communications services than could the local communications companies. For all these years, that is where our focus has been -- on the internal customer who works for the utility."

However, competition in the industry has intensified interest in telecommunications and will contribute to "a spurt of big investments in information products by electric utilities during the next several years," he says. "Most of these -- still in the internal area of the utility's operations -- will be in remote meter reading and distribution automation, which are on the verge of significant growth. People have been talking about these applications for years, but haven't done much about them because they have been too expensive. Now, as equipment costs come down, and priorities and operating conditions change, both will become cost-effective in certain areas of the business."

Lit fiber. BG&E also is interested in the external side of telecommunications. The utility has a 223-mi fiberoptic telecommunications superhighway -- a fiber ring -- that serves external business opportunities as well as its internal systems. "On the external side, we are leasing capacity -- 'lit fiber,' rather than dark fiber," he says, observing that about half the highway is on the transmission system in optical ground wire, and the other half is divided up among distribution poles, and underbuilt on transmission lines. "We lease the fiber to companies that want to avoid access charges by the local telephone company for long-distance calls, and contract with large businesses to extend our fiber system onto their premises and connect them to their long-distance carrier, bypassing the local telephone company. They go from their premises, to BG&E, to Metropolitan Fiber Systems (MFS) -- with whom we have a partnership arrangement -- to the carrier. We do business with government systems, and credit-card companies, and are presently courting some banks. Further, we have a partnership with MFS and haul some of their voice and data traffic, too.

"We originally built the backbone system as a large, private, internal network for our own use -- for protective relaying, and for our internal voice and data needs covering electric operations, billing, etc," he says. "We own 31 PBXs at 31 different sites that are linked together by fiber and microwave," Dieter adds.

Networking. BG&E has a "lot of rapidly expanding local-area and wide-area network connectivity," and growth in distributed computer architecture that need "seamless connectivity through our backbone network, to accommodate BG&E applications such as energy management and automated mapping and facilities management [AM/FM]. These are now done by leased telephone lines, but will be switched over to our internal system. We also carry part of our 800-MHz mobile radio traffic on it. All this will place a greater demand on our fiber system," he says.

GHz upset. Besides the fiberoptic highway that it constructed in 1986, BG&E also has a point-to-point analog microwave system it is converting to digital -- with good reason. In 1989, Dieter says he recognized that with the advent of digital personal communications systems (PCS) to compete with analog cellular technology, BG&E would probably lose its reliable 2-GHz frequencies for point-to-point voice and data communications.Reason: The Federal Communications Commission (FCC) indicated that it wanted to put the new high-tech phones on the 2-GHz frequencies, raising the possibility that they would interfere with

utility telecommunications operations.

Digital loop. "Our analog system was 20 years old and running out of gas anyway," says Dieter. "It was pretty well loaded up. So, we had to look at our entire network architecture and figure out where we were going. We decided that what we really needed was a series of digital loops. We developed a scheme with a central loop completely of fiber, and hybrid northern and southern loops constructed of fiber and high-capacity, 135-megabit digital microwave. The three loops are now connected at two sites and form BG&E's backbone network that links its major properties. At the present time, our 800-MHz system is on the old analog point-to-point microwave, but as we convert to the digital system, we are moving [away from] it."

Intruders. According to Jeffrey L. Sheldon, general counsel for the Utilities Telecommunications Council (UTC), FCC granted PCS licenses on the 2-GHz frequency because it was eager to foster new technology. "However," says Sheldon, "FCC has indicated that under no circumstances can there be interference to an electric-utility microwave system. If there is, the PCS licensee would have to pay the utility to move to another frequency band or communications system. When the new licensees come into a utility area to build their systems," he continues, "they will have to do this without causing interference to the utility's microwave system. If they can't do that, then they will have to discuss with the utility how they can move it to a different microwave band, or install fiber optics for them, opening up a whole new realm of possibilities."

