Eye-Skew Modeling and Mitigation in 4-PAM Modulated VCSEL Links with Data Rates above 50 Gbaud

Background

The vertical-cavity surface-emitting laser (VCSEL) is the light source of choice optical interconnect applications in datacenters. Directly modulated solutions over multimode fiber (MMF) provide low-cost, power efficient links in these massive hubs. As new standards emerge with lane rates exceeding 50 Gbps, 4-PAM is the preferred format for such interconnects. As this is a multilevel format, sampling of the lower, middle and top eyes are crucial for detection and demodulation. It has been shown that timing impairments are introduced in high data rate 4-PAM links, caused by the relatively slow and nonlinear modulation response in VCSELs (e.g. group-delay variation). These impairments ultimately complicate sampling and degrade the bit error ratio results in such links.

Objectives

The purpose of this project to initially identify all important parameters that affect the skewing of the received eye, such as the dependence on biasing conditions, spectral characterictics of VCSELs (singlemode vs multimode) or modulation parameters.

In the second part of the project, solutions for mitigating skewing should be investigated. This can involve many approaches, such as pulse shaping or equalization on the receiver side through modeling and simulation. Ideally an improved or novel method of improving eye characteristics will be the result of the project. The laboratories offer many options to experimentally demonstrate and verify ideas.

Content

- Writing planning report
- Literature study
- Understanding basic VCSEL optical performance characteristics
- Identify key parameters affecting VCSEL output eyes of 4-PAM
- Simulation of eye skewing and mitigation algorithms
- Optionally demonstrate results experimentally
- Writing a report
- Oral presentation
- Writing and submitting scientific paper (possibly, depending on results)

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