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Readout and data acquisition in the NEW detector based on SRS-ATCA

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The Scalable Readout System (SRS) was defined by the CERN RD51 Collaboration as an scalable readout platform for a wide range of front ends. In 2014, SRS was ported to the ATCA (Advanced Telecommunications Computing Architecture) standard.

NEXT is an underground experiment aimed at searching for neutrinoless double-beta decay. NEXT-DEMO, a small-scale demonstrator, was read-out using SRS. NEXT has adopted SRS-ATCA for its first stage, called NEW. Our presentation will describe the readout, DAQ and trigger for NEW based on SRS-ATCA. This is, to our knowledge, the first experiment operating entirely on SRS-ATCA.

Summary

The Scalable Readout System (SRS), proposed in 2009, was developed in the framework of the RD51 Collaboration at CERN as a modular (6U 19" Eurocrate mechanics), scalable, multi-channel readout platform that could easily adapt to a wide range of front ends. The SRS has two main building blocks: the Front-End Concentrator card (FEC), a flexible front-end interface and data concentrator, and the Scalable Readout Unit (SRU), a second data concentrator stage intended for large scale applications. Both modules are based on FPGA and can interface the Data Acquisition (DAQ) PC farm via GbE links, thus reducing the DAQ and trigger systems to a network-based architecture. The FPGA in these modules allows to implement data processing in the DAQ chain and to customize the module functionalities and algorithms to target applications. Closer to the front-end, the use of DTCC links allow to carry clock, slow controls, trigger and data over copper (four LVDS pairs over off-the-shelf HDMI or RJ-45 cable) or optical fiber.

The FEC module, together with DATE (the ALICE Experiment DAQ environment, which supports the readout of the SRS modules through GbE) represents a suitable solution for the NEXT experiment and so the NEXT-DEMO detector, a small-scale demonstrator for NEXT, was readout using custom front-end electronics, SRS FEC modules and the DATE environment.

The ATCA (Advanced Telecommunications Computing Architecture) standard was adopted in 2013 by many experiments as a replacement for VME. In 2014, the SRS (an IP co-owned by CERN, Universidad Politécnic de Valencia and IFIN-HH Bucharest) was ported to the ATCA standard upon agreement with the German company EicSys. The ATCA-SRS FEC blade is functionally equivalent to the "classic" SRS FEC module, although the use of certified crates with built-in and redundant cooling, power and shelf management make it a more robust mechanical and electrical solution for prolonged operation in experiments.

NEXT has adopted SRS-ATCA for its first stage, called NEW. NEXT is an underground experiment aimed at searching for neutrinoless double-beta decay. NEXT technology combines an excellent energy resolution with tracking capabilities thanks to a combination of optical sensors: PMTs for energy measurement and SiPMs for topology reconstruction.

We have designed the front-end electronics for the tracking plane (which consists of close to 1800 sensors with a 1-cm pitch arranged in twenty-eight 64-SiPM boards) and made them compatible with SRS. A 12-link digital mezzanine has been designed to interface the front-end to the SRS-ATCA FEC blade. The front-end electronics for the energy plane (12 PMTs) are read-out via an ADC mezzanine plugged on the SRS-ATCA FEC blade.

DTCC links connect each SRS-ATCA FEC to the trigger module (another SRS-ATCA FEC), which receives trigger candidates, implements a reconfigurable trigger algorithm on FPGA and sends trigger accept commands to the FEC blades.

Our presentation in TWEPP 2015 will describe the readout, DAQ and trigger for the NEW experiment based on SRS-ATCA. This is, to our knowledge, the first experiment operating entirely on SRS-ATCA.

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