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TUNING

Fiber management components, filters and lasers from Schott are critical to the Internet's ability to keep pace with exploding demand.

Optical signal processing is the only way to control this phenomenal flood of data, and is increasingly used not only for long-distance applications in wide area networks, but also for shorter connections within regional and local networks, right down to data transfer within host computers and multi-processor systems. Schott has strengthened its operations in this area of the data and communication technology sector, establishing start-up companies in the US and Germany as well as investing in a further German company.

Optical fibers replace cable spaghetti

Schott Communications Technologies Inc. (SCT) in Southbridge (Massachusetts, USA) produces fiber management components and optical connection technology. "Optical shuffles", as flexible optical cabling systems are known, are an elegant replacement for complex cable harnesses. "They boost our customers' switching and routing systems, enabling their optical connections to reach new heights of efficiency at the high bit rates of several gigabits per second that are currently required", explains Dr. Andreas Zenz, Head of Business Development and Marketing at SCT.

"New fields of operation in telecommunications and data communication will enable Schott to achieve a major element of its Vision 2010 targets by gaining leading positions in its markets."

Dr. Udo Ungeheuer,
Schott Managing Board

As the data flow in optical networks around the world increases, the number of channels and connection ports for servers, routers and control boxes – all requiring interconnection – is skyrocketing. Both the tangled masses of copper wiring that have been used to date and the combination of many separate fiber connections are highly susceptible to faults, costly because of the quantities of material and work

Not a slump in sight! The information and telecommunications industry is booming as much as ever. Annual sales in Western Europe exceed 500 billion euros, and according to a study by the European Information Technology Observatory (EITO) the global market will expand by ten percent this year to top 1.8 billion euros. Almost one of every two Americans and over one of every three West Europeans have their own computer, with more and more users lining up for access to the Web. Internet and intranet traffic has boomed, with data flows already swamping those of telephony-based voice communication. Internet volume explodes by over 50% annually; some service providers have even registered a 100% increase in traffic over a six-month period. "The global flow of data on the Internet is currently around one terabit per second", confirms Alastair M. Glass from Bell Labs in Murray Hill (New Jersey, USA). Tera is the prefix for one billion. In information terms, a terabit is the equivalent of around 300,000 fat books. If this dramatic development continues – and all the signs say that it will – by the year 2005 the Internet will need a capacity of 280 terabits per second for the US alone.

