IPTECHNOLOGY

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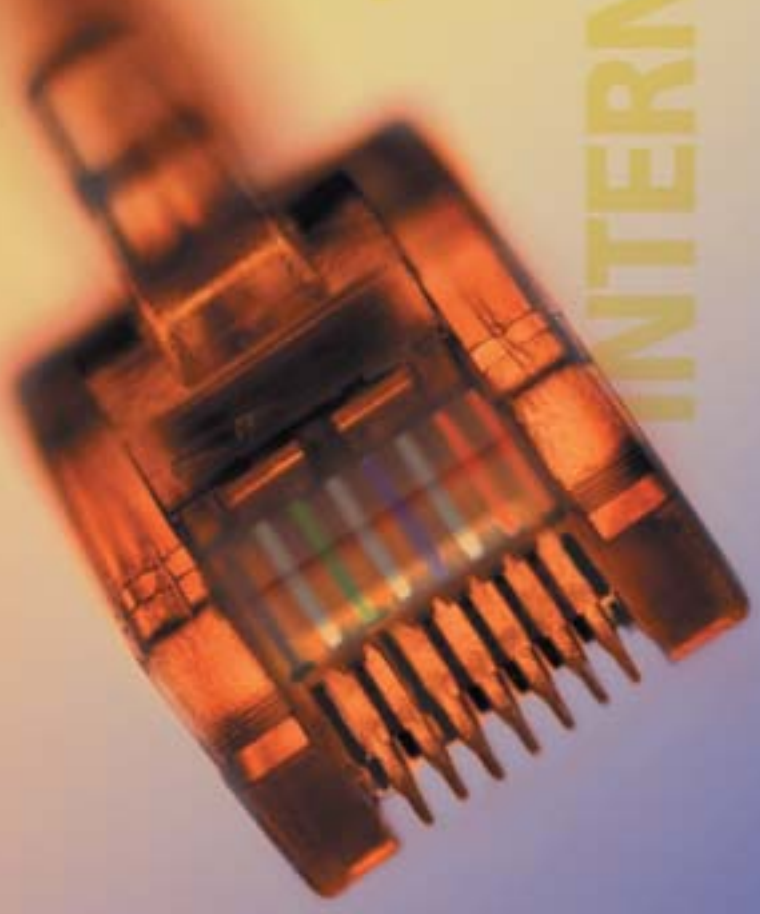
A Special Technology Report

Using Internet Protocol for Audio & Broadcast

An IP Guidebook for Radio



BROADCAST TECHNOLOGY INTERNET PROTOCOL PROGRAM ASSOCIATED DATA

Welcome to IP

This Special Technology Report on Using the Internet Protocol for Audio and Broadcast is intended as an IP guidebook for radio broadcasters, and aims to provide an introduction to the basic concepts and applications of a new technology that should prove to be exceptionally important as it is integrated into radio facilities in the coming years.

The common data platform of IP, already well-established in the computer networking environment, is now beginning to open doors for the cost-effective transfer of digital audio and program-associated data in the professional production space, providing universal connectivity between many different types of products in the broadcast signal chain and throughout the installed base of IP networks.

As a result of IP technology growth, an entirely new way of studio planning, design and system integration is developing. Like most new technologies, there are concerns among industry professionals about its widespread deployment and acceptance. The pages that follow will explore these issues and the many values of current and proposed future usage of IP technology in the broadcast environment.

"As a result of IP technology growth, an entirely new way of studio planning, design and system integration is developing."

The editors of Radio World, recognizing the significance of this developing trend, have devoted this entire publication to the subject of IP Audio. It's written by Skip Pizzi, a Contributing Editor to Radio World, who has built a career on working at the leading edge of audio and broadcast technology. His years of experience in the world of digital media standards, PC software and the Internet make him an eminently qualified guide for your tour of this emerging paradigm for audio distribution.

Skip Pizzi

We hope you find this guidebook a useful and informative presentation of a technology that many feel will have the biggest impact on the radio facility since the introduction of the PC.■

IP Explained

The ABCs of IP

Like the acronym "CD," which has two distinct and equally popular meanings — one from the music world and one from the financial — the term "IP" is ambiguous and necessarily defined by its context. Even then it sometimes is unclear, given the high-tech world's overlapping interest in Intellectual Property and Internet Protocol. In this case, we are concerned with the latter.

