Proposal for a training week on White Rabbit solutions for SBN Program at Fermilab

Motivation

The Short Baseline Neutrino (SBN) Program at Fermilab foresees the deployment of 3 liquid Argon Time Projection Chamber (LAr-TPC) detectors along the Booster Neutrino Beamline (BNB) at Fermilab, at 110 m, 470 m and 600 m from target respectively, to study neutrino oscillations over short baselines and investigate possible existence of a fourth sterile neutrino states.
At the same two of these detectors will study interactions of neutrinos coming from another beam-line (NuMI).
Operations are expected to start in 2018, lasting 5 years at least.

Being the detectors based on the same technique, they have common requirements on synchronization of the sub-detectors (PMTs for detecting scintillation light, TPCs for collecting ionization charge and external scintillation counters for tagging particles entering the detector) with each other and with the beam extraction signals coming from the RWM counters. This should be at the ns level in order to exploit the bunched beam structure of the beam for rejecting the spurious triggers caused by cosmic rays entering the detector in coincidence with the beam gate signal.
A timing distribution system based on White Rabbit (WR) would excellently fulfill this need, giving alongside the interesting option of distributing the trigger system through the same infrastructure.
Therefore the scope of this training is to give the opportunity to the team working on the timing distribution system to discuss with the experts the optimal layout and a plan for commissioning and maintenance.

It should be pointed out that the middle detector (MicroBooNE, located at 470 m from target) is already taking data with a custom timing distribution system, and an upgrade to the WR system is not an option for the time being.

Time-stamping

One of the basic needs is the time-stamping of each clock (RWM's and PMT, TPC and CRT digitizer's for each detector) with respect to a common reference one.
Here is a list of the topics we would like to cover during the training.

1) Which considerations should me made when choosing the type of master clock and its physical location? Do you suggest to have a GPS-locked system even if no information on the absolute timing is needed?
2) Is the distribution of a pps enough (or even preferred)?
3) Is it more appropriate plugging the WR TDC boards at the level of the front-end digitizers or would it be enough at the level of the DAQ nodes? Would it be possible to have different approaches for different sub-systems?
4) Become familiar with the operation of VME, PCi-e and possibly PXi-e TDC boards.
5) Although the WR is supposed to be self-calibrating, is there any set of parameters that should be looked at in order to ensure the correct operation along the 5 years? Is any additional calibration suggested?

Triggering

There is some interest in investigating the possibility of using the WR network also for distributing the trigger signal.
Even though we do not mean to enter into the details of this issue during the training, it would be worthwhile pointing out the requirements on the detector side, in order to get some suggestions and feedback from the experts, even at a later stage.

Organization

We expect 5 SBN persons to be present at CERN for attending the workshop:

- Angela Fava
- Cat James
- Donatella Torretta
- Igor Kreslo
- Wesley Ketchum

And 3 more connecting from remote:

- Erich Church
- Georgia Karagiorgi
- William Badgett

Is there the possibility to organize some “hands on” session with a basic WR set-up for time-stamping? Possibly with all 3 mezzanine card types (VME, PCi-e and PXi-e).
If so, it would be preferable dedicating the mornings to the hands-on, in order to give the possibility to people in the US connecting to the brainstorming sessions.

There is full availability, on the SBN participants side, from the afternoon of Monday, October 3rd to the morning of Friday, October 7th . We rely on expertise of the CERN group to suggest a possible agenda.