CMS pixels, upgrading an obsolete system

Jan Troska

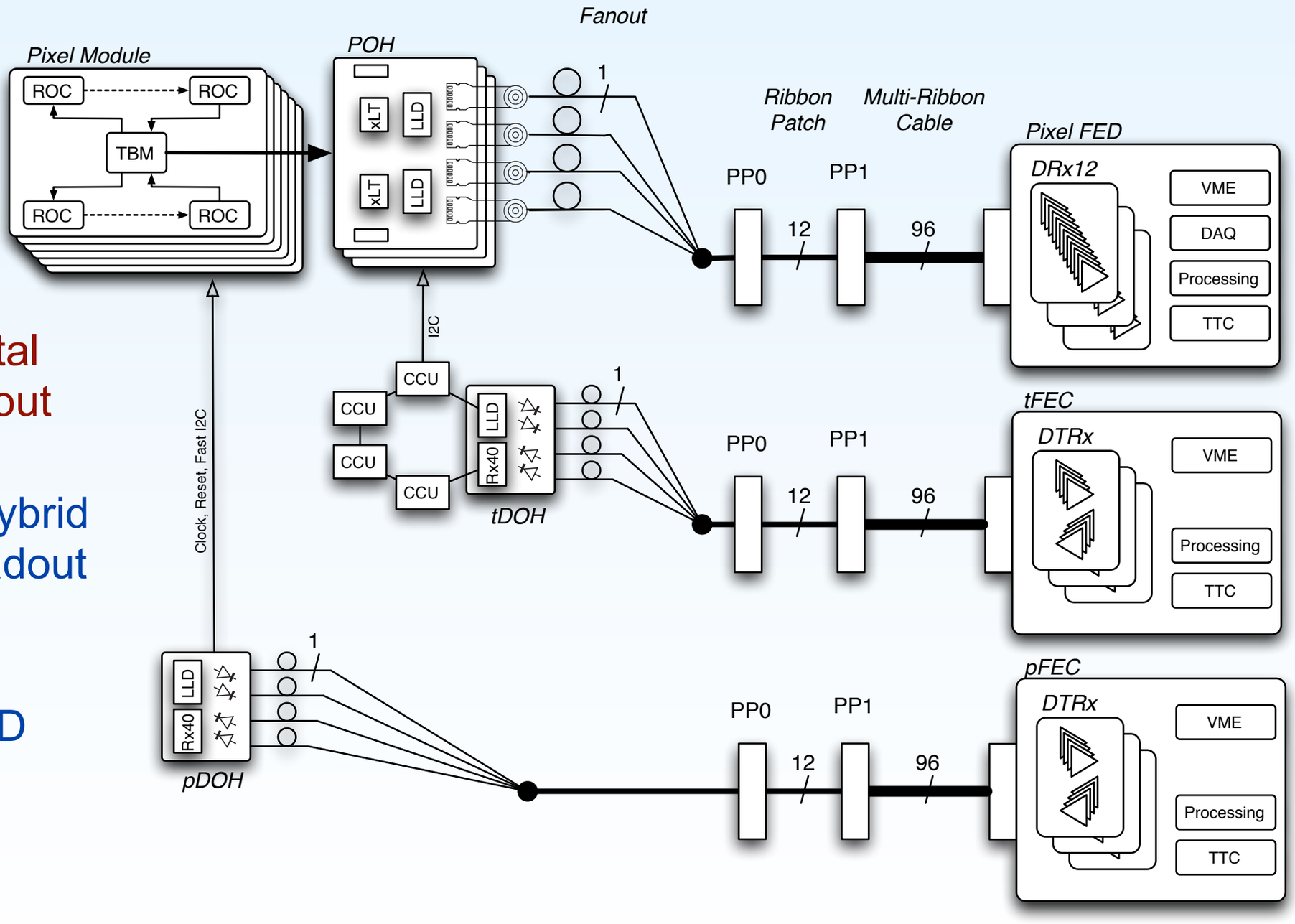
Optical link system for upgrade

- Premise: keep as much as possible from existing system
  - The installed fibres from PP1 to USC55
  - The control system (DOH & FEC)

