DUNE Timing System – uTCA Installation at CERN Protocol update

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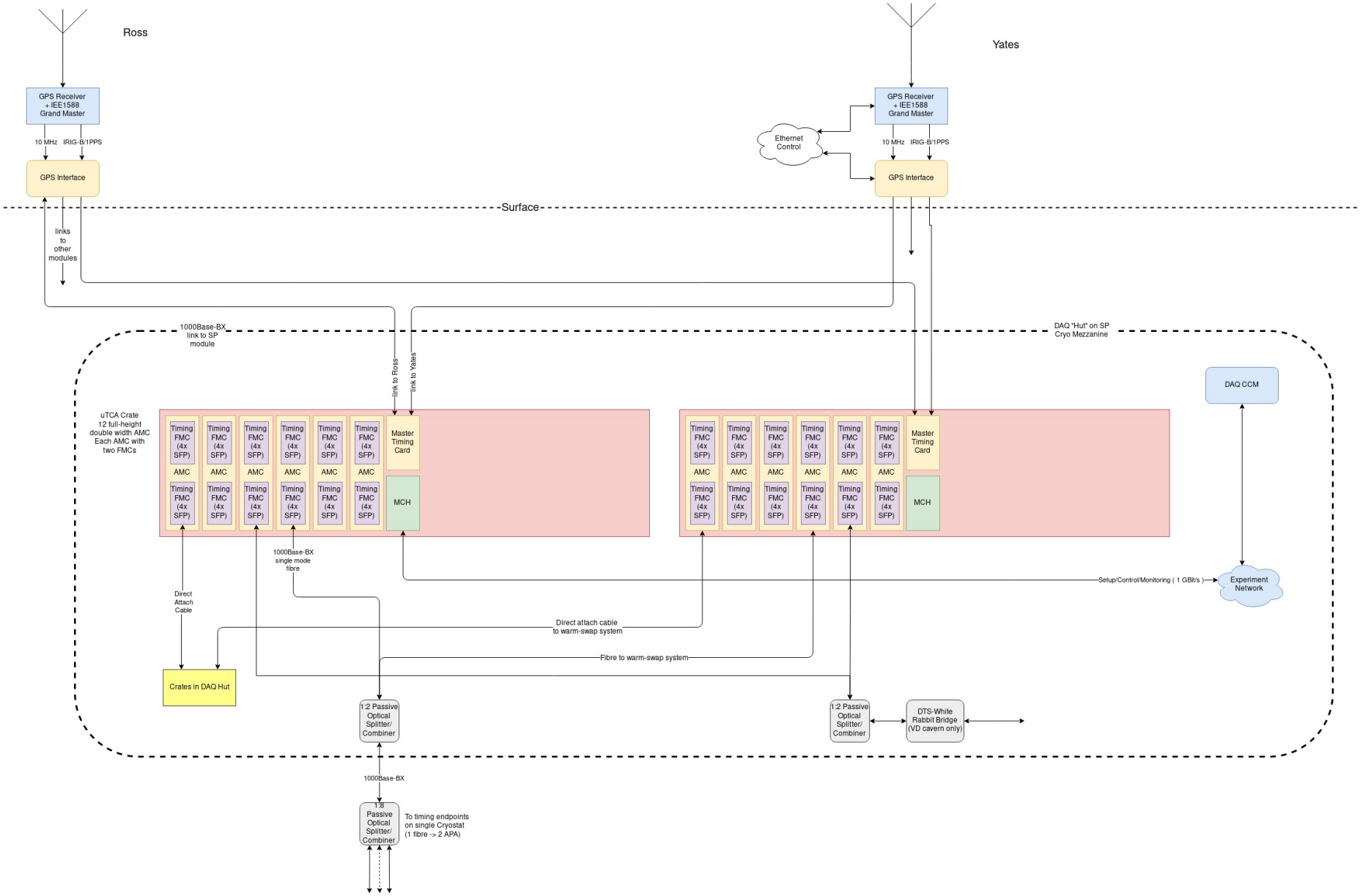
DUNE Upstream DAQ Meeting
23/11/2021

