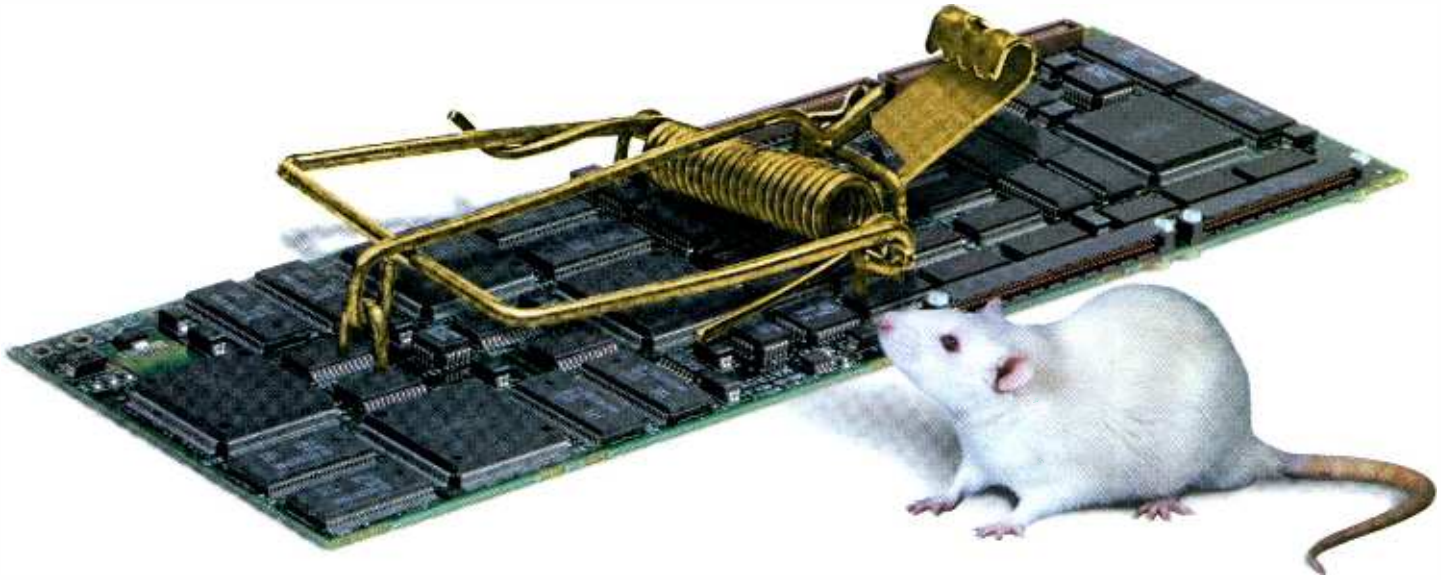

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Is your tower ready for digital?

as to how they will safely and efficiently build the tower. They should perform a site visit prior to finalizing the pricing and design. Do they have the equipment to build your tower? What is their engineering capability. Should field conditions necessitate modifications that impact the design? In the case of large projects, a full turnkey company may be desirable. Such organizations can, under one roof, handle the engineering, drafting, fabrication, erection and management of your tall tower project. It was recently noted in a DTV-related article that for towers more than 1,000-feet, there really are only three North American companies capable of all the above. Certainly, for towers in the 1,500-foot to 2,000-foot range this is true.

If the cost of a new tall tower is too expensive for an individual station, it could be worthwhile for several stations in one market to cooperate on a single tall tower project to serve their DTV needs. Numerous common towers have been built in Canada and the United States in previous years, allowing FM and TV stations to "share" the cost of the tall tower and the coverage benefits of a combined antenna system. Tower leasing and site management companies (such as Lodestar in Florida) may be willing to build and operate a common broadcast tower facility, leasing the antenna usage back to the individual stations.

It may also be advantageous to bring in an outside consultant to review the tower design and proposal. A plus to this is if the tower company is using its own software, the consultant's design review will serve as a software check, providing added confidence in that company's design abilities. However, be sure to select organizations that can work cooperatively on your project. It may also be helpful to use an outside consultant to prepare the bid documents to ensure you don't overlook any relevant specifications, such as steel grade, galvanizing, painting and wind- and iceloading. This also helps to ensure all bidders are working on a level playing field, and you are comparing apples to apples when reviewing the pricing.

Beat the rush

Many broadcasters will be looking at their time-frame for going digital. It's necessary to start planning now for the antenna space on your tower, and to find out if the tower is in shape for the new loads or if you should be looking at building a new tower. Although there are lots of regional tower companies, many taller tower owners know that there are only a few companies capable of successfully servicing their needs. A simple calculation of "major markets 'X' number network affiliates" shows that there are literally hundreds of towers that have to be checked out. With the wave of new stations now preparing to go digital, it's time to take a close look at the condition of your tower to avoid being swept away in the flood. ■

John McKay is a sales engineer for LeBlanc & Royle Telecom, Ontario, Canada.

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Nitrogen vs. air pressurization

The cost/benefit of air vs. nitrogen.

By Lloyd Keyser

THE BOTTOM LINE:
Although many stations pressurize transmission lines with nitrogen, the cost and benefits of using air are worth considering. Many stations may be unaware that nitrogen is highly regulated by state and federal codes. Stations can also be fined if they fail to provide proper safeguards when using nitrogen. Modern air-pressure systems can avoid the legal issues while protecting your transmission lines. $

Moisture entering a transmission line, whether it has an inner conductor or not, condenses and collects as water in the lowest gravity point in the horizontal run. At the very least, this moisture creates VSWR problems of poor signal transmission and can cause the transmitter to shut down or even worse. Water promotes corrosion, which results in oxides that flake from the inner and outer conductors of the line. If these oxides fall and collect on the inner insulation rings, they eventually form a conductive path that can arc over and result in disastrous downtime so the line can be rebuilt.

The determination of dew point is the key to corrosion prevention. Dew point is the temperature at which moisture condenses on a cooler surface when the air becomes saturated with moisture. Corrosion begins at the dew point; thus, a lower dew point is more desirable. To keep a transmission line moisture-free, it is pressurized, most commonly with nitrogen or dry air, to maintain a low dew point in the system. Although much has been said (and assumed) about nitrogen being a better choice than dry air, there are advantages and disadvantages. The choice should be made only after careful review of the properties, hazards, cost and availability and system design, as well as total system and recurring costs.

Reliable transmission lines are dry transmission lines. Moisture in the

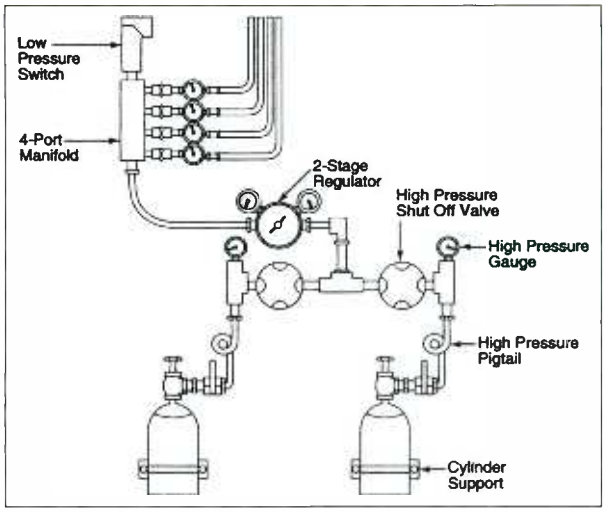

Figure 1. Owning this dual-cylinder system, amortized over a 10-year period, costs $281 per year. Operating costs add an additional $1,134, bringing the yearly total to $1,415.

transmission line can lead to transmitter shut-down and expensive repairs, not to mention time off the air.

General physical properties

The dew point of nitrogen depends on the purity of the gas. Three purities are commonly available in 300ft3 cylinders. The most economical is the industrial-grade with a purity of 98.8%, a moisture content of 32ppm (vol/vol) and a dew point of -61°F. This is the grade used in the telecommunications industry. The second is grade 0 or high purity with a purity of 99.998%, a moisture content of 3ppm and a dew point of -92°F. The third is grade 5 with a purity of 99.999%, a moisture content of 1ppm and a dew point of -105°F. Both the second and third grades are used by laboratories.

GAP (mm)	AIR (kV)	NITROGEN (kv)
2	7	8.5
6	19	20
10	28	30

Table 1. Breakdown strength of air vs. nitrogen.

