7 Better Phones; Quality Sound

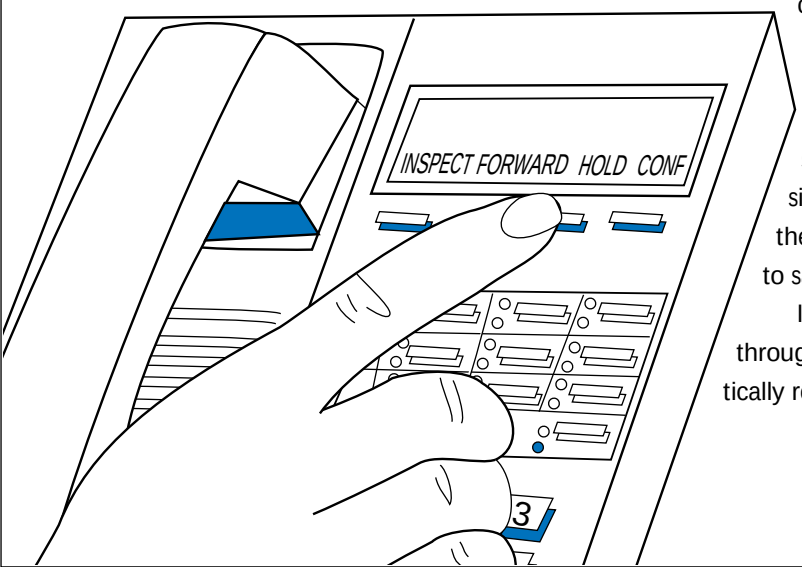
Often lost in the excitement of high-speed data transmission, multiple channels on the same line, and unique full-time packet connections is another simple fact: ISDN also offers better, more responsive, and much more sophisticated voice telephone services. ISDN is, in fact, the telephone service of the future.

It also offers the digital connections to make high-speed, high-quality transfer of sound an economic reality.

Dialed digital ISDN connections offer a broad range of advanced features and capabilities:

- *Clear, quiet digital connections.* Digital lines are so quiet that several telephone carriers have seriously considered generating artificial "white noise" when calls are put on hold so callers will know they're still connected.
- *Much faster connections.* From the last digit dialed to the first ring often takes less than a second, even for long distance calls.
- *Call intelligence.* The ISDN D channel carries information about where the call is coming from, and the type of transmission being received (voice, data or other).
- *Multiple devices.* Up to eight devices (telephones, PCs, faxes and more) can be attached to and use the same line.
- *Two conversations at once.* Two voice conversations (or a conversation and a facsimile or data call) can travel through a single copper twisted-pair wire at the same time. Both calls could also take place while the D channel was being used for packet transmission of data.
- *Multiple telephone numbers.* Not only can each device have its own telephone number, but any device can have multiple appearances of the *same* number, as well as up to 64 other unique numbers. A single phone in a busy office, for example, could be properly answered, by name, for many individuals.

Softkeys.
The softkeys of an ISDN telephone give quick access to a range of important features such as hold, call forwarding and three-way conferencing. An inspect button reveals even more features.



What these many capabilities give an ISDN-based system is an enormous responsiveness to almost any need, and the equally significant potential to save money.

In a number of controlled tests throughout the country, ISDN dramatically reduced the number of lines

and telephones needed, simplified wiring, and produced quieter calls, faster connections and much higher data speeds as well. One corporate office building of 580 people reported that ISDN reduced telephone and telecommunications operating costs by more than a million dollars a year – or about $1,725 per employee per year.

