

# AT&T INNOVATION BRIEFS

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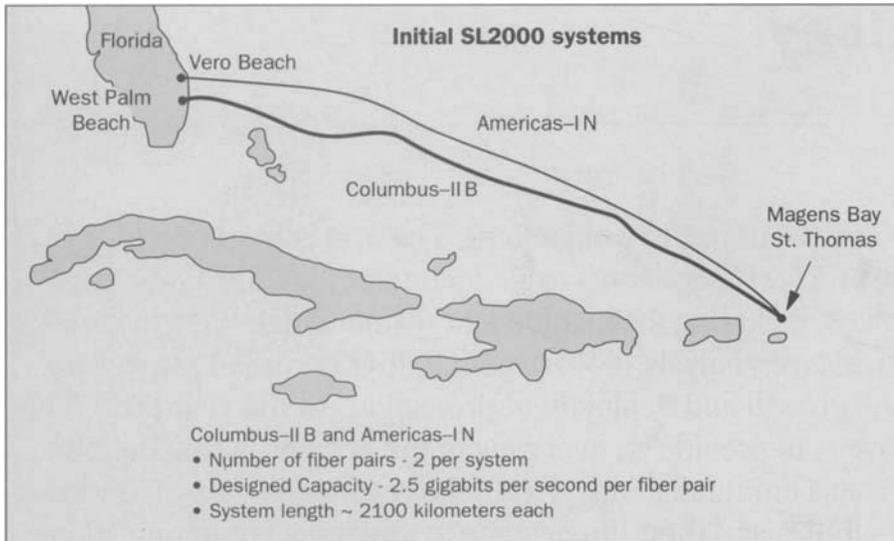
*Innovation Briefs are summaries of recent discoveries and developments within AT&T Bell Laboratories. Those wishing further information, or AT&T readers who would like to contribute future items, are encouraged to contact the AT&T Technical Journal editor.*

## **Intelligent Memory System for Computers**

Emerging telecommunications and on-line information services will require significantly more flexibility, processing capacity, and input/output bandwidth than current, general-purpose processors are capable of providing. The Structured Wafer-based Intelligent Memory System (SWIM), recently designed by AT&T Bell Laboratories' researchers, implements a new and unusual way of computing, one in which the memory participates with the central processing unit (CPU) in completing a computational task. SWIM places processing logic inside each memory chip. This permits the chip to perform data-structure operations locally, communicating directly with either a disk or communication line. A complex processing task can be distributed among a large number of small memory processors. Each processor performs a sub-task, while retaining a common locus of control for higher-level functions, in the CPU. Use of programmable, memory-based input/output co-processors will enable scalable, high-performance database and communication processing systems to be built. SWIM's capability in searching and sorting massive amounts of data — in real time — is also particularly applicable to advanced directory services. Further, an intelligent memory system offers a natural and efficient framework, by directly supporting objects in memory, for object-oriented programming. This is significant because much of the investment in large networks is in software.

## **Undersea Cable Upgrades Proven Feasible**

AT&T Submarine Systems, Inc. recently succeeded in transmitting 10 billion bits of information per second (10 Gbits/s) over a commercially installed undersea fiber-optic cable system. Success of the experiment, which was conducted on a 2,000-km link of fiber extending from West Palm Beach, Florida, to Magens Bay in St. Thomas, the U.S. Virgin Islands, gives AT&T the potential to upgrade optically amplified cable systems to 10 Gbits/s. This higher transmission speed greatly increases the capacity of the undersea cable. The test span was one segment of the 13,000-km Columbus II Cable System that connects the United States to Mexico, Italy, Portugal, and Spain. Because the test was conducted on a commercially installed fiber-optic system, rather than in a laboratory, it gives AT&T the potential to upgrade installed fiber-optic communication systems without making any adjustments to that portion of the cable system on the sea

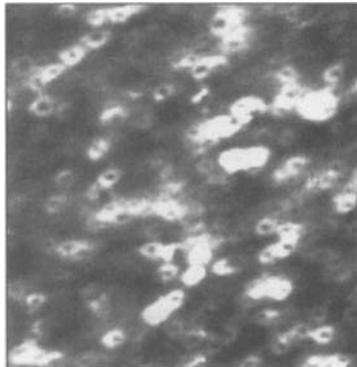


**A 2,000-Km undersea fiber-optic cable links West Palm Beach, Florida, and Magens Bay in St. Thomas, U.S. Virgin Islands.**

floor. Using a technique called wavelength division multiplexing, which involves transmitting information on more than one wavelength (or color) of light on each fiber, AT&T Bell Laboratories' developers accomplished the upgrade at the fiber's transmitting and receiving ends. The experiment quadrupled the transmission capacity on the Florida-to-St. Thomas link, which normally operates at 2.5 Gbits/s.

**A thousand points of light, from Quantum Caverns.**

### Quantum Caverns: A Thousand Points of Light



AT&T Bell Laboratories' researchers have succeeded in directly imaging the individual light-emitting centers that constitute the luminescence of a layered semiconductor sample. The imaging was achieved using a cryogenic, near-field scanning optical microscope, whose resolution can exceed that of a diffraction-limited optical microscope by one order of magnitude. Each light-emitting region marks the location of a center, or bulge, between two parallel barrier sheets that confine electrons and holes to a semiconductor layer. Optically created electron-hole pairs, which are squeezed between these corrugated sheets, migrate in this quantum well until they are captured by one of these bulges. Here, the electron and hole annihilate, releasing their energy as light having sharp spectral lines reminiscent of atomic spectra. Such individual spectral lines provide a wealth of nano-scale details. For example, by mapping local color variations the atomic smoothness of the barrier interface is directly imaged, thereby providing a new tool for characterizing and improving crystal growth. Smoother, high-quality surfaces are important technologically, and have a potential for affecting such devices as quantum-well lasers, optical detectors, and high electron-mobility-transistors.