In the digital communications environment, a protocol is an agreement on the format of data passed between devices. It is a set of rules defining numerous parameters of the communication, including the data rate(s), the type of error checking used, the data compression format (if any), the method of communicating the end of a message, the form of the acknowledgement that a message has been received, whether the data communication is synchronous or asynchronous, whether the channel is full or half-duplex and so on.

The Internet Protocol specifies these functions as it defines the format of packets of data used on IP networks (called datagrams), and the scheme used for their addressing. The latter function defines the IP address assigned to any device on a network using IP (such as a LAN or the Internet), and is specified as a 32-bit numeric address, written in the form of four decimal-format numbers separated by periods. Each of the four numbers can range from zero to 255, such as 155.80.220.1 or 16.199.1.255.

IP usually is combined with a higher-level protocol called Transmission Control Protocol (TCP), which is used to initiate a connection between devices on the network. While TCP establishes a path from a source to one or more destinations on a network, IP addresses and packages the data that flows on the path.

"Of special interest to broadcasters are IPv6's improvements in multicast functionality and its support for real-time data flow, host mobility and security."

Although the TCP/IP pairing is common, IP data can be used with other transmission protocols such as the User Datagram Protocol (UDP). In contrast to TCP/IP, a UDP/IP approach provides fewer

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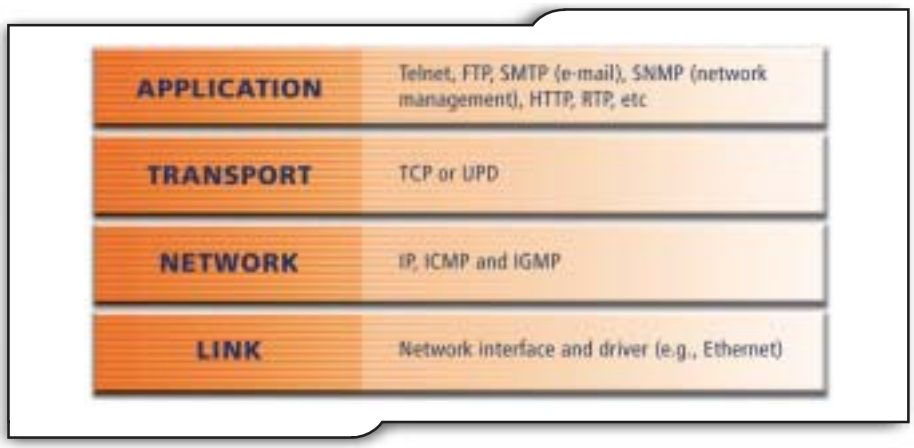

In contrast to the familiar OSI model that divides the network stack into seven layers, the IP approach defines only four, as shown on the left. At right are examples of typical protocols or functions used in each layer. (ICMP = Internet Control Message Protocol; IGMP = Internet Group Management Protocol)

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error recovery services, but offers a more-direct way to send and receive data packets. It is most often used for broadcasting a message over an IP network. When streaming media is the application, some services use the Real-Time Transport Protocol (RTP) on top of UDP.

THE FUTURE

The current version of IP is called IPv4. The successor system, now beginning deployment, is called IPv6. The core set of IPv6 protocols became an Internet Engineering Task Force draft standard in August 1998. (The IETF is the technical standards body for the Internet.)

"The current version of IP is called IPv4. The successor system, now beginning deployment, is called IPv6."

It may be hard to believe, but IPv4 has been in use for nearly 20 years. Although it has served remarkably well over that period (if six months is an "Internet decade," IPv4 has lasted four Internet centuries!), it is showing signs of aging. Like the telephone system, its success and popularity have forced it to grow beyond initial design expectations. The most fundamental problem with IPv4 is the limitation of its addressing scheme. As more and more devices connect to the Internet, a shortage of IPv4 addresses is occurring.

