protoDUNE WIB software

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DUNE WIB meeting

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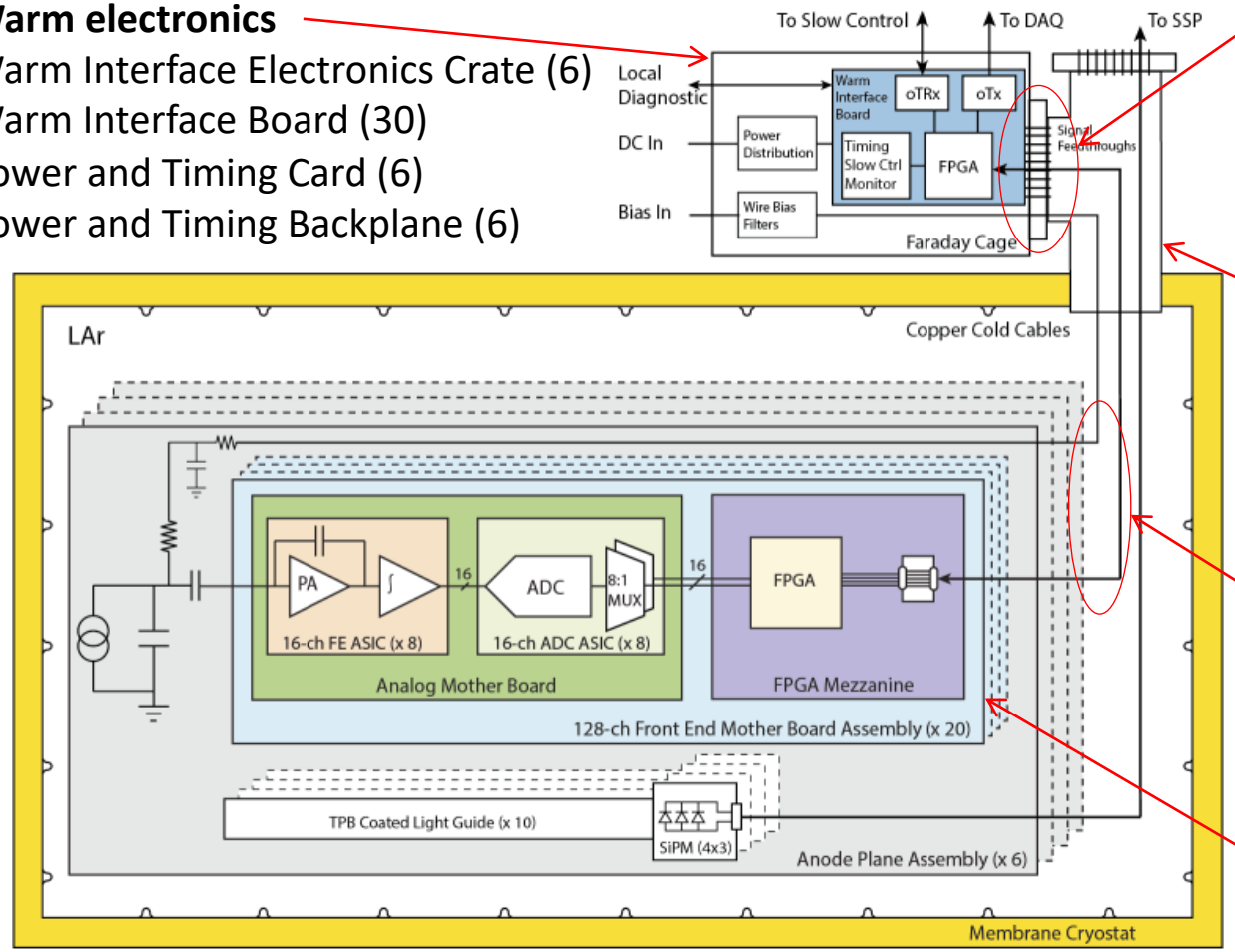
protoDUNE Cold Electronics