New Digital data readout

New Optohybrid for data readout (POH)

New FED



Total Fibre Channels

~2400

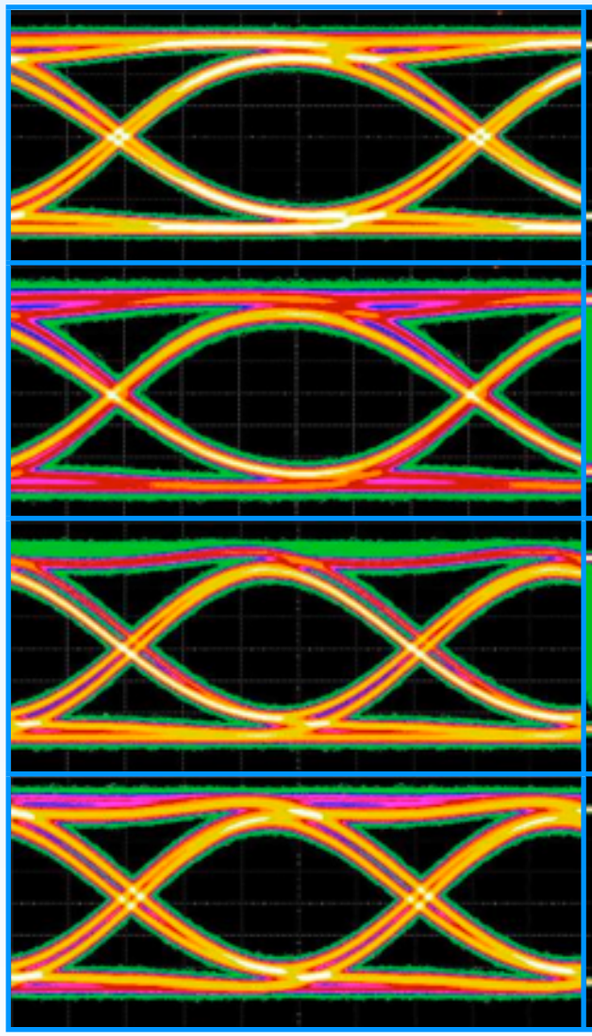
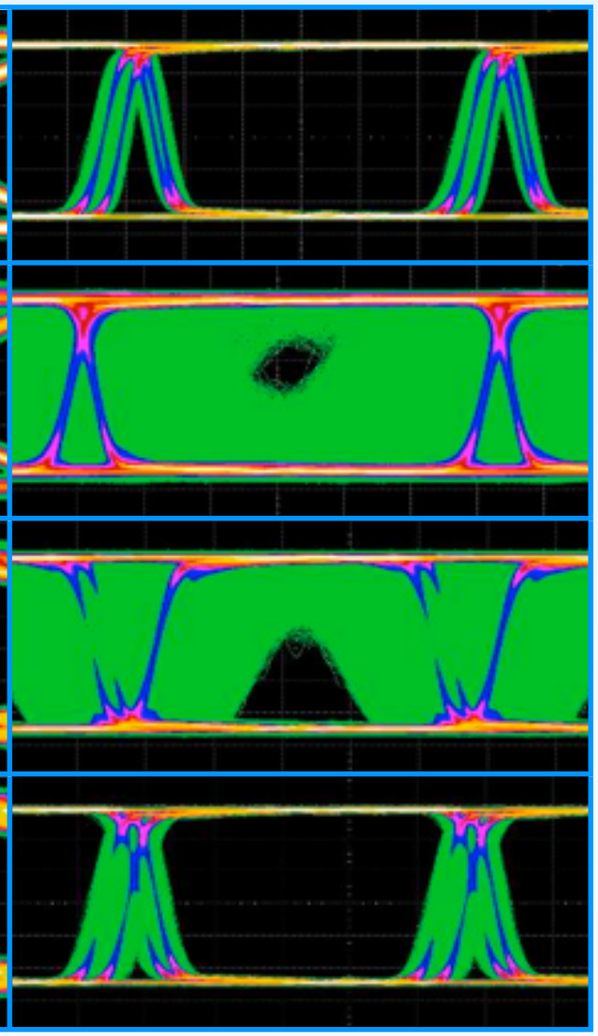
64

