SBND T-1053 DAQ Meeting

A few comments on SBND/Neutrino Test Stand area at DAB and White Rabbit

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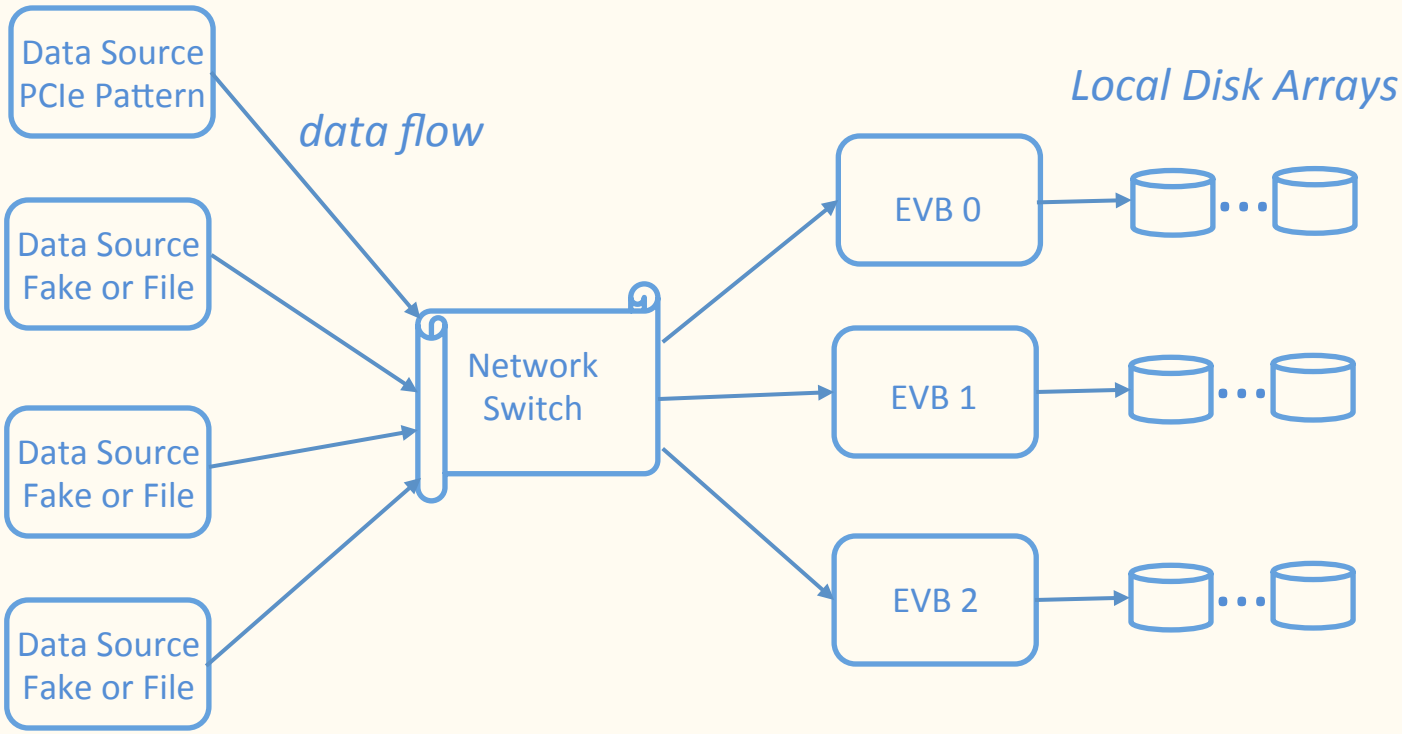
Neutrino Division DAB Test Stand Room

- Room 313 at DAB, “The Annex”, “µBooNE Annex”, just east of D0 Hurricane Deck
  - Recently housed µBooNE Chimney, DUNE 35 ton, ANNIE (ongoing)
  - Informally the Neutrino test area, formalized per agreement with PPD on November 6, 2015 – my ND group has formal control now
  - Linda Bagby acting coördinator, *tbc*
- Based on past experience, will be undergoing electrical refurbishment soon
  - More power and more types of sockets than you can dream of
- Legacy test stands and other misc. equipment to be cleaned out
  - µBooNE test stand decommissioned (?) – can the chimney be removed?
- Beginning plan for future Neutrino test stands SBND, Icarus, …

SBND Activity at DAB

- Plans for SBND at DAB Room 313
  - Will house vertical slice chimney > 1 year
  - Implement DAQ part of test stand now, in parallel with PNNL activity
- Hardware available
  - Geoff has procured there server class computers, retired from FCC
  - Have essentially unlimited number of thin worker type servers available – unfortunately noisy, placement should be flexible
  - One Phenix PCIe card borrowed from Leslie
- Propose to use DAB computing as test bed for ArtDaq multiple aggregator / event builder configuration
  - Use server class comps as event builders
  - Good probability this feature will be needed for high rates at SBND
  - Avoid duplicating effort at PNNL
  - Can spin patterns from PCIe card and fake data from worker nodes

ArtDaq EVB Testing at DAQB



Initial work to concentrate on event distribution and building logic rather than through-put rate and latency measurements

