Parallel Optics Technology Assessment for the Versatile Link Project

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Abstract

This paper describes the assessment of commercially available and prototype parallel optics modules for possible use as back end components for the Versatile Link common project. The assessment covers SNAP12 transmitter and receiver modules as well as optical engine technologies in dense packaging options. Tests were performed using vendor evaluation boards (SNAP12) as well as custom evaluation boards (optical engines) designed by Fermilab engineers. The measurements obtained were used to compare the performance of these components with single channel SFP+ components operating at 850 nm over multimode fibers. In addition to the test results for these components, the design of custom hardware to serve as evaluation platforms for optical engine products will be described. This hardware is being designed by Fermilab engineers to operate in stand-alone bench tests as well as serving as a mezzanine card for a µTCA carrier board.

Summary

The Versatile Link project includes a work package for the assessment of suitable back end components (devices that do not reside within the harsh magnetic and radiation environments of the detectors). These components, wherever possible, should be selected from devices that are commercially available to take advantage of the developments led primarily by customers in the telecommunications market. In addition to single channel devices (in the SFP+ standard), Fermilab engineers are exploring possibilities in parallel optics modules to take advantage of the density and ease of handling of multiple channel devices. By using parallel modules and ribbon fibers, improvements in the board area needed for supporting modules and cable management can be gained.

One mature parallel standard is the SNAP12 standard with separate transmitter and receiver modules (12 channels each). This scheme nominally calls for operation at 2.7 Gbps but modules were procured and tested at 5 Gbps (to comply with the nominal Versatile Link rate). Data has been collected to characterize the performance of both the transmitter receiver modules for this standard. The data collected will be compared to the data from SFP+ single channel devices selected as reference components for multimode versions of the Versatile Link.

The SNAP12 standard, while mature, has some disadvantages in the manner in which devices are packaged and attached to the carrier boards. Driven by emerging 100 Gbps standards in the telecommunications industry, dense parallel optical engines are becoming part of vendor portfolios. As the standards have not yet converged, there are multiple options being offered by different vendors. One option has already been evaluated by Fermilab engineers. The promising results of that option have led to an initiative to continue the evaluation of other modules from multiple vendors. Fermilab has begun working with additional vendors to design evaluation platforms for the characterization of these additional components.

As part of its responsibilities to the Versatile Link project, Fermilab is tasked with making limited versions of optical component samples and evaluation platforms available to other members of the collaboration as well as interested customers of the Versatile Link. Since parallel optical engines are an integral part of the boards on which they are mounted, Fermilab has undertaken the effort to design demonstrator boards of optical engines. These boards will make use of the CAPTAN data acquisition system developed by our team (Ref 1) and come in two versions, each of which can operate stand-alone or as a mezzanine card on a

µTCA carrier board. One version will utilize gigabit transceivers available in FPGAs while the other version will utilize discrete commercially available SerDes devices to attain the highest bit rates at reasonable costs.

References:

[1] CAPTAN: A Hardware Architecture for Integrated Data Acquisition, Control, and Analysis for Detector Development, N70-3, IEEE Nuclear Science Symposium, 2008.