Better Call Handling

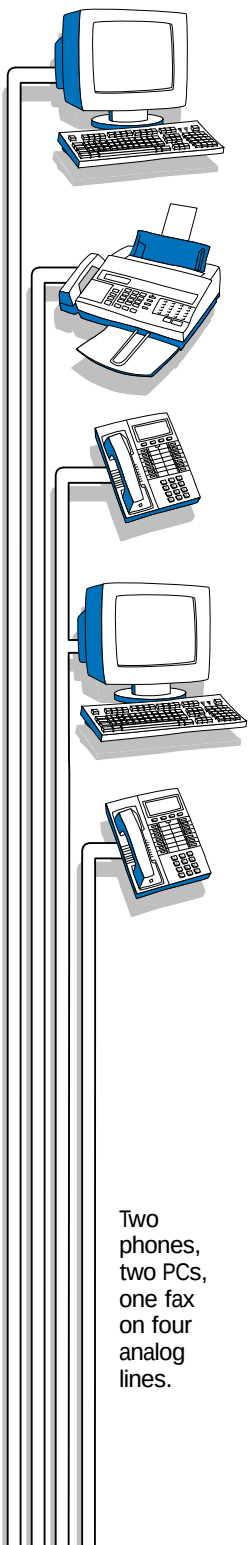
ISDN also offers better call handling – that is, the ability to control, route and manage phone calls. Virtually all ISDN telephones have liquid-crystal displays (LCDs) linked to the D channel.

The result: useful telephone functions are offered as simple softkey options under the LCD screen, rather than buried in a complex system of dialing codes. Some of the universally available functions include hold, call transfer to another number, and three-way conferencing.

A broad range of additional features are also becoming available, depending on the type of switch that serves a location, and the functionality available in that switch. For ISDN Centrex users, many of these features are available now for calls within the same switch. Features include:

- *Call Forwarding, Busy.* Forwards calls when the called number is busy or unanswered.
- *Call Forwarding, Variable.* Incoming calls can be forwarded at the central office switch (which means quickly and transparently) to off-site locations, car and mobile phones.
- *Directed Call Pickup.* Calls *from* specific numbers or extensions can be automatically forwarded to another number.
- *Call Pickup.* Lets calls be answered from another phone.

Some simple math in a typical office. *The typical small analog office (right) compared to the same office with ISDN (far right).*



Two phones, two PCs, one fax on four analog lines.

PC-Aided Call Handling

The next step in using ISDN for voice is to link the D channel not directly to phones, but to a PC or similar desktop system equipped with one of today's ISDN call handling software packages. The PC reads and displays the calls received for an attendant, and either automatically responds to the call, or displays options on the computer screen.

These systems can operate in a busy message center, for example, or can help a small to mid-size group better access and use the many office systems – telephones, fax machines, voice and image mail box systems, PCs, LAN servers, printers, modems and more – at their command.

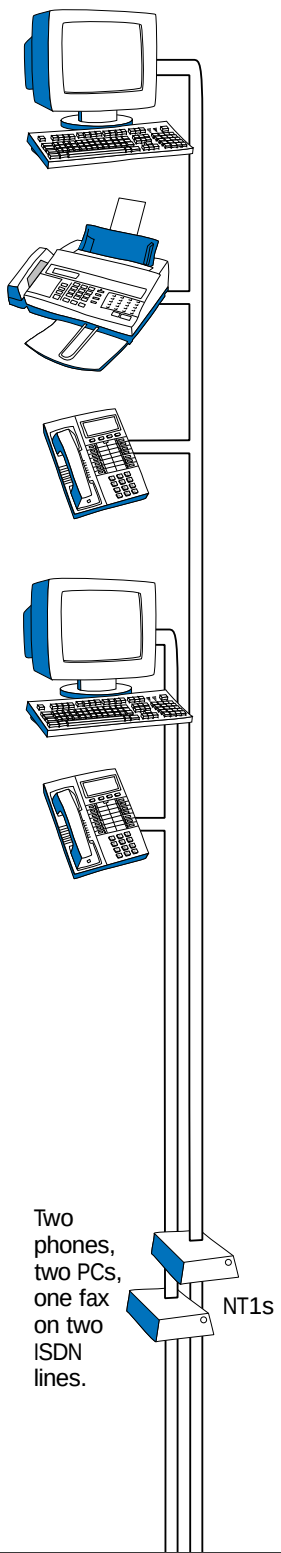
Using mouse clicks on a screen, an attendant or user can handle a full range of voice, data, fax and other calls. In a busy call center, the advantages are many:

- *Visually displayed call intelligence.* The system reads the incoming Call ID, and displays the caller's telephone number and name when available. *Even when the called phone is in use*, this data can be received. An attendant can connect or redirect a call as appropriate.
- *Automatic routing.* The system also knows what kind of call is being sent, and automatically routes fax calls, for instance, to an appropriate fax machine.