IPv6 will allow more unique addresses in a hierarchical fashion, providing substantially improved scalability for the Internet. This will become increasingly important with the expected growth in mobile devices and the use of the Internet for entertainment content distribution to multiple devices in a user's domain.

The new system also improves routing and network auto-configuration. IPv6 is designed to coexist and interoperate with IPv4, allowing a long and gradual transition period, which has begun. This evolutionary design is a fundamental premise of IPv6, not an afterthought.

IPv6 also envisions more multimedia usage of the Internet. Of special interest to broadcasters are IPv6's improvements in multicast functionality, along with its support for real-time data flow, host mobility and end-to-end security. Broadcast customers will enjoy IPv6's "plug-and-play" installation of local network devices and easy selection of service from multiple ISPs.

As useful as IP is today for broadcasters, it will only get better as the migration to IPv6 continues.■

IP Audio in the Radio Facility

In the beginning there was analog, and it was good. Then came digital audio, and it was better (after a little tweaking).

Next followed data compression, and it was, well, controversial, yet enabling. Now comes the next stage, IP audio distribution. It is widely considered a significant move forward. Here's why.

A close-up of the Radio Systems StudioHub rear panel shows how the multiple RJ-45 connectors are interfaced to the rack frame.

HOW WE GOT HERE

When digital audio first came to radio, it lived on CDs and digital audio tape formats. Specialized digital audio workstations based on computers of various sorts followed, but today the nearly universal common platform for the production and playback of digital audio is the PC.

The PC was not natively an audio production device but became so through the addition of a peripheral device known as the *sound card*. This hardware converts either analog audio inputs or digital audio interfaces of various formats (S/PDIF, AES3, ADAT, optical, etc.) into data that the PC's internal architecture can ingest and process via audio workstation and/or radio automation software.

When these applications were called upon to play back the audio, the sound card was used to reverse the process and create an audio signal. The inputs and outputs of the PC's sound cards were treated like any other audio source or destination in the facility, and routed via audio circuits and routing switchers to their appropriate locations in the audio chain.

This is how most computer-based audio systems have functioned at radio stations for several years.

The quality of the audio largely is dictated by the quality of the sound cards, which vary. The cost of these cards also varies accordingly. Because so many computers are used in a typical radio station, the cost of outfitting them with high-quality sound cards can be significant.

The PCs used in these systems almost always are connected to a local-area network of the client/server variety via Ethernet connections. Over the last several years, the bandwidth of these LANs has increased from 10 Mbps to 100 Mbps to 1,000 Mbps (the latter being today's state-of-the-art, the so-called Gigabit Ethernet systems).

Earlier daisy-chained coax systems (10Base2) have given way to star-configured copper (typically Category 5 twisted-pair wiring) or fiber. Ethernet-based IP networks have gone from being a scheme for

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WCBS in New York has installed a Radio Systems StudioHub system, which includes an RJ-45 patch panel for manual switching. Each RJ-45 connector carries a balanced, bidirectional stereo pair. Gray switches in the center row of each rack control normaling between the upper and lower rows.

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signal transport that was regarded warily by audio pros to a highly favored approach.

These LANs are used for the transport of all sorts of computer data. At radio stations this often includes audio files, although generally in the form of file transfers of completed, stored programs between PC hard drives.

"The IP Audio network can be extended from LAN to WAN applications among facilities around the city, region or world."

In addition, the growth of online media applications has given rise to systems specializing in streaming and the file-transfer of audio in the TCP/IP data format used on the Internet.

All of these processes have created an environment that allows for the substantial streamlining of computer-based digital audio in the broadcast facility and a move to the next level: real-time signal routing using IP networks.

LEVERAGING BENEFITS

Putting these elements together provides a favorable arrangement of technologies for today's radio studios.

Given the maturity of current-generation PCs and networks, much of the discrete and traditional circuit-switched approaches used in radio now can be replaced by a more modern, packet-switched interface style without sacrificing quality, reliability or user friendliness.

In this brave new world, audio still typically makes its initial entrance into the computer environment through a sound card; but once in that "PC domain," it now can stay there much longer as it courses through the radio station's regular processes.