Since no PCS licenses are likely to be granted until next fall and FCC is putting together rules on auctioning off the frequencies, "nothing can happen for at least a year," comments Dieter. He reveals that BG&E is now starting, as part of its load-management system, a one-year pilot comparing a two-way, automatic meter-reading radio system and a one-way, N-scan, meter-reading system. "We are also doing some distribution-automation feeder switching," he notes, adding that "If we do vacate the 2-GHz frequency, we'll go to 6 GHz, which isn't much of a problem here in Maryland. It could be in some other areas, though."

Tampa Electric Co's (TECO) Gregg Ehlers, vice president of information and technology engineering, says that his company has already made the switch from 2 to 6 GHz (Fig 2). "We haven't had that much of a problem with six. If there was going to be one, we would definitely experience it before most other utilities. [Tampa has been called the lightning capital of the US.] If we get much above 6 GHz, then we would start having problems."

Nightmare. He observes that "If PCS does show up across the US, it could be provided by as many as seven phone companies in a single city. What's the load on an electric utility's infrastructure if it has to supply pole attachments to seven new producers whose micro cells have to be interconnected? Will it be an opportunity, or a tremendous increase in operational costs, because of lag-time alone. To move a pole takes forever. Coordination will be a nightmare." TECO's proposed solution to this is building a common fiber ring in its service territory and leasing space on it to PCS "and anyone else who needs it for communications services."

Mobile radio. Many utilities, of course, operate their own private mobile communications systems, and, according to a new survey of 36 private and

public utilities, "How Utilities Use Radio," by Buford Goff & Associates Inc, Columbia, SC:

-- Many utilities use more than one radio system, including mobile and portable units. While one system is used for general communications, others are dedicated to special functions -- such as load management, telemetering, alarms, signaling, powerplant operations, and backbone or interconnections. The most important use of radio is for control of emergency operations.

-- Voice radio systems, which are used primarily for work assignments and maintenance orders, are very evenly distributed in the four radio-frequency bands allocated by the FCC: 23% of the 36 utilities in the study use VHF low band (30-75 MHz); 23% use VHF high band (130-175 MHz); 23% use UHF low band (410-470 MHz), and 23% use UHF high band (800 MHz-1 GHz). Some 7% of the respondents use microwave (greater than 1 GHz).

-- The number of mobile units used varies almost linearly with geographic area covered, up to 30,000 mi2. The average mobile density is one for 15 mi2 of coverage.

-- Only one-third of utilities currently carry data on their radio systems -- used mostly for load control.

-- Utility radio systems are highly reliable -- average system reliability is 97%.

-- Excluding customer relations, two-way radio is second only to the telephone as the primary method of utility communications -- 25% use radio as the primary method.

-- Within the next two years, six out of every seven utilities will modify their radio systems to improve communications, reduce costs, or provide better control of their operations. The increased use of mobile data will be the most significant change in the future of utility-based radio. An increase in the use of remote meter reading is also expected.

Buford Goff says it is presently under contract to Consumers Power Co to provide engineering services for the design and implementation of a new 800-MHz trunked radio network for the utility. This project covers the entire lower portion of the state of Michigan. It involves implementation of a mobile data conduit to allow high-speed data transmission to the mobile radio fleet while maintaining voice communications for dispatching. It involves 2500 mobile radios and is estimated to cost $ 22-million.

Another project involved the planning and implementation of a two-phase backbone microwave system for the Allegheny Power System, to carry voice, data, and radio control circuits within three electric operating companies' service areas. Phase I included installation of a microwave loop system consisting of 32 hops of 6-GHz and 2-GHz microwave equipment located throughout Pennsylvania, Maryland, Virginia, and West Virginia. Phase II of the project involved radial extensions off the backbone system encompassing 41 additional sites, which cover the remaining operating companies' service areas. Also included in Phase II are three fiberoptic extensions of the microwave system into generating plants.

