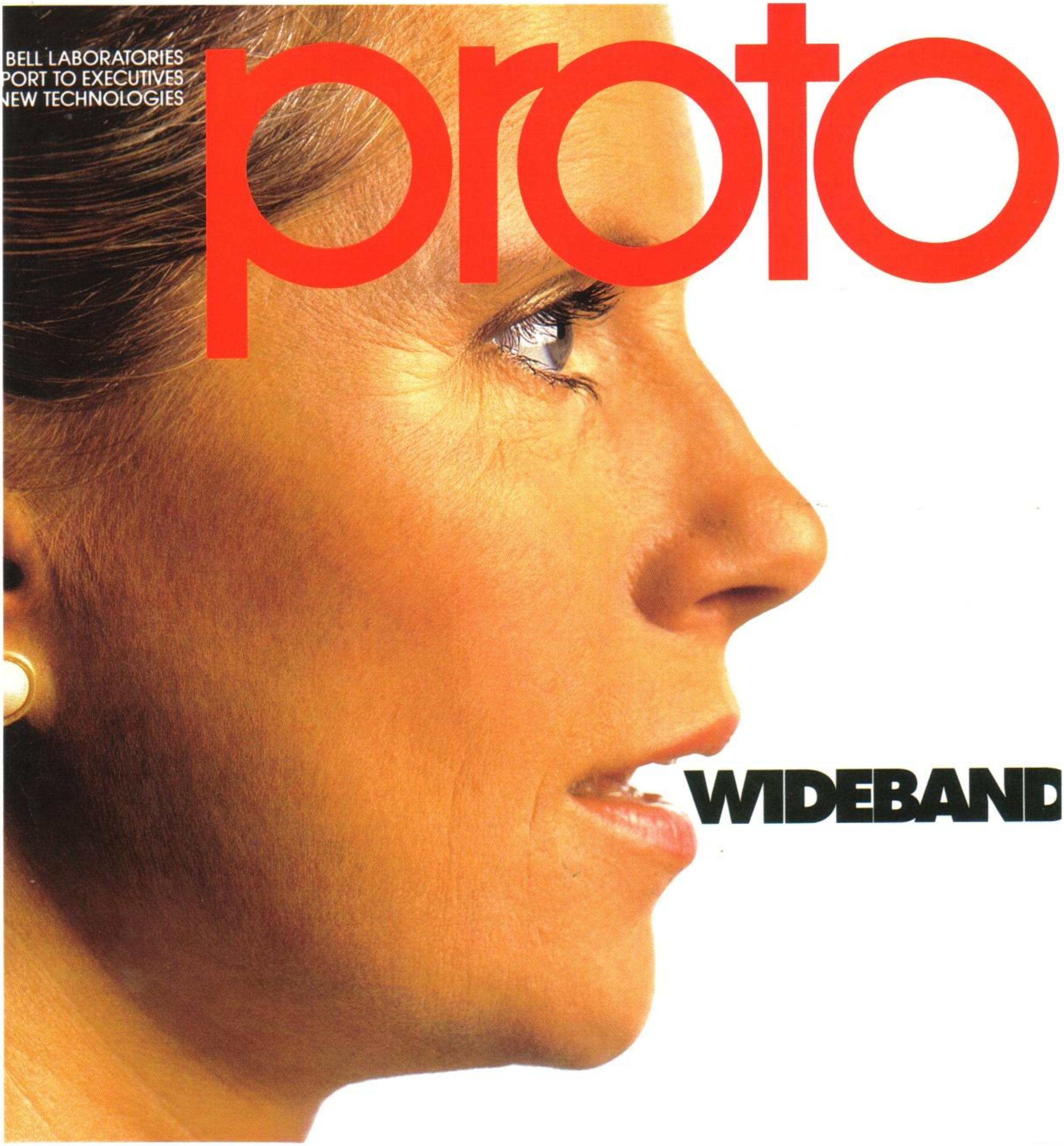