Warm electronics
Warm Interface Electronics Crate (6)
Warm Interface Board (30)
Power and Timing Card (6)
Power and Timing Backplane (6)



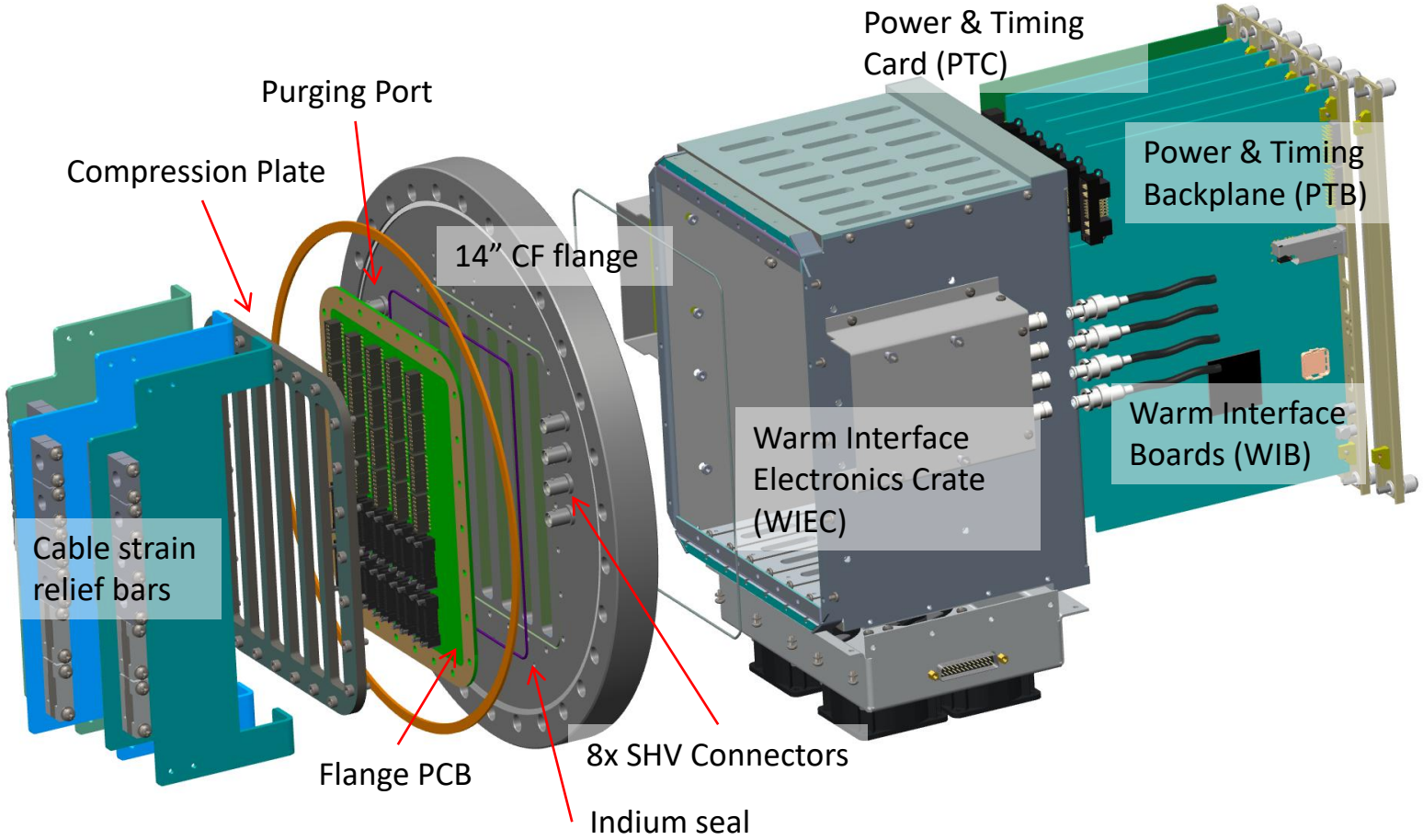
CE flange
Flange assembly with cable strain relief and flange PCB for cable/WIB connection (6)

