

**Distributed WDM  $N^3/N^4$  VCSEL based switching network development**  
**Reno/Tahoe Photonics Cluster chapter meeting of the**  
**Optical Society of America**  
**May 13, 2004**  
to be held at OptiComp Corporation with a facilities tour

Multiple platforms exist require data communication systems that can accommodate large numbers of switching nodes, many of which require high data rates. These switching nodes may be on-board sensors, control actuators, or computers. Distributed, wavelength division multiplexed (WDM) optical networks offer an ideal solution to meet these requirements. However, most WDM optical systems employ hardware that is large, heavy, and also consumes large amounts of power. Vertical-cavity, surface emitting laser (VCSEL) technology has the potential of addressing many of these hardware problems. Besides being small in size and having low power consumption, VCSELs can be densely integrated into two-dimensional arrays. However, current VCSEL-based solutions have not integrated WDM or other functionality enhancements for improved network performance.

OptiComp Corporation (OCC) is developing an approach that implements advanced switching architectures by distributing integrated, WDM, VCSEL-based modules at each node in the network. Our network designs enable high data throughput and switching speeds, low latency, and system scalability through advanced system topologies and monolithically integrated optoelectronics. The distributed WDM switch consists of pairs of monolithically integrated VCSELs and resonant cavity photodetectors, each at a different wavelength, interconnected along a common waveguide with all multiplexing and demultiplexing done on-chip. Different levels of connectivity and functionality are available by interconnecting the optoelectronic switches in various configurations. A distributed crossbar switch with  $N$  access ports, referred to as an  $N^3$  architecture ( $N^3$  interconnect paths), can be realized by interconnecting an  $N$ -element VCSEL array with an array of  $N$  photodetectors. Our WDM optoelectronic switches also permit transparent optical transport, enabling signal routing without the need for detection and subsequent re-transmission, reducing the latency of the system. In addition, the parallel nature of the  $N^3$  and  $N^4$  network topologies makes the system redundant and fault tolerant. If one optical path is broken, the system can route the optical signals on another parallel path, enabling the system to continue functioning.

We wish to acknowledge the Missile Defense Agency (MDA), Air Force Research Labs (AFRL), the Defense Research Project Agency (DARPA), and the Navy Air System Command (NAVAIR) for their support of this effort.

**Dr. Duane Louderback** is an expert in designing, modeling, fabricating, and characterizing oxide-apertured VCSELs and resonant cavity photodetectors for fiber and free-space optical interconnects. He has extensive experience in integrated optoelectronics, as well as waveguides and in-plane laser structures. He is proficient at semiconductor device packaging and high-speed link testing. Dr. Louderback received his Ph.D. in EE from UC Santa Barbara in 2002.

**Peter S. Guilfoyle**, President and CEO of OptiComp since 1987, has been responsible for all aspects of corporate development. The company has received the SBIR Tibbetts award for 2000, 1998, and 1996, and the R&D 100 award for 1994. In 2001, he has also received the Nevada Inventor of the Year and the Desert Research Institute Gunnerman Award. He is a senior member IEEE, and a member of OSA, APS, SPIE, and SEG, has published over 100 papers and holds many patents. He received his BSEE and MSEE from Carnegie-Mellon in 1974 and 1975 respectively.

