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A light and reliable software solution for data processing tasks within the underwater vessel in Hyper-Kamiokande

One of the requirements of the front-end electronics in the HK experiment is that it must be designed to be placed inside the water vessels due to the detector size, which amounts to a total of ~40,000 inside photo-sensors. Otherwise, the cables connecting to the roof would be too heavy and long, which would cause a reduction in signal amplitude and quality degradation. This solution poses several challenges, one of them being the inability to replace, maintain or repair a broken module easily. Thus, the system must have mechanisms that increase its fault tolerance such as redundant components and failure control mechanisms.
To overcome this problem, the front-end electronics will be placed inside the water, close to the photo-sensors allowing for shorter and lighter cables.
The aim of this talk is to discuss a reliable software solution that performs all the required tasks for processing the data acquired by the digitizer from the PMTs and send it to an external datacenter: (1) Manage the data coming from the digitizer ensuring that it is correctly buffered in the DPB (Data Processing board) main memory (2) Read the buffered data, package it in a TCP/IP frame and send it through a redundant fiber optics link. (3) Receive timing information for timestamping and clocking purposes and send it reliably to the digitizer (4) Redundant system boot up and remote access to ensure 24/7 operation and perform firmware updates.
The chosen system will be a DPB sporting a state-of-the-art Xilinx FPGA-based architecture: Zynq Ultrascale+, where a powerful ARM64 CPU is combined in the same silicon die with FPGA cells to bring both flexibility and power to instantiate any hardware core that suits the needs of the experiment without compromising compatibility with Linux, the chosen embedded operative system to support these software tasks.

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