Optimal optical communication

Fiber optic communication, that is, the transmission of messages by light waves in special fibers, is becoming more of a practical technology. Systems that actually transmit messages in this way are under test in a number of the world's telephone systems. Their performance seems to be feeding the enthusiasm of those who advocate their use, and such people freely predict that fiber optics will be the best or the only way to provide the number of channels that future communications traffic will require.

It happens that light wavelengths between 1 and 1.6 micrometers (roughly red to infrared) experience optimum transmission through the silicon-based fibers that are being used. Attenuation of the power of the light waves by the fiber material reaches a minimum at 1.53 micrometers; dispersion or spreading of the pulses is at a minimum at 1.3 micrometers. Dispersion tends to govern the spacing of the repeaters, the circuit elements that periodically restore the shape of the pulses. Repeaters are costly and require maintenance occasionally. The fewer of them the better. 1.3 micrometers seems to be the optimal wavelength to use.

Yet, until recently the fiber optic systems under test used much shorter wavelengths, often about half that. The reason was that lasers capable of producing light of this wavelength and coupling it into a fiber were not available. Now they are, and two systems using 1.3 micrometer light have been successfully tested. One is in Japan, in the suburbs of Tokyo, the other in the United States, in the suburbs of Washington, D. C. First reports on both were delivered this week in San Francisco at the Third International Conference on Integrated Optics and Optical Fiber Communication. Eiji Iwahashi of Nippon Telephone and Telegraph's Yokusuka Electrical Communication Laboratory described the Japanese system. Whit Cotten of Digital Communications Corp. in Germantown, Md., speaking for himself, R. DeWitt of Continental Telephone Co. of Virginia in Middleberg, Va., J. Hwang of General Optronics Corp. in South Plainfield, N. J., and G. Gibbons of Plessey Research Limited in Caswell, Towcester, England, related the American experience.

The American system is what is called an inter office trunk. The Japanese line qualifies as a long haul in telephone system terminology. It runs from the Musashino Electrical Communications Laboratory to the Fourth Electrical Communications Laboratory by way of four central offices, Kokubunji, Hachioji, Sagamihara and Atsugi, for a distance of 76 kilometers. The American line, installed for Continental Telephone Co. of Virginia, is 17.1 kilometers between a toll center in Woodbridge, Va., and a central office in Triangle, Va., by way of the Dale City central office.

Installation for the Japanese line began in October 1980. The Virginia one is about contemporary with it. Both lines have operated with power loss and information loss at or below expectation. The American line has no repeaters in its length. The Japanese line averages about one every 20 kilometers. Even longer distances between repeaters seem possible.

Light transmission of this character permits a high rate of information transmission. Higher rates of information transmission permit a larger number of channels for simultaneous transmission of messages in the same line. Information transmission is counted in "bits" per second. The Japanese installation is rated at 400 megabits per second, the American one at 44.7 megabits per second. The American figure is about the bit rate for this kind of inter office trunk in current practice. The Japanese figure is very large, but Nippon Telephone and Telegraph believes that it will need such a capacity in its future long haul line. It proposes to begin working this technology into its long line system by 1983.

Laser development makes it possible. Lasers have to be what is called heterostructures, alternations of different materials with different electronic qualities precisely put together. They have to be stable, reproducible, and they have to function at ambient temperatures. The American group credits the new technique proton implantation, whereby protons are fired into the material to come to rest in predetermined places and alter its qualities there, with making the lasers possible. So stable and reproducible are the lasers now that General Optronics, which provided the lasers for the American experiments, announced during the meeting that it is starting to market a commercial line of them. □

End to gene-splice rules?

A subcommittee has been set up to consider whether the regulations governing experiments using recombinant DNA should be made voluntary. At the recent meeting of the Recombinant DNA Advisory Committee of the National Institutes of Health, two biologists proposed removing all penalties for failure to comply with the NIH guidelines and reducing further the recommended precautions. Most members of the committee were in favor of the deregulation, but some worried that public distrust of genetic engineering persists. Representatives of the institutional biosafety committees have also recommended substantial decreases in safety requirements (SN: 12/6/80, p. 357). The advisory committee voted to study the proposed deregulation and solicit public comment. A decision is expected at its September meeting. □

Hyperthermia's hot spot is engineering


Jerome McCavitt/Carnegie-Mellon Univ.

Rabbit's ear is window to tumor studies.

The hundreds—some say thousands—of years old practice of attacking cancer with heat, hyperthermia, is undergoing a renaissance (SN: 8/30/80, p. 141). Yet in many ways, how and why it works is still a mystery. In fact, until recently, thermal prescriptions—how much heat to apply, for how long, to which parts of the body and by which means—amounted to little more than educated guesses. But mathematical models are crafting a revolution in hyperthermia dosimetry. And this week, Rakesh Jain of Carnegie-Mellon University, a leader in developing those mathematical models, described tools his lab has developed for establishing baseline data being used to assess the safety and efficacy of hyperthermia treatment.

Blood supply in most solid tumors is only a fraction—perhaps a tenth to fortieth—of that in normal organs, Jain explains. So when heat is deposited in tumors, it is dissipated—cooled by blood flow—much less quickly than in normal tissues. Ideally, Jain says, hyperthermia treatment should be designed to capitalize on that. And that's one reason there has been interest in glucose therapy as an adjunct to hyperthermia.

"We know that when pH is lowered some tumors become more sensitive to heat," Jain explains. "We also know that when the blood flow rate is lowered, heat does not escape from a tumor as quickly. By injecting glucose, we have found that we can both lower the blood flow rate and increase the pH difference between normal and cancerous tissues, thus making the tumor much more sensitive to hyperthermia."

Tests of the glucose therapy showed that the technique works beautifully in helping shrink or eliminate the primary, or original, tumor in rats treated with hyper-