Data Acquisition System and Network Scheme of the ICAL experiment

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The India-based Neutrino Observatory (INO) collaboration is planning to set up a magnetised Iron CALorimeter (ICAL) detector to study atmospheric neutrino oscillations with precise measurements of oscillations parameters. ICAL detector will use 50kton low carbon steel as target mass and about 28,800 single gap Resistive Plate Chambers (RPCs) of about 2m × 2m in area and operated in the avalanche mode as its active detector elements.

Each RPC has 64 X- and 64 Y-strips which may fire if a charged particle passes through the RPC. These signals are amplified and digitized by pre-amplifiers and discriminators, mounted very close to the RPC. These signals are processed by a dedicated module present in every RPC, called the RPC-DAQ module. The primary function of the RPC-DAQ is to collect and process the RPC data, package it and transmit it to the backend via a TCP-IP based network interface. The RPC-DAQ module is thus the backbone of the data acquisition system of the ICAL. A soft-core processor, interfaced with a network interface is also part of the module. A considerable part of the RPC-DAQ module hardware including the processor is implemented inside an FPGA. The RPC-DAQ module also collects ambient parameter information as well as RPC health parameters like RPC high voltage and chamber current. For the purpose of communication and data transfer between the RPC-DAQ and the back-end, the former is configured as a network element with a unique IP number. Thus the entire ICAL detector becomes a large Ethernet LAN. This network interface for the RPC-DAQ is interfaced using an ASIC based TCP-IP hardware stack from Wiznet, the W5300. The W5300 provides a host interface for interfacing with an OS-less system making it ideal for this application.

Design aspects and detailed prototype studies of this work will be presented.

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