640

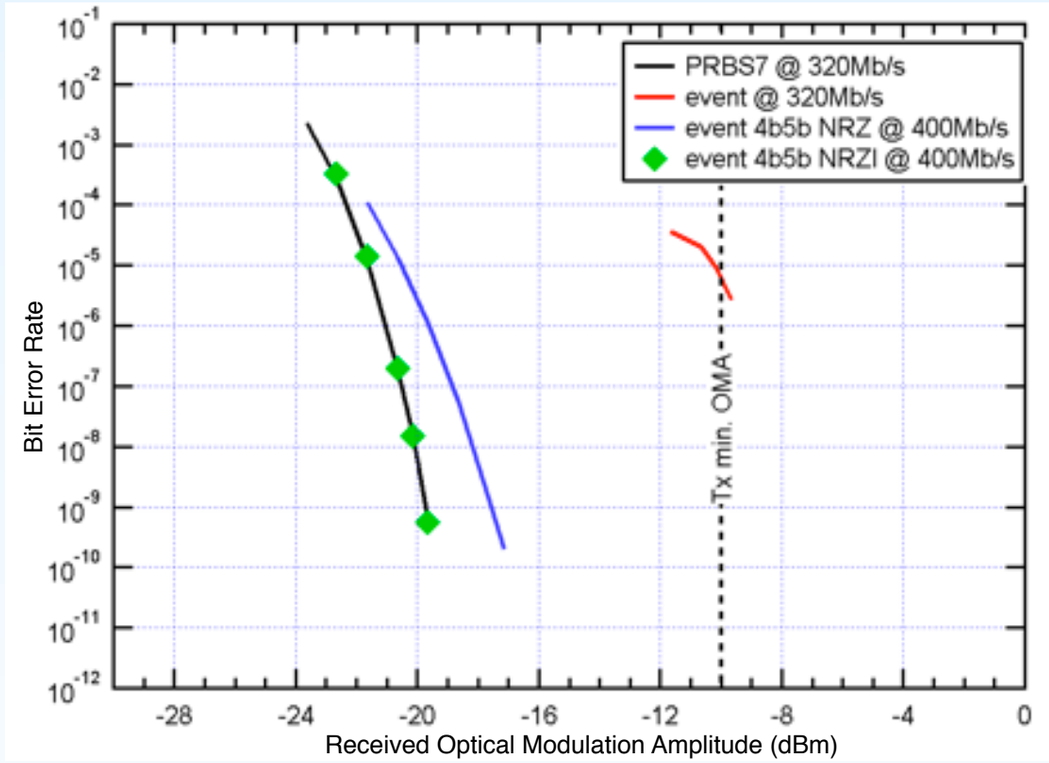
Constraints from re-use

- Re-use of existing fibre plant
  - Single-mode system
- Re-use of existing control system
  - Build new DOH modules based on existing design
  - Need to procure new parts (photodiodes) and re-use existing parts (lasers, drivers, receivers) that have been in storage for a number of years
- Re-use existing electronics in Tx data path
  - Pixel Module -> Analogue Level Translator (ALT) -> Linear Laser Driver (LLD)
- Need to find new TOSA
  - existing chip no longer manufactured
- Need to find new Off-detector Receiver
  - existing Rx no longer manufactured & bandwidth too low

RX module pattern dependence

Pattern	POH output	Candidate Rx module output
PRBS7 320 Mb/s		
Event 320 Mb/s		
4B/5B NRZ 400 Mb/s		
4B/5B NRZI 400 Mb/s		

