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System-level Testing of the Versatile Link Components

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During the first upgrade phase of the Large Hadron Collider experiments, high-speed optical links will be deployed to achieve the bandwidth needed to exploit the increasing luminosity and to allow data acquisition at higher rates. The Versatile Transceiver (VTRx) and Versatile Twin Transmitter (VTTx) modules are in their final development phase before production. They support different link architectures and offer compatibility with either single-mode or multi-mode fibre plants. This paper describes the supported link configurations and presents the system-level testing of the VTRx and VTTx front-end modules with various commercial-off-the-shelf back-end components.

Summary

The Large Hadron Collider (LHC) will be upgraded in multiple phases in order to achieve higher luminosity and to improve its physics performance. These periods offer unique opportunities for LHC experiments to perform the necessary maintenance and upgrade tasks allowing them to follow the evolution of the accelerator. As part of their upgrade programme, some detectors will deploy high-speed optical links during Long Shutdown 2 (2017-2018) to deal with the increasing data volume and higher trigger rate. To satisfy the bandwidth requirements and to cope with the on-detector radiation levels, the Versatile Link common project proposes link architectures based on radiation-resistant, low-mass and low-power front-end components, the Versatile Transceiver (VTRx) and the Versatile Twin Transmitter (VTTx) modules together with commercial-off-the-shelf (COTS) back-end components. The choice of these components depends on the architecture of the readout system as well as on the fibre plant (single-mode or multi-mode) already present in the experiments.

To support single-channel bidirectional as well as multi-channel unidirectional link architectures we have identified and tested COTS back-end devices that meet the Versatile Link system requirements. These candidate components are recommended for new optical systems designed to be compatible with the Versatile Link specifications. To verify the interoperability between existing VTRx/VTTx flavours and the selected COTS components, system-level tests have been performed. Apart from demonstrating feasibility, these tests were used to explore various options (e.g. optical cable type and length) and to quantify any incurred penalty on the link performance. They also allowed to measure parameters which are often not specified in device data sheets (due to the fact that the link may operate at a non-standard bit rate, e.g. 4.8 Gbit/s) or go beyond the original Versatile Link specifications. Finally, these tests enabled us to validate/verify optical link budget calculations carried out using parameters from the system specifications.

The paper will describe test systems based on high-end bench-top instruments and FPGA-based development platforms. We will present the results obtained from production-grade VTRx and VTTx devices linked with different back-end components.

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