Vanilla music. Catastrophic events from ice storms to earthquakes have long demonstrated the need for utilities to own and operate their own internal communications systems and utilities, such as Detroit Edison Co (DE), Columbus Southern Power Co (CSP), and Northeast Utilities (NU), have recently installed cutting-edge communications technologies to automatically give quick fixes on outage locations when customers call in to report them -- and to enhance their customer-service images. "There's nothing that will tarnish the image of a utility faster than a 20-min busy signal followed by two hours of vanilla music when a customer is trying to report a nighttime power outage in frigid weather," comments one industry observer.

Outage analysis. At DE, company officials built a "best-in-class" telecommunications facility to reduce the "busy" signals that commonly greet the thousands of customers trying to report power outages. The utility spent $ 11-million on centralizing telephone operations and purchasing state-of-the-art equipment that could drastically increase the volume of customer calls during regular business hours and in emergency situations. All telephone operations are now centralized in a single suburban location, where a voice-response unit (VRU) operates 24 hours a day and processes trouble calls directly into the utility's computerized outage-analysis system, and then to dispatchers. The system also updates customers on when restoration is expected. Further, the number of telephone trunk lines was increased from 212 to more than 1300 and the number of incoming phone lines from 288 to 1536.

Footprint. CSP also has a new telephone answering system that solves the problem of "peak loads on the telephone lines." CSP spokesmen say it virtually eliminates busy signals and provides fast answers for customers. Developed with Twenty First Century Communications Inc, Columbus, Ohio, the system provides more capability to handle overflow calls during widespread outages, and quickly records and tracks phone calls to give utility dispatchers a "footprint" of the problem areas.

Computer dialers. At NU, dramatic advances have been made in its customer-communications system. According to Tod O. Dixon, NU's vice president for information resources, computer dialers were installed to cut downtime on credit and collections, and 800 numbers are used for all calls not directed to specific company individuals. Further, the customer-service number will soon be tied into Southern New England Telephone Co's introduction of statewide automatic number identification (ISDN). With this new technology, a customer account appears on the customer-service representative's information screen as soon as the rep picks up the phone. Customers do not have to begin the conversation by stating their names and addresses, since the computer has already identified them by their phone number.

NU also is automating outage reports with VRUs that use ISDN to pinpoint the location of customers when they phone the utility from their homes during power outages. This allows customers to report outages without speaking to customer-service representatives. The system also communicates restoration information to customers, along with an estimate of how long power will be out. When fully implemented, the system will allow NU to answer up to 672 calls simultaneously.

With the multiplicity of new applications, however, can arise an unforeseen demand for bandwidth. "NU's demand for bandwidth is growing several times faster than we anticipated," he says. "In fact," he continues, "the bandwidth that

our people are looking for this year is three times greater than we previously had planned for. The big reason for this is our image applications, especially in the customer-service area. We do multiplexing to the point where we have put video [five video-conferencing sites], data, and voice on all the same digital circuits and use frame-relay communications protocol equipment at 23 of our sites to deliver the bits/sec.

"During the next three months, we are going to build a very high-speed asynchronous transfer mode (ATM) network and piggyback everything together on it. ATM runs only on digital circuits, which are virtually error free, so there is very little error correction. This permits us to get a great deal more data through and meet our bandwidth demands. The ATM 'pipe' is a very big and wide communications path, and when it reaches the end unit, it fans out to serve all the end users." Incidentally, he says, "all our sites are linked by fiber, digital microwave, and leased T1 communications lines to ensure more than 100% redundancy in our communications system."

NU is in the process of re-engineering, and telecommunications plays a critical role in it, implies Dixon. "The ability to communicate is inherent in almost every company redesign we think about, and the availability of data as we move more and more into a competitive environment is going to be vital to our survival."

Added value. "A utility's communications system needs to be evaluated on the totality of the services it can provide, and particularly on its ability to enable it to get closer to its customers," comments Paul Spaduzzi, an Atlanta (Ga)-based utility marketing consultant working in interactive telecommunications. "Interactive communications systems allow the utility to provide new services to its customers, and to segment its market."

