Advanced Optical Transmitter and Receiver Design for Short-Reach Scale-out Interconnect Arrays

This talk presents recent advances in high-speed optical transmitter and receiver circuits for short-reach scale-out optical interconnects.

First, a 40-Gb/s 1-to-N VCSEL driver implemented in a 150-nm GaN HEMT process is introduced. Leveraging the high breakdown voltage and broadband capability of GaN devices, the driver directly supports series or parallel VCSEL array configurations without a pre-driver stage. The prototype demonstrates up to 8 mW optical modulation amplitude (OMA) at 40 Gb/s NRZ and supports PAM-4 signaling up to 38 Gb/s while enabling scalable multi-VCSEL operation for higher optical power.

Second, a power- and area-efficient 48-Gb/s PAM-4 optical receiver implemented in 28-nm CMOS is presented. The receiver employs a transadmittance-transimpedance (TAS-TIS) architecture that eliminates inductive peaking and CTLE while maintaining high gain-bandwidth product and linearity. Combined with a 2-tap feed-forward equalizer (FFE) and 2-tap decision feedback equalizer (DFE), the receiver achieves −5.1 dBm sensitivity at 48 Gb/s PAM-4 with 1.28 pJ/bit energy efficiency and only 0.06 mm^2 active area.

Together, these transmitter and receiver designs demonstrate a scalable and energy-efficient optical front-end architecture for next-generation short-reach optical interconnect arrays.