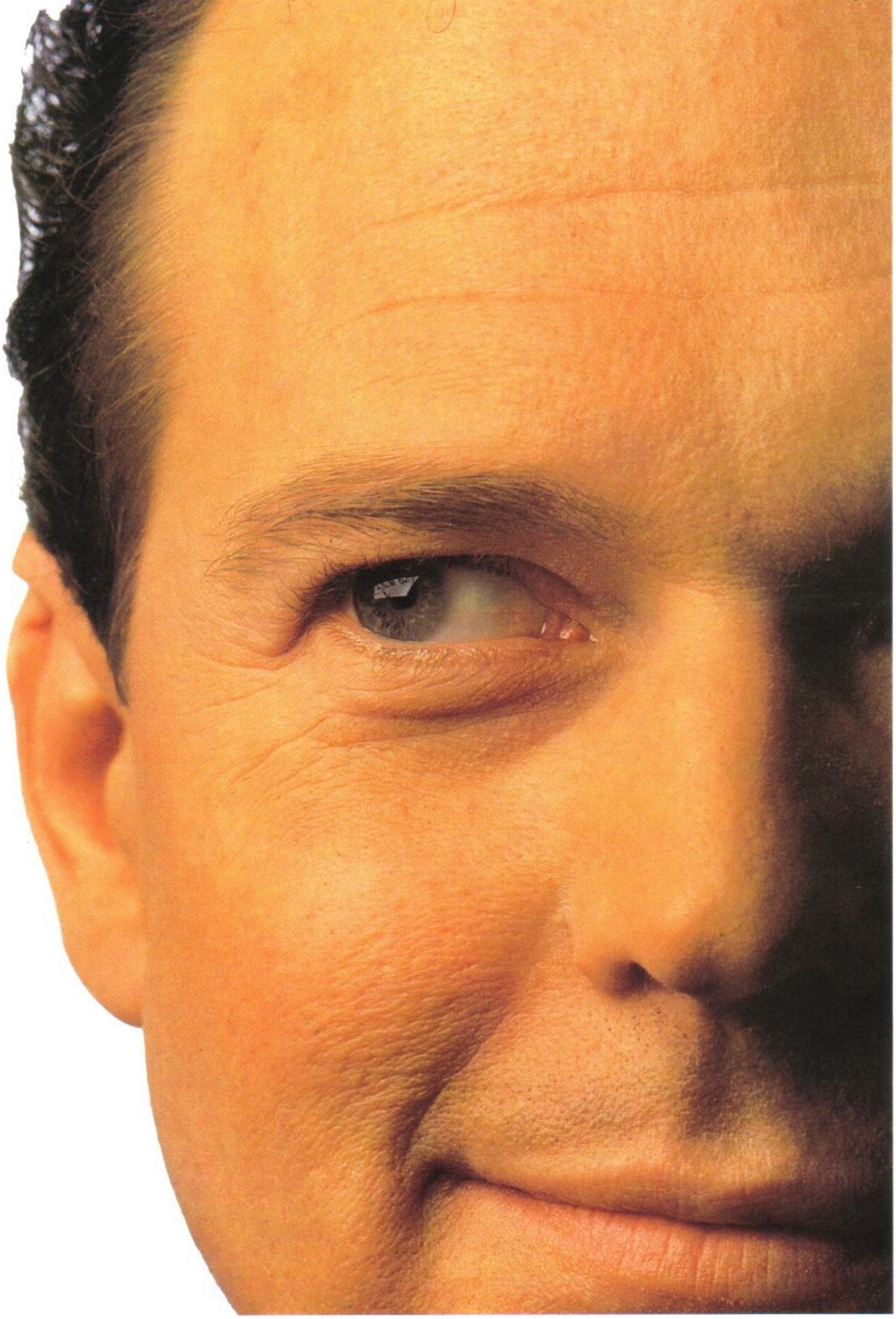