> We can take today's office phone, with all those features you can't figure out, put a screen on it and make it do what we want. It can even do video conferencing.
>
> William Gates, Chairman
> Microsoft Corporation

- *Call status displays.* Each active call is displayed. Calls on hold for more than a set time turn to red or flash to let the attendant offer assistance.
- *Screen-based call handling.* A single attendant can typically handle up to 60 calls at a time, compared to a fraction of that number with traditional systems. Messages require no more than a mouse click and a brief typed entry, since both the calling and called number are automatically logged.
- *Comprehensive call records.* A computer-stored record of all calls and messages helps in tracking calls, measuring usage, and calling back those who hang up while on hold.

Most of these call handling systems are designed to run on standard PCs. In a smaller office, they can be simply another application running on a normal desktop system.



Two phones, two PCs, one fax on two ISDN lines.

NT1s

A call handling system.
Calls are visually displayed and can be connected, forwarded, transferred and more with the click of a mouse.

CALL CENTERS FOR SALES AND SERVICE

The most advanced capability of ISDN to control and manage calls is in the typical sales or service center. For not only can incoming data from the D channel shape the way calls are answered and handled, but D-channel signals from the call center can, in fact, control much of the functionality of the public telephone network itself.

Today, almost everything we buy can be purchased by phone – from airline tickets and hotel reservations to computers and televisions; from stocks and bonds to shirts and socks. These and hundreds of other products and services are offered through telephone agents who greet customers, discuss options, and take orders on the spot.

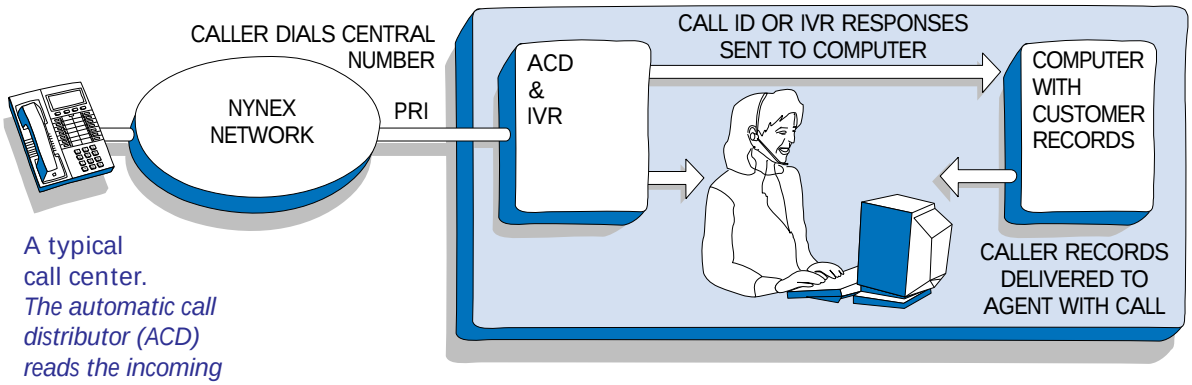
And sales are only the beginning. Companies in hundreds of fields – computer and automobile makers, power and water utilities, food and toy companies – all maintain call-in product and technical service centers to answer questions, solve billing or service problems, and help users and technicians maintain and repair installed equipment.

Automatic Call Distributors, and More

Virtually all of these call centers use the power of the telephone with some sort of system that answers incoming calls, plays an appropriate message, offers the caller a series of options, queues each call and forwards it intelligently to the next appropriate agent. Generically, these systems are known as *automatic call distributors* (ACDs), and today more and more of them are incorporating the exceptional responsiveness and control offered by ISDN.

Almost always, call center systems include a computer that contains appropriate sales, service or product records. ISDN opens the path to simple and almost seamless integration of this data into the call-center system. It offers:

- *Information about the caller.* The D channel carries complete Call ID information for an incoming call, which can be sent directly to the computer to access the caller's record or other information – and deliver it automatically to the correct agent's screen. Several ISDN-equipped call centers report that Call ID cuts some 15 to 45 seconds from the typical call. The results: better service, more calls handled by each agent, lower phone bills, happier customers. When the Call ID is not available, the system can also prompt for an account number or similar data.
- *Greatly simplified wiring.* A single ISDN connection can carry voice calls to two separate agents through its two B channels,



A typical call center. *The automatic call distributor (ACD) reads the incoming Call ID – or the integrated voice response (IVR) unit prompts the caller for key data. When an agent is ready, the ACD delivers the call while the D channel tells the computer to deliver the caller's record. The result: better service, shorter calls, happier customers.*

while computer records travel to and from both agents through the D channel.