Instead of coming back out of each PC used in the broadcast facility as an audio signal of some type — analog, AES3, S/PDIF, MPEG Layer II, etc. — and being routed through mixing consoles, processors, routing switchers and other storage devices in that form, the data can be transported through these chains in IP format via LAN-type connections.

Alternatively, new terminal devices can eliminate the need for a PC and sound card at any audio I/O point on the IP network. These small, inexpensive units look and act like modems, converting one or more sets of analog or digital audio input(s) and/or output(s), on XLR or other typical audio connector(s), to IP Audio on Ethernet via an RJ-45 connector.

Today's computer hardware and LANs — and an increasing amount of professional digital audio and broadcast equipment — now allow this without compromise to the robust, real-time processes that radio facilities demand.

The Belden DataTwist CAT-6 cable

Moreover, they can accomplish this at a substantially lower cost than the dedicated devices traditionally used for these processes. Just as broadcasters harnessed the considerable processing power and economies of scale of the PC for audio storage, production and automation, now the same kind of value can be applied to the end-to-end signal path in the radio station.

Remember that the PC once was frowned upon by production experts as inappropriate and inadequate for their needs, but it went on to become the primary platform for the radio production and automation industry, thanks to improvements made possible by high sales volume (which, in turn, was spurred on by lower costs).

The same metamorphosis is taking place for Ethernet-based IP networks. Earlier assessments that such a topology could never be used for professional media distribution are being replaced by a solid interest in developing these systems to great advantage in that space, including their use in streaming live audio.

"Users can employ the connectivity that already exists in a private corporate environment, or readily available systems in the public switched environment."

The greatest savings come in the wiring and routing systems of the station.

Instead of requiring specialized analog audio or AES3 crosspoint switchers, signal destinations are simply given unique IP addresses, and audio files or real-time signals are routed as packets on the audio LAN. Signal routing and switching can be managed by relatively inexpensive Ethernet routers or hubs. Ethernet switches allow each link to own its entire theoretical bandwidth, and full-duplex operation is now routine. System expansion also is simple and cheap.

Intermediate processing and other station devices also can do without expensive audio I/Os and ADCs/DACs stages, using an Ethernet port instead. A single RJ-45 jack can replace many XLR connectors on these devices, further reducing the physical size and cost of the hardware as well.

Using IP data for audio transport also allows users to employ the connectivity that already exists in a private corporate environment, or readily available systems in the public switched environment. This can provide lower cost alternatives to dedicated audio circuits, or allow connectivity where dedicated paths cannot be provided.

Another advantage of IP that may become

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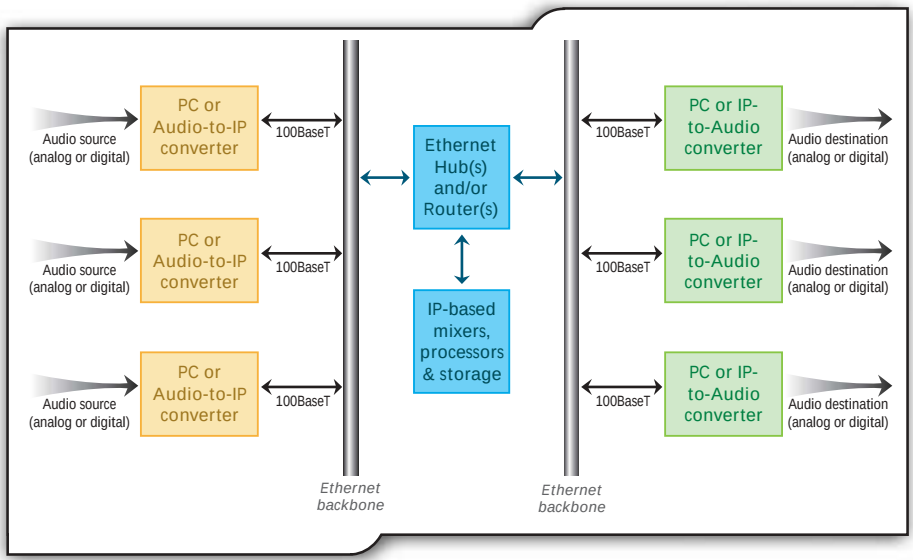

Conceptual block diagram of an IP Audio system for radio

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more important over time is its inherent ability to mix various media types in a synchronous manner on the same link. An example of this could be the integration of program audio streams with visual auxiliary data envisioned for future digital radio transmission, or for advanced Web services.