Thoughts about White Rabbit Timing System

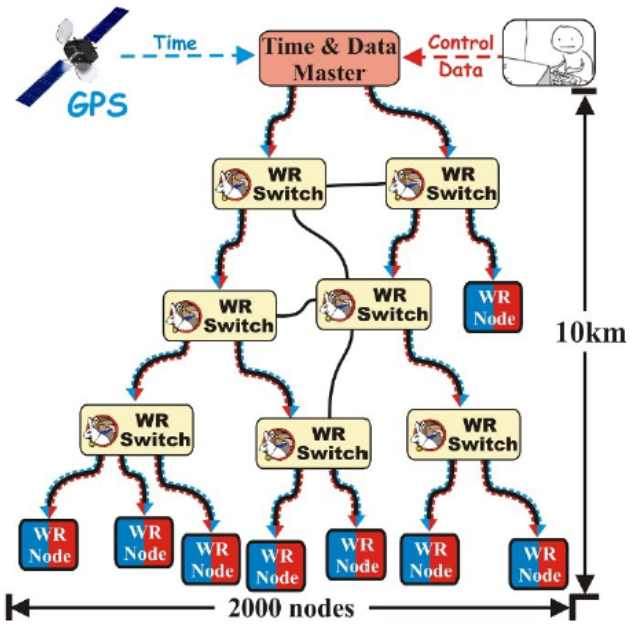
- Introduced by Eric two weeks ago
- Interesting documents about White Rabbit Timing Distribution
  - http://icalepcs.synchrotron.org.au/ click on "WEC3 Timing and Sync"
    - Recent ICALEPCS conference, topic CERN+LHC
  - http://www.ohwr.org/projects/white-rabbit
    - Open hardware project description
  - https://espace.cern.ch/be-dep/CO/ICALEPCS 2009/1158 The White Rabbit Project
    - Nice overview, with some CERN LHC specifics
  - http://accelconf.web.cern.ch/AccelConf/ICALEPCS2013/papers/thppc092.pdf
    - White Rabbit used at FAIR
- + other experimental physics uses…

White Rabbit, ICALEPCS

White Rabbit – A quick recap

3

- **Based on Gigabit Ethernet**
  - > 2000 nodes in a network
  - > 10 km distance (single mode fiber)
  - All nodes synchronized to less than 1 ns
  - With jitter of < 20 ps
  - Deterministic data transfers
- **Data and timing in the same network**
- **Using standards:**
  - IEEE1588 (Precision time Protocol)
  - Synchronous Ethernet
- WR PTP Core: embedded WR stack
  - Single VHDL module
  - Provides 125 MHz, PPS and TAI time
  - ... and Ethernet MAC functionality



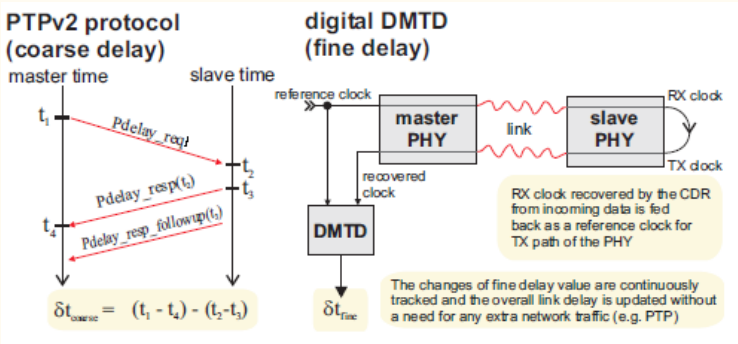
T. Włostowski, et al, ICALEPCS 2015 Proceedings WEC3O01

T. Włostowski
Trigger and RF distribution using White Rabbit

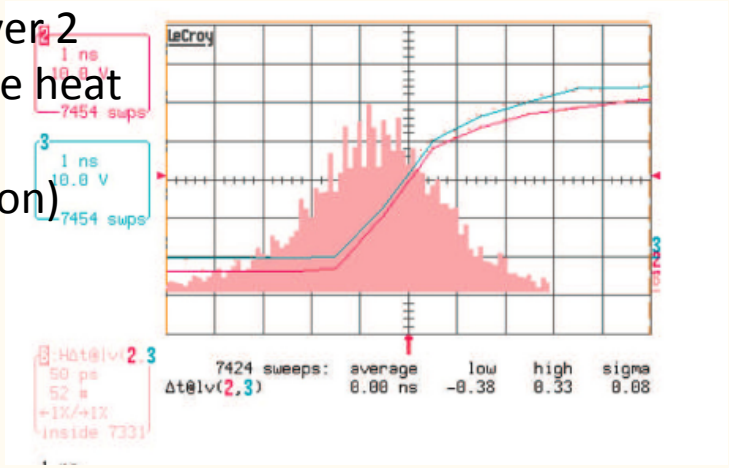
White Rabbit Advantages

- An open hardware and software standard
  - Multiple vendors, reasonable cost
- Used or will be used (LHC, DUNE) by particle physics experiments
  - Developed and supported by people we know
- Uses industry standard synchronous Ethernet and PTP
- ~ 1 ns accuracy over 10 km (compare to our ~ 1 km) with small jitter
- Continuously correcting for variable latencies, especially over fiber
  - WR impervious to extreme temperature variations
  - Thermal effects significant in long fibers, especially in our extreme climate at FNAL

PTP IEEE 1588 Logic Diagram



Latency jitter over 2 km with extreme heat application (50 ps per division)



White Rabbit at SBN

- Time matching between near, (middle) and far detectors critical with common beam line
- Why not use a common White Rabbit Time Grant Master?
  - Requires long distance fiber underground from GPS interface to the two (three) experiments ~ < 1 km
  - On the order of 2 WR synchronous Ethernet switches per experiment
  - One PCIe card or equivalent for all end points that need the time
- GPS absolute time for Super Novae
- If GPS has problems, still have common local synchronous clock
- Can we get SBND and Icarus on board?
- µBooNE in future?
- Can use existing GPS antenna at D0 for testing (assuming it is still there)

- Note: CosyLab representative here November 11, 2015 at 9 a.m. in the Huddle (AD Cross Gallery) – timing and control systems.