- *Better call routing.* The power of the D channel also lets the call center system automatically forward calls to virtually any agent in any location, including those working at home.

  The design of these ACD systems varies widely with the size and physical distribution of the call center itself, the maximum number of agents to be served at any given time, and the number of calls to be received.
- *On-site systems* range from small PC systems designed to serve ten to twelve agents to large mainframe systems handling thousands of calls and hundreds of agents.
- *Intellipath-based systems* use a NYNEX central office digital switch equipped for ACD applications. These systems tap the enormous power of today's digital telephone switches and offer exceptional flexibility for future growth.
- *Distributed Call Centers* can literally direct and shape the nation's public switched telephone network through the D channel. In effect, they turn the network itself into a powerful worldwide virtual automatic call optimizer by forwarding calls directly to any agent, in any office, anywhere in the world.

Long Island Lighting Company

The customer service center at *Long Island Lighting Company* is one of the largest in the nation, with more than 200 agents serving customer needs, responding to service problems and outages, answering billing questions.

"We used to have four centers around Long Island for handling service problems ," says Chris Bishop, LILCO's training and contingency administrator, "as well as eleven district offices answering billing and similar questions." The difficulty, he noted, was that during storms and the like, individual centers would be badly overloaded – yet other centers couldn't help out.

The answer was the consolidation of the offices in a central location in Melville. It offers a single number for all of LILCO's customers, better resource scheduling and management and, in general, better service for customers. Agents can now help each other respond to any kind of question from any customer.

LILCO uses a NYNEX Digital ACD Prime system which is an integral part of the AT&T 5ESS switch serving the location. The system offers a host of advantages, says Bishop, including the ability to route calls logically to any agent.

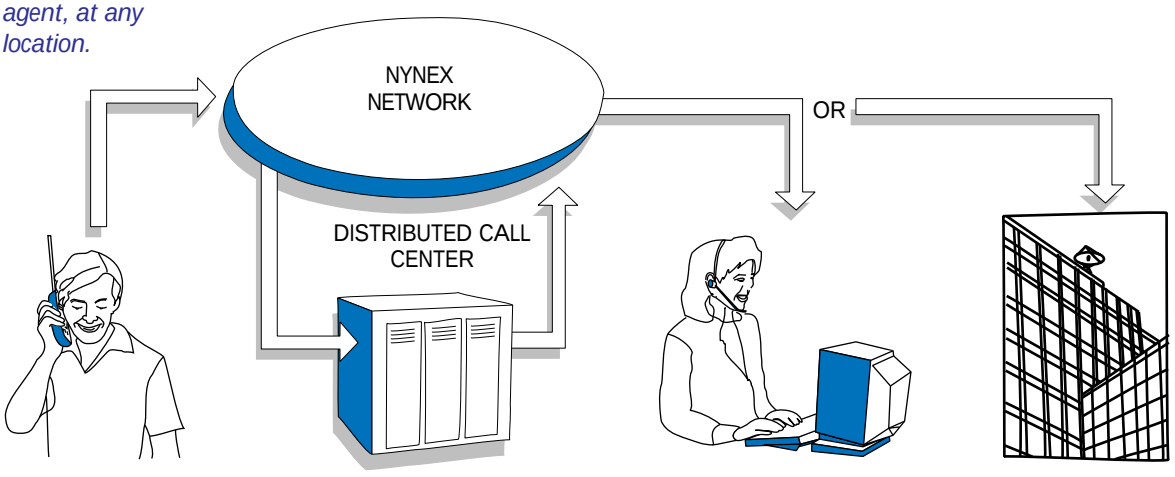
"The system sends calls to the most appropriate agent whenever possible," he notes, "but in busy times it will also route calls to any available agent."