These applications need not be constrained to the physical facility.

"Much of the discrete and traditional circuit-switched approaches used in radio can now be replaced by a more modern, packet-switched interface style."

The IP Audio network can be extended from LAN to WAN (wide-area network) applications among facilities around the city, region or world. Products taking this approach are beginning to hit the market, and all indications point to this becoming a mainstream trend in the radio studio audio environment soon.

Adapters that take program audio and convert it to/from IP packets for transmission already are available. These can be used in local or global contexts, across any kind of link supporting IP transport. This implies that their application can range far beyond the studio environment to interfacility links using the public Internet, virtual private networks, ATM or Frame Relay connections, packet switched networks or even DSL and cable modem systems.

This provides extensive flexibility and cost-effectiveness in setting up permanent or temporary point-to-point or point-to-multipoint, multichannel STLs or remote backhaul systems using IP transport for audio signals.

CHALLENGES, COMPARISONS

One of the early criticisms leveled against IP for professional use was that it was a packet-switched system not well-suited for robust, continuous, synchronous connections at constant bit rates required in a radio environment.

Moreover, IP networks often are "best-effort" systems, meaning that there is no guarantee of continuity or specified error rate, nor is there any quality-of-service (QoS) functionality that would allow tradeoffs between payload capacity and robustness, as offered on some other digital paths and networks. The dropouts, delay or impaired audio fidelity that would result were considered unacceptable in earlier times.

Various coding techniques were developed to manage these issues. Some used redundant coding, in which data was transmitted multiple times. This reduced the effective payload bandwidth available, but added significant reliability. Other systems took a nonredundant approach, in which sophisticated receive-end processing was used to compensate for lost bits. These were the basis for the first streaming audio systems developed in the mid-1990s.

More recently, QoS support has emerged in the IP world; the Resource Reservation Protocol (RSVP) is a prime example. This work has occurred primarily in the telephony space, where service robustness is highly valued, as in the broadcast world. In fact, much of the funding and development of the advances in IP now trickling into the pro audio environment has come from telecom.

As a result of these advances, and the far more localized scope of application, IP-based systems intended for professional broadcast use today need not exhibit any of the artifacts typically ascribed to streaming audio on the public Internet, where high latency and signal losses or impairments remain common.

"It is expected that the technology eventually will become the dominant mode of audio transport in broadcast facilities."

A typical studio facility's IP network running on a 100BaseT LAN will not exhibit lost or significantly delayed packets. Buffers don't have to be excessively large, so throughput delay will be low. Because bandwidth is plentiful, there also is no requirement for data compression across the network, further reducing the potential for delay and maintaining audio quality. A well-designed Ethernet audio transmission system can support multiple, bidirectional, uncompressed audio channels on a single physical link with latency below 10ms.

Note that an Ethernet LAN can be used for such purposes *without* employing IP by simply packetizing audio data into raw Ethernet frames. This approach uses less bandwidth because the bits required for IP headers would not be necessary.

Formats like Cobranet have taken the raw Ethernet route, while other systems like VoIP — Voice over Internet Protocol, currently being deployed in the telecom industry and elsewhere — use IP headers and thereby have the advantage of being able to pass through existing IP equipment and networks.

The extra overhead bits required to enable this are becoming cheaper all the time, and appear to be worth the tradeoff in professional audio and broadcast facility applications because they enable the use of plentiful, off-the-shelf hardware, and the ability to travel on the Internet and many other similar applications.

The AudioScience ASI6114 Digital Audio Adapter Card is used for broadcast/IP applications.

ULTIMATE APPLICATIONS

Just as any new and highly touted technology appears rosy from a distance but shows some warts upon closer inspection, IP Audio distribution has its strengths and weaknesses.

