

Distributed WDM Optical Networks for Avionic Platforms

P.S. Guilfoyle*, D.A. Louderback, G. Pickrell, H.C. Lin, M.A. Fish, J.J. Hindi, and M.C. Simpson

OptiComp Corporation (OCC), P.O. Box 10779, 215 Elks Point Road, Zephyr Cove, NV 89448

*[*peter@opticomp.com](mailto:peter@opticomp.com)*

Avionics platforms 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 a novel 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. Each VCSEL and photodetector are connected using an interconnect media such as silica-based waveguides and/or optical fibers. Using this configuration, each port can listen to all interconnect paths simultaneously. When a port senses no traffic on an interconnect path, it can transmit its signal onto that path. This implementation can use single-wavelength switches on parallel interconnect paths, or alternatively an N^3 network can be realized with WDM optical switches operating along a single interconnect path. Further complexity in network topology allows for the realization of N^4 architectures by using parallel, WDM, N^3 systems. N^4 topologies allow for increased scalability, thus dramatically increasing the data handling capacity of the network, as well as the number of nodes that can be accommodated.

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.

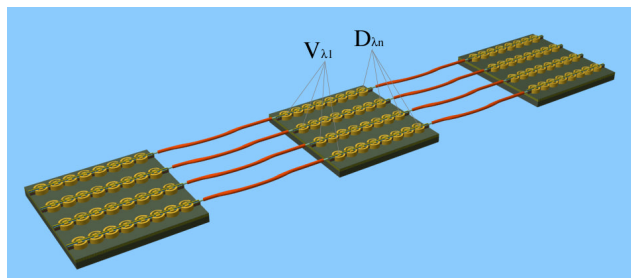


Figure 1: Schematic of an N^4 network architecture using WDM arrays of VCSELs and photodetectors along a common waveguide.