System BER



DC-balanced line coding mandatory in TBM

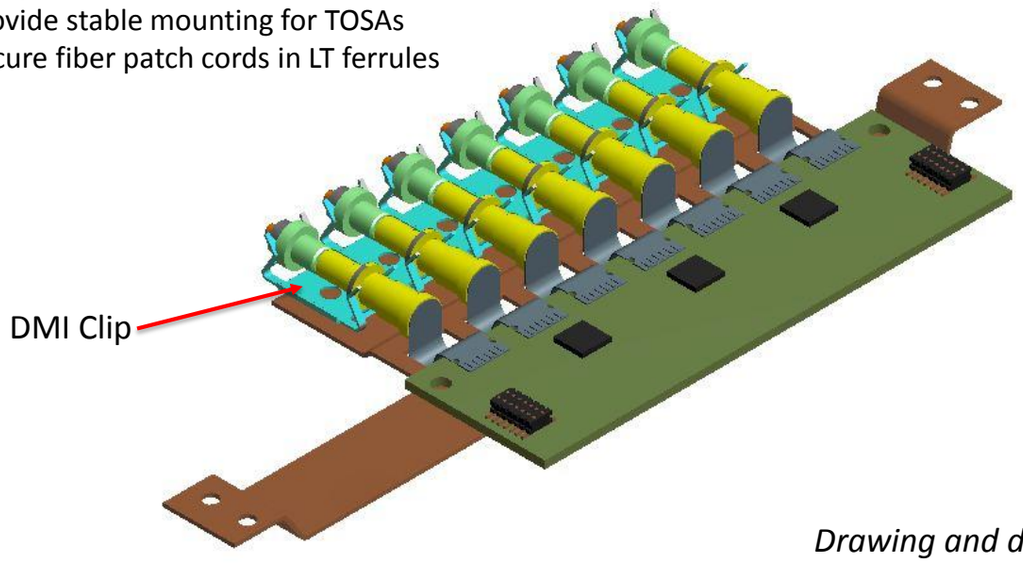
POH with ALT operational at 400 Mb/s

but little margin -> design new Digital Level Translator (DLT)