University of BRISTOL

Overview

- Prototype DUNE Hardware
  - Overview
  - Tasks remaining
  - Installation at CERN
- Protocol Update
- Timetable

DUNE FD Timing System



Hardware Components

- Endpoint (PDS,TPC,Calibration,etc.) ← Fibre Interface Board (FIB)
  - FMC format. Custom design
- AMC ← FIB
  - FIB mounted on AFC, a CoTs microTCA board (AMC)
- AFC+FIB in microTCA crate
- AFC+FIB ← Micro TCA Interface board (MIB)
  - AMC format, in "crate controller" (MCH) slot. Distributes clock, messages. Custom design.
- MIB ← GPS Interface Board (GIB)
  - On surface, next to GPS disciplined oscillator. Custom design
- GPS ← GIB

Timing Team

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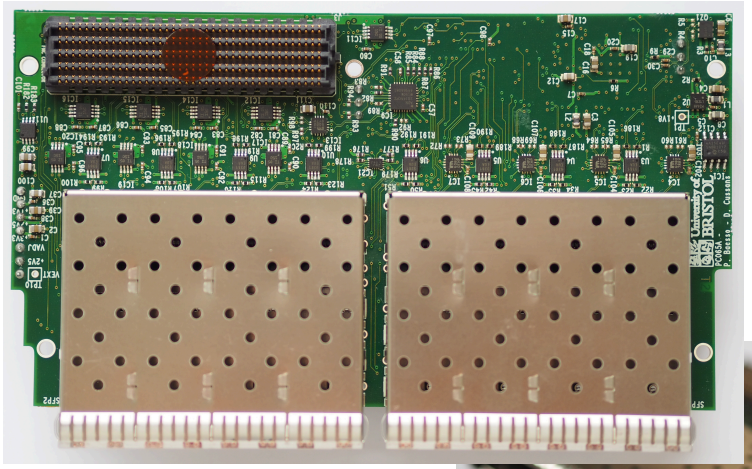
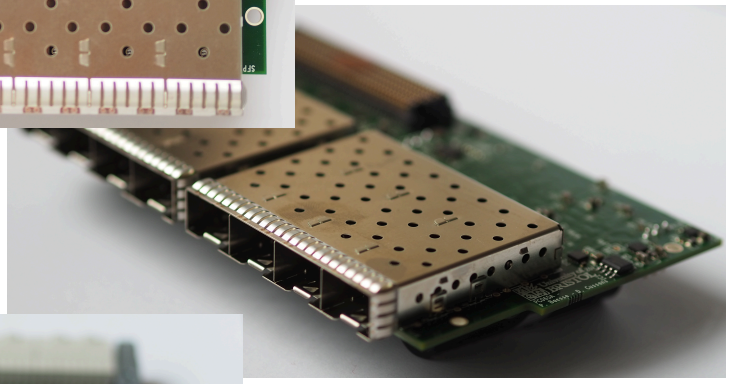
  - **David Cussans – Hardware, Firmware, Management (40%)**
  - **Adam Barcock - Firmware**
  - **Magnus Loutit – Hardware (20%)**
  - **Dave Newbold – Firmware (consultancy)**
  - Sudarshan Paramesvaran – Testing, documentation (10%)
  - **Stoyan Trilov – Software, (Firmware), Installation at PD-2**

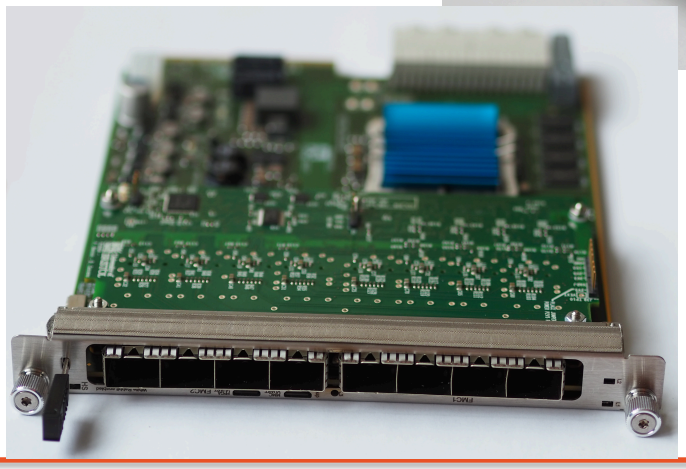
FIB – Fibre Interface Board

- Houses eight 1000Base-Bx SFP optical transceivers
  - Fibre combined with fibre from redundant system. Split 6 or 8 ways to timing endpoints
- Prototypes constructed and verified
  - Will be used at ProtoDUNE-2 and used to inform design of final boards
- Mount on off-the-shelf AMC carrier board
  - Artix-7 based OpenHardware “AFC”