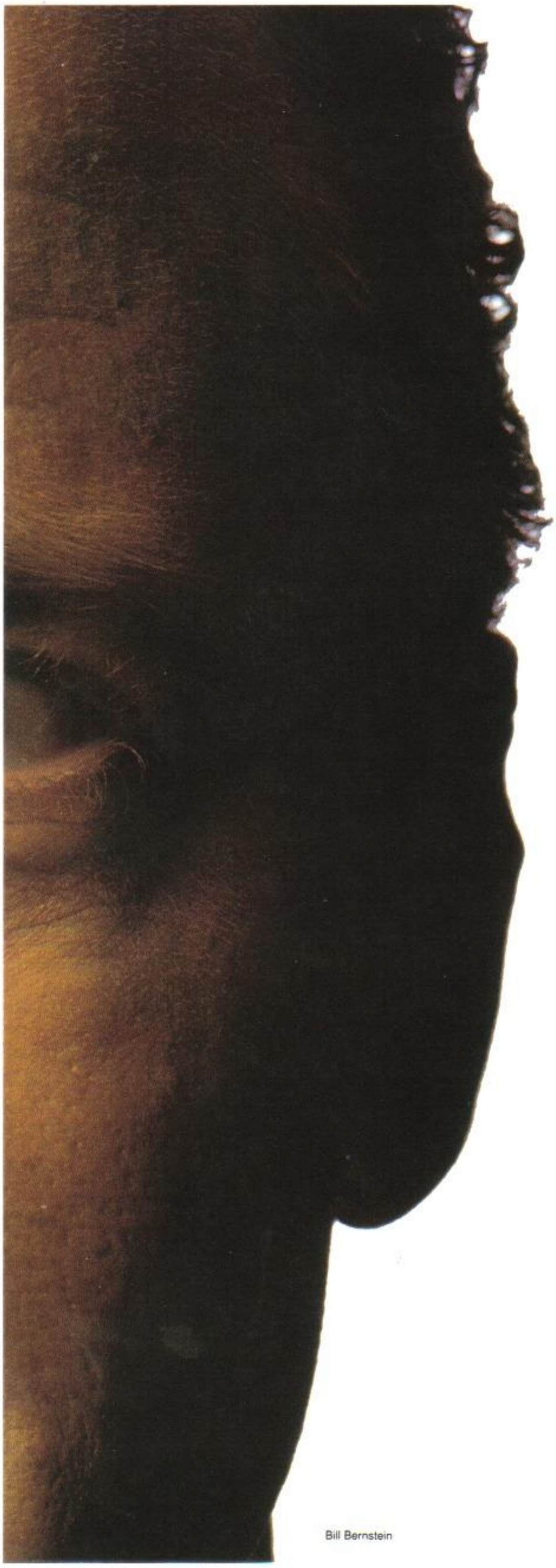

