Contribution ID: **115** Type: **Oral**

The 10G TTC-PON: Challenges, Solutions and Performance

Thursday 29 September 2016 12:00 (25 minutes)

The TTC-PON (Timing, Trigger and Control system based in passive optical networks) was first investigated in 2010 in order to replace the current TTC system, responsible for delivering the bunch clock, trigger and control commands to the LHC experiments. A new prototype of the TTC-PON system is now proposed, overcoming the limitations of the formerly presented solutions. A new upstream data transmission scheme relying on longer bursts is described, together with a high-resolution calibration procedure for aligning bursts in a time division multiplexing access. An error correction scheme for downstream data transmission is also depicted.

Summary

The TTC-system (Timing, Trigger and Control) is responsible for distributing the bunch clock, carrying the level-1 trigger accept decision and some control commands to the detector sub-partitions. The current system employs a unidirectional optical link multiplexing two channels at 40Mb/s each, and an external electrical link is employed to allow busy/throttle status signals propagation from the front-end buffers to the trigger control system.

An alternative for this system, based on FPGAs and passive optical networks (PONs) was initially proposed in 2010 in order to overcome the limitations of the current TTC-system (low bandwidth, lack of bidirectionality). Passive Optical Networks are a consolidated solution widely adopted by the telecommunication industry in the FTTx (Fibre to the X) premises for delivering high bandwidth to the subscribers. It is based on a point-to-multipoint optical communication system, which allows bidirectional data transmission in two different wavelengths. A master node, called OLT (Optical Line Terminal), broadcasts information to several slave nodes (downstream data transmission) and the slaves, called ONUs (Optical Network Units), send information back to the OLT in a time division multiplexing (TDM) scheme.

The original TTC-PON prototype, based on 1G Ethernet PON technology, was built in 2010 and fully characterized in 2012, when a set of metrics was adopted to evaluate the quality of the downstream and upstream data transmission schemes. In 2015 a new prototype based on the XGPON technology was built. However, it presented some limitations in the upstream data transmission scheme (very low dynamic range, very sensitive to temperature variations, need for customization of the commercial components) and in the downstream data transmission scheme (low split ratio with a safe margin). In addition, all the previously developed prototypes were using a single FPGA to emulate the full system. Even though the FPGA firmware was carefully partitioned, this solution was not close enough to the final application.

A new prototype was therefore implemented using individual Kintex-7 FPGA development boards (KC705 boards) for each node of the system, which are independently controlled via Ethernet. In order to overcome the limitations of the formerly proposed solution, a new upstream data transmission scheme consisting of longer bursts (125 ns) has been defined and a fine calibration procedure allowing high-resolution (0.417 ns) burst positioning has been implemented. In the downstream data transmission path, an error correction scheme is being developed in order to allow a higher split ratio. The challenges and proposed solutions of this new prototype will be presented together with a full characterization of the system.

Primary author: BRANDAO DE SOUZA MENDES, Eduardo (CERN)

Co-authors: SOOS, Csaba (CERN); KOLOTOUROS, Dimitrios Marios (University of Ioannina (GR)); VASEY, Francois (CERN); BARON, Sophie (CERN)

Presenter: BRANDAO DE SOUZA MENDES, Eduardo (CERN)

Session Classification: Optoelectronics and Links

Track Classification: Opto