DAQ Consortium Deliverables

# Introduction

The idea of this document, as also pointed out in the previous DAQ consortium Deliverables document, is to have a common DAQ Consortium for both single phase and dual-phase technologies.

The description of the DP specific digital FE electronics is contained in the Front-End electronics DP Consortium Deliverables document. The DP digital FE electronics deals with the digitization of both charge and light signals. The digitization is performed in high channels density AMC cards hosted in uTCA crates. The crates are then connected to the DAQ system with 10 or 40 Gbit/s Ethernet optical fiber links. A White Rabbit slave node card is also inserted in each uTCA crate for timing/trigger distribution on the backplane of the crate to the AMCs.

The charge readout FE digital system is designed in order to support **continuous, non-zero-suppressed, zero-loss-compressed readout** of 3m long charge readout strips, arranged in two collection views of 3 mm pitch on the anode PCBs of the Charge Readout Planes (CRPs). Similarly the light readout FE system can produce high bandwidth data and also issue light triggers transmitted via the White Rabbit network. The readout granularity corresponds, per 10 kton module, to 153600 charge readout channels and a few hundred light readout channels. The DAQ system common to SP and DP should as well be capable of supporting this high data bandwidth from the FE electronics.

The DAQ system, common to both single and dual phase, is expected to be a network based DAQ system capable of:

1. Collecting this high bandwidth data volume coming from the data links of the FE crates
2. Putting together the data streams from different crates in regions of interest or over the entire detector volume
3. Processing this data flow on an online processing farm in order to select relevant events to be recorded on disk: neutrino beam, and off-beam events.
4. Producing charge readout triggers independently on the light readout triggers and beam spill information. In particular triggers over a sliding timing window of about 10 seconds may be issued by the farm for the search of SN neutrinos on the basis of the presence of low energy depositions, in order to dump on disk the entire content of the SN trigger sliding time window.

It is assumed that the DAQ system will be constituted by a set of event building machines, high performance network elements, an online computing farm and a high bandwidth distributed storage system based on an array of storage servers operating in parallel. An example of such architecture, inspirational to the one still to be developed for the DUNE FD SP and DP DAQ system, can be obtained from the DAQ backend architecture actually foreseen at EHN1 for protoDUNE-DP. That system is already designed to be capable of supporting with a data bandwidth of 20 GByte/s.

The following list of deliverables is identical to the generic list already compiled for the SP, which was already generic enough to cover both technologies, with the addition of a requirement on the presence of a White Rabbit backbone network.

# Hardware Deliverables

## Timing & fast control system (allows, among other features, to tag specific time ticks with information about external systems that fired, for calibration, testing, classification, … purposes). **For compatibility with the DP FE electronics the timing and fast control system should include a White Rabbit (WR) network backbone: a GPS timing source; a Grand Master switch; a chain of slave switches to feed the FE White Rabbit slave nodes hosted in the uTCA crates; a WR time-tagging card used to time-stamp external electric signals for calibration triggers. All these parts constituting the WR network backbone are off-the-shelf commercial components.**

## Readout system [For TPC and Photon Detectors]

## DAQ network

## Data selection system (may be one or more systems and include custom and/or commercial hardware)

## Storage system

# DAQ Software Deliverables

## Timing & fast control system fw & sw

## Readout system fw & sw

## Data selection framework fw & sw

## Data selection algorithms

## Data flow system (readout, messaging, event building, event dispatching and storage)

## Run control system (finite state machine, command distribution, user interface)

## Software Process management

## Automated error/anomaly detection and handling

## Operational monitoring system (gathering, archiving, visualization)

## DAQ network monitoring

## Configuration system (databases, configuration distribution, archiving, editing tools)

# DAQ Simulation Deliverables

## Readout system simulation

## Event selection simulation (incl. triggering)

## Overall data flow simulation

# DAQ Emulator Deliverables

## Detector(s) emulator(s)

## Event selection feeder (data source emulation)

# Physics Deliverables

## Online data monitoring and event display

## Data selection performance

## Data taking efficiency monitoring

# Integration Deliverables

## Support to integration with TPC

## Support to integration with PD

## Support to integration to other detectors (e.g. muon tagger)

## Integration DAQ – accelerator signalling

## DAQ Integration test-bed setup and maintenance (evolving to control & administration of final installation later)

## DAQ geographical layout, powering, cooling, cabling and cable maps

## Event formats and decoding libraries

## Software management and version control management

## Documentation management

## Installation/Commissioning management and planning (future)