Signal feed-through
Tee pipe with 14” Conflat flanges and crossing tube cable (CTC) support (6)

Cold cable
LV and data cable (120+120) to FEMB and APA wire-bias SHV cable (48)

Front End Motherboard
(FEMB) 128 channels of digitized wire readout enclosed in CE Box (120)

CE Warm Components



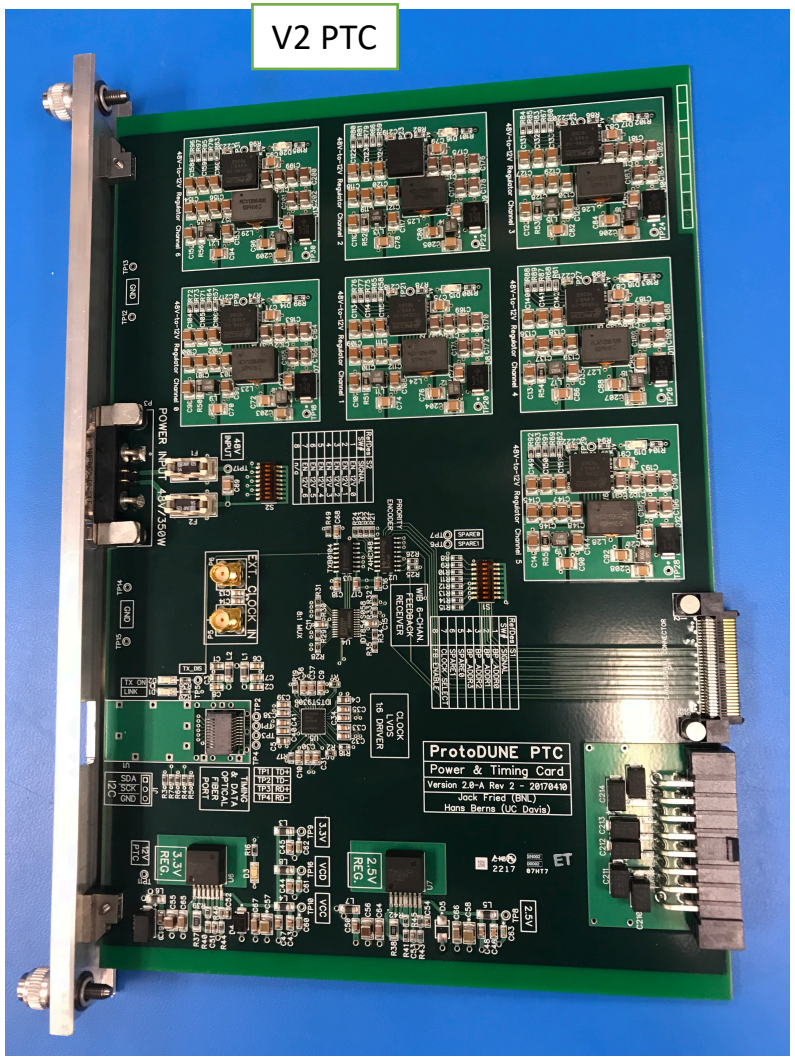
CE flange and WIEC are a single assembled unit

PTC/PTB

- PTC: design collaboration between BNL and UC Davis (H. Berns)
- Inputs
  - 48V power from DC supply
  - Timing signal (including return path from individual WIBs)
- Outputs
  - 12 V and timing signal fanout over passive backplane
  - Crate location for WIB IP address:

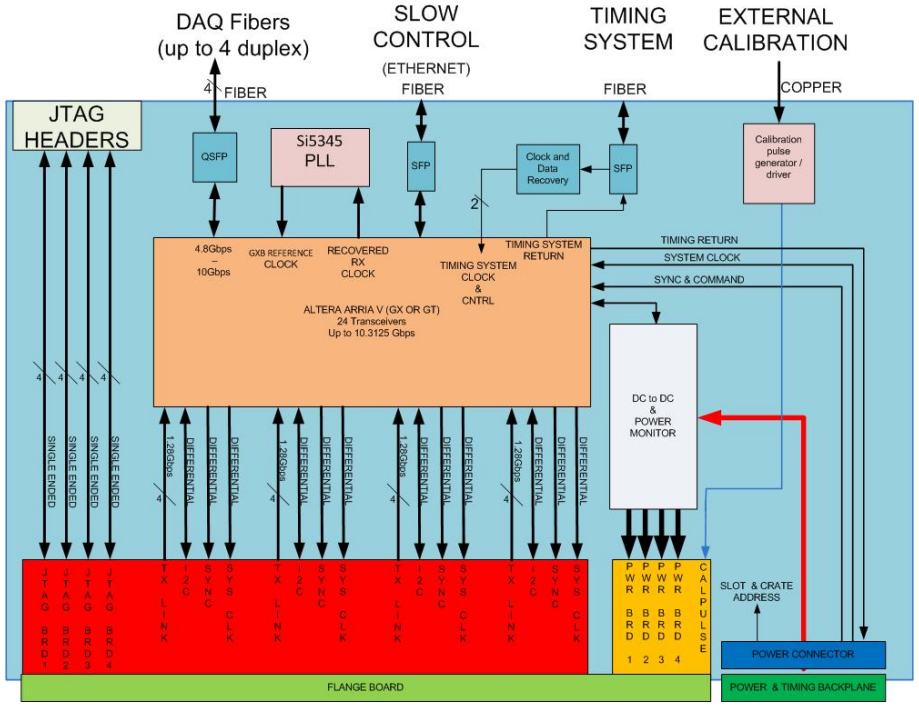
https://docs.google.com/document/d/1gTWQ8o0j5eLqMWQ2_qdFCAeU2HQu0Fvyct5JglauJLI