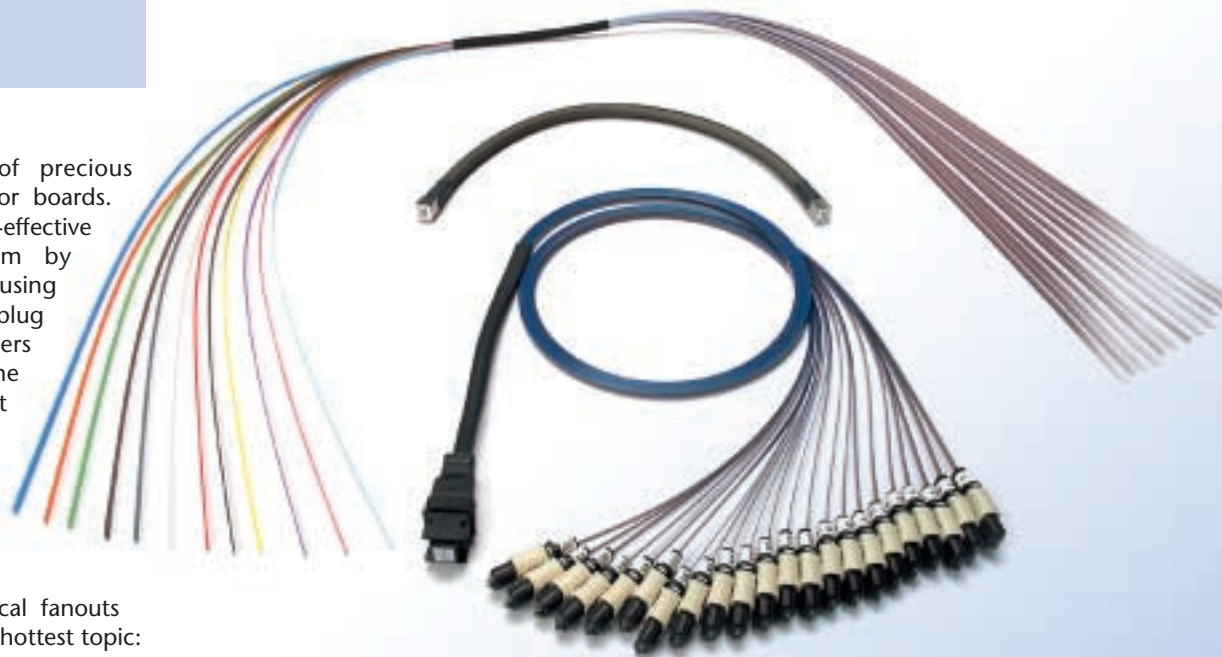
GLASS FIBERS



Higher content

Around 40% or 112 million US citizens already surf the Internet, making the US the number one surfing nation. However, in terms of percentage of population, Canada is ahead, at 43%. The "Internet Industry Almanac" forecasts that by the year 2002 601 million people will surf the net every year.

involved and wasteful of precious space on central connector boards. "We offer a compact, cost-effective solution to this problem by developing light guides using only a small number of plug connectors, that customers can easily plug into the ports they need to meet their individual requirements", says Alexander Hagemann, CEO and President of SCT. SCT has now moved into production of other components such as optical fanouts that support the industry's hottest topic:



Fiber management components such as "optical shuffles" and optical fanouts enable optical connectors in switching and routing systems to reach new heights of efficiency.



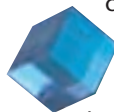
single optical fiber, thus increasing the fiber's transmission capacity. While this process enables optical connections to take on more channels as required, individual wafers must be coated for each wavelength range. "The smaller the distance between the channels, and thus the greater the data volume that can be transmitted, the more layers we have to apply to the glass substrate", explains Dr. Danielzik.

Experts estimate that the market for opto-electronic components, placed at US\$6.7 billion in 1999, will leap to US\$23.1 billion by 2003.

Laser diodes for data coupling

U.L.M. Photonics GmbH has also developed sophisticated methods of applying multiple wafer-thin coatings. SCT is the main investor in this start-up company, founded at Germany's Ulm University. An expert team of scientists and engineers at U.L.M. use the molecular beam epitaxy process to develop special semiconductor laser diodes. These components, known as VCSEL (Vertical Cavity Surface-Emitting Laser), are used as light sources to transform electrically stored information into optical signals. "Data is transferred to the optical cables by switching a laser diode on and off – and we produce

The glass filter cubes used in DWDM systems measure 1.4 x 1.4 mm and have a hundred individual layers a mere 20,000 to 30,000 nanometers thick.

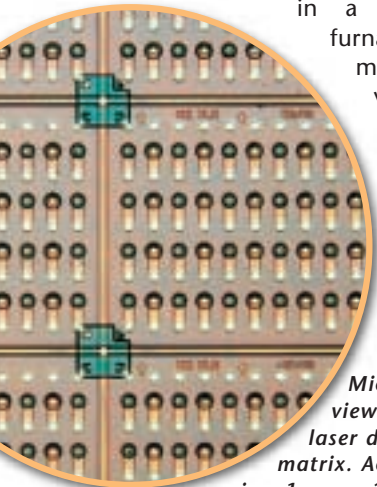


switches based on tiny, movable micromirrors (MEMS). SCT's products are used for high-precision optical connection of up to several thousand channels in an area of only a few square centimeters with an array of signal processing boards. In addition, SCT's future developments will address optical connection needs for massively parallel data transfer, for example in servers or in direct chip-to-chip communication.

