Advanced Modulation Techniques for High-Performance Computing Optical Interconnects -
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We experimentally assess the performance of a 64 × 64 optical switch fabric used for ns-speed optical cell switching in supercomputer optical interconnects. More specifically, we study four alternative modulation formats and detection schemes, namely, 10-Gb/s nonreturn-to-zero differential phase-shift keying with balanced direct detection, 10-Gb/s polarization division multiplexed (PDM) quadrature phase-shift keying, 40-Gb/s single-polarization 16-ary quadrature amplitude modulation (16QAM), and 80-Gb/s PDM-16QAM, with coherent intradyne detection, in conjunction with an optimized version of the optical shared memory supercomputer interconnect system switch fabric. In particular, we investigate the resilience of the aforementioned advanced modulation formats to the nonlinearities of semiconductor optical amplifiers, used as ON/OFF gates in the supercomputer optical switch fabric under study. In addition, we compare their performance using as a benchmark the performance of conventional 10-Gb/s intensity modulation direct detection (IM/DD). We show that the choice of the appropriate advanced modulation format can increase the capacity of the switch fabric, while, at the same time, it can mitigate the main nonlinear effect, i.e., cross-gain modulation that arises when using conventional IM/DD. Nonlinear phase distortion becomes the main limiting factor when advanced modulation formats are used.

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