Adds Dieter: "It is only in the past several years that utilities have recognized that they have a lot of expertise in telecommunications that could be wed to the good relationships they have with their customers. We realized that there is more we could do for and with our customers if we could communicate with them -- not by just sending a bill every month, but by actual two-way communications involving such value-added services as real-time pricing, or appliance diagnoses and controls."

Customer choice. One example of an advanced utility telecommunications project that demonstrates the value of adding interactive information-carrying capability to utility lines, is an Entergy Corp pilot project going on now at 50 residences in Chenal Valley, Ark. Called "Customer Choice 2000" and jointly developed by Entergy Enterprises Inc and First Pacific Networks (FPN), Sunnyvale, Calif, Powerview is a high-speed, real-time, intelligent electronic demand-side management (DSM) system, using standard communications protocols, giving customers greater control over electricity use, and providing a constant, interactive communications link between the utility and its customers. Sponsored by Entergy Enterprises -- the unregulated Entergy subsidiary that owns 9.95% of FPN -- and joined by Sprint Corp, and Honeywell Inc, Minneapolis, Minn, the homes on the Powerview system are linked to the utility through its 700-mi-long fiberoptic installation and its coaxial cable networks, enabling customers to automatically shift electricity consumption away from peak-demand periods. Entergy also uses its "fiber backbone" internally for billing and other communications purposes.

Three networks. The system is made up of three major networks: the home network, the distribution network, and the utility host network (Fig 3). The home network has three primary components: the intelligent utility unit (IUU), an electric meter, and an in-home user interface. The IUU is a communications switch powered by a microprocessor that provides the key communications interface between the home and the utility. The home network also has a user interface and controllers for appliances so customers can preprogram them to respond to utility price signals.

Although Entergy has only 50 homes in its present pilot project, "we have asked regulators for permission to install 35,000 of the units this year and next," says Jack L. King, president and chief operating officer of Entergy Enterprises Inc. "Eventual installation will come to 500,000 in our service territory," he adds.

Hard DSM. Describing the system's genesis, King says that "a few years ago, we were looking for the best verifiable, 'hardened' DSM program we could find, because we had real concerns about some of the DSM activities that were going on around the country. They were what we call 'soft,' because their effectiveness could not be quantified satisfactorily. FPN, we eventually discovered, had telecommunications technologies that showed real promise. We entered into negotiations with them, and jointly modified their technology to accomplish what we wanted to do."

Dark fiber. King says the saving to Entergy from the resulting DSM activities will more than offset the total cost of installing the Powerview telecommunications infrastructure. "It was cheaper to build our communications infrastructure, which is primarily fiber optics, than it was to build new powerplants to satisfy demand. But the real kicker is that you only need about 5% of the system's capability to do all the DSM and other electric-utility operations. So, 95% of our telecommunications infrastructure will be dark fiber -- unused. This means Entergy will be marketing that other 95% to try to optimize the use of the system. We will sell that space to whomever needs communications, ranging from home security and home shopping to telephone service and entertainment."

Footprint. Meanwhile, the 5% Entergy does use will be doing a lot for the utility side of the business, he says. "For example, it makes automated meter reading very easy. It allows itemized billing in which we can identify the footprint [electrical use pattern] of 37 different appliances. It gives us remote on and off capabilities, provides power on and off indicators that let us know -- at the same time as the customer -- when there's an outage, and through data-processing equipment feeding back to us, locates the device that's causing the problem.

"But all of these are side benefits. The real economic drivers are the DSM activities, such as real-time pricing, appliance disconnects, and other optimal smart-home energy controls using power-line carrier, ATM interface devices, and special-purpose 386-processor computers. With this telecommunications system," King continues, "we can communicate with every customer on the system within 10 seconds. In other words, the amount of electrical load that is running out on our system and that powerplant dispatchers have control over will be monitored and updated every 10 seconds."