Information from the ISDN D channel also offers a powerful management tool. Supervisors now have the real-time status of every agent displayed on their PC screen. "We can see exactly how many calls are coming in at any time," says Bishop, "and react immediately to almost any need. It takes the weak links out of our system."

The system handles a virtually unlimited number of calls, and gathers much better statistics, including the number of calls, call length, how long people waited, and if any callers hung up during busy times. "The numbers help us plan our staffing for maximum response," he adds.

The Call ID information received through the ISDN D channel also lets calls be handled faster, according to Bishop. "We know where the call is coming from, and often who is calling, so the right records can be quickly called up to the agent's computer screen."

A distributed call center. Using D channel signals, the system "controls" the telephone network, and routes calls logically to any agent, at any location.



A customer calls a central number through the public network, as usual.

The D channel tells the distributed call center system what it knows about the call. The system selects the optimum agent, and tells the network..

The network routes the call to the selected agent . . .

. . . or to the most appropriate telemarketing center.

Visiting Nurse Association of Boston

The *VNA of Boston* is the second largest organization of its kind in the nation, with some 300 registered nurses on staff and more than 1000 other health-care professionals. It handles more than a million in-home visits a year.

"We receive almost 100 calls a day," says Carol O'Leary, the VNA's administrative services manager. "They're from physicians, nurses, hospital discharge planners, a range of social-service agencies and even family members." Calls come into a single central number, she explains, and routing them correctly is a major requirement.

"Calls need to be routed logically to the right one of our four offices throughout the city, and to the right specialty group, such as the special HIV nurses, if necessary." A Teloquent Distributed Call Center responds to the need by linking agents at the four offices into a single virtual office through the ISDN D channel.

"The system lets all of our locations act like one office," says O'Leary, "and also gives us great statistics for planning and scheduling."

BROADCASTING AND SOUND

The growing availability of audio *codecs* (*co*der-*dec*oders that transform audio signals into digital pulses, and vice versa) has opened a wave of high-quality sound transmissions through the end-to-end dialed digital connections of ISDN. Today, high-quality 15KHz (kilohertz) monophonic sound can be sent through a single B channel, with 20KHz stereo transmitted through the two bonded B channels of a BRI.

Worldwide Duets

Two recent albums featuring Frank Sinatra are probably the most celebrated uses of ISDN for the transmission of high-quality sound. For both CDs, Sinatra recorded duets with other leading singers from around the world. At the time the recordings were made in Los Angeles, however, many of the collaborating artists were on location in other cities and even other countries.

In both CDs, titled *Duets* and *Duets II*, almost half of the more than twenty artists featured with Sinatra literally "phoned in" their performances through ISDN connections. Aretha Franklin, for example, sang in Detroit, Tony Bennett called in from New York, Charles Aznavour from London, and Liza Minelli from a studio in Brazil. The recordings were taped "live" in Hollywood. After the live recording, both the voice and instrumental tracks recorded in Los Angeles were transmitted back to the East Coast for final editing and production at Manhattan's *Music Factory*.

Sound transmitted through ISDN has "excellent quality," said Phil Ramone, who produced both albums. "When you hear how wonderful it sounds," he said in an interview, "there is no question about its quality."

The Sinatra recording used *EdNet*, one of the nation's first networks devoted exclusively to sound transmission. EdNet uses private high-speed T1 connections between New York and San Francisco, with other dedicated connections to Los Angeles, Berlin, Paris and Rome. Dialed ISDN connections "open" this network to individual studios.

EdNet and a similar but unaffiliated company, *IDB*, offer proprietary sound transmission networks that currently transfer works between many of the nation's most notable studios. Locations around the world use dialed ISDN to tap into these high-speed backbone networks. Both EdNet and IDB use proprietary encoded transmission equipment, which makes them effectively closed systems.

