Timing Distribution System (TDS)

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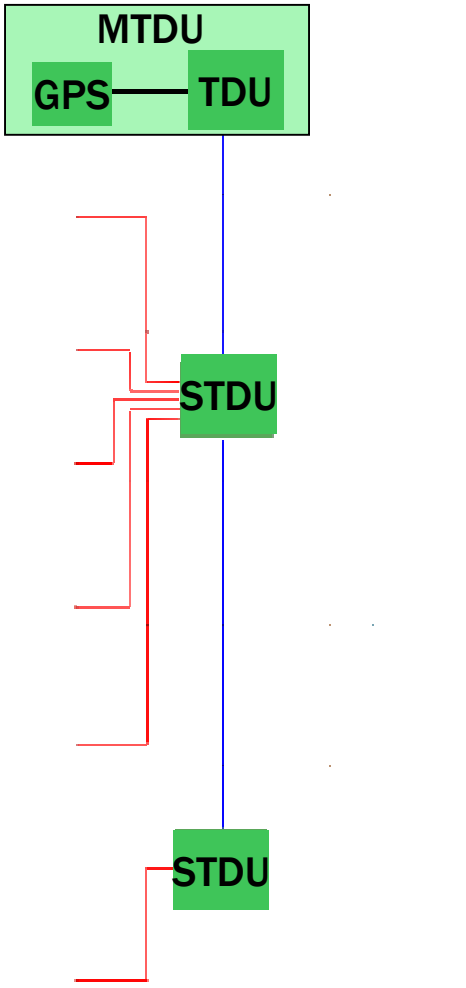
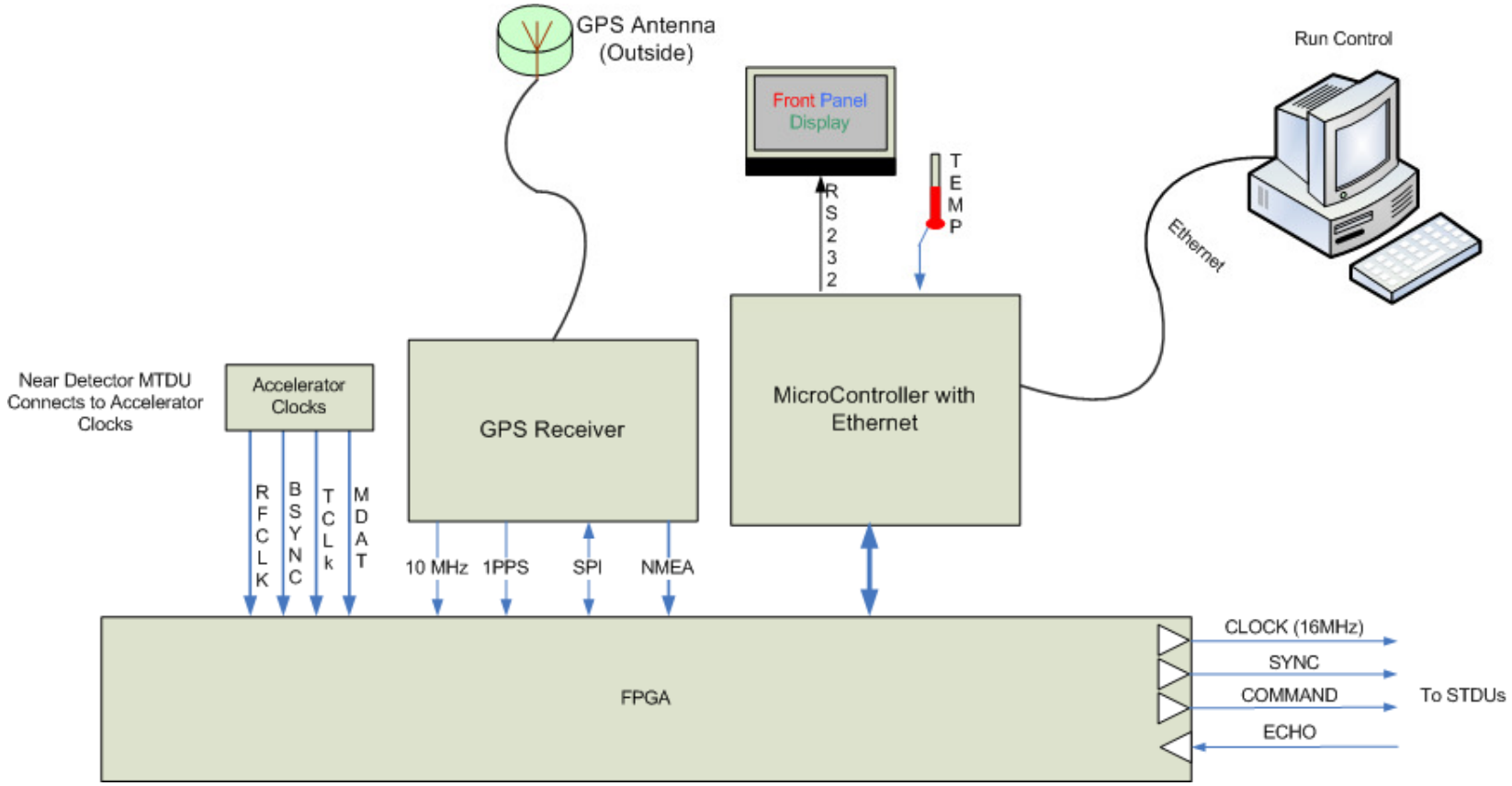
NOvA Timing Distribution System Features

