AT&T INNOVATION BRIEFS

This new feature responds, in part, to the results of last year's survey of Journal readers within AT&T. The readers asked for brief descriptions of recent discoveries and developments by members of their own technical community. AT&T readers who would like to contribute to future editions of Innovation Briefs should first contact the Technical Journal editor.

Instant Lock for Burst-Mode Data Transmission Clock Recovery

A traditional limitation of circuits commonly used for clock recovery (or bit synchronization) in digital communication receivers has been the time it takes for the circuits to reach steady-state operation. The reduced transmission efficiency caused by this limitation is particularly significant in systems where data are received in asynchronous bursts. Bell Labs researchers have come up with a new clock recovery method that locks "instantaneously" and stays that way, even with low transition density data. The researchers' technique yields fully integrated, low-complexity circuits suitable for high-speed operation, and should have a substantial impact on the design of future AT&T digital communication systems.

Variable Bit-Rate Video

Digital video has traditionally been transmitted at a constant bit rate. Its growing use, however, makes the application of a variable bit rate (VBR) increasingly desirable. But VBR has its own set of problems. Before being sent through a Broadband Integrated Services Digital Network (B-ISDN), VBR data must be separated into a string of "cells." The cells are then pumped asynchronously into the network. Data describing an image are compressed at the transmission end and decompressed at the receiver. Left on their own, these data would alternately overwhelm and starve buffers in both the senders' and receivers' equipment. Because an uncontrolled, highly variable data flow jeopardizes the integrity of transmitted data, B-ISDNs must, in effect, limit the transmitted bit rate they can guarantee the user. Bell Labs researchers have developed methods to determine encoded video bit rate constraints and to ensure that a video system stays within buffer- and network-imposed limits. The researchers have also developed methods to handle additional VBR constraints that exist whenever digital video signals are transmitted to and from orbiting satellites.

Real-time Thermal Imager Can Study, Predict Device Failure

A Bell Labs researcher has developed an infrared imaging system that maps microscopic devices' and circuits' temperature profiles in real time. The system employs an

indium antimonide focal plane array camera whose images—with a spatial resolution of a few micrometers and a temperature resolution of 10 millikelvin—are viewed on a high-resolution computer monitor. The system has been used to identify nonradiative defects and degradation modes in semiconductor lasers, transistors, and microwave circuits. Combined with techniques such as Raman microprobe spectroscopy, luminescence, and finite element analysis, this thermal imaging system should make it possible to produce accurate three-dimensional thermal models of microelectronic devices, paving the way to increased device yield and reduced manufacturing cost.

Work Progresses Toward an All-dry Lithography Process

Bell Labs scientists have discovered the key step needed to develop an all-dry lithography process that forms circuit patterns on silicon wafers. A commercialized all-dry process might allow fabrication of semiconductor devices inside a series of atmospherically controlled, interconnected chambers, with no need for costly clean rooms. The key step—deposition of a high-performance photoresist from a gas instead of a liquid—takes an organosilicon gas such as methylsilane and excites it with low power radio frequency energy. The resulting molecules bind into larger molecules that deposit uniformly on the wafers. Exposed to ultraviolet light and air, the methylsilane films convert into materials similar to amorphous silica. Subsequent dry development with halogen-based gases removes the unexposed region. In most cases, patterns can be etched into the substrate in the same chamber used for development. With this process, researchers can create high-resolution device structures whose size is limited only by the wavelength of the light used.

New Heat Sink Material: Synthetic Diamond Film

In a broad effort led and coordinated by Bell Labs, the first commercial application of chemical vapor deposited (CVD) free-standing thick films of synthetic diamond has been developed. Product of an advanced thin film metallization bonding technology invented at Bell Labs, the thick films represent a new class of microelectronic heat sink materials that combine high functionality and maximum heat extraction capability. The film's first use is in submounts for high-power semiconductor lasers. The combined development effort included an internal engineering organization and a number of major CVD-diamond manufacturers.