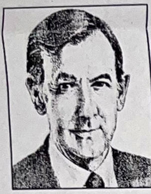
APPLIED INTELLIGENCE

Broadband ISDN: High-Speed Information Highway



JAMES MARTIN

This is the third of a six-part series on Integrated Services Digital Network (ISDN), a communication technology that will have great strategic importance in the future.

In considering the need for broadband services, the available bandwidth under a digital communication system such as ISDN is much greater than with a predominantly analog network. In the current implementation of ISDN, the basic channel available to all users has a bandwidth of 64K bits per second, although bandwidths available with fiber optics are considerably larger.

As copper wires in the telephone network are progressively replaced with fiber-optic cables, bandwidths available to each subscriber will dramatically increase from 64K bps to 150M bps. To the network operator, the increased capacity of a network means that more traffic and greater diversity of services can be put into operation—both of which will improve revenue.

Data Communications

Another aspect of bandwidth and services relates to the increasing demand for computer data communications. Sending data over an analog telephone line requires the use of a modem. With a digital circuit, all the user needs to connect a computer to the telephone network is a standard telephone plug and the appropriate communications hardware and software in the computer.

While data communications still accounts for only a fraction of the total network traffic (voice is, by far, the largest proportion), the demand for data communications is rising rapidly. To fulfill this demand both now and in the future, networks must be available that facilitate rapid growth in data communications at the lowest possible cost. The best way to do this is through the use of digital switching and high-bandwidth transmission networks.

The growing availability of high-bandwidth circuits is having a tremendous impact on users. Corporations that previously used voice-grade analog circuits for computer-to-computer communications were frequently restricted to a communications speed of 1,200 to 9,600 bps. These links were often unreliable and prone to errors because of noise and distortion. As digital circuits became available, line speed immediately increased to 64K bps (equivalent to about 8,000 characters per second).

Thanks to technologies such as fiber optics, it is possible to transmit information at very high bit rates (currently in the region of billions of bits per second). Bit rates of a trillion bits per second will be possible in the near future. At present, most installations of fiber-optic systems in corporate networks operate at speeds between 100M and 565M bps.

While 64K bps is the transmission rate for a standard digital communication circuit, higher-bandwidth circuits are needed to handle traffic as it passes through the network. Using the techniques of Pulse Code Modulation and time-division multiplexing, different multiples of 64K-bps channels are combined to create higher-bandwidth circuits.

In North America, the various multiplexed 64K-bps circuits are known as T carriers. The most common is T-1. This carrier uses paired wires with digital signal repeaters spaced every 6,000 feet and has a capacity of 1.544M bps. Each T-1 carrier has the capacity to transmit 24 separate 64K-bps channels.

Although the T carriers were originally designed to carry traffic within the public network, demand for high-bandwidth circuits from corporations resulted first in T-1 and then T-3 circuits being made available to them to lease as part of their private networks. (In North America, T-3 circuits operate at 44.736M bps.)

Both T-1 and T-3 circuits are used extensively in private networks, interlinking offices and factories across the country, carrying a variety of voice, data and video traffic.

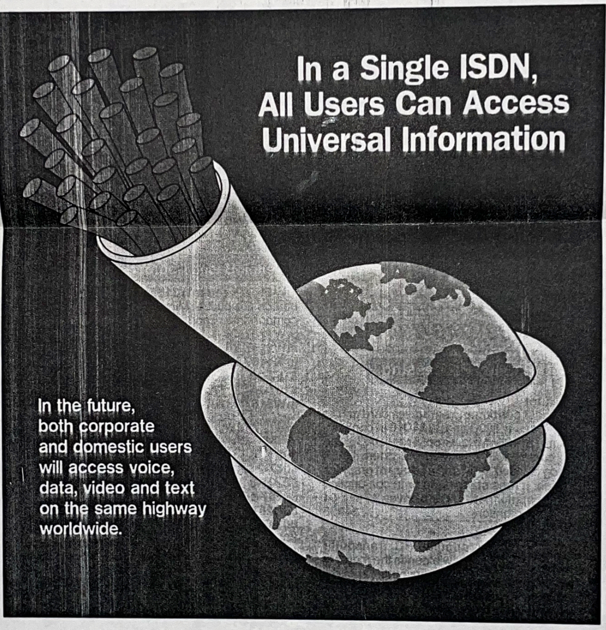
T carriers form the backbone of a digital network. Initially, the very-high-capacity, optical-fiber circuits with a transmission capacity of billions of bits per second are being used on long-distance routes to carry calls between high traffic centers such as the large cities on the east and west coasts of America.

As the cost of optical-fiber technology continues to fall, more of the existing T carriers are being converted to fiber, thus boosting their transmission capacity.

One great advantage of high-capacity fiber-optic transmission systems is that many different channels can be accommodated within a single circuit, and the various channels supported by the circuit can be configured in a wide variety of ways.

The circuit can be configured to carry only voice traffic with, in some cases, many thousands of 64K-bps voice channels operating over a single fiber. Alternatively, the type of traffic could be mixed; that is, some 64K-bps circuits for voice, 1.544M-bps circuits for data, other higher-speed channels for video or television, and so on.

The design constraints of analog networks (which resulted in the development of separate networks for voice, data and telex traffic) do not apply to digital networks. A common information highway can be developed using high-capacity, fiber-optic circuits to carry all types of traffic at speeds from a few bits per second to millions of bits per second.



Maryellen Zawatski

Eventually, a single ISDN network will replace all existing networks, giving users access to a universal "information highway" for all domestic and corporate communications.

The "information highway" is a single common network to which users have access for all voice, data, text and video communications requirements. Eventually, a single ISDN network will replace all existing networks, giving users access to a universal information highway for all domestic and corporate communications.

The concept of a common, single-transmission "pipe" is fundamental to ISDN, as this is the essence of an integrated digital network. As ISDN is constructed at present, the information highway is limited to a transmission speed of 1.544M bps in North America and Japan, and 2.048M bps in Europe, thereby limiting the number of 64K-bps channels available to either 23 or 30.

The Next Generation

The next generation of broadband ISDN will use fiber-optic transmission systems to link users with the network. These fiber-optic networks will provide a huge increase in the amount of bandwidth available to users. It will be common for corporations to have access to circuits operating at speeds from 50M to 500M bps. When circuits such as these are available, the concept of a common digital information highway will be the building block of future networks.

Future broadband ISDN networks operating at speeds in excess of 500M bps will be constructed of multiple numbers of 64K-bps circuits, creating networks that provide bandwidth "on demand."

For example, an ordinary telephone call requires a single 64K-bps circuit. The transfer of a large file (containing, perhaps, a mixture of text, high-resolution graphics and video) requires a much higher bandwidth—perhaps as much as 50M bps. A common information highway can easily accommodate both requirements. Both high- and low-speed data can travel over the same network, leaving it up to the user or the application itself to determine how much bandwidth is required.

One of the most important aspects of ISDN as presently configured is that it sets a precedent for future network development. However, a major problem is its limited bandwidth. The significance of the current implementation is that it has promoted the creation of a base set of standards upon which future broadband networks will be developed.

Next week, we will look at the specific ISDN services and applications that you can expect to be using in the future. ■

The James Martin Productivity Series, an information service updated quarterly, is available through High Productivity Software Inc., of Marblehead, Mass. (800) 242-1240. For information on seminars, please contact (in the United States and Canada) Technology Transfer Institute, 741 10th St., Santa Monica, Calif. 90402 (213) 394-8305. In Europe, contact Savant, 2 New St., Carnforth, Lancs., LA5 9BX United Kingdom (0524) 734 505.