- Distributes system clock and synchronizes time stamp registers of all DAQ devices on detector.
- All timing system links are CAT5e cables except Near Detector MTDU to STDU1 (need fiber to go the 200 or so meters).
- Configurable and monitorable via DCS.
- DCMs have two clock system interfaces, so a complete redundant clock system can be deployed if desired.
- Can correct for cable delays using TOF/2 method if desired.

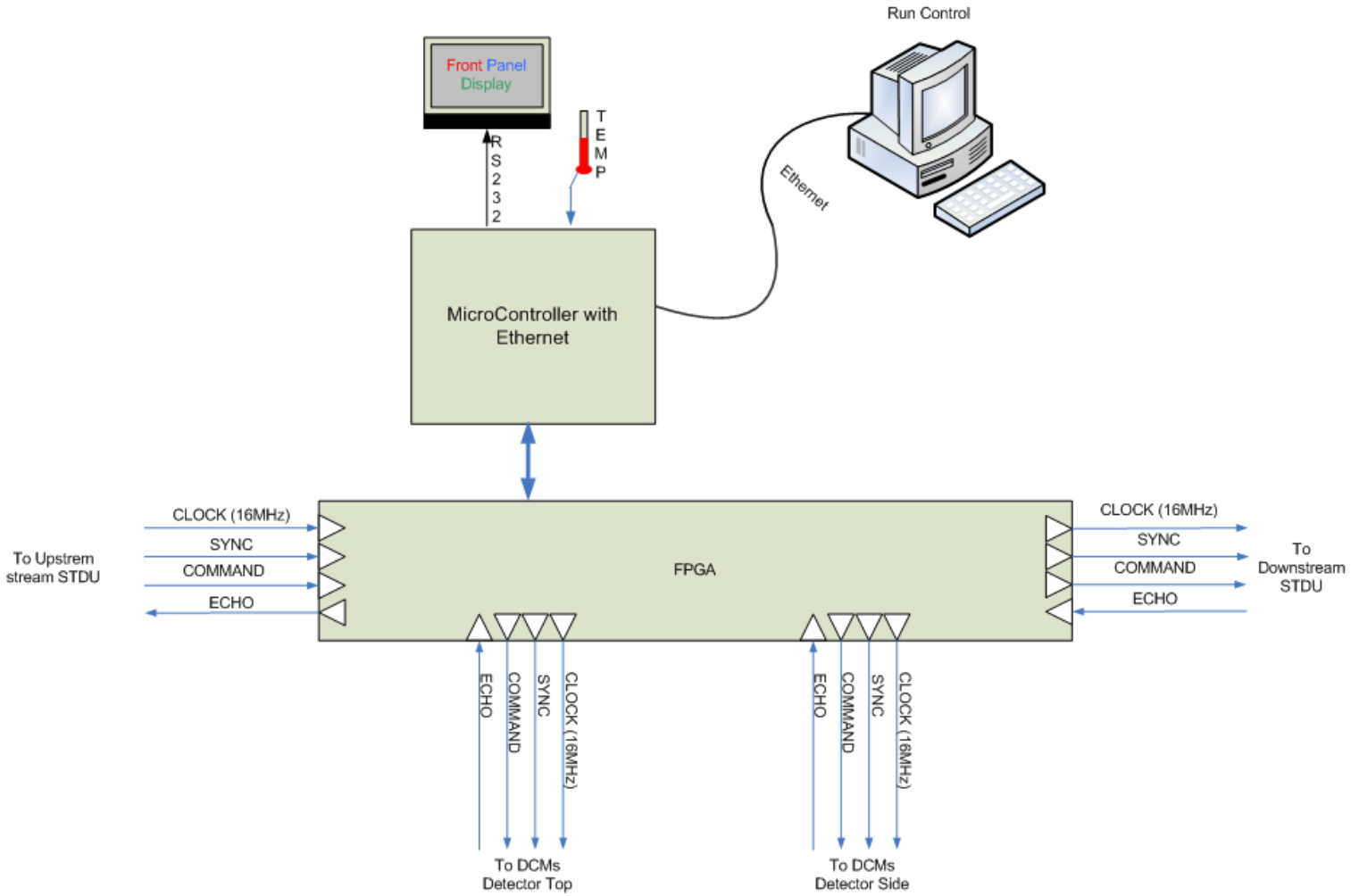
TDS to DAQ System



Master Timing Unit



Slave Timing Unit



Some Functional Details

- Timing system's main connection to DCS is to MTDU via Ethernet.
- Timing critical commands are transmitted to system from MTDU through timing links.
- Timing critical events are synchronized with SYNC signal on timing links (generated by MTDU).
- STDU can be queried for status via Ethernet, but cannot inject commands or SYNCs.
- MTDU and STDU firmware remotely loadable via Ethernet.