Video programming. "Our ultimate telecommunications goal is giving our customers the very best real-time demand-side and operational improvements that we can come up with," he says -- "creating customer communications and services that no one else can match, thus greatly enhancing our competitive position. For example, we have the capability of doing video programming to communicate with specific customer segments, and we can do real-time pricing on each individual residential customer -- eventually doing the same with our commercial and industrial customers."

Field of dreams. "When we complete this system," he declares, "it will be an information superhighway for which Entergy has a real need and for which there is already a market. It's not that way with the telephone and cable companies, however. They may be talking about building information superhighways, but they are basing their discussions on a field of dreams -- markets that have not yet developed. What they are saying among themselves is: 'If we build it, they will come.' Entergy can build its superhighway for existing markets and it won't require government subsidies, accelerated depreciation on existing telephone equipment, or rate increases. In fact, it will lower electric rates."

Deep pockets. One utility observer, who says his fiberoptic system is equal in cost to "a third of a 'good-size' fossil-fired powerplant," cautions that "just stringing the fiber costs about $ 30,000 a mile, not counting the electronic end devices -- which would double the cost. The moral is that if you are going to spend millions to install a fiber system that is practically limitless when it comes to carrying information, be sure that there are going to be enough applications to run on that fiber to make your investment worth it, and that someone else with even deeper pockets than you doesn't parallel your wire and compete against you."

Second entry. Entergy is not the only utility that will be using FPN's Powerview product. The Southern Company says it is buying 3500 units of FPN's Powerview product with an option to purchase 5000 more, for testing in the utility's service territory. The utility also says it will purchase a technology license from FPN, paying an initial license fee installment of $ 5-million, and will assist in further development of the product. The utility, which also has advanced DSM and automatic meter-reading projects going on at Gulf Power Co and Georgia Power Co, respectively, intends to match Entergy's stake in FPN by acquiring a 9.95% interest in the firm.

The Southern Company has also formed a non-regulated wireless company that is putting in an 800-MHz trunked mobile radio system throughout its service area, where it will use a combination of microwave and fiber for the utility's operating companies and, with Securities & Exchange Commission approval, to businesses in such areas as the public-safety sector.

Joint ventures. "The main thing we are trying to do internally as far as the wide-area part of our backbone network is concerned," says M. Euel Wade, senior vice president of Southern Company Services and chief information officer of the the Southern Company, "is get a fiber infrastructure built that will give us a two-way feed to all of our major powerplants, division offices, and corporate headquarters. We are also doing the same thing with our local-area networks, putting a telecommunications system in place to implement our client-server architecture. One major application -- human resources -- is up and running on the client-server network now. The next application will probably be customer service. We have about 600 miles of fiber left to install to do all this."

High capacity. Wade indicates that the company has already installed about 1400 miles of high-capacity fiber for its internal uses, "at virtually no cost to the company." He explains that "we formed joint ventures with other carriers. They provide the dollars, we provide the rights-of-way, and we share the fibers." About 96% of it is installed on the transmission ground wire, "and there is plenty of extra capacity we can leverage," he says.

"What we are trying to do here is establish an environment where we can pass data, voice, and video seamlessly, not only throughout our enterprise but also throughout our customers' and our clients' [enterprises]," he explains. "The one thing we have decided is that the control of information about our product to our customers is a strategic imperative. Meanwhile, he says, "The Southern Company intends to play a role in the Clinton Administration's information superhighway. Certainly," he continues, "with the fiber backbone that we have installed right now, we ought to be involved at least on a regional basis. These are exciting times."

Massive. Wade is part of a group of electric-utility executives who met with Clinton Administration officials recently to discuss the importance of their playing a major role in the development of the nation's information infrastructure. The group explains that since electric utilities are already using one of the most massive and sophisticated telecommunications systems in the world to monitor and control energy demand in the US, and since utilities have extensive experience in deploying fiber and operating advanced mobile radio systems, they would be invaluable in constructing the NII. Adds Edison Electric Institute's Walker F. Nolan, "electric utilities already run a separate wire to virtually every home in America. Many have already made substantial investments in fiber optics [with] significant capacity that could be used for different purposes."

