Carrying communications loads lightly

Communications in the 21st century are likely to depend on the relatively new technology of light pulses moving in glass fibers. Even as the first fruits of these inventions are being placed into commercial service, the laboratories keep providing new superlatives and breaking old records in finding ways to make lightwave communication ever faster and more efficient.

"Single mode is the way to go," Russell Dewitt of Contel Services Corp. in Merrifield, Va., told last week's meeting in New Orleans of the Conference on Optical Fiber Communication. He was reporting the first commercial installation of single mode optical fiber in the United States by Continental Telephone of New York. On Sept. 14 1983, a 37 kilometer line went into service between exchanges in Norwich and Sidney, New York, and less than three weeks later another line of the same distance opened between Sidney and Greene.

Single-mode technology has become possible only in the last few years (SN: 4/23/83, p. 260). It depends on the development of lasers that concentrate their emissions in a single longitudinal vibrational mode, that is, a very pure "tone" of a single wavelength, and fibers engineered for optimal transmission of this pure wavelength. The wavelength used tends to be around 1.3 to 1.5 micrometers, in the boundary region between red and infrared. The older technology, multimode, involves a certain spread of wavelengths. Single mode promises faster and more efficient transmissions of virtually error free data.

The most densely trafficked lines in commercial telecommunications today are rated at about 400 million digital bits of information (400 megabits) per second. (A bit is a yes or no to a question or a zero or one in a binary number that codes some piece of information.) Laboratories, however, are working for a denser future. A group from AT&T Bell Laboratories at Holmdel, N.J., R.A. Linke, B.L. Kasper, J.C. Campbell, R.G. Dentai and I.P. Kaminow reported transmission of a signal of one gigabit per second (one billion bits) over 120 kilometers without a repeater in the circuit. Repeaters boost and reshape the signal to repair degradation naturally occuring during transmission. Long distances without repeaters are a goal, as they lower capital and maintenance costs.

Linke pointed out that although some lower bit rate signals have gone longer repeaterless distances this is a record for a signal denser than 500 megabits; and it is an absolute record for the product of bit rate times distance, a criterion important to communications engineers.

Gigabits are not enough however. Two reported experiments extended the modulation band width for lightwave signals beyond 10 gigahertz. The rate at which information can be transmitted depends on the maximum speed at which modulation of the signal can be repeated. The first of these experiments by K.Y. Lau, and colleagues of Ortel Corp. in Alhambra, Ca., and A. Yariv of California Institute of Technology in Pasadena, reached a maximum modulation rate of 10 billion times a second. The other experiment, by researchers at AT&T Bell Laboratories at Holmdel, and Murray Hill, N.J., reached 10.6 billion times a second. This can mean data rates to 10 gigabits per second. As Chinlon Lin of Bell Labs/Holmdel pointed out, pulses repeating at this rate are only 25 picoseconds long (25 trillionths of a second, 25×10^{-12}). Often at such high rates the signal cannot get up to its full strength. However, electrical biassing can sometimes compensate. The Bell labs experiment reached 10.6 gigahertz at full signal strength, but drove to 11.2 gigahertz at 90 percent strength.

Lau pointed out that interest in these high modulation rates arises from the desire to translate microwave radio signals into light pulses. Light transmission suffers very low losses, while electric transmissions in copper cables loses heavily. Immediate applications would be in radar installations or in synchronizing antennas that work together in large arrays, a favorite technique of radio astronomers, among others.

Another way of increasing information capacity is multiplexing, sending several signals in the same fiber. One way to do this is to use different carrier wavelengths for the different signals, wavelength division multiplexing. Fiber exists that will accomplish single mode transmission at more than one wavelength. N.K. Cheung, C.R. Sandahl, J. Lipson, N.A. Olsson, W.T. Tsang and C.D. Sallada of AT&T Bell Laboratories at Holmdel, and Murray Hill N.J., and Allentown, Pa., used fibers of this kind and single frequency lasers to transmit 432 megabit per second signals at three wavelengths, 1.274, 1.333 and 1.512 micrometers over 32 kilometers of fiber, the first three channel wavelength multiplexing to be reported.

Finally, where systems require only low bit rates, multimode equipment may still have its day. V.J. Mazurczyk of AT&T Bell Laboratories at Holmdel, N.J., reported repeaterless multimode transmission up to 202 km at three, 45 and 90 megabits per second. These trials are preparing for a 150 km unrepeated undersea lightwave system that Bell labs plans to deploy early next year. *— D.E. Thomsen*

Subtle is the virus: Cells stay intact

Without causing noticeable structural damage, a virus administered to laboratory mice has been found to disrupt hormone production in a particular type of pituitary cell. This novel observation — that viruses are able to injure their hosts in ways not previously suspected — may trigger a far-reaching search for viruses as the causes of many unexplained human diseases.

Cell destruction has been the hallmark of most viral diseases. A virus can kill cells directly or, scientists have more recently learned, it may trigger an immune system assault that turns against the body's own cells. But experiments reported in the Jan. 19 NATURE demonstrate that viruses also can destroy a cell's specialized function without doing structural damage to the cell.

Newborn mice were inoculated with a virus that naturally infects mice but can also cause illness in humans. After 15 days, the mice were shorter and lighter than uninfected pups of the same age, report Michael B.A. Oldstone of the Scripps Clinic and Research Foundation in La Jolla, Calif., and his colleagues. The mice infected with the virus, called lymphocytic choriomeningitis virus, also had deficient levels of blood glucose and impaired blood glucose control.

The reason for this group of abnormalities was a deficiency in growth hormone, measured in the pituitary glands of the infected mice. The scientists found evidence of the virus only in the pituitary cells that make growth hormone. No cells had structural abnormalities visible with high resolution microscopy.

To further demonstrate the growth hormone deficiency, Oldstone transplanted growth-hormone producing cells into the abdomens of the infected mice. These animals grew normally and showed normal blood glucose levels.

It is most likely that the viruses affect the cells' synthesis of growth hormone, the scientists say. Production of viral proteins may overload the manufacturing system, so that the cells' major nonessential product, growth hormone, is no longer made. "Alternatively, the virus may induce a specific alteration in an enzyme or transport system needed for the production and release of growth hormone," the scientists suggest.

Human diseases involving faulty manufacture of such substances as neurotransmitters, insulin and other hormones and immune system regulators may be caused by an unsuspected viral infection disrupting specialized function of a cell. Bernard N. Fields of Harvard Medical School in Boston comments in the same issue of NATURE, "[Oldstone's observation] should stimulate a closer look for viruses in other diseases where the function of differentiated cells is abnormal."

—J.A. Miller