

SEMINAR

Room 1003 ETB

February 4, 2016 3:55-5:10 P.M.

Energy Efficiency Comparisons of NRZ and PAM4 Modulation for Ring-Resonator-Based Silicon Photonic Links

by

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Abstract: Advanced modulation schemes, such as PAM4, are currently under consideration in both high-speed electrical and optical interconnect systems. This paper analyzes how NRZ and PAM4 modulation impacts the energy efficiency of an optical link architecture based on silicon photonic microring resonator modulators and drop filters, and how this changes as CMOS technology scales from a 65nm to a 16nm node. Two ring modulator device structures are proposed for PAM4 modulation, including a single-segment device driven with a multi-level PAM4 transmitter and a two-segment device driven by two simple NRZ (MSB/LSB) transmitters. Modeling results with carrier-depletion ring modulators and transmitter driver and receiver circuitry show that the PAM4 architectures achieve superior energy efficiency at higher data rates due to the relaxed circuit bandwidth, with the cross-over point scaling from 30Gb/s in the 65nm node to 50Gb/s in the 16nm node.

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