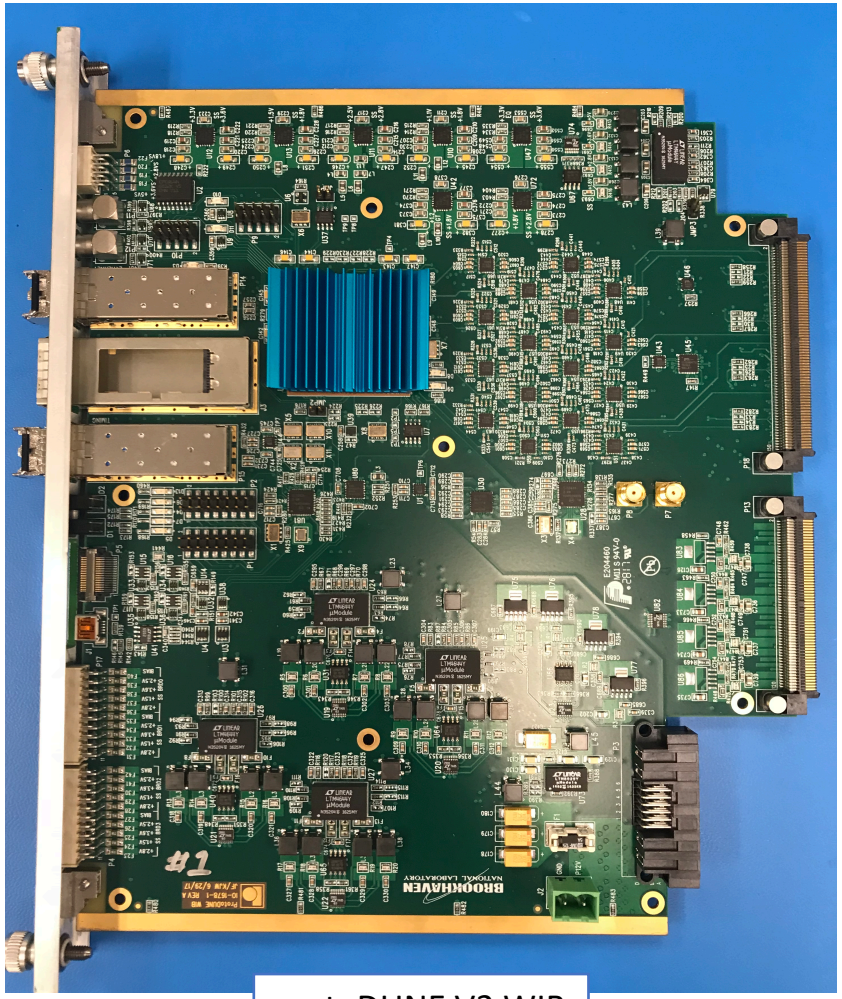
- PTB: passive backplane in WIEC



protoDUNE WIB

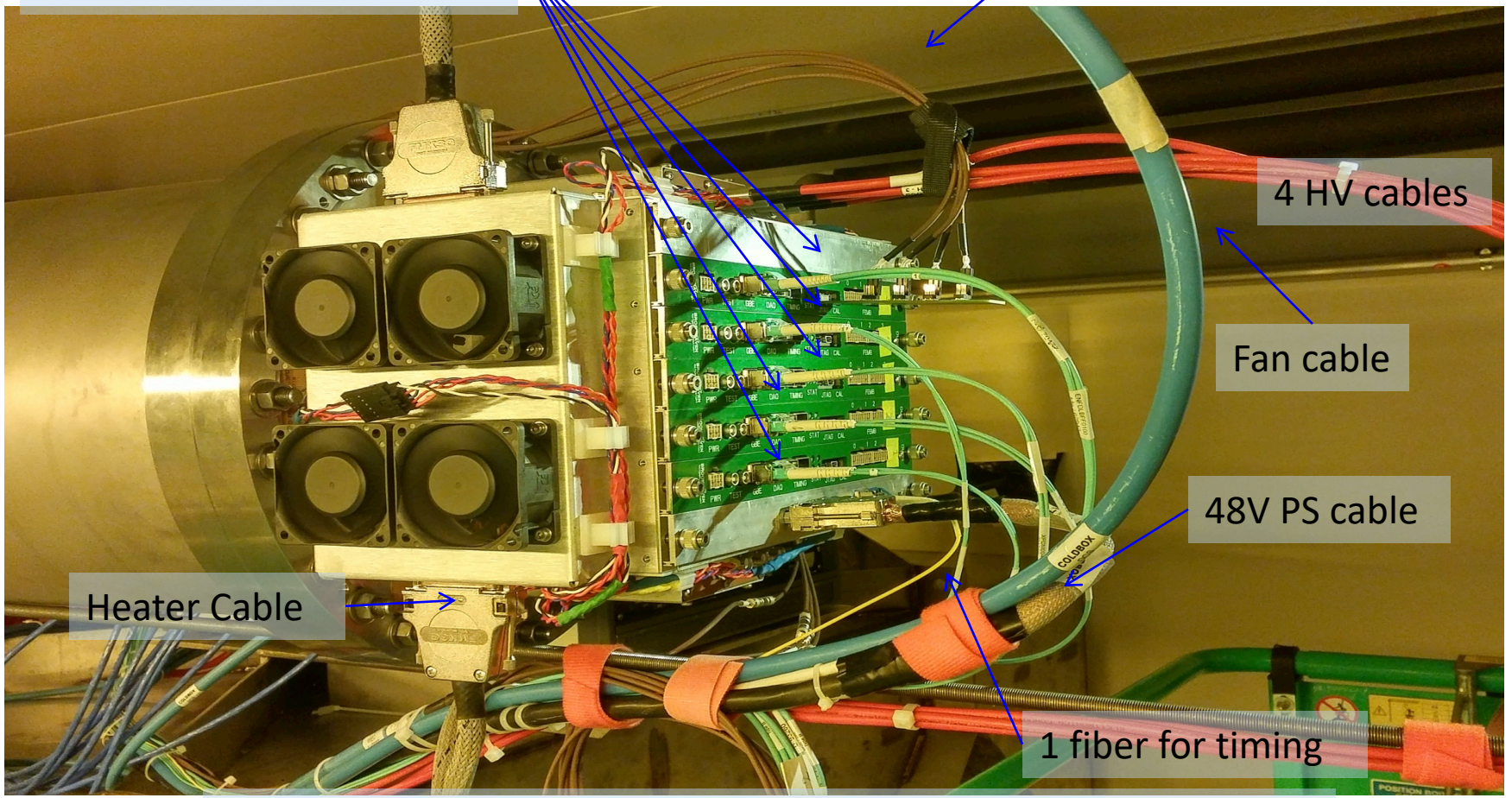
- Collaboration between BNL (hardware) and Boston U. (firmware)
  - Altera Arria V GT FPGA (10+ Gbps)
  - Onboard *power and control for up to 4 FEMB*
  - Ethernet for configuration/slow control and *real-time diagnostic readout*
- Integration with DAQ/slow control done by physicists and students from LSU, MSU, BU