While it is expected that the technology eventually will become the dominant mode of audio transport in broadcast facilities, radio stations will still need to support traditional audio systems, at least over a transitional period of several years. Therefore, today's studio equipment will be challenged to manage both IP Audio via Ethernet as well as traditional audio signals, and ideally do so in a manner that operates seamlessly across these domains.

The power and advantage of IP Audio broadly deployed in the radio space presents a scenario in which content can flow in nearly unlimited fashion, and at substantially lower cost and higher quality than that of earlier processes. The change is profound and worthwhile. ■

The Neutrik EtherCon connector series provides a secure latching system — a feature not found on other RJ-45 receptacles.

What's Next for IP?

The current level of development in radio stations toward IP Audio over Ethernet for primary, real-time audio distribution looks like it may be the vanguard of a trend that will take hold and become universally adopted in short order.

Like the CD format in the 1980s, the new technology may hit a few potholes on its road toward acceptance, and the trip may be uphill in some more traditional circles; but it appears likely to succeed eventually.

A number of manufacturers have incorporated this technology into their products to significant advantage for their customers (see Vendor Guide, p. 14). As a result, these companies probably have the best view on where development of this technology is headed.

For example, Steve Church, president of Telos Systems, is bullish on IP Audio's prospects.

AES3, the current standard for professional digital audio interconnection, is "looking ready for retirement," he said. "It was designed in the dark ages before PCs and data networks were everywhere."

The Telos Zephyr Xstream includes Ethernet for HTTP remote control and IP Audio connections.

He pointed to some of that format's shortcomings: "It only has a two-channel, unidirectional capability. It can pass data only in a primitive and slow fashion. It usually uses soldered-on and bulky XLR connectors. It cannot leverage components from the high-volume computer network world."

Weighing this against the alternatives, he concluded, "Ethernet is better on every count."

Dan Braverman, president of Radio Systems, agrees — not surprisingly; his company has been one of the first and foremost backers of IP Audio for radio facility infrastructure.

"I think that the heavy dose of IP in every broadcast facility is rushing this technology on us all," he said.

Braverman feels a sense of urgency in this transition: "Digital routers and consoles, digital delivery systems, ISDN phone interfaces, codecs, TCP/IP-based remote control and even the GM's PC are forcing all of us to learn, confront and integrate this technology. In other words, we can't ignore it.

The biggest challenge we face with the new technology is keeping personnel trained and capable of using the new features. — Bob Cauthen, SCMS

"So, out of necessity, we will learn to use it. Hopefully, the new technology will bring efficiency and improved quality to our facilities as well."

Bob Cauthen, president of SCMS feels that the platforms used for these implementations will be critical to their success.

"Stations need to go to Windows 2000, which has proven to be much better for management of the system with passwords, protections from hackers or disgruntled employees, and it almost never crashes."

He acknowledges that new systems bring new training requirements.

"The biggest challenge we face with the new technology is keeping personnel trained and capable of using the new features."

Church feels it's high time for such retooling.

"The radio broadcast industry is ready for a new way to interconnect studio components," he said. He advises that the path forward is not always along the direction initially intended, and that broadcasters must remain open to new ideas along the way.

"We have moved decisively to digital for audio storage/retrieval and are now going rapidly to digital for mixing, routing and transmission. But what has not been so evident is that this will take place in the context of computer networking technology from the telecom world, fueled by its transition from circuit-switched to packet-based systems and the growth of audio transmission over IP networks."

Church thinks this is an appropriate tack for radio to take. "Radio is a small industry, and we usually are led to our technologies by developments in computing and telephony. That's why developments in those fields are significant to our future."

He said that, although IP has taken its deepest roots in the computer world, the telephony environment is embracing it heavily. As an example, he cites AT&T's announcement that it will begin to transition its networks away from its former pride-and-joy 5ESS switches to IP transport and call routing.

He adds, "It is interesting that AT&T was one of the co-inventors of ATM, but apparently will not use it for their next network phase."