The dew point of ambient air, which is used in dry air pressurization systems, varies with the moisture content. Pressurized dehydrator systems are designed to provide a consistent dew point from -10°F to lower than -50°F (63ppm moisture content). Dehydrators that use membrane technology can achieve the lowest dew point. Purity of air is not a factor in achieving a dew point.

The dielectric strength of dry air and nitrogen is virtually identical at the same dew point: 1.0005364 and 1.0005480, respectively; the difference of 0.0011593% is irrelevant. Therefore, arc suppression is no greater with nitrogen than dry air.

A comparison of the direct current breakdown strength of nitrogen vs. dry air at various gap lengths and at 293°K is shown in Table 1.

Hazards

Nitrogen poses some health hazards, while air typically does not. Nitrogen is a simple asphyxiant and is a colorless, odorless, flavorless, non-toxic gas. The liberation of a large amount in a confined area, such as an equipment shelter, could cause suffocation without warning.

Nitrogen cylinders are furnished at 2,640psi and should not be transported in an enclosed space, such as a car trunk, van or station wagon. The cylinder relief valve, consisting of a lead seal or a rupture disk, is a safety valve that releases pressure in an overheated condition and produces a startling noise upon opening. The noise can distract the driver, and the gas can cause asphyxiation in an enclosed vehicle.

If a cylinder should explode or if a cylinder without a limiting orifice is mishandled in a way as to shear the top valve, it has enough energy to "rocket" through a masonry wall. Oil should not be used anywhere on a gas regulator.

Air, on the other hand, has none of these hazards. Dry air is generated in the dehydrator at 8psi and, thus, does not need special high-pressure equipment.

Cost and availability of nitrogen

The most common-size cylinder for industrial use is 300 cubic feet, which measures 10 inches in diameter and 61 inches in height, including the safety cap, and weighs 143 pounds empty and approximately 165 pounds filled.

Nitrogen is readily available at welding supply distributors that are located in almost all major cities. One-day local delivery is the norm and it costs

Nitrogen vs. air pressurization

approximately $15 per cylinder.

A logistics problem occurs if the customer has, for example, multiple distant/remote broadcast sites to supply. The cost for remote delivery is estimated at $30 to $50 per cylinder. As a result, some customers stock several full cylinders and have someone in house deliver and install at the remote locations as required. Storage requires additional building space, proper cylinder restraints and an open vehicle equipped with a hydraulic lift to transport the cylinders in a vertical position. A cylinder transported horizontally in a pickup truck is difficult to handle and extremely hazardous.

There are additional costs associated with selecting a nitrogen system, such as a rental fee of $5 per cylinder per month, an environmental fee of $6 per month per site, the cost of refilling cylinders (depends on system leak rates), storage racks at $500 to $1,000 for three- to six-cylinder capacity, a special four-wheel truck for moving cylinders at about $150, remote site transportation (time and vehicle to service remote sites or time to at least meet the supplier at the site to unlock the gate and shelter) and the incidental costs of ordering, paying monthly invoices and storage. In climates where inclement weather is a problem, there can be additional risk and/or cost to service remote sites. (See Figure 1.)

System design

Pressurized nitrogen should not be used at a site that is not always accessible. Vandalism, particularly a ballistics hole in the waveguide, would immediately deplete the nitrogen tanks. A dehydrator system, however, does not need this kind of accessibility. In the event of a bullet hole, the system would run continuously, protecting the line and antenna from moisture and maintaining enough pressure to keep the station on the air until a repair can be made.

The total system volume to be pressurized must include the volume of each air-dielectric line at the site. For an earth station antenna site, it may be only the feedhorn and, possibly, the combiner. For a microwave or broadcast site, the transmission line volume is normally quite large, but the feed itself negligible.

The amount of gas required is the sum of the total volume, plus an anticipated leak rate, plus the volume required to maintain pressure during a fast temperature drop of 35°F in one hour. A tight system should have less than 2% leakage. In some leaky systems, gas loss may be as high as 10%.

At least one full cylinder of nitrogen should be available for changeover when the on-line cylinder is exhausted. Monitoring procedures range from checking the nitrogen pressure daily at a manned site, where manual cutover would be

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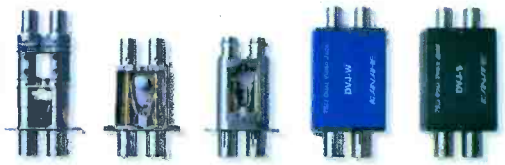

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Nitrogen vs. air pressurization

needed, to cylinder changeover by a pressure regulator switching monitor at an automated site. Automatic systems are relatively expensive, but they are a must at remote sites.

Dry air is generated as needed and, therefore, not stored (see Figure 2).

Purging a transmission line requires flushing out the existing air to remove moisture. For a 300ft3 system with a flow rate of 1.7ft3 per minute, approximately 1,065 minutes would be needed to replace the oxygen/water vapor mix.

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Design engineering* * @ $100/h	400	800	2,000	4,000	400
Installation @ $40/h	120	240	240	480	40
Total costs	1,518	2,810	4,754	9,141	2,524
Total costs/yr	152	281	475	915	252

*Dehydrator sized to compare with semi-automatic dual cylinder nitrogen system.
**Design engineering includes developing system requirements; design of system including hazard, space, etc.; hardware specifications; and supervision of installation.

Table 2. Non-recurring system design and installation costs.

Six cylinders of nitrogen would be needed according to this formula. This represents a $200 charge for the initial installation, and each time a major repair to the transmission line requires flushing the system. Dry air systems are designed to operate cyclically or continuously, thus the cost of purging is based on power consumption.

Nitrogen generators

An alternative to nitrogen cylinders are a pressure swing adsorption (PSA) nitrogen generator and a membrane nitrogen generator. These methods were originally designed for higher-capacity industrial use and require "shop air" or large air compressors.

The PSA nitrogen generator is similar in operation to older design pressure swing dry air dehydrators. A sieve bed adsorbs moisture and oxygen and passes industrial-grade nitrogen to the output. These devices regenerate themselves by cycling and "blowing down" the moisture and oxygen; some of the output nitrogen assists in the process.

A large compressor and companion storage tank require at least 7ft2 of floor space and 40ft3 of room volume. They are noisy at 80dBa and must be well-ventilated to purge the expelled enriched oxygen. Less space is needed and less noise is generated if compressed air is available within the building. The sieve bed must be changed every 2,500 hours of operation.

The nitrogen membrane process is a more complicated version of the dry air membrane process. The pressure and flow rate determine the nitrogen purity as moisture and oxygen are separated

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Nitrogen vs. air pressurization

by the membrane. These large-capacity units are used in process manufacturing and require external compressed air. These two alternate methods range in cost from $4,500 to $20,000.

Air dehydrator

The membrane air dehydrator is an advanced air system for pressurizing transmission lines. It provides high reliability and low dew point. With about 80 fewer parts than a comparable pressure swing system, a membrane dehydrator provides an MTBF as high as 55,000 hours and a minimum dew point of -50°F.

A complete pressurization system can be built into a convenient, two-chassis package consisting of a dehydrator and line monitor. The package contains all components typically needed to pressurize an antenna and transmission line system. The line monitor panel can be mounted in an equipment rack and the dehydrator can be located in a remote area. Membrane dehydrators are priced between $1,800 and $4,000, depending on options and system volume requirements.

General comparison

There is no meaningful difference in dielectric strength between nitrogen and dry air. The assumption that nitrogen is better than dry air is based on comparisons of nitrogen under pressure with dry air at atmospheric pressure. When the pressures are the same, dry air and nitrogen are about equal in terms of peak RF power ratings.