FIB top view

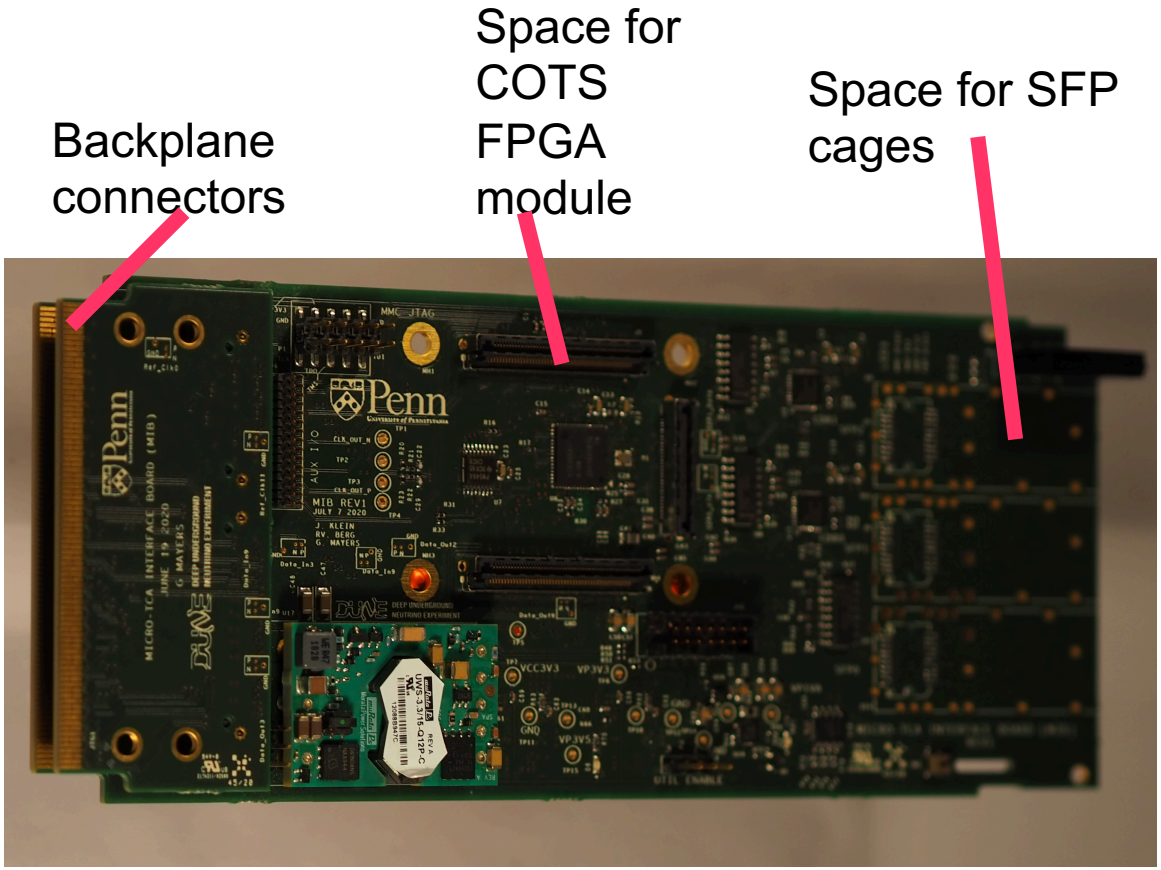




FIB mounted on AFC

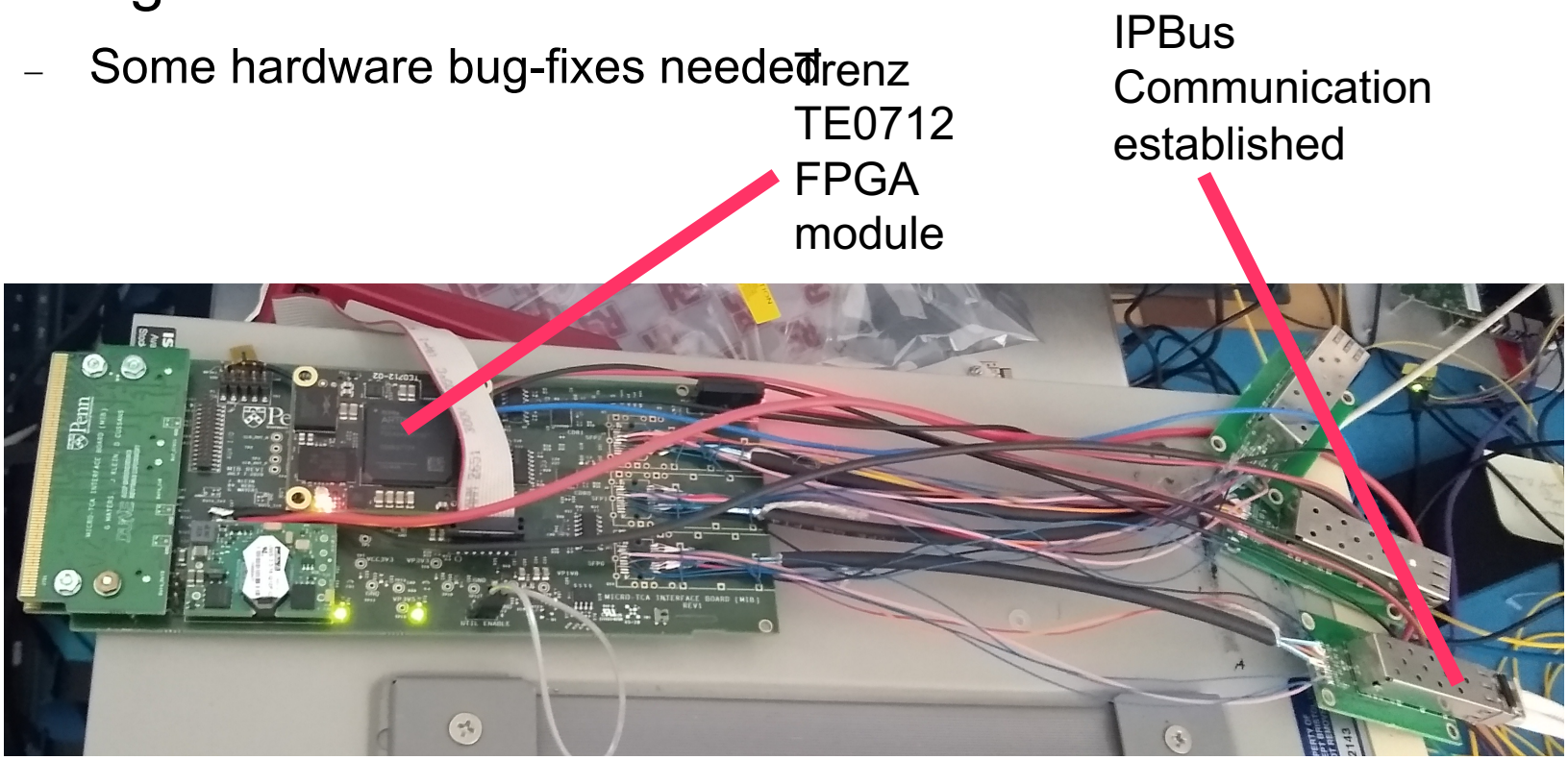
MIB – MicroTCA Interface Board

- Receives timing data from GPS system on surface
  - Two inputs – two duplicate GPS systems
- Design in UK, Schematic capture and PCB layout at Penn
- Transmits clock, timing data on uTCA backplane
- Two “upstream” interfaces to surface