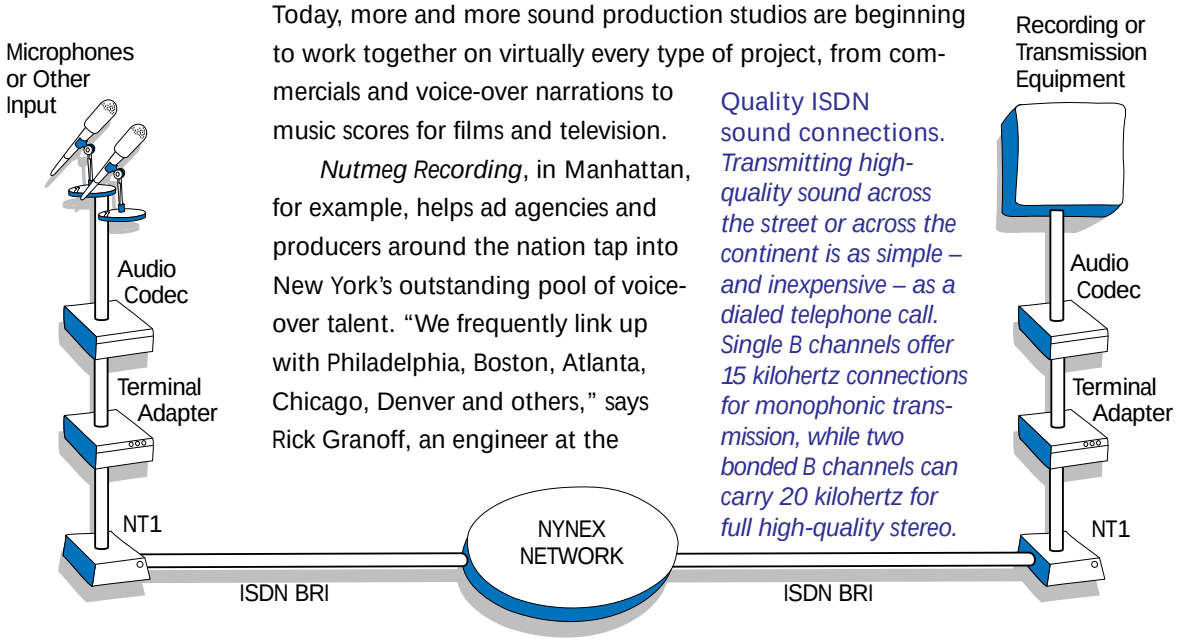
"These proprietary networks are only a beginning," says David Immer of *DIGIFON* in Fairfield, CT. "Because ISDN makes it possible to establish a direct "virtual network" between any two points, anywhere in the world." Immer is a sound engineer and producer, who also helps production studios, radio stations and others around the nation select and set up ISDN audio systems.

"A host of new equipment is responding to this market," he says, "and prices are rapidly coming down." Immer also distributes a worldwide directory of ISDN-capable studios, with the types of codec capabilities each has.

Linking Facilities Together

Today, more and more sound production studios are beginning to work together on virtually every type of project, from commercials and voice-over narrations to music scores for films and television.

Nutmeg Recording, in Manhattan, for example, helps ad agencies and producers around the nation tap into New York's outstanding pool of voice-over talent. "We frequently link up with Philadelphia, Boston, Atlanta, Chicago, Denver and others," says Rick Granoff, an engineer at the



Quality ISDN sound connections. *Transmitting high-quality sound across the street or across the continent is as simple – and inexpensive – as a dialed telephone call. Single B channels offer 15 kilohertz connections for monophonic transmission, while two bonded B channels can carry 20 kilohertz for full high-quality stereo.*

Sound Algorithms Explained

"An algorithm is a set of rules," says David Immer, an expert sound engineer who also helps other studios define needs and install equipment. "It's built into an audio codec and defines how to reduce the size of a digital sound bitstream so that it can be transmitted efficiently."

Sound algorithms are like compression, he explains, but different. "Compression implies that something can be decompressed back to its original form. But bit reduction actually throws information away. The object, of course, is to throw away only that information we don't really need."

Most of the algorithms offered today are based on "psycho-acoustic" models, notes Immer – which means they were tested extensively to determine what sounds best to the human ear. "And each algorithm throws away something different, so it's impossible for one to talk to another."

