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Network Time Synchronization of the Readout Electronics for a New Radioactive Gas Detection System

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In systems with multiple radiation detectors, time synchronization of the data collected from different detectors is essential to reconstruct multi-detector events such as scattering and coincidences. In cases where the number of detectors exceeds the readout channels in a single data acquisition electronics module, multiple modules have to be synchronized, which is traditionally accomplished by distributing clocks and triggers via dedicated connections.

To eliminate this added cabling complexity in the case of a new radioactive gas detection system prototype under development at the French Atomic Energy Commission (CEA), we implemented time synchronization between multiple XIA Pixie-Net detector readout modules through the existing Ethernet network, based on the IEEE 1588 precision time protocol. The detector system is dedicated to the measurement of radioactive gases at low activity and consists of eight large silicon pixels and two NaI(Tl) detectors, instrumented with a total of three 4-channel Pixie-Net modules. Detecting NaI (Tl)/silicon coincidences will make it possible to identify each radioisotope present in the sample. To allow these identifications at low activities, the Pixie-Net modules must be synchronized to a precision well below the targeted coincidence window of 500-1000 ns. Being equipped with a 1588 compatible Ethernet PHY that outputs a locally generated but system-wide synchronized clock, the Pixie-Net can operate its analog to digital converters and digital processing circuitry with that clock and match time stamps for captured data across the three modules. Depending on the network configuration, the implementation is capable to achieve timing precisions between 300 ns and 200 ps.

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Description

Net Time sync

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