OTMB Development and Upgrade Plan for LS2

Jason Gilmore

Texas A&M University

USCMS Phase-2

Forward Muon Upgrade Workshop

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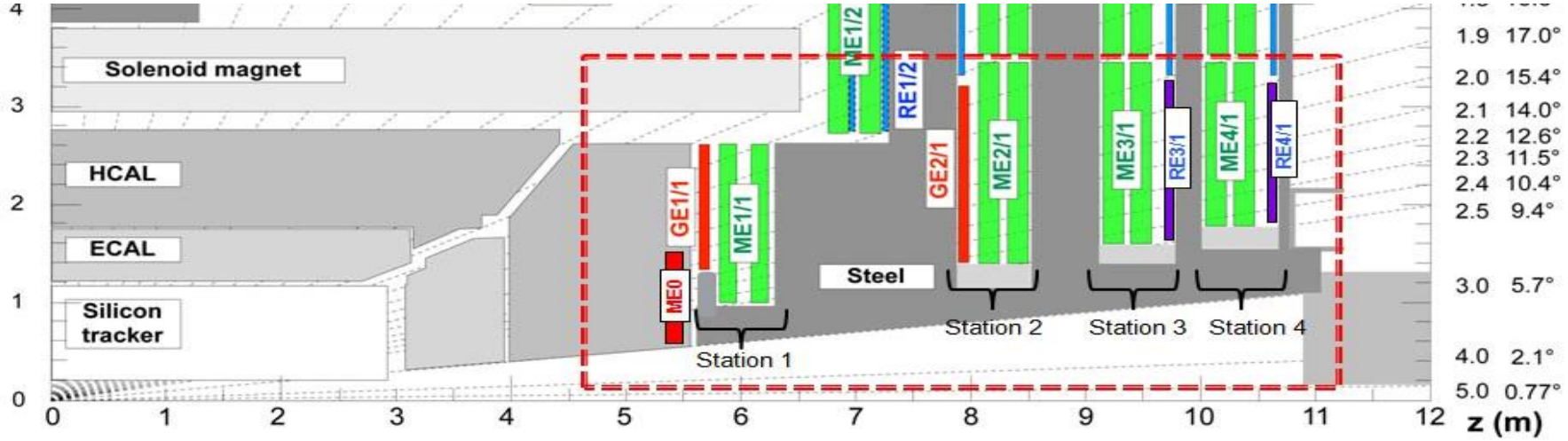
OTMB Design: Baseboard + Mezzanine

- The current OTMB capabilities
  - Receives fiber optic data from 7 DCFEBs using 3.2 Gb/s links on ME1/1 CSCs
    - Optical Trigger Motherboard interface is required for all chambers with DCFEBs
  - Much more logic capability than old 2005 version; used for improved CSC trigger
    - Necessary for efficient HL-LHC trigger operation and including GEM primitives
  - Full backwards compatibility with the copper cable inputs from old CFEB boards
    - Uses 570 i/o pins on the FPGA

Considerations Beyond the DCFEB Links



- GE1/1 installs during LS2
  - GE1/1 front-end will have fiber links to ME1/1 OTMBs
    - 2 fibers from each GEM layer (total 4 to each OTMB)
  - 10-degree GE1/1 matches 10-degree ME1/1
- GE2/1 and ME0 install later
  - GE2/1 front-end will have fiber links to ME2/1 OTMBs
    - 3 fibers from each GEM layer (total 6 to each OTMB)
  - 20-degree GE2/1 matches 20-degree ME2/1
- ME0 has 6 layers, might not connect to CSC OTMBs