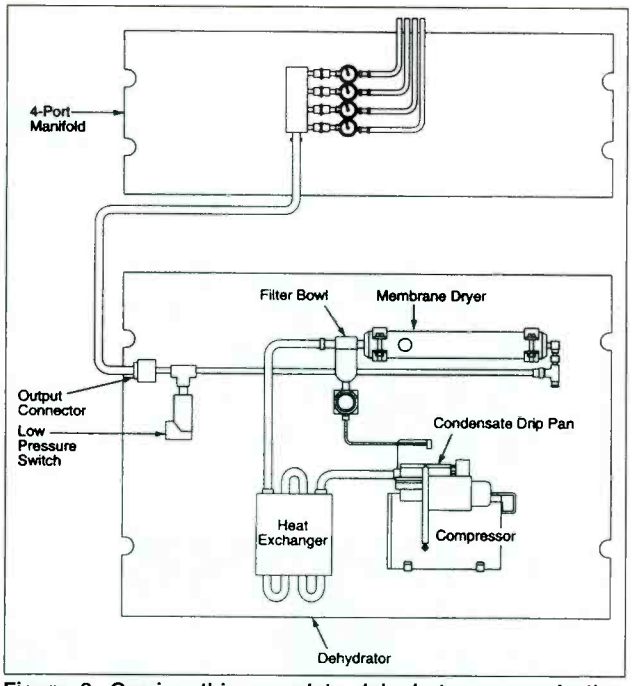

Figure 2. Owning this complete dehydrator pressurization system, amortized over a 10-year period, costs $252 per year. Maintenance costs add an additional $41, bringing the yearly total to $293.

Nitrogen does not support combustion. However, under high energy conditions, such as a lightning strike, nitrogen may form compounds with the insulators and change the performance characteristics of transmission lines. Oxy-

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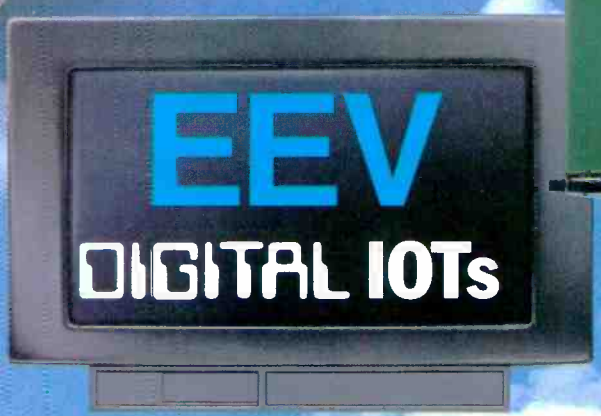

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Nitrogen vs. air pressurization

gen in a dry air dehydrator under similar conditions, could also combine with the insulators and cause a system failure.

In a properly grounded transmission line, lightning energy is not directed to the internal parts of the transmission line. Systems containing Teflon insulator rings will char in a dry air system during an arc-over, but will not support combustion and burn. Nitrogen also will not prevent an arc-over condition.

Advantages of nitrogen systems

In the simple one- or two-cylinder nitrogen system, external power is not required. In a fully automatic nitrogen system, electrical power is needed to operate the control module. Electricity is always required for a dry air dehydrator.

Nitrogen does not support combustion. Dry air supports combustion, however, internal transmission line components will not support combustion and burn.

A nitrogen cylinder system is passive and does not require a compressor. Both nitrogen generator and air dehydrator systems require a compressor.

Cylinder nitrogen systems are completely quiet. Nitrogen generator compressors, on the other hand, produce noise as high as 80dBa. Air dehydrators vary from 55dBa to 82dBa, depending on size and voltage. Sound-deadening kits are available for some systems.

Advantages of air systems

Maintenance of a nitrogen system requires someone knowledgeable about the hazards posed. The person must be trained to safely handle heavy cylinders, know proper operation of the valves and regulators, and must be supplied with proper handling equipment. The larger, more complex nitrogen systems require highly trained personnel.

Once installed, membrane dehydrators, which contain considerably fewer parts than other systems, require minimal maintenance and a skill level commensurate with changing an air intake filter.

The initial capital cost of a single cylinder nitrogen system is usually less than a comparable air dehydrator. System maintenance, however, is more intensive. System maintenance includes daily monitoring, cylinder handling, transportation, storage and changeover. Support services, such as ordering new cylinders and paying bills, add an additional level of expense.

A membrane air dehydrator requires a semi-annual filter change and a compressor overhaul after 6,000 hours of run time.

In a large transmission line, as for a TV station, it may take several cylinders of nitrogen to purge the system or time must be allotted for a vacuum pump to evacuate the system. For a 300ft3 system, from three to six cylinders are required to adequately purge such a system.

A nitrogen system has a fixed reserve volume, depending on tank capacity, at any given time. A leak in the system may empty the nitrogen tanks in minutes. At that point, moisture will enter the transmission line.

Membrane dehydrators are designed for cyclic or continuous running, so, in the case of a line problem or vandalism, the dehydrator will prevent moisture from entering the transmission line, though the optimum pressure may not be maintained.

Comparative costs

Table 2 compares the costs between nitrogen and air dehydrator systems. All cost figures are estimates based on generally published manufacturing prices for equipment.

In any application where a pressurized transmission line is used, a dry air system is less costly, less dangerous, less space-consuming, less labor-intensive and less regulated than a comparable nitrogen system.

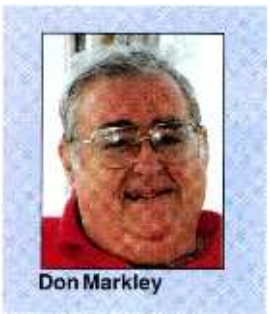
An assessment of needs and situations is necessary when any decision is made regarding transmission equipment, and pressurization method is no different. Careful assessment and consideration will lend itself to the implementation of a reliable system that best fits your needs. ■

Lloyd Keyser recently retired as business unit manager for the pressurization product line at Andrew Corporation, Orland Park, IL.

By Don Markley

Exciters for digital television

The onset of advanced TV systems, including digital television, high-definition television, data and multiple audio signals, brings new and demanding requirements to the TV system. The new systems, while robust and resistant to the noise problems that have plagued stations in the past, are of an entirely different level of complexity.


Don Markley

For the average station engineer, who is somewhat unknowledgeable in the digital world, a new language will come into use and a new technology will be required. It's going to be fun.

All will not be new and strange. The exciter still will perform the accepted and usual functions. Namely, generating the initial RF signal, controlling the frequency to the necessary accuracy and providing sufficient drive for the IPA stages.

At that point, things change.Rather than simply being provided video and audio baseband signals, the digital exciter will be supplied with a 19.4Mb/s datastream. This datastream will contain all of the signals to be transmitted and will be encoded in accordance with the format to be transmitted. As has been often reported, this may be a single HDTV signal, multiple signals of more conventional proportions, interlaced or non-interlaced, some or lots of data, etc. All the exciter really will be concerned with is that the datastream comply with what is identified as the "transport layer" specifications. The transport layer includes such items as the STL and will convey the encoded signal from the studio to the exciter.

New exciter duties

Now, the new technology starts. The exciter must use the encoded input signal to generate an 8-VSB signal for transmission. The total system will use extensive digital correction to compensate for the normal non-linearities. This correction will extend over adjacent channels and will be especially needed in those instances where the station will operate with a first-adjacent channel. The exciter must also provide frame synchronization, Reed-Solomon encoding, data interleaving, Trellis coding and insert field and frame sync. Although all of this may sound frightening, it will have the big advantage common to all digital systems — once set up, it will stay that way. Stability will be much better than in the old analog systems.

Finally, this complex signal will be converted from digital back to an analog signal, which will be filtered and upconverted to the appropriate channel. The IPA stage will need to be extremely linear — as will the PA — and additional filtering will probably be needed at the IPA stage to eliminate any spurious signals into adjacent channels.

Some manufacturers are providing software and RS-232 ports so that system setup and monitoring can be performed easily. It will be possible to simply plug your laptop into the exciter to observe and control the overall system performance. This will be a great help in maintaining and troubleshooting the system.

Again, today's exciters are being designed for total hands-off operation. It is only logical to assume that the next step will be a modem allowing the chief engineer to call into the transmitter at the exciter level from the privacy and convenience of his own office (car, bedroom, watering hole, etc.) Pretty soon we will be at the point that the transmitter site is only visited for transmitter replacement every 20 years. Alas, we poor engineers will become as unused as steam-driven cars.


The Harris CD 1 exciter has been on the air at WRAL-HD in Raleigh, NC, since 1996.

Adjacent-channel problems

The big problem with all the new exciters will be in obtaining enough correction for the high-power devices and for attempting to diplex with first-adjacent channel operations. So far, it is fairly well agreed that operation

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odds are almost certain that you'll need tower work. And site surveys, local ordinances, FCC and possibly FAA approvals, custom fabrication, erection crews and weather all require the most specialized know-how and the longest lead-times in the DTV conversion process.

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more custom towers than any other company. LDL specifies, sells and installs RFS antennas. And we provide design, supply and installation of studio equipment and facilities through our affiliation with IMMAD, whose recent work includes NBC Olympics facilities, KHOU-TV, Houston and satellite uplink facilities for Echostar.

