Contribution ID: **91** Type: **Oral**

The lpGBT: a radiation tolerant ASIC for Data, Timing, Trigger and Control Applications in HL-LHC

Tuesday, 3 September 2019 11:55 (25 minutes)

The Low-Power Gigabit Transceiver (lpGBT) is a radiation tolerant ASIC for multipurpose high-speed bidirectional optical links in HEP experiments. It supports 2.56 Gbps for the downlink and 5.12 or 10.24 Gbps for the uplink. Its data interface to the detectors'frontends is highly configurable supporting multiple data rates. The lpGBT is a fixed and deterministic latency device that can be used for trigger and timing distribution. It features control interfaces and environmental monitoring functions to implement experiment control.
The device was fabricated in a 65 nm CMOS technology. This paper discusses the lpGBT architecture and experimental results.

Summary

The Low-Power Gigabit Transceiver (lpGBT) is a radiation-tolerant ASIC tailored to implement multipurpose high-speed bidirectional serial links in High-Energy-Physics experiments. It supports data transmission at 2.56 Gbps for the downlink (counting room-to-detectors) and at 5.12 or 10.24 Gbps for the uplink (detectors-to-counting room). It interfaces with frontend devices through an ad hoc electrical interface called eLink. This interface is highly flexible supporting multiple serial links with configurable data rates ranging from 80 to 320 Mbps for downlinks and 160 to 1280 Mbps for uplinks. Due to its fixed and deterministic latency design, the lpGBT can be used for timing distribution including precise trigger commands and clock signals. All 32 clock outputs are frequency programmable (40 to 1280 MHz) with four of those being additionally programmable in phase with 50 ps resolution.
In order to facilitate the usage of the chip in low mass systems, where lossy and low-bandwidth transmission lines are used, all eLink transmitters and receivers are equipped with programmable pre-emphasis and equalization circuits respectively.
For experimental control, the device features three I2C interface controllers and a General Purpose Input/Output 16-bit port as well as a master reset output. For environment monitoring, the device implements eight analogue inputs that can be read by a 10-bit ADC through a multiplexer. By combining two of the analogue inputs differential operation is also possible. Additionally, the analogue inputs can act as current sources at the same time as they are read by the ADC allowing, for example, to measure the voltage across a PT100 device used for temperature monitoring. Moreover, the lpGBT allows monitoring of its internal supply voltages and temperature. A programmable voltage output with 8-bit resolution and a 1 V reference voltage are also made available.
The lpGBT was fabricated in a 65 nm CMOS technology and uses radiation-hardening techniques for radiation tolerance to both TID effects and Single Event Upsets. The paper discusses in detail the lpGBT architecture and functionality. Extensive experimental results will be presented at the workshop.

Primary author: MOREIRA, Paulo (CERN)

Co-authors: FAES, Bram; HERNANDEZ MONTESINOS, Daniel (GBTx - BE Group); GONG, Datao (Southern Methodist Univeristy); PORRET, David (CERN); GUO, Di (Southern Methodist University); YANG, Dongxu; MO-

RON, Jakub (AGH University of Science and Technology (PL)); PRINZIE, Jeffrey (KU Leuven (BE)); YE, Jingbo (Southern Methodist University (US)); CARVALHO, Joao; FONSECA, Jose; MENDEZ, Julian Maxime (CERN); WYLLIE, Ken (CERN); SWIENTEK, Krzysztof Piotr (AGH University of Science and Technology (PL)); IDZIK, Marek (AGH University of Science and Technology (PL)); FIRLEJ, Miroslaw; PAULINO, Nuno; LEROUX, Paul (KU Leuven (BE)); VICENTE LEITAO, Pedro (CERN); GUI, Ping (Southern Methodist University (US)); SUN, Quan (Southern Methodist University); DE OLIVEIRA FRANCISCO, Rui (CERN); BARON, Sophie (CERN); BIEREIGEL, Stefan (BTU - Branderburg University of Technology (DE)); KULIS, Szymon (CERN); ZHANG, Tao; FIUTOWSKI, Tomasz Andrzej (AGH University of Science and Technology (PL)); ZHOU, Wei

Presenter: MOREIRA, Paulo (CERN)

Session Classification: ASIC

Track Classification: ASIC