He mentioned other leading manufacturers that are moving accordingly: "Cisco has been giving high-profile demonstrations for a few years of their routers running high-quality IP Audio and video alongside data traffic. VoIP telephony has moved from the experimental phase, with 3Com, Nortel, Avaya, Siemens and most of the other telecom gear heavyweights offering and promoting real IP-based products now."

COORDINATING EFFORTS

As the IP Audio revolution moves into the radio environment, some manufacturers feel that a coordinated, radio-specific approach should be taken. For example, Church says that IP Audio over Ethernet can help stem the tide of multiplying formats in the radio station.

"Most radio facilities have at least four networks in place: an Ethernet for the computers, a proprietary PBX for the office phones, dedicated on-air telephone system wiring and traditional audio wiring. The last is the least modern and most difficult to install and maintain, with its thick multiconductor wires, punch blocks, soldered-on plugs from the '50s and ad-hoc mixture of digital and analog in both pro and consumer forms. Ethernet gets us past all this."

With all the advantages they bring, IP-based systems are also exposed to new threats and vulnerabilities. SCMS's Central Regional Sales Manager Bernie O'Brien thinks the biggest problem stations face in this area are hackers and viruses.

"Stations should always use corporate virus subscriptions that automatically update, since most others are not updated properly or regularly," he recom-

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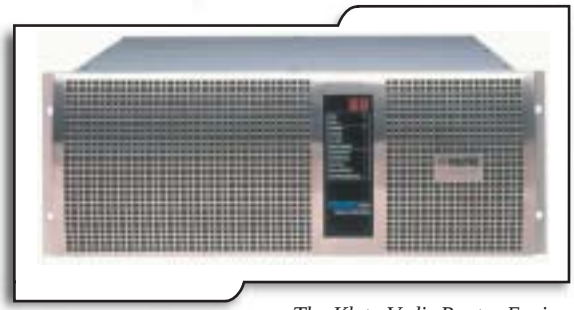
mends. O'Brien also notes that, like any computer-based system, IP Audio environments will exhibit lower tolerance than traditional systems to variation in mains current.

"Extensive surge protection and UPS systems need to be installed," he said. Finally, O'Brien points out the need for properly optimized maintenance and troubleshooting tools at any facility utilizing these new systems.

"The tools to troubleshoot an IP system are much more expensive than earlier audio formats. You either have to purchase that technology or have service contracts with someone who has it."



The Klotz Vadis Router Engine

READY FOR PRIME TIME?

Some industry vets question the value of an IP-based approach to audio transport, or feel that the technology is not yet mature enough for deployment. According to Chris Crump, Director of Sales and Marketing for Klotz Digital America, "There are some problems with the current iteration of Internet Protocol that limit the reliability of the medium." Crump believes that the real value of this approach will not take hold until there is broader deployment of IPv6 and related, next-generation systems. "It will probably require the very expensive and extensive rollout of the much-talked-about "Internet II" and a fully-fibered network infrastructure to really make this a viable medium for large-scale content delivery," says Crump.

He also notes that, while most manufacturers are moving beyond AES3 for digital audio routing within the studio, some prefer a proprietary approach instead of a fully IP-based solution today. These manufacturers are likely to offer full, end-to-end systems so they can provide a complete package, while others have chosen to use an optimized IP-based solution.

Crump says that Klotz remains open to the idea of using an IP approach for inter-facility audio distribution, noting that, "We'd be interested to see if there is truly a need for secure media transfer utilizing Internet technology."

Meanwhile, Bill Gould, the Broadcast Products Manager for Intraplex Products at Harris Broadcast Communications, thinks that answer is already known. He feels that IP Audio transport provides added flexibility and cost-effectiveness to broadcasters today, using existing LAN/WAN infrastructures, DSL or cable modems. "These facilities exist many times and in many places where dedicated copper does not," says Gould. "Using managed packet-switched networks like ATM, Frame Relay and corporate intranets, and even the Internet, will dramatically cut inter-facility communications costs," he adds.

Gould also thinks the continuing deployment of IPv6 and other service improvements make future prospects bright for this technology. "Rapid improvements in the quality of service in packet-switched networks will make them increasingly desirable for professional audio applications," he says. He expects particular interest in the short run from station groups who have (or have plans to) install robust inter-facility 10/100Base-T networks.