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with the DTV signal one channel below the NTSC signal will work, but will require careful correction of the digital signal. When operating with DTV one channel below the NTSC signal, some degradation of the lower edge of the NTSC channel will occur and the upper edge of the digital channel will experience distortion from the filters. The digital correction circuits will have to cope with that problem to avoid increasing the bit error rate before even reaching the air.

Diplexing the DTV operation one channel above the NTSC signal seems at this time to be unrealistic. There is no area in which a loss can be accepted. The top end of the NTSC channel contains the aural and color information, while the lower part of the digital channel contains vital information. To date, all diplexer manufacturers contacted have agreed that NTSC +1 channel is not possible.

Remember, it has previously been reported that the antenna and transmission line system performance must exhibit a return loss of 30dB or more across the 6MHz channel. That level of performance will have to be maintained throughout the transmitting equipment to realize optimum results from the digital process. Fortunately, the major manufacturers seem to be rising to meet the challenge. The equipment seen at NAB this year definitely demonstrated adequate control over the digital process to compensate for PA non-linearities up to the transmission line input.

> Although all of this may sound frightening, it will have the big advantage common to all digital systems — once set up, it will stay that way.

The next few years are going to be exciting and are going to require a lot of upgrading on everyone's part. As an alternative, you may want to consider taking up fishing in warm salt water. To the best of my knowledge, conventional fishing equipment and all fish are analog. I'll see you there as soon as we get all these DTV antennas working. ■

Don Markley is president of D. L. Markley and Associates, Peoria, IL.

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By Jack Gelman

AT&T's digital transport services

While the majority of TV broadcasting continues to be primarily supported by satellite technology, the use of digital, fiber-optic-based transport is increasing among TV broadcasters. And, although satellite is still the preferred method for broad distribution applications, land-based digital communications services offer greater quality, reliability, security, overall operational efficiency and cost-effectiveness for many new applications.

Why digital?

For broadcasting, terrestrial digital services offer several measurable benefits. First among these is flexibility. Satellite is limited to transmission requiring unidirectional, one-to-all transmission within a specific broadcast neighborhood on a full-time or reservation basis. In contrast, terrestrial services offer the flexibility of two-way connectivity and can be either full time, scheduled or on-demand with the ability to reach endpoints on a global basis. Digital, fiber-based services also cost-effectively support one-to-one or one-to-several communications for applications, such as programming backhaul, regionalized content distribution or direct affiliate-to-network and affiliate-to-

Terrestrial-based digital transmission offers unsurpassed reliability, especially for real-time applications when there is no opportunity to retransmit content. For broadcasts demanding uncompromising quality, such as sporting events, high-speed terrestrial digital services ensure the highest levels of video contribution programming with the cleanest image and minimal degradation. The combination of digital cameras, fiber-optic lines and digital recorders can maintain component digital signal quality end-to-end, providing studio-quality broadcasts from any location.

Service options

Terrestrial-based digital video offerings range from Integrated Services Digital Network (ISDN) to 45Mb/s digital service and asynchronous transfer mode (ATM). Providers such as AT&T are responding with a broad portfolio of digital networking solutions, which couple the best transmission choices with appropriate equipment options.

Depending on the requirements of the application, traffic requirements at each endpoint location and price/performance considerations, a total solution can be developed that incorporates a combination of products and services. Management options are typically provided in the service, to help ensure that all elements of the network, codecs, compression devices, routers, workstations, servers and the transmission facilities are performing up to specification and are proactively maintained. This turnkey approach is primarily offered through collaboration between equipment providers and telecommunications companies, ensuring investment protection and the ability to incorporate new technology as it becomes accepted by the industry.

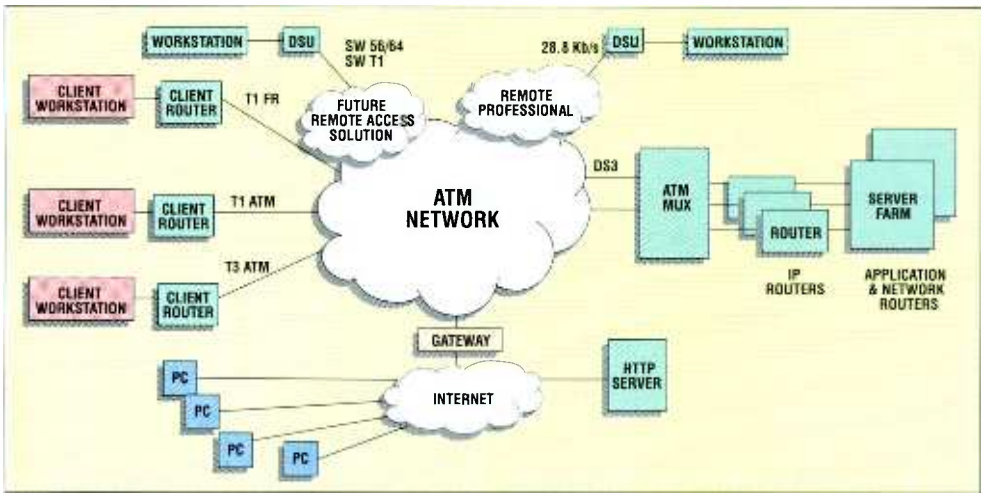


Figure 1. The AT&T Media ExtraNet encompasses a variety of digital interconnection technologies.

A variety of digital transmission options can be employed to address specific application requirements (see Figure 1). These include:

• ISDN (Integrated Services Digital Network): ISDN enables the transmission of voice, data video simultaneously at rates of 56/64kb/s, 384kb/s and 1.5Mb/s. In addition, multiple 1.5Mb/s facilities can be bundled together to provide higher rates, such as 3Mb/s, 6Mb/s

or 10Mb/s. ISDN is ideally suited for locations that can't justify full-time high-speed access (remote locations or small affiliates) and for applications requiring high-bandwidths for short lengths of time (such as downloading video clips or commercials).

• **45Mb/s occasional or full-time transport:** The staple of digital video services, this transport method, coupled with digital video codecs, allows for NTSC signals to be converted to digital and carried over fiber-based networks. New multiplexers and MPEG compression devices are rapidly making the economics of this service even more attractive. Service can be ordered in 30-minute increments or as dedicated full-time circuits. Options include one- or two-way transmission and point-to-point or multipoint connections. Typically, applications include live video feeds from venues to a broadcast center, backhaul from a satellite uplink or downlink and selective (one-to-several) distributions.

• **ATM (asynchronous transfer mode):** ATM will ultimately provide the most efficient transport method for distributing video files. The ability to handle large file sizes, transmit at high speeds and multicast to multiple endpoints is well-suited for broadcast industry requirements. ATM also can provide bandwidth-on-demand capabilities through switched virtual circuits (SVC), eliminating the need for reservation-based point-to-point switching. The other major benefit of ATM transmission is its ability to handle integrated voice, video and data transmissions. For a network operations center or a large affiliate, this means increased cost savings by integrating their telephone, Internet access, data networks and video over a common-access facility.

• **The Internet:** Although the Internet today is not a high-speed data transmission network, it represents a significant step in the convergence of broadcasting with the information age. Driven by the Internet, the new network computer will evolve as the convergence of the personal computer and television. This application will be capable of supporting today's information services and tomorrow's broadcast-quality video services. As a result, the Internet is rapidly becoming another distribution tool for the broadcast industry. Web sites can relate content being "aired" with content on-line. Video standards, such as MPEG, already are enabling consumers to view video files over the web, although the size of the files and available modem speeds limit its use to the truly dedicated. Ultimately, however, as modem rates and access line speeds increase, broadcast-quality video via the web will become a reality.

Applications

The range of broadcast industry applications supported by high-speed data services is increasing continually. The primary drivers today include the need for any affiliate or production group to selectively identify and download desired content (news clips, promotional materials, etc); the ability to control escalating operational costs through reduced dependence on transponder availability; a desire to reduce reliance on people-intensive, manual content acquisition; the ability to link and consolidate multiple, stand-alone operations into more efficient hub architectures for broadcast, cable or web-based applications and; the need to increase revenue through more accurate and flexible ad time-trafficking systems and rapid delivery of spots.

Vendors like AT&T are collaborating with equipment manufacturers and content providers to create leading-edge, broadband-based solutions for the media industry. These best-of-breed solutions bundle high-quality digital services and advanced technology for true end-to-end digital solutions that support a wide variety of applications, including remote production, network-based archiving and storage, web-based browsing and electronic commerce.