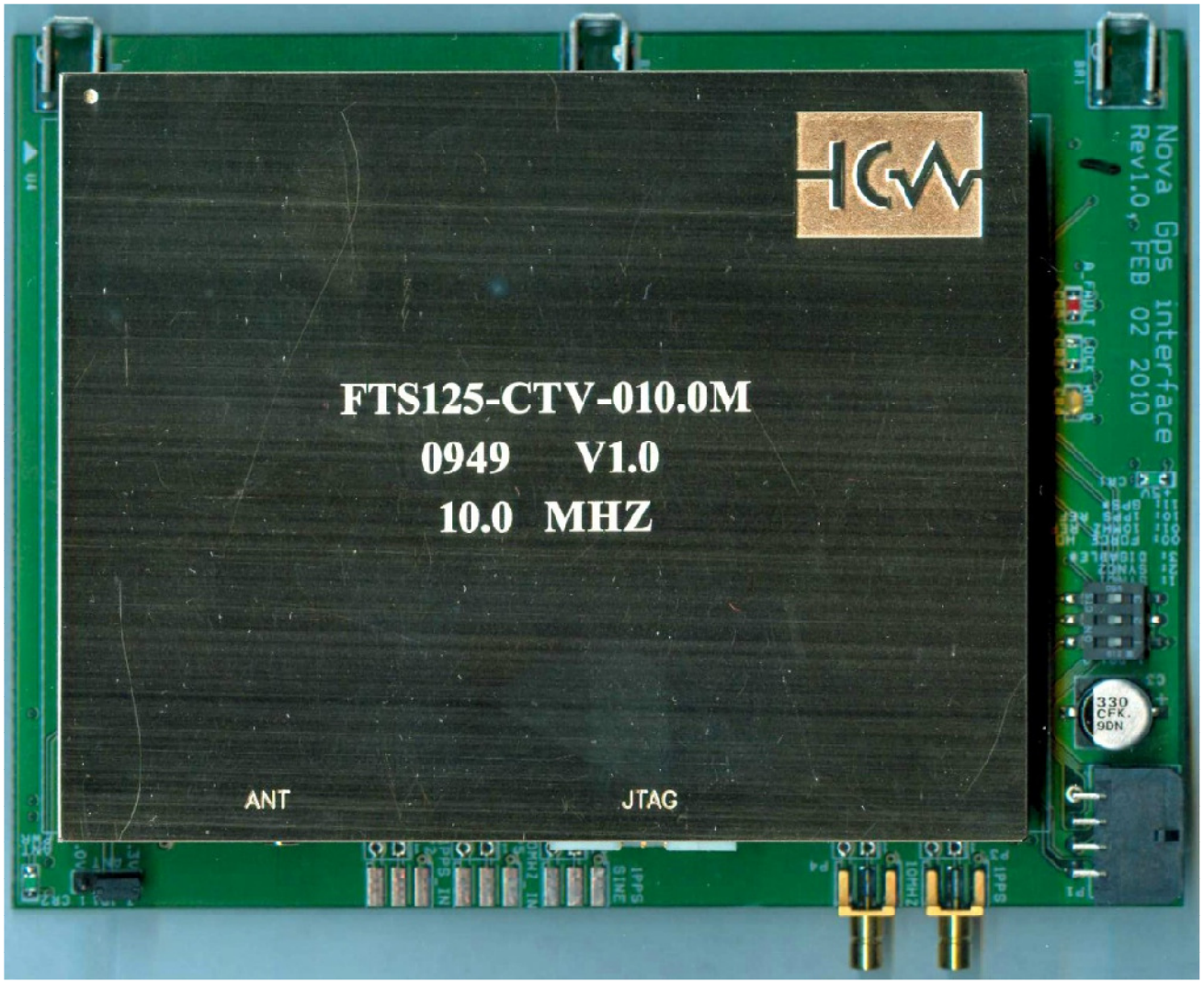
On System Startup…

- MTDU put into “Delay Learn” mode.
  - Transmits a SYNC pulse to slaves.
  - Measures time of round trip via ECHO signal.
  - All STDUs and DCMs do the same.
- MTDU synchronizes timing registers in all DAQ devices.
  - Transmits Timing Register Preset command.
  - Issues SYNC to start Timing Counter on all devices on the same clock cycle.
- MTDU issues command(s) to set mode in all DCMs and FEBs.
  - FEB and DCM control registers write accessible via timing link.
- MTDU periodically issues a Timing Register Verify command as a sanity check.