are coated onto the glass wafers, each layer less than one μm thick. "High-precision process control of the thickness of each layer is critical for filter quality", explains Dr. Burkhard Danielzik, Managing Director of Schott Telecom Optics GmbH (STO). These filters are the key to increasing the data transmission capacity of optical fibers. Far smaller than a cube of sugar, they filter precisely defined wavelength ranges out of the light beam that transmits the data. These filtered ranges define the "lanes" on the data highway. The microscopic glass components use DWDM systems (Dense Wavelength Division Multiplexing) to increase the coupling and decoupling frequency of multiple light beams in a

Secret coating process

Shift from the US East Coast to Mainz, Germany. Under the bluish light of a plasma source, a complex coating process is taking place in a high-vacuum furnace. Approximately 100 individual layers



Microscope view of 4x8 laser diode matrix. Actual size: 1 mm x 2 mm.

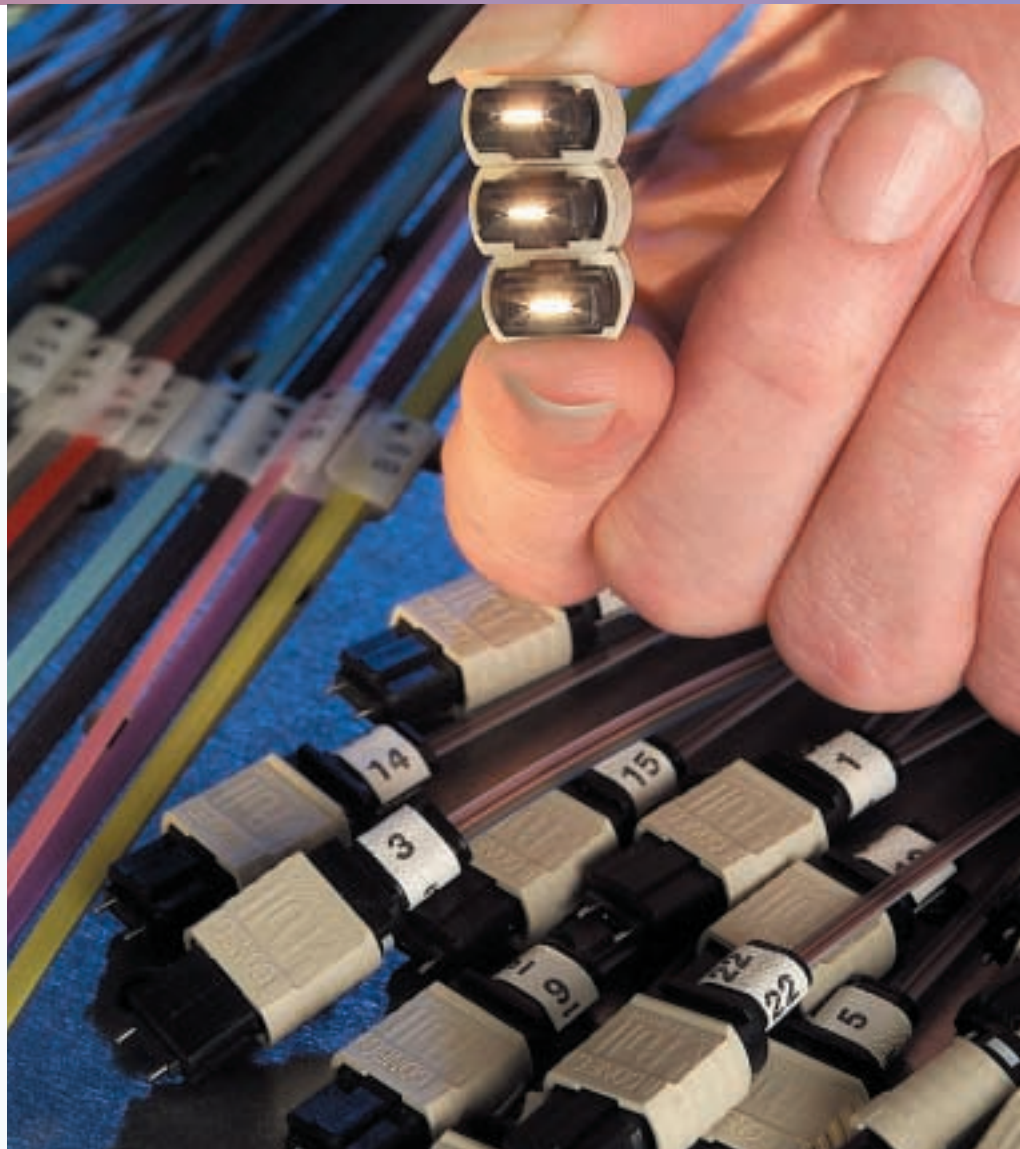
Completed wafer with around 90,000 diodes and individual laser diodes in electronic packaging components.