Working with NBC during the 1996 Olympic Games, AT&T created a comprehensive broadcast solution based entirely on fiber transmission. For U.S. coverage, NBC used AT&T long-distance digital video circuits to create a first-ever "Virtual Broadcast Center," which linked NBC's production facilities in Atlanta and New York, 900 miles apart. The center enabled NBC to manage the production and editing operations between the two locations, significantly reducing the number of people and amount of equipment moved to Atlanta.

For compression, transmission and multiplexing, MPEG-2 4:2:2 Profile @ Main Level digital compression technology delivers digital compressed video transmissions at the highest levels of quality over a given bandwidth. Last year, AT&T and Sony successfully trialed an end-to-end solution at the Republican National Convention using the new Sony 4:2:2 technology and DS-3 transmission lines that allow broadcasters to carry twice the program signal over one DS-3 line, or, for pre-recorded video feeds, to send the content in half the time it takes for a normal broadcast transmission.

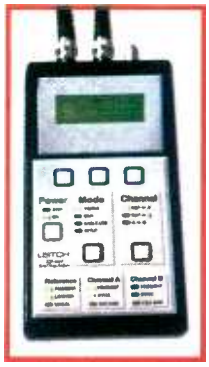
In pre- and post-production, key applications include quickly locating archived video and audio clips, creating digital storyboards and collaborating with others digitally from anywhere on the globe. Several technologies are emerging for these applications including MPEG-2, IP-based networks, ISDN and ATM.

In another case, AT&T is providing broadcasters, movie houses and related organizations with a video library and distribution service based on ISDN networks. The service offers customers the ability to download video clips and images, including news features, B-roll footage and other images. Advantages

Continued on page 104

new products

By Deanna Rood



Portable analyzer
Leitch

• Serial timing analyzer (STA-7000H): this device allows you to easily time serial digital signals (143-360Mb/s); the signals are compared to each other or to a separate reference signal and analyses are clearly displayed on the unit; the analyzer locks to a house reference signal and maintains a stable lock for up to 15 minutes after the signal is removed; it also provides error detection and handling monitoring, as well as cable length and equalization measurements.

Leitch, 920 Corporate Lane, Chesapeake, VA 23320; 800-231-9673; fax 757-548-4088
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Digital non-linear editing system
United Media

• On-Line Express: a completely flexible digital editing and media production system with real-time performance, allowing you to provide true broadcast-quality video from your desktop under Windows 95 and Windows NT; the software package uses Matrox's DigiSuite PCI bus boardset and interfaces with the high-speed Movie-2 bus for maximum performance; On-Line Express includes an intuitive drag-and-drop time-line interface, as well as the power to adapt to different methods of operation; other features include instant playback of edits, real-time effects, no rendering, real-time audio mixing, 2-D and 3-D digital video effects, paint, titling, compositing, batch digitizing and other professional video and multimedia production features.

United Media, 4771 E. Hunter, Anaheim, CA 92807; 714-777-4510; fax 714-777-2434; www.unitedmediainc.com
Circle (253) on Free Info Card

Digital-S product line expanded
JVC Professional Products

• BR-D750U (editing recorder) & BR-D350U (player only): these two products bring high-end performance of the Digital-S format to a broad spectrum of users by providing high-quality 4:2:2 component digital performance at an affordable price; the BR-D750U features 4:2:2 component digital recording, mild 3.3:1 compression for superior multigeneration picture quality and two-channel PCM audio; it uses the same robust ½-inch metal particle tape as the high-end Digital-S products, but features only one audio cue track, no jog dial and clear front-panel buttons.

JVC Professional Products, 41 Slater Dr., Elmwood Park, NJ 07407; 800-582-5825 or 201-794-3900; fax 201-523-2077; www.jvcpro.com
Circle (259) on Free Info Card

High-performance digital transport for video and audio
Fiber Options

• Series 1250SB 12-bit digital transport system: designed for use within broadcast facilities and remote field production, this system links composite video and up to eight channels of audio; the system features a bandwidth of 10Hz to 8MHz for video and 20Hz to 20kHz for audio.

Fiber Options, 80 Orville Dr., Suite 102, Bohemia, NY 11716-2533; 516-567-8320 or 800-342-3748; www.fiberoptions.com; info@fiberoptions.com
Circle (252) on Free Info Card

Widescreen SDTV camcorder for ENG
Sony

• DNW-9WS: a DTV-ready camcorder that uses a high-performance widescreen Power HAD IT CCD and is designed specifically for ENG environments; the DNW-9WS can switch between 16:9 and 4:3 and is ideal for nighttime ENG shooting; the camcorder uses a plug-in setup card to store full camera pre-alignment making the ENG system instantly ready for a given shooting environment; in addition to a two-inch-wide 16:9 viewfinder, the camcorder is capable of full broadcast-quality color playback in the field without an adapter.

Sony, Sony Dr., Park Ridge, NJ 07656; 800-686-SONY; www.sony.com/professional
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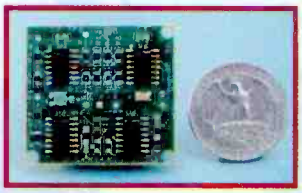
Zoom/focus accelerator

Turbo Focus Inc.



• Boomerang: this zoom/focus accelerator is designed to bring hyperzoom speed to TV camera focusing and framing; available for use in any professional ENG/EFP, studio or field lens, the Boomerang automatically zooms out to the maximum tele position while the lens is focused and then zooms back to the original position in as little as two seconds; this speed is achieved by temporarily overriding the servo speed limits imposed by lens manufacturers and by taking advantage of the wide safety margins engineered into the servo zoom operating speeds.

Turbo Focus, 9913 N.W. 20th St., Pompano Beach, FL 33071; 954-340-1969
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Computer displays for prompting

Listec Video Corporation

• Vu-Lite displays: a line of TFT LCD flat-panel prompter displays that incorporates back-lit technology for lightness and brightness; the LCD panels weigh five pounds, while the total system weighs 10 pounds; the all-up prompter system includes mirror/hood and easy-mount adjustable hardware; the displays can produce fully saturated colors with no smear and can be driven by standard VGA, composite video (NTSC or PAL M) or S-Video.

Listec Video, 707 Chillingworth Dr., West Palm Beach, FL 33409; 561-683-3002; fax 561-683-7336
Circle (255) on Free Info Card

Dual-antenna truck system

Advent Communications

• Dual-antenna system: this system allows two complete uplink chains to be accommodated on a single compact vehicle; the typical system includes a 2m Advent Lynx motorized antenna and a 1.2m Advent Newswift motorized antenna; the antennas' design allows the larger Lynx antennato "clam close" over the smaller Newswift antenna so that when the antennas are stowed for transit, they maintain a low profile; the systems are available in analog only or analog digital.

Advent, Preston Hill House, Nashleigh Hill, Chesham, Bucks HP5 3HE, England; +44(0) 1494 774400; fax +44 (0)1494 791127
Circle (260) on Free Info Card

Lavalier microphone
Electro-Voice

• CO_2 Pro lavalier microphone: this new version of the CO_2 lavalier microphone includes five additional mounting clips so that the microphone can be attached in a wide variety of ways; the CO_2 Pro includes a wired XLR connector module, two types of microphone tie bars, a mic-mount tie tack and a cable-mount tie tack; also included are a single microphone cable-holding tie bar, tie-tack mic clip, mic-mount vampire clip, cable-mount vampire clip and a zippered vinyl protective pouch.

Electro-Voice, 602 Cecil St., Buchanan, MI 49107; 800-234-6831 or 616-695-6831; fax 616-695-1304
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Low-profile digital video exciter
LNR Communications

• DVE exciter series: representing the next generation in MPEG-2/DVB satellite uplinks, these digital video exciters offer a complete solution for combining MPEG-2 encoding, DVB modulation and RF frequency conversion functions into an integrated package; the source video, audio and data are input, and RF Satcom frequency is output; the compact size makes these units ideal for flyaway or mobile DSNG applications.

LNR, 180 Marcus Blvd., Hauppauge, NY 11788; 516-273-7111; fax 516-273-7119; dvenmtg@lnr.com
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Digital video transport
Barco

• Luxor digital optical link: the slim-line Luxor is a low-cost version of Barco's six-slot Luxor fiber link and provides a solution for the reliable and secure transport of uncompressed video, audio and data in all existing standards over distances up to 20 miles; the interchangeable units are housed in a 19-inch 1U enclosure with two slots and the units can be removed without disconnecting the fiber link; Luxor also allows for remote machine control such as remote video tape recorder start.