BELL LABORATORIES
PORT TO EXECUTIVES
NEW TECHNOLOGIES
proto
WIDEBAND

PACKET




Bill Bernstein

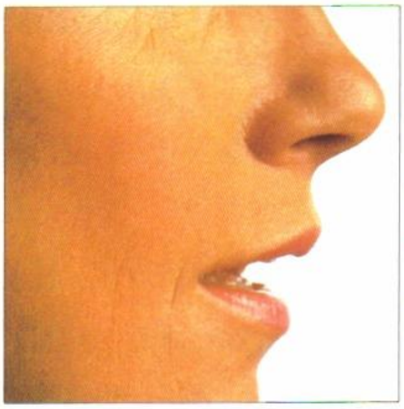
NOW THERE'S A NEW SYSTEM THAT SQUEEZES VOICE, VOICEBAND DATA, AND VIDEO OVER DIGITAL LINES LIKE IT'S NEVER BEEN DONE BEFORE

Voice on a packet network. It never seemed too practical...or plausible. Packet networks were designed for data, which moves sporadically — in fits and starts. Voice travels in a continuous, uninterrupted flow.

Well, sometimes it does. And sometimes it doesn't.

AT&T Bell Laboratories scientists capitalized on the "sometimes it doesn't" in creating wideband packet technology — the first of its kind to accommodate both voice and data, and meet international

BY HOLLY BIGELOW MARTIN



standards/protocols for network transmission.

Just as there are gaps between information when data is sent, there are silent pauses when someone talks on the phone—the ummhs, aahs, uuhs, and moments of thinking when no words are spoken. Eliminate the silence, and more voice, like data, is compressed into the speechless spaces.

The good part: The voice still sounds like voice. The better part: Now telephone companies can fit more voice traffic—their largest revenue source—on the local network along with data.

And there's already an AT&T product available to bring all the benefits of wideband packet technology directly to telephone companies and their customers.

SPEAKING OF WIDEBAND...

Wideband packet technology shrinks the words of your telephone conversation into small bundles that criss-cross the network. Each one is addressed with a particular destination (wherever the other person is located) so it won't get lost as it travels among other conversations and communications. Upon arrival, bundles are "opened" and the entire message is reconstructed—all in the blink of an eye.

But it wasn't always so easy. Or fast. Or efficient. When you take information apart and put it back together, there's obviously some delay. Almost imperceptible when sending data. Quite noticeable when talking to someone on the phone.

How to eliminate the effects of these delays? Bell Labs researchers found a way: Time-stamp all bundles as they leave their source, then realign them—in their proper order—at the receiving end. As the bundles begin to arrive at their destination, play back the message just as it was uttered. Now there are no gaps in transmission. No hollow spaces between words.

Beyond transmitting voice, wideband packet technology offers another considerable advantage over conventional packet technologies: variable packet lengths.

Other packet technologies have fixed packet lengths. The drawback: Information is sent whether or not they're full, so there may be unused capacity. Wideband packet solves that problem with packets of different lengths. For example, a 64 kbps voiceband signal can actually be sent at 32 kbps—in a smaller packet. That way, there's still plenty of room for another voiceband signal to travel along at 32 kbps at the same time.

This is the beauty of wideband packet technology—it opens up the bandwidth, or information-carrying capacity of the network, to let more traffic pass through. In fact, it increases bandwidth over 400 percent beyond what it is today.

WIDEBAND OUT-OF-THE-LAB

So Bell Laboratories researchers proved they could send more information—including voice—over data networks. The next step: Take the technology into the real world and shape a product that puts it to good use.

And the outcome? The AT&T Integrated Access and Cross-Connect System (or IACS). It's a system with the intelligence to identify both voice and voiceband data messages—then decide the most economical way (at what speed or bit rate) to propel them through the network.

The IACS works instantaneously and dynamically (in other words, "in real time") to make these decisions. It sizes up the information and gives it just the bits it needs right when they're needed—a concept known as "bandwidth-on-demand."

Exactly how the IACS works depends on the amount of information coming through the network at a given time. If there's no traffic, there's more bandwidth available to speed a message to its destination. During peak periods, the IACS actually changes the bit rates of incoming messages, opening the way for more and more traffic to pass through.

With voice communication, idle time is stripped out. For example, if a voice packet comes in at 64 kbps, the system may shrink it down to 32 kbps by using a more efficient coding technique, and send it through at a 2-1 compression rate. And compressions up to 5-1 are possible by removing the silent periods between words.

If there's especially heavy congestion (on Mother's Day, for example), then an even higher compression can be achieved by shortening a voice packet now and again to keep traffic moving along. And the IACS makes sure that one voice sample is not over-compressed while another is left intact. So there's no noticeable difference in voice quality.

What's more, wideband packet transport through the IACS is about five times more efficient than circuit alternatives. Anywhere from 96 to 120 circuits now travel a line that would normally carry only 24.

As for voiceband (communication sent via facsimile or modem), the IACS again checks the speed (low, medium, or high?) and again provides the message with the most efficient bit rate available.