protoDUNE V2 WIB

Cold Box WIEC



protoDUNE fibers are ~50m long from cryostat to DAQ barracks

WIB Software

- protoDUNE WIB and FEMBs controlled by FPGAs with minimal memory
  - All control was done with register writes via UDP GbE
- C++ compiled executable: BUTool.exe
  - Executable based on same C++ classes that provides interface to WIBs and FEMBs, including standalone command line control
  - http://gauss.bu.edu/redmine/projects/dune-wib/repository/software
- Monitoring done by CERN DIM
  - All WIBs are on the CERN network with a unique IP address determined by crate and slot
  - DIM computer reads registers from each WIB over UDP ethernet link via a simple executable developed by BU
    - Potential collision on network: DIM reads are disabled during WIB/FEMB configuration
- Run Control configured WIBs with an artdaq BoardReader
  - WIBs send data continuously to the DAQ: only need to configure WIBs and FEMBs during initialize transition and start streaming data

Current Status

- BUTool is basically unsupported
  - Matt can hack around in the WIBsoftware installed at protoDUNE and ICEBERG
- SBND started from BUTool and has made an actively developed version: WIBTool
  - Improvements in things like port usage to prevent WIBs “talking over” each other during configuration
  - https://cdcvs.fnal.gov/redmine/projects/wibtools/wiki/Wiki
  - Other things useful for DUNE like configuring the timing system have been removed

Lessons Learned and Improvements

- Using the same GbE fiber for DAQ configuration and DIM reads could cause collisions
  - Fixed by a “do not disturb” bit written to the WIB to tell it to not listen to requests from the DIM until the bit is unset
- WIB/FEMB configuration was slow
  - Optimize and reduce/remove the built-in delays in the software
- Real-time local diagnostic readout over the same GbE fiber was started but never finished
  - Should be completed so swapping back to “BNL firmware” unnecessary
- Update to TCP/IP
- Current granularity of configuring the CE is “FEMB” size
  - Gain, shaping time, calibration pulser setting, etc are the same for an entire FEMB in the software
  - Should add chip and channel level granularity to the FEMB configuration software
- Conversion of WIB and FEMB voltages and currents from the monitoring chip on the WIB to human readable values was approximated
  - Should be finished to get correct values
- All the WIBs use the same ports on the DAQ server
  - Adopt the SBND scheme to have each WIB use unique ports for reads/writes