Barco, 3240 Town Point Dr., Kennesaw, GA 30144; 770-218-3200; fax 770-218-3250
Circle (262) on Free Info Card

HDTV camera
Hitachi Denshi America

• SK-3000: a multistandard camera that provides simultaneous HDTV and NTSC (16:9 and 4:3) outputs; the digitally compressed camera head uses 2,000,000-pixel CCDs and operates in a 16:9 format at all times; digital processing is accomplished with a 12-bit A/D converter and a single Hitachi VLSI that has up to 20-bit internal processing accuracy; the VLSI uses 0.35 micron technology to provide 1.8 million gates, allowing increased functionality over previous VLSI designs.

Hitachi, 150 Crossways Park Dr., Woodbury, NY 11797; 516-921-7200; fax 516-496-3718
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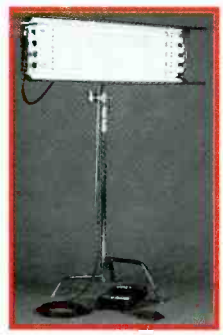
new products



Location lighting system
Kino Flo

• Select location lighting systems: Kino Flo's own electronic Select ballasts can operate on the light stand with the fixture or they can be removed as far as 75 feet away to run the lights, allowing the operator to switch the light from zero to maximum output in half f/stop increments.

Kino Flo, 10848 Cantara St., Sun Valley, CA 91352; 818-767-6528; fax 818-767-7517
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Automated Betacam videotape recycling and rejuvenation
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• Pro Line 7100 cart machine with TapeChek Pro Line 4100 Betacam videotape cleaner/evaluator/recycler: a labor-saving computer-operated system that completely automates the routine of recycling tapes; the Pro Line 7100 accommodates one or two TapeChek 4100 cleaner-evaluator-erasers and holds 123 small Betacam cassettes, 82 large cassettes or a combination of both; all tapes for EFP, ENG, LMS and production VTRs can be recycled in one batch; the TapeChek 4100 cleans both sides of the tape surface, removing contaminants that could damage VTR heads and cause dropouts.

RTI, 4700 Chase, Lincolnwood, IL 60646-1689; 800-323-7520 or 847-677-3000; fax 847-677-1311; Email@RTI-US.com
Circle (265) on Free Info Card

Digital video recorders
Fast Forward Video

• Omega series: a range of stand-alone, multifunctional digital video decks that replace the most commonly used broadcast tape decks; the series includes the Omega Deck single-channel digital video recorder, the Omega Double Deck dual-channel version featuring independent and simultaneous record and playback capability and the Omega RAID Deck dual-channel recorder with a built-in RAID (disk array) controller; all three versions deliver the advantages of smooth random access, non-linear editing with the same industry-compatible controls for recording and playback. ■

Fast Forward Video, 18200 W. McDurmott, Irvine, CA 92714; 714-852-8404; fax 714-852-1226
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Choosing an intercom system

Continued from page 52

the next decision is how big and how much will it cost. It's common for an intercom system to mature and evolve (and grow) over time so it's important to invest in a system that is well-supported by the manufacturer and to design with an eye for future needs.

A distributed crosspoint system is intrinsically infinite in size, though limited in the number of available circuits. A centralized crosspoint system is limited to the physical frame size, but has virtually unlimited circuits. The frame size is defined by the number of ports that the circuitry can support within one frame. Frame sizes range from 50 to 200 ports with larger numbers available by tying multiple frames together.

It is rare that a system will fit every situation without some attention from engineering. The best system is one that will meet 100% of the requirements 90% of the time without engineering having to modify or change it. That last 10% of events that require engineering to modify or change the system are typically the largest and most complicated events. Don't hesitate to use a system resource for a function that it is not typically used for. A willingness to change the system at that level will allow greater versatility while keeping costs down.

Consider the supplier

Some manufacturers only produce one type of architecture while others make all types. Most larger systems, like in a full-size production truck or a large studio/news control room, use a combination of distributed and centralized crosspoint architectures. It's not uncommon for the two-wire and four-wire components to come from different manufacturers because each is considered better at one technology than the other for a specified system.

When discussing your needs with manufacturers, make it clear what your engineering manpower resources are. Try not to get a system that is so sophisticated or complicated that it becomes a maintenance or administration burden.

The first time I purchased a matrix system, I was intimidated by the complexity and versatility. My goal was to emulate the two-wire system that the operators were most familiar with. The factory perceived this desire as a lack of understanding of the system's capabilities. Instead, I saw it as a wise choice. After all, if I wasn't comfortable with the system, the operators and other engineers certainly wouldn't be.

Like the water from a fountain or the elevator I mentioned earlier, intercom systems don't get much notice until they fail. So, when all is said and done, if your new intercom system meets your operators' needs and does so reliably, then you (and the manufacturer) have done your jobs. ■

Andrew McHaddad is a remote audio maintenance engineer with The Nashville Network.

computers & networks

Continued from page 22

The same goes for network segmentation. It's easy to imagine that an accounting group might need to exchange many files with an accounting file server. In the same way, engineering might need to access a common drafting plotter for CAD drawings. How often does accounting need to access the drafting plotter? Probably never. How often does engineering need to access the accounting server? Perhaps only on an occasional basis. This looks like a perfect candidate for a segmented network.

Shown in Figure 1 is a concentrator for accounting and a concentrator for engineering with a bridge connecting the two. The bridge sits in the middle between the two networks listening in to both segments. When it detects a message on one segment of the network that is directed to a computer on the other side of the network, it routes that message across from one segment to the other.

Routers, bridges and switches

Bridges are just one type of device used to segment network traffic. Routers and switches perform the same function, but in different ways. Bridges allow you to segment a network, but they don't do much else. Routers not only allow you to segment your network, but they may also provide some protocol translation. For example, they can allow communications between devices speaking Ethernet and Appletalk. Routers can also provide some limited firewall protection in the case of a datastorm. Datastorms occur when a network interface card (NIC) fails and generates messages on the network continuously. The router senses this failure and doesn't permit the offending packets to pass across to other segments. Although this may not do local users any good, it keeps the datastorm from spreading to other network segments.

Another feature of a router is that, in complex networks, it will send a packet via the shortest route to its destination. When designing large networks, you might want to consider that some network protocols cannot be routed. Therefore, many large companies have standardized on TCP/IP because it's easily routed and also easy to connect to the Internet.

Network switches are different from bridges and routers. Switches are generally used to connect major areas of a network to a backbone. As such, you may see switches used to connect your network to the Internet or you might see them employed to connect one building to another in larger systems. Switches can also be used to provide high-bandwidth connections between segments. This is something broadcast network designers should consider, given the tremendous bandwidth required for video.

With the two parts of this column, you now have enough information to get started building a network. And the best way to learn about networking is to try it. It's a combination of hard core engineering and black art, but that's what makes it fun. ■

Brad Gilmer is director of network operations & technology for Turner Entertainment Networks.

applied technology

Continued from page 93

of this service include the ability to browse, select and distribute video footage to approximately 300 locations nationwide, all in real time, while maintaining high video and audio quality.

New features

Advanced digital technologies for multimedia and the desktop will eventually link multiple video transport methods to create a seamless network for locating and distributing content. AT&T is currently trialing a new video capture and indexing technology that enables broadcasters to capture aired video content dynamically and associate text and audio information with it. In effect, this creates a transcribed storyboard version of the content in real time.

Such a system would allow authorized users to search, browse and download content for production applications or archiving. This advance is based on technology from AT&T Labs that captures transcripts of videos from the closed-caption feature, translates this into HTML format, adds hypertext links and transmits them on the web via high-speed digital services. Additionally, the supporting software enables users to perform content-based sampling by specifying keywords, full-motion video segments or specific frames to be captured.

Increased competition in broadcasting is driving the need for unique, high-quality content, distributed through multiple broadcast, cable and Internet distribution channels with maximum efficiency, reliability and security. While satellite technology will continue to dominate one-to-all distribution applications, digital networking solutions based on fiber-optic transport like ATM and ISDN, coupled with emerging digital broadcast equipment, video compression and storage technologies, will give the broadcast industry unlimited choices and more control over costs, program quality, reliability and content.