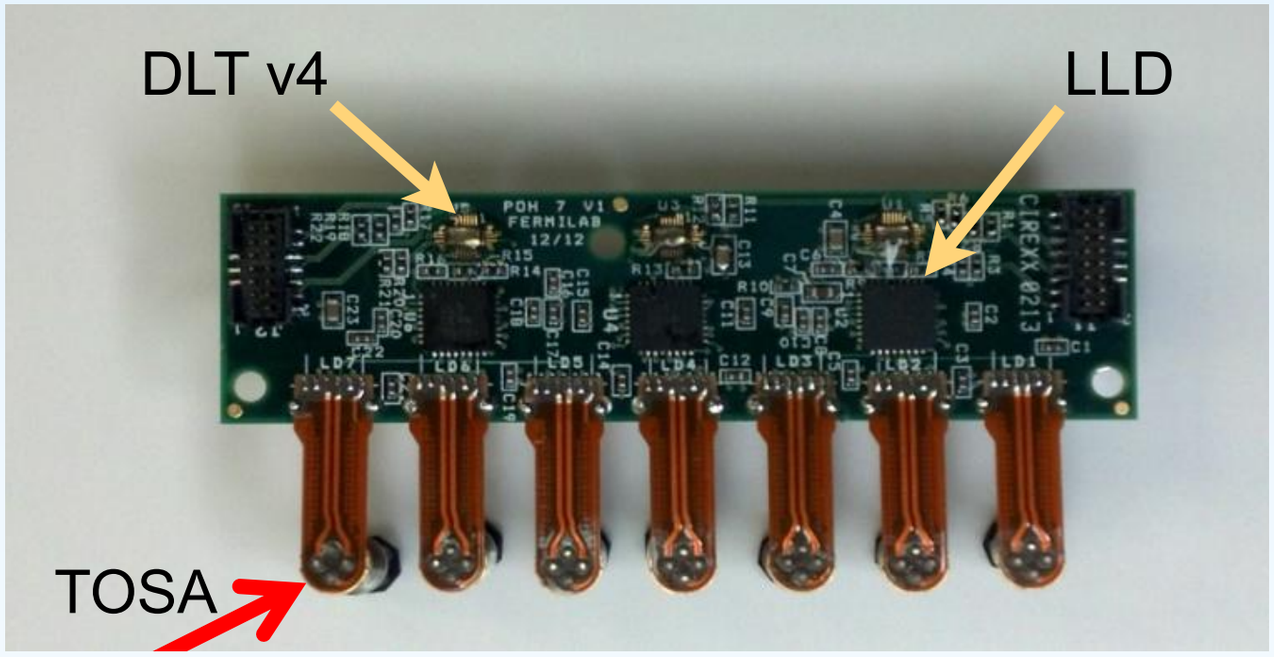
FPIX POH

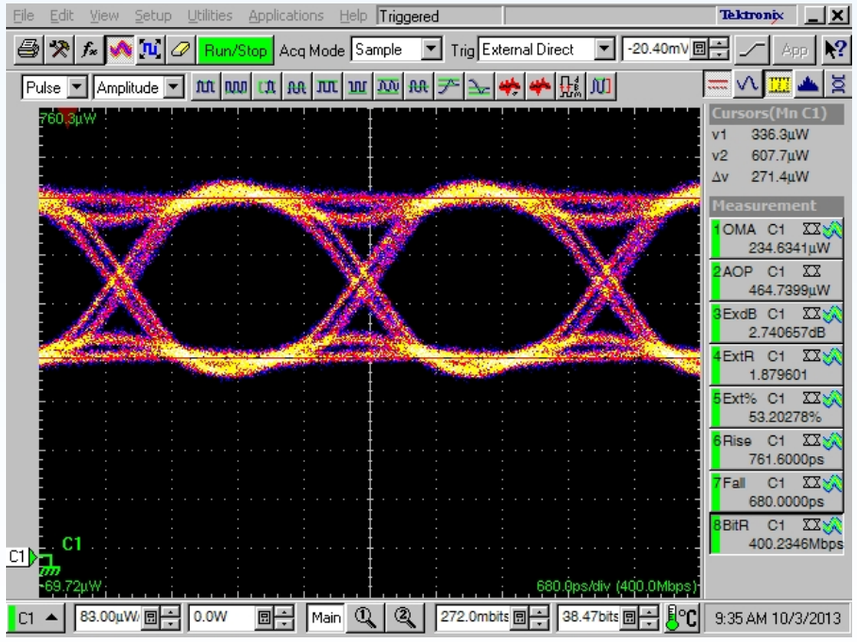
- Prototyping and evaluation complete
  - Now moving on to system-level evaluations

DMI Clips
Provide stable mounting for TOSAs
Secure fiber patch cords in LT ferrules



