Limits of Electrical Signaling

Horowitz, Yang, Sidiropoulos,
"High-Speed Electrical Signaling: Overview and Limitations,"
IEEE Micro, 1/98
Sidiropoulos, Horowitz, Yang, Chapter 19
Multiplexed Transmitter

Different on- and off-chip bandwidths
Transmitters have to drive low impedance

Multiplexer

Output pulse width closure (%) vs Bit time (normalized to FO-4)
Tx Multiplexer

Pulse width limited

Overlapped signals

From Horowitz

Performance Limit

Eye closure (%) vs. Bit width (FO-4)
Demultiplexing Receiver

Demultiplexing Data
PLLs vs. DLLs

PLL and DLL Response

Response to a supply step
Delay Element and Interpolator

- Replica biasing
- Delay buffer
- Interpolator

Phase Picking

- Clock generator
- Multi-phase data receiver
- Data recovery

Phase-picking data recovery
Clock waveforms are oversampling the data stream
Cable properties

Frequency response
12-meter and 6-meter RG-55U

Time domain response of a square pulse into 12m cable

Predistorted Pulse

Unequalized
Equalization pulse
End of cable
4-PAM Data Eye