There are five dominant algorithms being used in today's codecs, he notes. They are:

- *G.722*, the original algorithm, developed by AT&T for mono transmissions through Switched 56 lines. It is widely used for voice-overs, remote feeds and the like.
- *MPEG Layer 2*, perhaps today's most widely used algorithm. It is versatile and scalable, which means it can adapt to the bandwidth actually available for the transmission. It was developed by the German *Institut Fur Rundfunktechnik* and selected by the International Standards Organization as the algorithm of choice for ISDN at bit rates of 192Kbps and up. It is featured in the CGQ2000: Musicam from CCS, and offers up to 12:1 bit reduction.
- *MPEG Layer 3*, used by the Telos Zephyr, is optimized for transmission at low bit rates. It offers 15KHz channels for good fidelity through a single 56Kbps line.
- *Dolby AC 2*, is the high-end system of choice for many major production houses. It is, however, expensive and requires 256Kbps, the equivalent of four bonded B channels. It is one of the algorithms used by EdNet.
- *APT-X*, developed by Audio Processing Technologies in Ireland, requires bandwidths of 192Kbps for each mono channel. It offers, however, minimal delay, or *coding latency*, and easily supports simultaneous live performances in multiple locations. This is the main algorithm used by the IDB network.

Which is best? "They're all good, all different, and all incompatible," says Immer, "but things are getting better fast." Several services now exist, he notes, including both EdNet and IDB, that can link equipment at one site to different equipment at another studio. Using ISDN, both locations merely dial into the service, which then literally "hard-wires" the two together.

studio. "The quality is so good, the talent might as well be standing at a mike in the other city." The firm uses a CGQ2000: Musicam codec, and Motorola ISDN equipment.

While many studios are accessed through EdNet, the studio also uses its ISDN connections to forward finished commercials to DG Systems in San Francisco for redistribution to radio stations worldwide, and for links to other studios around the country. "It works like a charm," notes Nutmeg's Byron Campbell.

Max Music in Miami, FL, adds an international beat by transmitting digital sound files to and from its headquarters in Spain. The company is the largest distributor of recorded dance music in Europe, and both the American and Spanish locations are actively involved in recording and mixing sound tracks.

"ISDN makes it possible and simple to send music back and forth across the ocean," said Mel Carmona, head of the Miami studio. "In effect, the connections let us exchange digital sound files as if we were in the next room, rather than thousands of miles apart." The firm uses Euronis Planet-ISDN systems and *TheLink* software to join Macintosh networks at each location.

Following the Action

Hundreds of radio stations are now using ISDN for the broadcast of sporting events, concerts, political conventions, and other newsworthy happenings. Just a few of the stations using ISDN are:

- *WGBH*, Boston, one of the leading public radio stations in the nation. According to John Voci, operations director for radio, the station uses ISDN for live and taped spoken-word transmissions to National Public Radio, as well as to networks in Canada, Britain and Australia. "We're also initiating an international news program with the BBC," says Voci. "Hosts and commentators on both sides of the Atlantic will often be linked through ISDN connections."

"The connections let us exchange digital sound files as if we were in the next room . ."

- *ESPN Radio*, which offers extensive pre-game and live coverage of major sporting events, including the Super Bowl, NCAA Final Four, World Series and others. According to the network's operations manager, Bob Sagendorf, ISDN is used for live transmissions from many remote sites to ESPN studios in Bristol, CT – as well as for feeds of complete programs to *ABC Radio* in New York.
- *WSYR*, the flagship station covering Syracuse University sports for a network of some 16 affiliates throughout New York. "In the past, our options were to use frequency extenders (to combine three standard phone lines for 5KHz audio signals) or microwave," said Conrad Trautmann, the station's chief engineer. "One option gave us poor quality," he said, "the second was expensive." ISDN has solved both problems.
- At the *1996 Olympic Games* in Atlanta, ISDN capabilities will be installed at every competitive site. While these preparations are focused on scoring, competitor accreditation and other data and security systems, ISDN will also make low-cost, high-quality sound channels available to virtually any broadcaster who needs them.

Worldwide Sound Distribution

Digital Courier International in Vancouver, BC, accepts finished commercials from its subscribers, and forwards them through ISDN connections – with attached scripts, confirmations and traffic instructions – to radio stations and production studios.

"Speeds are very fast," said technical director Pat White of Vancouver's KOKO Productions. "If something has to get to a station in an hour, it's no problem – even if that station is on the other side of the continent."