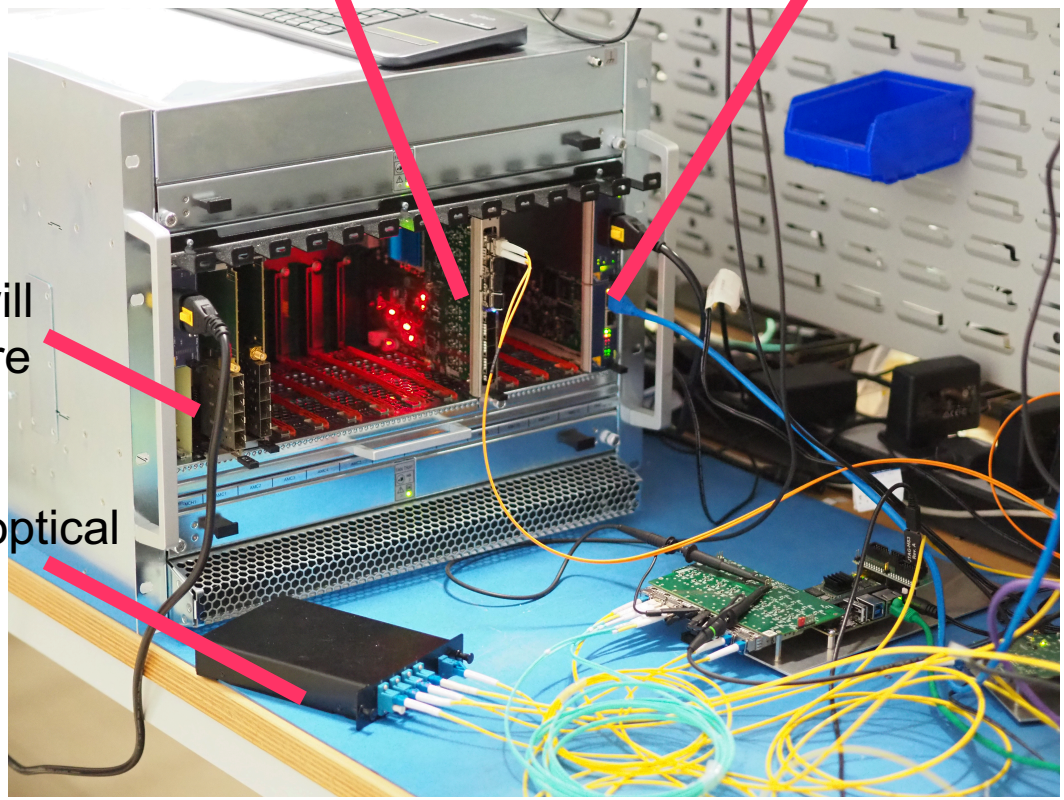
MIB – MicroTCA Interface Board

- Prototypes in hand
- Being commissioned
  - Some hardware bug-fixes needed



