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TEXAS A&M UNIVERSITY

S E M I N A R

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A Low-Power Dual-Mode 20-Gb/s NRZ and 28-Gb/s PAM-4 Voltage-Mode Transmitter

by

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Abstract: A dual-mode NRZ/PAM-4 differential low-swing voltage-mode transmitter employs a quarter-rate output multiplexing architecture for low-power operation targeting short-reach (SR) applications. In NRZ mode, 2-tap feedforward equalization is realized with analog replica-bias tap control that is configurable in high-performance controlled-impedance or energy-efficient impedance-modulated settings. This analog control also allows for efficient generation of the middle levels in PAM-4 operation. Fabricated in GP 65nm CMOS, the transmitter supports an output swing range of 100-400mVppd with up to 12dB of equalization in NRZ mode and achieves energy efficiencies of 1.48 and 0.91pJ/b at 20-Gb/s NRZ and 28-Gb/s PAM-4 data rates. Operation in the NRZ energy-efficient impedance-modulation setting allows for power savings of up to 32% relative to the controlled-impedance setting.

Noah Haewoong Yang (S'13) was born in Seoul, Korea. He received the B.S. and M.E. degrees in Electrical and Computer Engineering from Texas A\&M University, College Station, TX, USA, in 2007 and 2009, respectively. He is currently working toward the Ph.D. degree at the Analog and Mixed Signal Center (AMSC) of Texas A\&M University.

His interests are in low-power high-speed electrical link circuits, clock generation circuits, and signal integrity. Mr. Yang is a co-recipient of the Student Best Paper Award in the 2014 Midwest Symposium on Circuits and Systems.