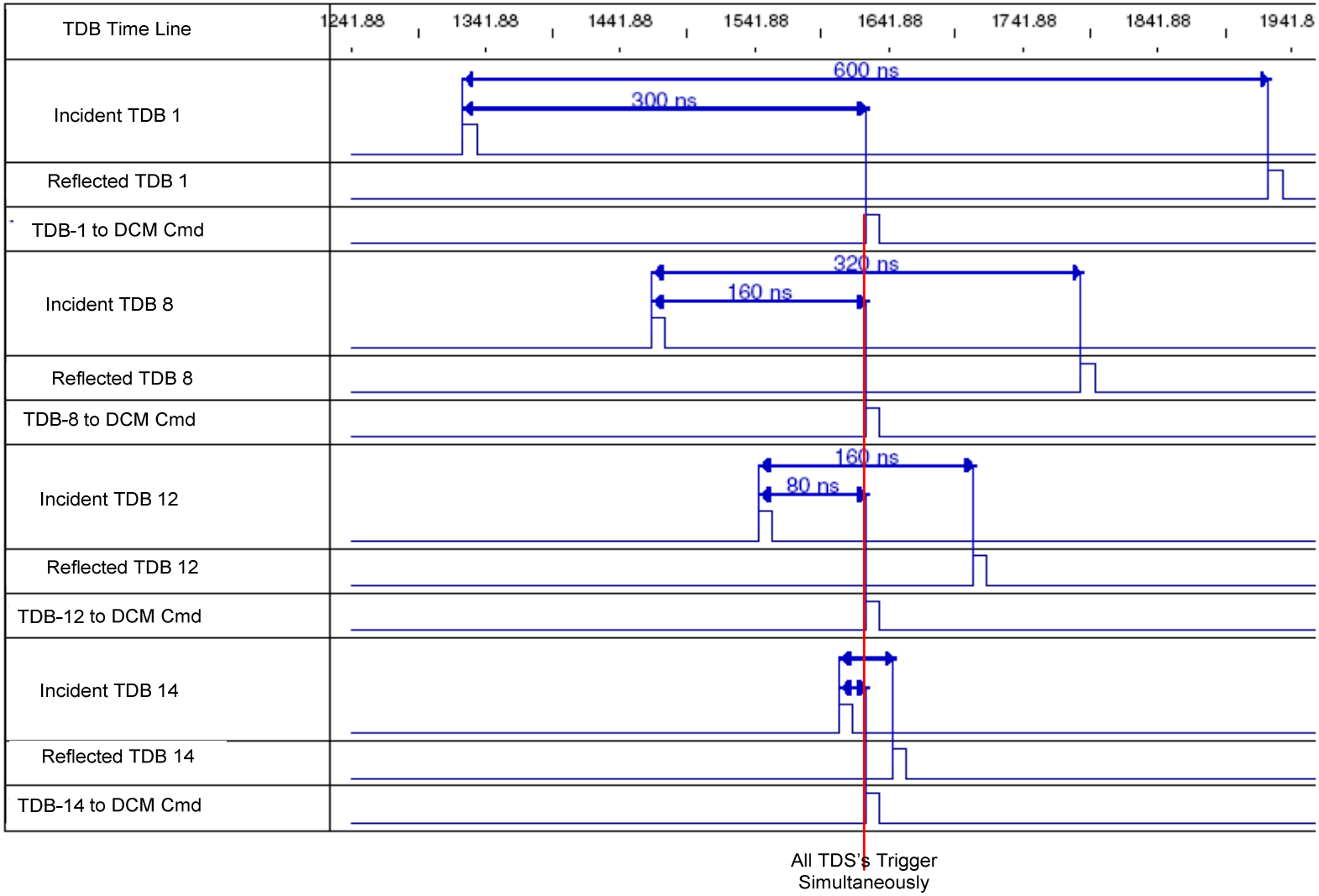
MTDU


NOvA
TDU Master
GPS IN
SFP MODULE
GPS LOCK
LINK
ERROR
TCLK
MDAT
BSYNC
RFCLK
PPC HOST PORT
TIMING CHAIN IN
TIMING CHAIN OUT
TIMING OUT TOP
TIMING OUT SIDE
ARM HOST PORT

GPS Module


FTS125-CTV-010.0M
0949 V1.0
10.0 MHZ
ANT
JTAG
Nova Gps interface
Rev1.0 FEB 02 2010

TOF/2 (Time of Flight / 2)



Schedule & Summary

- We have two assembled prototype TDU modules (STDU and MTDU use same board). Hardware is working.
- We have four GPS units and four antennas.
- We expect to have two assembled CPU daughter boards and two more TDU modules by end of month.
- For NDOS we will need:
  - One Master Timing unit.
  - One CPU daughter board.
  - One GPS module and antenna.
  - 1 Slave Timing Distribution unit (two would be nice).
- We expect to have firmware working that will be functional but may not be 100% feature complete.

Timing Distribution System (TDS)

Questions?

Supporting Notes

- Following are notes of the above slides

Master Timer

- Incorporates a common view GPS trained clock generator with a time-stamp counter.
- Capable of decoding Fermilab beam timing signals (RF-Clk, BSync, TClk, MDat).
- Capable of broadcasting time-of-day and time-stamp to Far Detector (100Mb ethernet).
- Provides a USB slave port (alternate computer connection).
- Provides repetitive timing & control packets to downstream distribution boxes.
- Measures & stores roundtrip time-of-flight of timing commands.

Timing Distribution Unit

- Coherent timing along the backbone of the detector.
  - Timing is referenced to the far-end cable loopback.
  - Synchronization is within +/- 1/2 clock cycle (16.834Mhz).
- Synchronization is based on the roundtrip time-of-flight of timing packets.
  - Digital equivalent of the time-of-flight of a reflection on a coax cable using a Time Domain Reflectometer.
  - Time-of-flight measurements are stored for later readout.
- Propagation delays are self compensated
  - No need to match cable pair lengths (xmt & rcv)
- Distributes Clock, Timing & Control commands to DCMs

Timing Distribution System (old design)