MicroTCA System

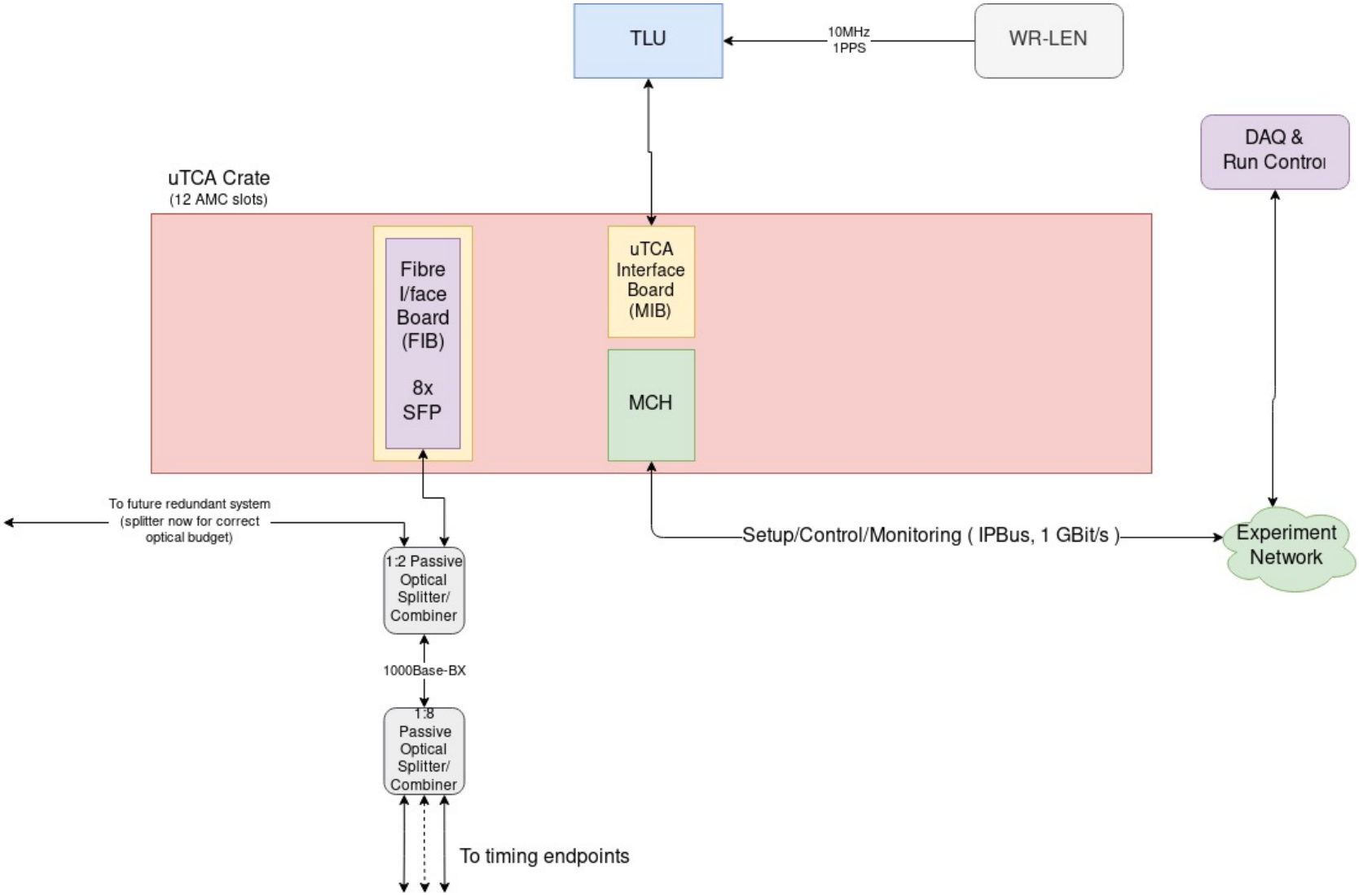
- Test system in Bristol
  - Will test entire chain
- 3 Crates in hand
  - One for CERN
  - Two in Bristol