With digital data (what packet systems were designed for in the first place), the IACS removes the flags and idle codes. These essentially say "Keep the connection open" or "Keep me logged on" from one PC to another. There's no real activity here but the messages do take up precious space. Now they're simply not sent across the network; rather, they are recreated and played out at the far end. In so doing, more bandwidth is freed up to accommodate the essence of other messages.

The IACS also sends images much the same way as it does digital data. Working with small-screen telephone sets, pictures are taken and sent across the network.

All of these little gaps seem inconsequential when you look at one telephone call, or send a simple message to another PC. But if you were to add them all up, say for example, across a local exchange network, imagine how much additional information fits into that space.

CUSTOMERS ARE TALKING

Voices are already traveling

packet networks in the south—back and forth between Atlanta, Georgia and Birmingham, Alabama; and in the north—from Juneau to Anchorage, Alaska.

Bell South decided to trial the IACS in their corporate network. "We started with voice and voiceband data," reports Larry Corley, one of Bell South's managers responsible for evaluating transmission products, "and no one could tell the difference between packet-voice and circuit-voice." They added digital data in February and are now doing a technical evaluation of the system. The next step is to study additional network applications.

When Bell South installed the IACS, they were looking for more than just a way to add voice to their data networks. "The concept was interesting," Corley says, "but our ultimate goal was to get more traffic over the facilities we've got today.

"Now we can send voice, voiceband data, and video over the same pipeline—without reconfiguring, without separate networks for different kinds of traffic. And that gives us a lot more flexibility in managing our network."

At Alascom's corporate offices, network planners were taking a careful look at voice compression equipment. Their goal was the same as Bell South's: Fit more traffic on existing facilities. But the transmission technology up north's a bit different. The majority of traffic to and within Alaska takes a 48,000 mile trip on satellite circuits.

Late last fall, Alascom began an IACS field trial on their satellite link between Juneau and Anchorage. "We were looking for a way to increase the efficiency of our digital satellite system and use that to replace analog circuits," says transmission planning manager, Ed Calhan. "Now you might think that traffic's not much of an issue in a sparsely-populated state like Alaska. But all it takes is something like the Valdez oil spill to send a location's calling volume through the roof.

"When that happens, there's no choice but to block calls that exceed the equipped capacity of the network. As volume increases, however, the IACS compresses at a higher ratio and provides more usable circuits while we're scrambling to add facilities."

AND BEYOND VOICE?

It would seem only natural to look for new business applications from a technology as promising as wideband packet. And telephone companies will find them in virtual private networks.

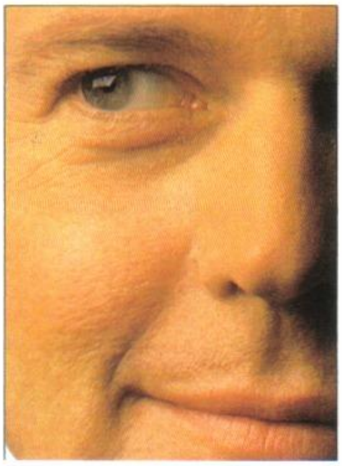
These are networks that exist—in essence, open up—only when information is sent. And that means considerable savings for any business. They pay only for what's used, without paying for full-time operation of a private network.

It's sort of a semi-private, private network. Other businesses use the same facilities at the same time. But all businesses sharing a virtual private network get service—voice, voiceband data, image—whenever they need it.

In fact, a virtual private network may even be used in combination with a private network. A large business, for example, may want to tie in a smaller, more remote location not on the network.

And virtual private networks take advantage of existing operations and management systems. So telephone companies and business customers alike have close to a maintenance-free network.

Virtual private networks may very well prove to be the first in a new generation of bandwidth-on-demand services available through wideband packet technology. That means customers can design something akin to a personal communications network—one that's instantaneously as big, or as small, as it needs to be.



WIDEBAND PACKET TECHNOLOGY SHRINKS THE WORDS OF YOUR TELEPHONE CONVERSATION INTO SMALL BUNDLES THAT CRISS-CROSS THE NETWORK