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Performance characteristics of COTS 10Gb/s Optical Links for SLHC Experiments

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We report on the evaluation of Commercial Off-The-Shelf (COTS) optical transceivers for use in future readout and control systems of upgraded detectors for SLHC. The critical performance metrics and operational constraints on the required inputs – notably the reference clocks –will be described. Measurements of these performance metrics on samples of COTS small form-factor XFP transceivers operating at line-rates of 10Gb/s will be reported.

Summary

The detector systems currently being produced and installed in the LHC experiments all rely heavily on the optical transmission of both readout and control data. Data rates for transmission between the counting rooms and the detectors currently reach up to 1.6Gb/s for radiation-tolerant data links. The upgrading of the LHC luminosity at Super LHC (SLHC) will lead to an increase of the particle interaction rate and thus to an increase in the amount of data to be transmitted by the detector readout systems. It is thus pertinent to assess the possibilities of increasing the data transmission speeds available on individual optical data channels. With the target of reading-out an upgraded Tracker of the CMS detector at SLHC, we have begun evaluation of commercial data transmission components operating at the emerging 10Gb/s data transmission protocols such as 10Gigabit Ethernet (10GbE).
Standardization within the telecom and datacom industry has led to a Multi-Source Agreement (MSA) for a small formfactor transceiver of type XFP. The XFP MSA Group has created a specification for a module, cage hardware, and IC interfaces for a 10 Gb/s hot-pluggable module converting serial electrical signals to serial optical signals.
The specification aims to be protocol-agnostic, operating over a range of bit-rates (9.95 –11.1 Gb/s). This range would allow the matching of rates derived from a 40MHz or 80MHz bunch-crossing frequency at SLHC.
The measurement protocols, including eye-diagram measurements, required to assess the performance of such highspeed data links will be outlined. These will be decomposed into measurements pertaining primarily to the system, the transmitter and the receiver parts. Data will be shown for COTS XFP samples. Finally, the requirements for operation will be outlined and compared to the typical environment found in currently implemented optical data transmission systems in HEP.

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