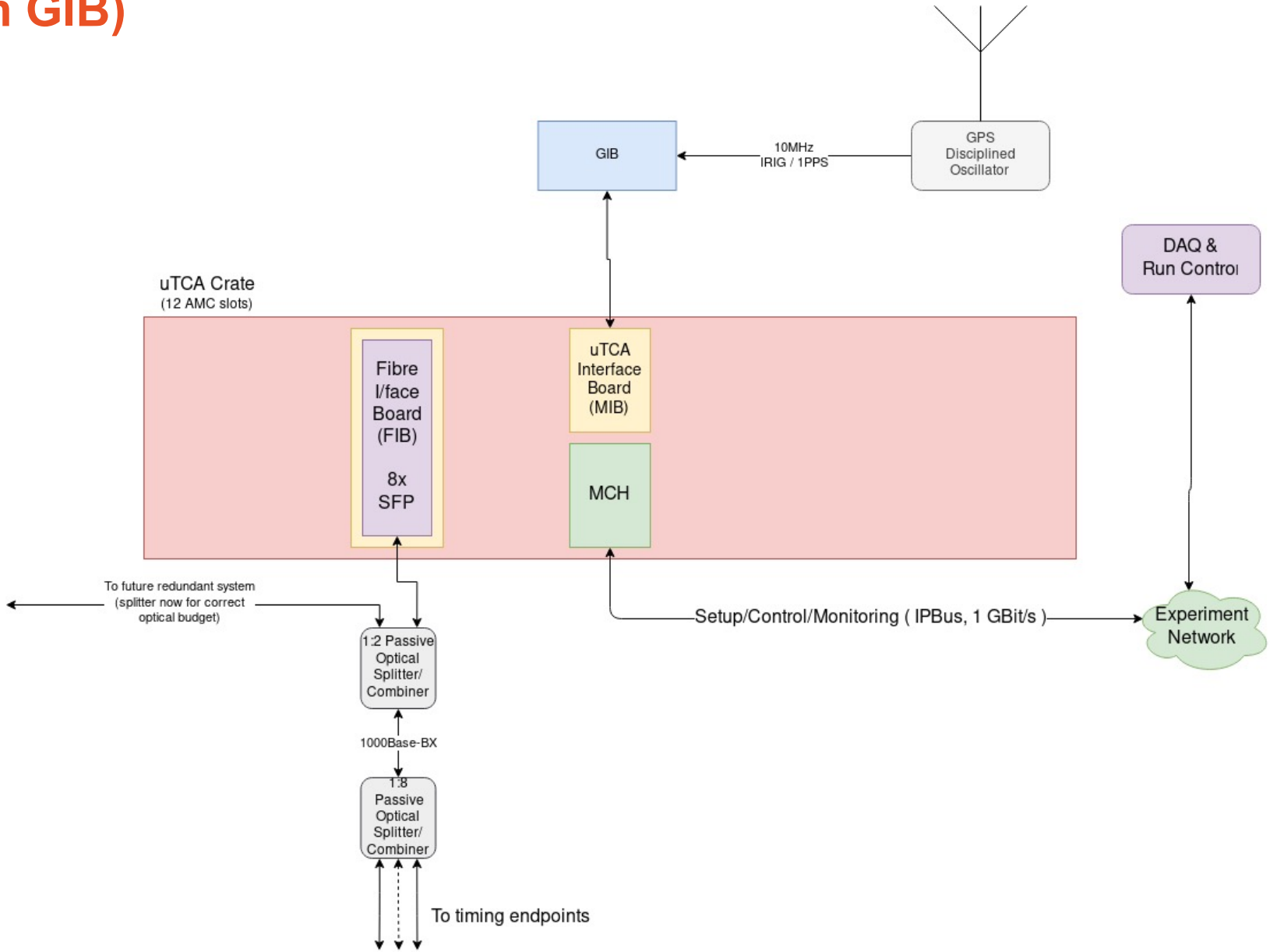
GIB – GPS Interface Board

- Interfaces to GPS receiver
- Design in UK, schematic capture and PCB layout in Penn
- Hardware commissioned
- Will be used at PD2
  - Subject to details of sharing GPS receiver with Dual Phase/VD system
  - Initial tests with TLU rather than GIB

DUNE Prototype Hardware at ProtoDUNE-II (Initial)



DUNE Prototype Hardware at ProtoDUNE-II (With GIB)



Timing Protocol

- Protocol extensively tested in lab and at ProtoDUNE-1
  - Will be modified to give:
    - More “partitions”
    - More timing commands
    - Bigger endpoint address space
    - Draft specification available
- Other firmware features also needed (but independent of firmware)
    - Interface to GPS (integration of OpenSource firmware)
    - Handling of swap over between redundant systems
- Will include software support

Schedule

- Slowed down due to injury (~ 6 staff-weeks lost)
- Q4 2021
  - Complete basic firmware for MIB
  - Complete MIB support s/ware
  - Test path from TLU → MIB → AFC / FIB → Endpoint in Bristol
- Q1 2022
  - Ship uTCA crate to CERN
  - Install in Vertical Slice Test
- Q1/Q2 2022
  - Implement new timing protocol
  - Write support s/ware
  - Test in new protocol in Bristol and at PD2 VST
- QX 2022
  - Switch all systems to new protocol when endpoints ready.
    - i.e. not before WIB1 are retired