OTMB Mezzanine, a Small Redesign…

The FPGA: XC6VLX240T-1FFG1156C

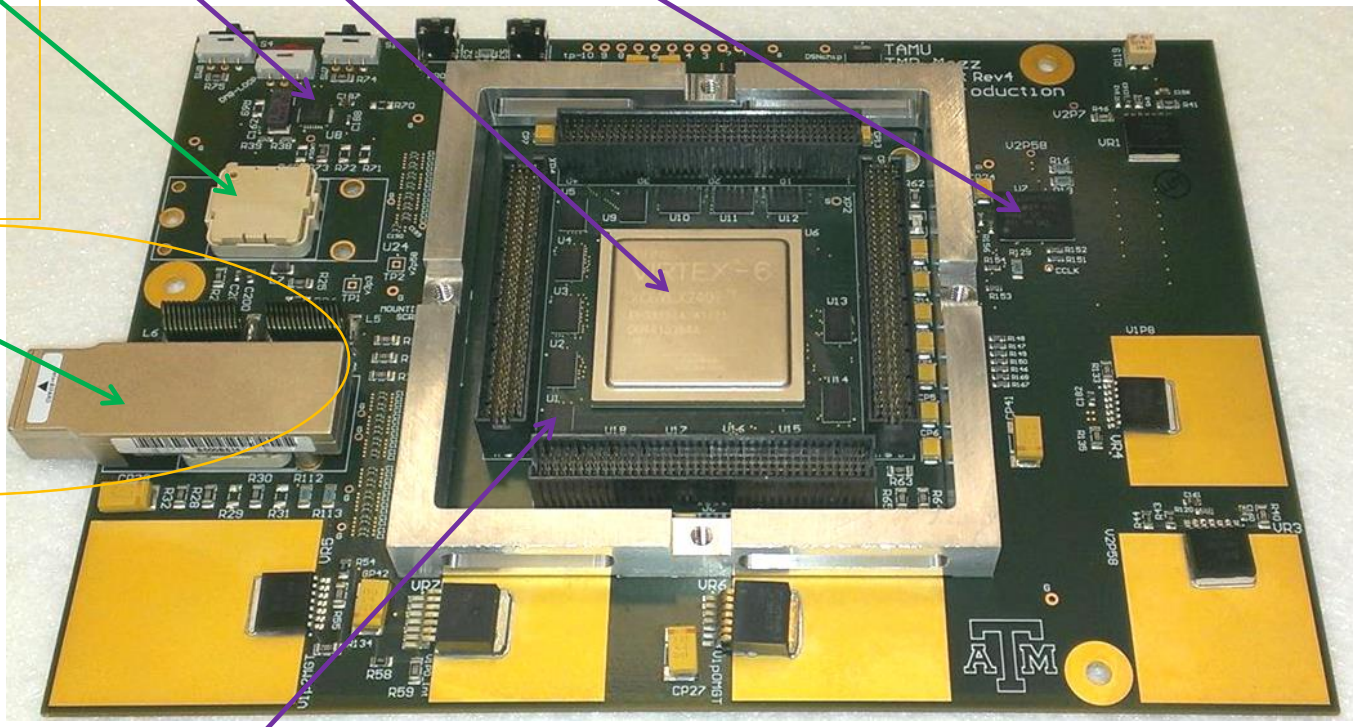
Virtex-6 FPGA + PROM

Cern QPLL

Keep this transmitter port?
-Additional Rx channels not really needed
-Still need to change the model used

Snap12 Fiber Receiver
- 12 fibers from CFEBs, GEM, rated at 3.5 gbps

These are now complicated to buy… a replacement must be considered



I/O Voltage-level shifters, 3.3 V to 2.5 V

PCB Dimensions: 7.5” long by 5.25” wide
11 mm clearance from TMB base board

…or a BIG Redesign if PROM needs to change

NON Virtex-6 + NON Xilinx PROM

The FPGA: Artix-7, Kintex-7?

New LDO circuits to match FPGA + PROM

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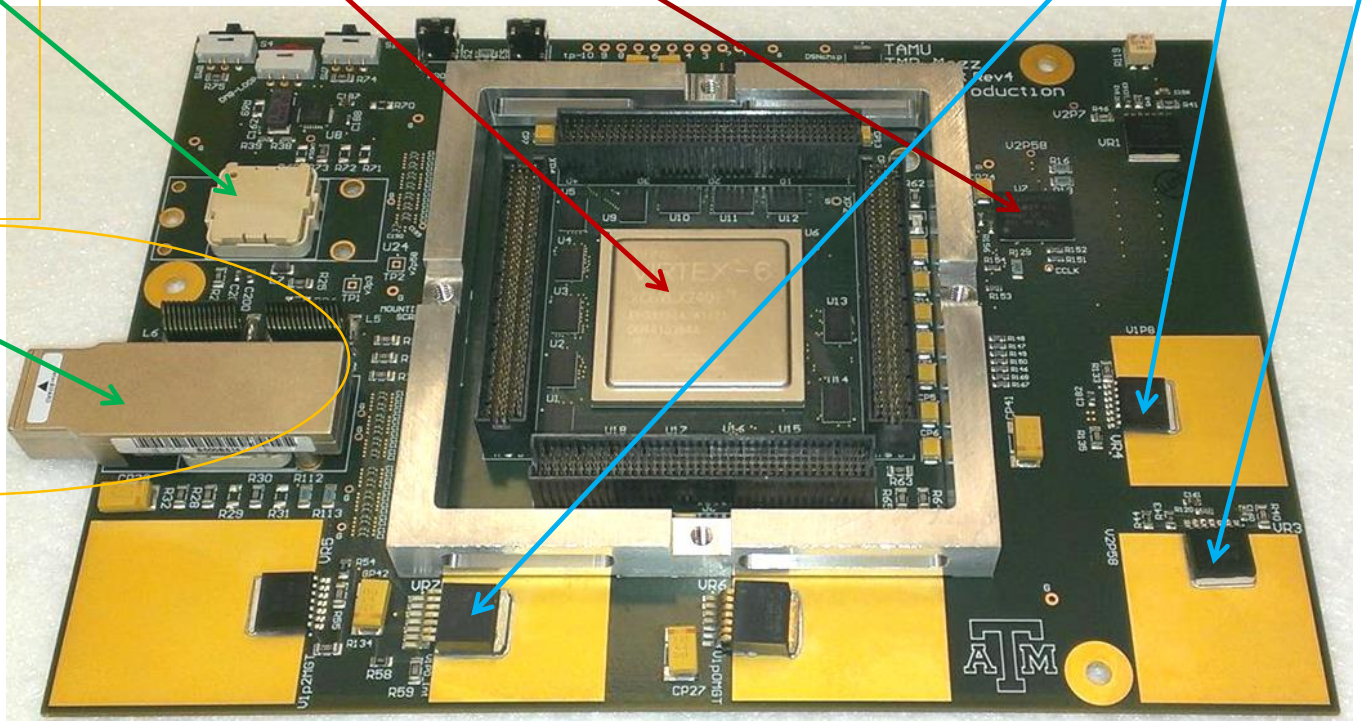


Smaller FPGA! Requires to remove front-panel SkewClear connections due to i/o limits – no more backwards compatibility – ok?

