North American Workshop on Silicon Photonics for High Performance Computing

May 17-18 2018, Fort Collins, CO

Can Coherent Optics Invade the Datacenter, and then HPC Systems?

Clint Schow
University of California Santa Barbara
schow@ece.ucsb.edu

Abstract – Over the last several years it has become clear that datacenters, and not HPC systems, are the primary technology drivers that are demanding ever more aggressive performance targets and shorter development cycles from the optical transceiver industry. However, the system-level requirements for optical links in HPC and datacenters are not exactly the same. The potential opportunities for Si photonics in next-generation HPC networks must therefore be considered within the context of the volume-driven market reality. The good news is there is overlap between the demands of datacenters and HPC for next-generation networks, so technology platforms can potentially evolve to support both applications.

Coherent detection of phase-modulated signals is widely understood to be a path to higher bandwidth optical interconnects, but is also perceived to be too power hungry for links within the datacenter. However, an "analog coherent" approach, based on optical phased locked loops (OPLLs), provides a path to dramatically lower the power consumption and cost of coherent signaling by eliminating the need for the power-hungry DSP circuits required by conventional telecom coherent links. For HPC systems, DSP-free coherent technology offers a path to higher bandwidth without having to rely on the forward error correction (FEC) that multi-level signaling requires (*e.g.* 4-PAM), with the critical benefit of minimizing latency. Furthermore, in contrast to long-haul coherent optics that were developed to maximize spectral efficiency, the key advantage for using coherent links in data center applications, and potentially HPC networks, is a large improvement in receiver sensitivity compared to direct detection. The expanded link budgets provided by coherent detection can fundamentally enable new network topologies based on all-optical switching and routing that are currently not possible due to the poor sensitivity of today's direct-detection links. Developing a viable short-reach coherent technology that can deliver on these promises presents many challenges that provide fertile areas for research and innovation.

Bio – Clint Schow received B.S., M.S. and Ph.D. degrees from the University of Texas at Austin. After positions at IBM and Agility Communications, Dr. Schow spent more than a decade at the IBM T.J. Watson Research Center in Yorktown Heights, NY, as a Research Staff Member and Manager of the Optical Link and System Design group. He has led international R&D programs spanning chip-to-chip optical links, VCSEL and Si photonic transceivers, nanophotonic switches, and new system architectures enabled by high-bandwidth, low-latency photonic networks. In 2015, Dr. Schow joined the faculty of the University of California at Santa Barbara.

Dr. Schow has served on numerous international conference committees and has been a longtime volunteer for the Optical Fiber Communications Conference (OFC), as a Program and General Chair, and as a member of the Steering and Long Range Planning Committees. He is a Fellow of the OSA and the IEEE, has published more than 180 journal and conference articles, and has 28 issued patents.