No common carriers. The visit appears to have had an effect. In a December 1993 trial-balloon speech at the National Press Club in Washington, DC, Vice President Gore referred to "utilities'' as players in the NII. In Gore's speech on January 11 at the University of California, he specifically mentioned electric utilities as players. "It took a while time to get that word 'electric' in there," Entergy's King advises.

"We certainly want to play a role in the NII," Wade informs, "but we are not sure right now what that role is. What we are sure of, however, is that we don't want to be labeled as common carriers and be burdened with their restrictions."

What Gore said in his address on January 11 was: "The pressure of competition will . . . drive continuing advancements in technology, quality, and cost. . . . To take one example of what competition means, cable companies, long-distance companies, and electric utilities must be free to offer two-way communications and local telephone. To accomplish this goal, our legislative package will establish a federal standard that permits entry to the local telephone markets."

In the game. Dieter says, "We certainly would like to play a part in the NII if it's voluntary, sensible, and profitable. Such a highway may be a good alternative revenue source for BG&E -- a way of interacting with our customers, and a way of improving our own internal service. Utilities can play an important role providing a large part the backbone, but the industry has to get together and make sure that Congress does not keep it out of the game. It's a great

opportunity, but the window won't be open for long."

Proposed legislation. There is plenty of proposed legislation holding the windows open for now. In the last session of Congress, then Sen Al Gore and Sen Conrad Burns (R-Mont) cosponsored the Infrastructure Modernization Bill, (S 1200), aimed at implementing a broadband communications network with an emphasis on fiber optics. As Vice President, Gore is heading up an inter-governmental agency task force that is focusing on the development of the NII. Currently there is a bill in the Senate, titled the Telecommunications Infrastructure Act (S 1086), and there are two pending House bills: The National Communications Competition and Information Infrastructure Act of 1993 (HR 3636), and the Antitrust Reform Act of 1993 (HR 3626), all three of which are aimed at creating an advanced information infrastructure.

GRAPHIC: Photograph: 1. Linemen install fiberoptic cable at Pacific Gas & Electric Co (photo above) and Boston Edison Co (right). Companies like PG&E and Boston Edison are deploying fiber optics more and more as part of their "backbone" communications system along transmission paths and between substations. US utilities have already installed over 8000 miles of fiberoptic cable, for an investment of over $ 300-million ; Photograph: Wade: Getting on the superhighway ; Photograph: 4. Parallel highways -- one for autos, the other for information -- span Fox River in Green Bay, Wis, far below Wisconsin Public Service Corp lineman Walter Hoeft, who balances on chicken ladder atop 300-ft transmission tower, readying helical-wrap machine for installation of high-capacity, 100-mi, fiberoptic, voice, and data telecommunications link ;

Illustration: Diagram: 2. "Our vision for the future for our telecommunications system is 'easy access to shared data,' says Gregg Ehlers, vice president of information and technology engineering at Tampa Electric Co. He adds that "we're working on getting rid of a lot of the vertical communications systems that were built at TECO, and producing an enterprise-wide information network (above). We've moved to a fully digital telecommunications network -- a primary, 28-count, linked and cross-linked fiber backbone of 150 miles. It's all loop technology and without cost to TECO because of unique partnering opportunities we had with local bypass companies. They bought the fiber; we installed it, maintain it, and lease it back to them so they can use it for their point-to-point communications services in Tampa" ; Photograph: 3. The saving from its new DSM system more than offsets the cost of building Entergy's fiber-coax infrastructure, says Jack L. King (left), president of Entergy Enterprises. "The real kicker is that we only need about 5% of the infrastructure's capacity for DSM and other operations. Entergy may be marketing the other 95% to services ranging from home shopping to entertainment"

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