OTMB Hardware Development Outline

- We expect to build new boards with basically the 2013 design
  - MEx/1 requires 108 new OTMBs (baseboard + mezzanine) plus spares
  - There are definitely some obsolete parts to replace in the design
    - Low-profile SNAP12 receiver from Reflex Photonics
    - GTLP buffer/driver ICs (GTLP16612MEAX)
    - Need to evaluate SEUs and rad tolerance; proton beam tests are preferred
      - The rad tests (< 100 krad) will require planning/logistics work soon
      - Could possibly be done here at the TAMU Cyclotron facility (50 MeV)
  - We may need to replace the PROM… or maybe not
  - We will likely maintain the fiber transmitter socket option
    - Useful for testing, only insert fiber link when needed

- The new parts will require some small board design changes
  - Probably a few weeks for parts selection & design effort… then build prototype boards
    - Build them in spring 2017?
      - These boards will be used for rad testing, by summer 2017?

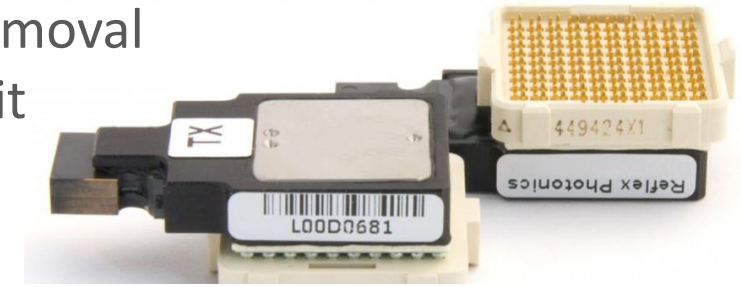
- The installation is planned for mid-2019 (if funded for LS2)
  - That gives us over 2 years to complete development & testing, then 6+ months for board production & delivery

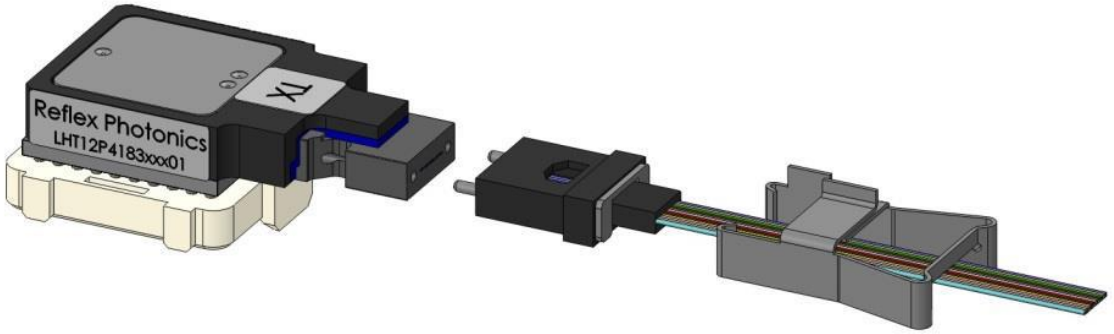
Replacement Candidate #1

- Samtec Firefly: ECUO-R12-14-030-0-1-1-2-01
  - Compatible with MPO connectors
  - Low profile: just 6.5 mm high and 18.5 mm long
  - Cost: about $250 each
  - Has 12 14 gbps fiber links, rated down to 0.5 gbps
    - 850 nm; receiver and transmitter models available
    - 1x12 simplex or 2x12 duplex transceiver system available
    - Protocol agnostic: supports all standard protocols
  - Device is socketed for easy removal
  - Ribbon fiber may not be removable

Replacement Candidate #2

- Reflex Photonics LightABLE system: LHR12P4183101AA
  - Compatible with MPO connectors
  - Low profile: just 8.5mm high and 26mm long (37mm w/fiber)
  - Cost: about $400 each
  - Has 12 10.3 gbps fiber links
    - 850 nm; receiver and transmitter models available
    - 1x12 simplex system
    - Protocol agnostic: supports all standard protocols
  - Device is socketed for easy removal
  - Fiber can unplug from the unit





More Replacement Options?

- Really hard to find information about these two…
  - No price, no specs, no web sites
- TE Coolbit Mid-Board Optical Transceiver
  - “TE Coolbit MBO”
- Avago MicroPod

The End