Longer-term, Gould is optimistic in his forecast for IP Audio distribution.

"Imagine the station of the future with all consoles, storage devices and even audio processing and transmitters sitting on a LAN with integrated audio distribution and distributed control over a single CAT-5 wire," he muses.

The Harris Intralink-IP IP Streaming Multiplexer

HYBRID PATHS

Some manufacturers are taking a step-by-step approach to IP Audio.

Mike Uhl, director of sales for Sierra Automated Systems, thinks that movement in this direction, at whatever pace feels right, is inevitable.

The RIOLink (top) from SAS provides remote I/O connectivity for the 32KD Digital Audio Network (bottom) via CAT-5 or fiber optic cabling.

"Taking advantage of computer-based technology is a sensible macroeconomic solution. Utilizing affordable technology for professional purposes is the way to go, if it can be done without sacrificing quality," he said.

To this end, SAS uses IP for control, while keeping program audio in the analog or AES3 environments.

"Using IP for control allows the router to talk to other devices like digital consoles, and this provides a seamless and welcome integration of functions for the operator."

SAS plans more in this direction, with a current project developing control panels that can interconnect to the router via the regular station LAN.

There are some problems with the current iteration of Internet Protocol that limit the reliability of the medium. – Chris Crump, Klotz Digital

While some companies do not yet transport program audio via IP, they have adopted the multiplexed digital approach over CAT-5 cable, using RJ-45 connectors, so a single cable type can be used for all digital signals. Cost savings on installation labor for such a system can be substantial.

For example, on one such system, a single RJ-45-terminated CAT-5 line can replace up to 96 individually shielded twisted-pair lines.

Uhl does the math and concludes, "That's almost 300 wires to deal with at each end, terminating in separate connectors or punching down onto blocks. Even if you have to pull new CAT-5 and fit on a couple of RJ-45 connectors, which would you rather install?"

This scaled, proprietary approach does have a downside. Although several manufacturers use CAT-5 cables with RJ-45 connectors, divergent signal formats and wiring conventions are used. This has motivated

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Dan Braverman of Radio Systems to call for standardization in this area.

"This is an opportunity for broadcast manufacturers to adopt pin-out, level and protocol interface standards," he said. Braverman advocates industry standarization. "Broadcast manufacturers need to cooperate now to implement a much higher level of compatibility for IP. Our clients would be much better served if we communicated at least as much as we compete."

Manufacturers also are allowing a wide range of possibilities so broadcasters can decide for themselves when and how to implement these new technologies. Philippe Generali, president of RCS, is a major supporter of the use of IP-based systems for many radio applications. One advantage he cites as a prime example is increased flexibility for off-site voice tracking.

"Talent can now interact with a radio station's automation system from great distances to be on the air, thanks to IP configurations," said Generali, whose firm has patented its application for voice tracking via the Internet.

He also thinks IP can play a major and growing role in administrative functions.

"Last year we relied on IP as the foundation for our new Selector Enterprise [music scheduling software] for radio groups who want to allow a cooperative database sharing of song audio and data codes. Today, entire music scheduling databases can be exchanged using IP, including both data and audio."

Comparing "spins" on three stations using RCS Selector Enterprise IP technology for cooperative data and audio sharing

Generali's comments mirror much of the industry's hopes for the ultimate incarnation of the technology at the radio station. The advantages are myriad, the downsides dwindling and the conversion costs relatively low. It is likely that this paradigm shift will happen quickly and quietly, but have no less of an impact than the conversion from traditional analog to digital audio and PC-based production had on the industry.

IP Audio distribution is clearly the next logical step in the digital conversion of radio. Like many successful conversions in the past, it has all the ingredients for rapid adoption: It provides clear and immediate benefits (including reduced cost, so return on investment is easily and quickly demonstrated), it employs well-established and highly favored technology and it leverages already deployed hardware and systems. Within a very few years, the radio industry will likely look back on traditional audio distribution techniques and consider them as quaint as the diamond stylus. ■

VENDOR GUIDE

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