High-speed, terrestrial fiber-optic transport services have consistently proven to be a viable option, from real-time live transmission to remote production and editing. As the broadcast industry continues to evolve, new sophisticated networked video applications will proliferate, enabled by industry standards and rapidly falling costs for digital broadcast equipment, workstations, servers and transmission. The result will be an end-to-end digital infrastructure, where digital fiber-based transport will emerge as the preferred method for high-speed video distribution. ■

Jack Gelman is media industries marketing director for AT&T.

Keeping digital transparent

Continued from page 58

fects of multiple recording generations are no longer a factor. Even VTRs that are doing mild compression, say 2:1 or 4:1, can go dozens of generations with no noticeable artifacts.

Also, be aware that there are items in the serial digital stream outside of the actual video data that can impact the handling of the video information. Many pieces of equipment, such as video switchers, strip off timing signals. In digital component video, there are no sync pulses anymore; instead there are timing reference signals (TRSs). There is one at the beginning of the active video for each line called start of active video (SAV) and one at the end of active video called end of active video (EAV). Each is comprised of four words and the first three are unique values, 3FF (all 1s) and two sets of 000. These first two bytes are a big reason some equipment strip these signals off. Once these serial bitstreams are converted to parallel data, which most equipment does for processing, they can play havoc if many video signals arriving in a given box have all their data lines going from all on to all off at once. The fourth word indicates whether the TRS is an EAV or an SAV, which field of the frame you're in, and whether you're in the vertical interval. You want the video to have the same TRS values out of a box that you put in.

Some devices use the video index data on line 14 in the vertical blanking to carry signal legacy information, helping some equipment process the signal (SMPTE RP 186). This data is hard to see on a traditional waveform display, because only the chrominance data is used, and each word represents only one bit of an 89-byte stream. A 0 bit is represented by hex value 200 for the whole word and a 1 by hex value 204. This will show up as a minute change in value in the Cr, Cb signals. This information needs to pass through intact.

Finally, another system can be used to ensure your video data values aren't changing between devices. This is the error detection and handling or EDH (SMPTE RP165). Devices that conform to this recommended standard place active and full-field check words in the horizontal blanking portions of line nine, which is in the vertical blanking. Included are two words that contain active and full-field error flags. These flags indicate whether an error has been discovered at the input of a particular box or upstream from that box. (For more information, see "EDH: Monitoring Networked Video," *BE*, April 1996.)

Because line nine is out of the optional video area described in SMPTE 125M, a box that strips and re-inserts TRS data and doesn't support EDH will remove the history or errors that the EDH datastream contained.

Digital video has proved to be robust. Once placed in a particular domain, it will retain the state and quality it had when it got there. Each successive domain change introduces some, although often small, degradation. These degradations can be kept to a minimum by reducing the number of domain changes a signal must undergoas it makes its way through your facility. ■

Jim Boston is a consulting engineer based on the West Coast.

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B&H PHOTO - VIDEO - PRO AUDIO

QUICK DIAL 74

NRG

POWER VEST SYSTEM

The Power Vest combines the comfort and convenience of a photo-journalist style vest with the power of NRG's highest capacity power belt. Available in two styles, the **Field** model is designed for use in a field production environment, while the **Event** model is for shooting events where style is everything. The Field model is ruggedly constructed from black high density weatherized ballistic nylon and has an open-cut style that makes it comfortable to wear in a variety of climates. Also has a highly adjustable design to fit almost any physical proportion.

- Internal and external pockets for blank tapes and accessories, a clear insert window for a press pass or business card, D-rings for cables and microphones, and an integral padded camera rest on the right shoulder.
- Cleverly concealed inside the vest is your choice of 12-volt 86 watt hour or 13.2-volt 95 watt hour nicad cell packs.
- A control box on the front features dual power outputs (dual cigarette, dual XLR or mixed).
- 7-stage "fuel-guage", charge status indication and auto-reset short/overload protection.

The **Event** model is very simliar to the **Field** except in place of rugged fabric and pockets it features shoulder to sternum black satin tux fabric. Worn under a suit coat, the **Event** model is indistinguishable from a formal dress vest and it still retains interior and low exterior pockets. Both vests include 300-series charger (12 hrs.) and can be used with the optional Intelliquick Fast Charger (2 hrs.)

POWER CAN SERIES

For powering single or multiple pieces of 12v DC equipment for extended periods of time, nothing beats the power and convenience of NRG's Power-Can Series. It integrates an ultra-high capacity, high-discharge-capable UPS type lead acid power cell, a world-wide fast charger, and computer-controlled monitoring system with display—in a single, rugged package. Connect up to four pieces of equipment simultaneously. From a midnight emergency scene to a wedding reception in the park, the Power-Can delivers ample power for extended running time.

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- An optional "Power Dolly" allows the Power-Can to be rolled for easy transport.
- Available in 18, 28 and 40 amp versions, each Power-Can has either four cigarette lighter connectors, four 4-pin XLR connectors or two of each.

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The BSG-50 provides an economical means for generating the most common RS-170A video timing signals used to operate various video switchers, effects generators, TBCs, VCRs, cameras and video edit controllers.

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SAG-50 -	**Safe Area, Convergence Pattern and Oscilloscope Line Trigger and Generator**

QUICK DIAL 72

GLIDECAM INDUSTRIES

V-16 AND V-20
Professional Camera Stabilization Systems

The GLIDECAM V-16 and V-20 Camera Stabilization Systems allow you to walk, run, go up and down stairs, shoot from moving vehicles and travel over uneven terrain without any camera instability or shake. Designed primarily for professional video and 16mm motion picture cameras, the Glidecam V-16 stabilizes cameras weighing from 10 to 20 pounds and the V-20 from 15 to 26 pounds. They are both perfect for shooting the type of ultra-smooth tracking shots that take your audience's and client's breath away – instantly adding high production value to every scene. With either of the "V" series stabilizers you'll be able to offer the type of professional shooting techniques that were previously available only to clients with full budgets. Whether you are shooting commercials, industrials, documentaries, music videos, news, or full length motion pictures, the Glidecam "V" series will take you where few others have traveled.

The Glidecam Support Vest

The lightweight and comfortable Support Vest can be adjusted to fit a wide range of operators. High endurance, closed cell, EVA foam padding and integral T6 aluminum alloy create a vest which can hold and evenly distribute the weight of the Glidecam V-16 and V-20 msystem across the operator's shoulders, back, and hips. For safety, quick release, high impact buckles allow the vest to be removed quickly.

The Three Axis Gimble

A free floating, precision Gimble incorporating Integrally Shielded Bearings creates the super-smooth and pivotal connections between the front end of the Dyna-Elastic Arm and the Camera Mounting Assembly. The Three Axis Gimble provides the operator with finger tip control over fluid tilting, panning and rolling. A locking mechanism allows the Gimble to be placed at varying positions on the Central Support Post. Moving the Gimble effectively adjusts the Systems Center of Gravity. The upper portion of the Sled's central support post includes guide markings. These markings allow for accurate gimble positioning.

The Dyna-Elastic Arm

The Exoskeletal, Dyna-Elastic Support Arm is designed to counteract the weight of the combined camera and Camera Mounting Assembly by employing high carbon alloy springs. The arm may be boomed up and down, as well as pivoted in and out, and side to side. It is the combined booming and pivoting action of the arm which creates the shock absorption necessary for ultra-smooth camera movement and mobility. The spring force is field adjustable to allow for varying camera weights. For safety, a Dual-Spring design is employed to reduce spring failure damage.

QUICK DIAL 74

lowel

ViP Video Lighting System

Designed for video, ViP systems provide 55 to 500 watt capabilities, powered by AC or DC. Mount one on-camera, on-stand, or hand hold it. Some ViPs feature adjustable beam angles. All are light weight and convention cooled.

V-light

Efficient enough to light a small room yet small enough to fit in a large pocket, the V-light provides a broad key light, back light or fill light (with umbrella or gel)

- Extreme wide-angle multi-use halogen source
- Mounts on stand, clamps, boom, wall, window, door-top
- 500 watt, AC powered (lamps not included)

i-light

Battery powered light provides excellent fill light, eye-light, or high-lights, with good contrast control for news and documentary shooting

- Small and lightweight (18 oz.) for on camera use
- Multi-use 6:1 focusing range with i-100 lamp (lamps not included)
- 55 or 100 watt (12/14 volts DC)
- Includes cig lighter connector or optional 4-pin XLR

Pro-light

Can be used as a low-level key or accent light, fill light (w/diffusion), backlight or background light.