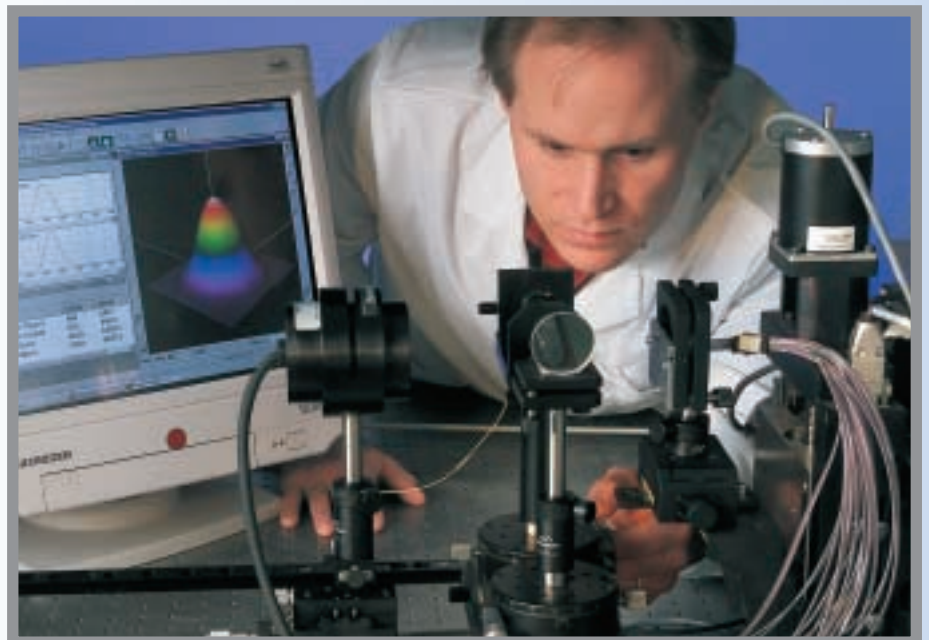
those diodes", explains Dr. Burghard Schneider, Managing Director of U.L.M. Photonics.

Multiple layers, some only a few atoms thick, are grown onto a gallium arsenide base. Most of them serve as mirrors, some also actively amplify the light. Incredibly, a wafer of around eight centimeters in diameter can take as many as 90,000 diodes, which undergo classic lithographic processing before completion. "In autumn of 2001 we will be opening our new clean room, which will include epitaxy facilities enabling us to metallize five gallium arsenide wafers simultaneously", says Schneider, outlining U.L.M.'s rapid expansion plans.

With its filters, lasers and products for fiber management and optical connections, Schott occupies an excellent position in the future-oriented Internet-based market. The initial strategy is to continue activities in the area of key components while remaining open for further options. The company's position is further strengthened by its expertise in materials, thin-layer technologies and optical processes, and by a research organization that spans the globe. Alexander Hagemann, SCT president, takes an optimistic view: "Schott has won new areas of expertise by focusing its research and development. Our three companies are now engaged in implementing these gains in business models around the globe. We are thus anticipating sales of over US\$100 million over the next five years, regardless of the downturn the industry is currently going through." Growth à la Internet – on both sides of the Atlantic ■



Compact and easy to use: Flexible optical connections that customers can plug into ports to meet their individual requirements.



Calibration of a precision beam profiling measurement test for optical fanouts. The glass fibers are tested for exact positioning and alignment.