**Frequency Stabilized Lasers for Coherent Optical (*FRESCO*) DSP-free WDM Datacenter Interconnects**

As data center ethernet switches scale toward 100 Tbps, the fiber interconnect will face significant cost, power, and engineering barriers. We describe FRESCO, a fiber data center interconnect (DCI) that brings high order coherent WDM Terabit links inside the data center without the need for DSP and other power consuming technologies. FRESCO replaces high power DSP- and PLL-based carrier phase recovery by employing integrated ultra-low linewidth stimulated Brillouin scattering (SBS) 1550nm lasers stabilized to reference µ-cavities for ~1Hz fundamental linewidth and 10s of Hz integral linewidth optical carriers. This enables the optical frequency stabilized phase locked loop (OFS-PLL) using low bandwidth (<1MHz), low power simple electronics to achieve a direct optical carrier lock with residual phase error variance of 3x10-4 rad2, sufficient for high-order QAM. The architecture is extended to shared source WDM operation using Kerr soliton optical frequency comb generators, amortizing cost and complexity over all channels. Fully integrated silicon photonic transceivers offer reduced footprint and power consumption.

To date, we have demonstrated a discrete component single channel 50Gbd 16-QAM FRESCO link using the DSP-free OFS-PLL with low bandwidth (<1MHz), low power electronics for carrier phase recovery over a 200m fiber channel achieving EVM performance within ~1% of a DSP based reference link. We have also demonstrated generation of an ultra-low linewidth WDM shared source using the frequency stabilized SBS laser to pump a Kerr soliton in a SiN microring. Operation as a shared source architecture offers unique opportunities for power savings and motivates current efforts in modeling the impact of stable, ultra-low phase noise optical sources on link performance and power consumption.  With our proposed DSP-free architecture, demands on data-chain electronics such as DACs and ADCs may be relaxed, offering additional power savings for tomorrow’s hyperscale DCIs. Future experimental efforts will scale baudrate, QAM order, and WDM count approaching energy efficiency below 10pJ /bit and 10s of Terabits link capacity.