- Multi-use halogen, focusing/tilting controlled with one hand.
- 125 or 250 watt AC, 100 watt 12 volt, or 200 watt 30 volt DC
- Optional cigarette, 4-pin and 5-pin XLR connectors
- Lamps not included.

Tota-Light

Provides a base or bounce light, backlight, or background light. Use it with an umbrella or gel frame with a diffusion kit. It is an ideal fill light or small soft key or illumination for copy work.

- Multi-use halogen source with 360° no-yoke tilting
- Choice of 300, 500, 650, or 750 watt AC lamps (not included
- Gull-wing reflectors close compactly for storage and travel

Omni-Light

Produces the ideal key or back-light, and with diffusion or an umbrella, it becomes a great soft fill source. With accessories, hand-hold the Omni, camera mount it, or choose from a wide variety of mounting systems.

- Multi-use halogen source provides a non-crossover beam
- Choice of optional quick-change Super-Spot Reflector for exceptionally long throws at all voltages
- Choice of lamps: 420 or 500 watt 120v AC, 650 watt 220/240v AC, 250 watt 30 volt DC, 100 watt 12 volt DC (lamps not included)

DP System

Only 3.9 pounds the DP Light offers a very powerful key, backlight, or background light with or without diffusion. When used with its umbrella or diffusion it provides a soft key, fill, or side light. It includes a #1 reflector for an 8:1 focusing range and a large cool-operating hand grip and knobs

- Multi-use halogen source with 170° no-yoke tilting
- Choice of 500, 750, or 1000 watts 120 volts; 650 or 1000 watts 220/240 volts (Lamps not included).

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anton bauer

Logic Series DIGITAL Gold Mount Batteries

The Logic Series DIGITAL batteries are acknowledged to be the most advanced in the rechargeable battery industry. In addition to the comprehensive sensors integral to all Logic Series batteries, each DIGITAL battery has a built-in microprocessor that communicates directly with Anton/Bauer InterActive chargers, creating significant new benchmarks for reliability, performance, and life. They also complete the communications network between battery, charger and camera. With the network in place, DIGITAL batteries deliver the feature most requested by cameramen: a reliable and accurate indication of remaining battery power.

DIGITAL PRO PACS

The ultimate professional video battery and recommended for all applications. The premium heavy duty Digital Pro Pac cell is designed to deliver long life and high performance even under high current loads and adverse conditions. It's size and weight creates perfect shoulder balance with all camcorders.

- **DIGITAL PRO PAC 14 LOGIC SERIES NICAD BATTERY**
  14.4v 60 Watt Hours. 5 1/8 lbs. Run time: 2 hours @ 27 watts, 3 hrs. @ 18 watts
- **DIGITAL PRO PAC 13 LOGIC SERIES NICAD BATTERY**
  13.2v 55 Watt Hours. 4 3/4 lbs. Run time: 2 hours @ 25 watts, 3 hours @ 17 watts

DIGITAL TRIMPAC

Extremely small and light weight, the Digital Trimpac still has more effective energy than two NP style slide-in batteries. High voltage design and Logic Series technology eliminate the problems that cripple conventional 12 volt side-in type batteries. The professional choice for applications drawing less than 24 watts.

- **DIGITAL TRIMPAC 14 LOGIC SERIES NICAD BATTERY**
  14.4 v 43 Watt Hours. 2 3/4 lbs. Run time: 2 hours @ 20 watts, 3 hours @ 13 watts.

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QUAD 2702/2401
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The lightest (and slimmest) full featured four position chargers ever. They can fast charge four Gold Mount batteries and can be expanded to charge up to eight. They also offer power from any AC main: all in a package the size of a notebook computer and weighing a mere four lbs! The 40 watt 2401 can charge ProPacs in two hours and TrimPacs in one. Add the Diagnostic/ Discharge module and the QUAD 2401 becomes an all purpose power and test system. The 70 watt QUAD 2702 bundles all Power/Charger features in the ultimate professional power system.

Dual 2702/2401
Two-Position Power/Chargers

The DUAL 2701 (70 watt) and 2401 (40 watt) are sleek, rugged and economical two position Power/Chargers that have all the features of InterActive 2000 technology including DC camera output and LCD display. The DUAL 2701 will charge any Gold Mount battery in one hour; the DUAL 2401 charges ProPac batteries in two hours and Trimpacs in one. Their compact, lightweight package design makes them the ultimate travel Power/Chargers. They can also be upgraded with the Diagnostic/Discharge Module and/or with the Expansion Charge Modules to charge up to six batteries of any type.

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QUICK DIAL 71

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By Paul McGoldrick

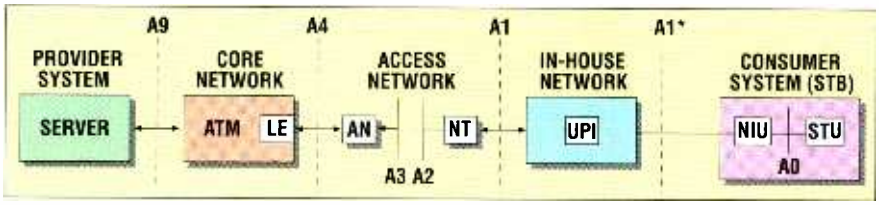
How DAVIC works for us

It was pointed out last month that although DAVIC was a European Commission initiative (for initiative, read m-o-n-e-y) it has considerable international support. In addition to the work of the international members, the standards are also being used in systems designs, such as the specifications being produced for two-way cable operation in the United States by Multi Cable Network System (MCNS) Partners. That work is proceeding considerably faster than the IEEE standards committee in the same arena, and will certainly be the system of choice for the operators because they *are* the members of MCNS.

Paul McGoldrick

This parallels the speed of the DAVIC specifications process work, which can be judged by the fact that the DAVIC 1.0 specification was published in December 1995, DAVIC 1.1 in September 1996 and DAVIC 1.2 was agreed to in December 1996. The next iteration, which will be either DAVIC 1.3 or 2.0, will be released about the time you read this. The later versions do, and will, specify different grades of the tool kit and additional tools, as well as provide compatibility with web browsers and Java. They will also deal with high-definition TV and teleconferencing issues, intellectual property protection and third-party security for electronic commerce.

The lower-layer protocols and the physical interfaces of DAVIC, together with the areas of the abstract system reference model (ASRM), are exceedingly complex and are probably not parts that many will ever explore. We should, however, be familiar with the delivery system architectures and how they tie in with MPEG (both 1 and 2) and ATM protocols.



The figure shows the general structure of a cabled network, such as for telecommunications or television, with the delivery system divided into three networks: the core, the access and the in-house. The defined reference points, as noted last month, determine compliance with DAVIC and the numbering is consistent across architectures. There may, however, be multiple networks in a complete system and each segment must comply. It's assumed that the core network will be ATM with all-digital signals. The interface from the core network to the access network (AN) is at the local exchange (LE) at reference point A4. The interface from the access network to the in-house network (the user-provided interface [UPI]) is reference point A1 at the network termination (NT).

DAVIC 1.0, however, ignores the in-house network and assumes that the consumer set-top box (STB) is connected directly to the network termination (thus the reference A1*.) Later versions will probably adapt this with some specific in-house networks that are LANs. The STB contains two parts: the network interface unit (NIU) and the independent set-top unit (STU). The NIU would contain the RF, demodulator and error-correction sections for the particular system — in terms of frequencies and modulation scheme used — and the STU would contain the transport and control functions. The broadcast (Hertzian or satellite) version of this architecture is inherently one-way (today) and the access network from A4 to A1 would have the transmitter or uplink as the access (AN), and the terrestrial receiver, or satellite receiver, as network termination (RC receiver in DAVIC parlance). The NIU portion of the STB would, of course, match the system used.

It's key to note that while DAVIC assumes that the A4 reference point is fully digital and ATM-based, the access beyond can be ATM or MPEG, with the latter having a mapping function to relate it to ATM. DAVIC 1.0 only considers the system between reference points A1 and A9. The later revisions specify forward to A0 and back to A10 through A11, which are between the content and service provider systems.

If all this isn't confusing enough — and you'll have to do a lot of reading if you need to get up to speed with it — just wait. Next month will be a catch up with some missing "stuff" and a look at a product out of California. ■

Paul McGoldrick is a free-lance writer and consultant based on the West Coast.

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