Drawing and design courtesy of Kirk Arndt

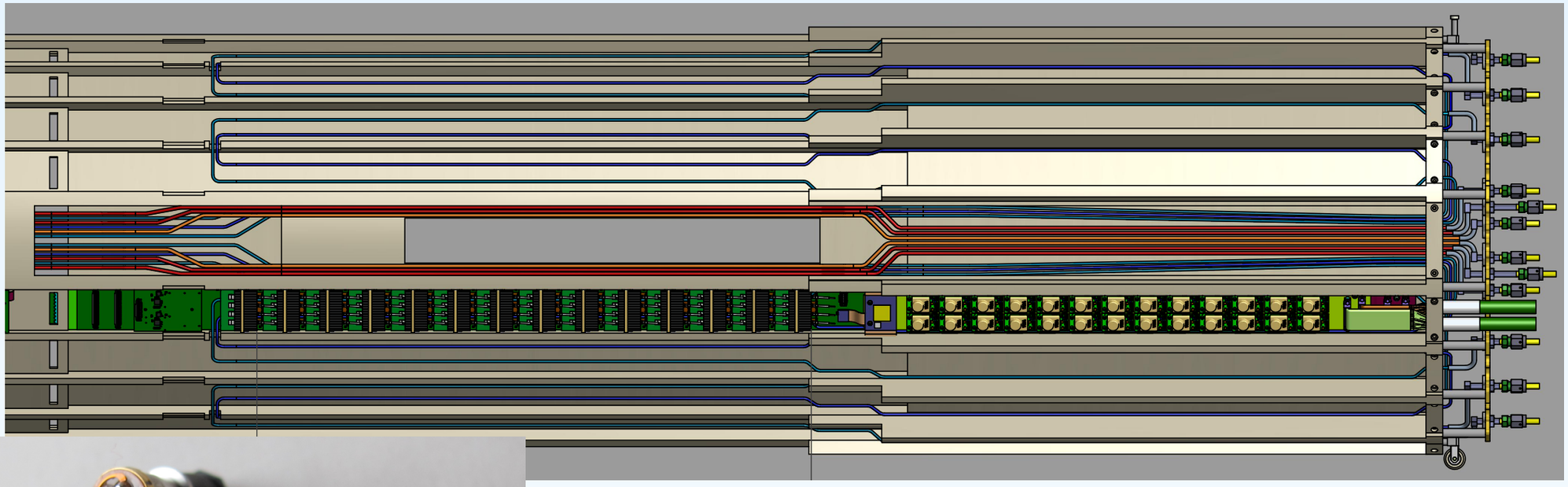


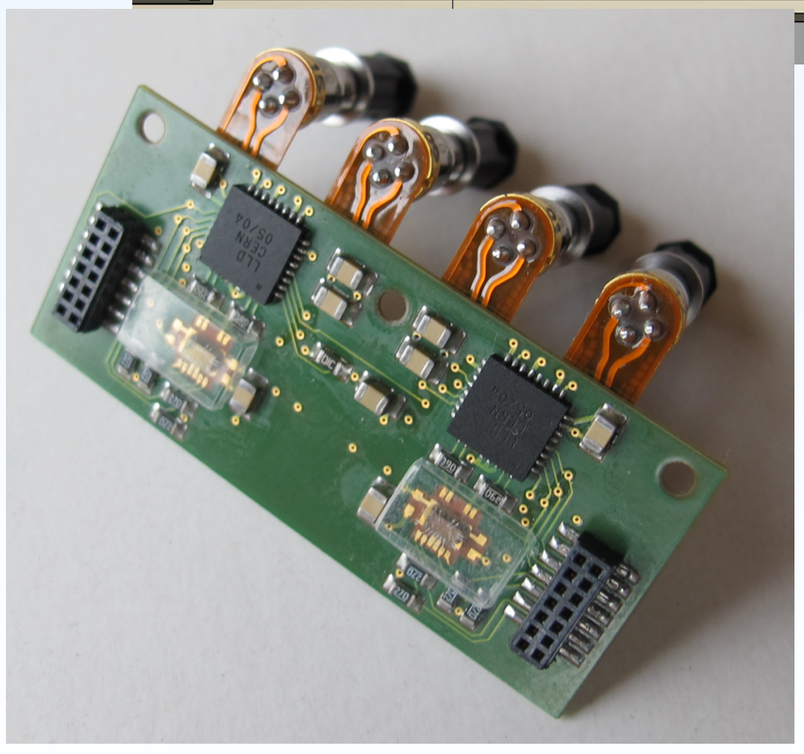


- POH7 includes DLT v4
- System testing with FE elements and Rx modules in progress
- Required number for upgraded detector is 96 POH7

BPIX POH

- ETHZ recently took responsibility for POH4 production
  - First prototype run of 20 boards being tested in Zürich

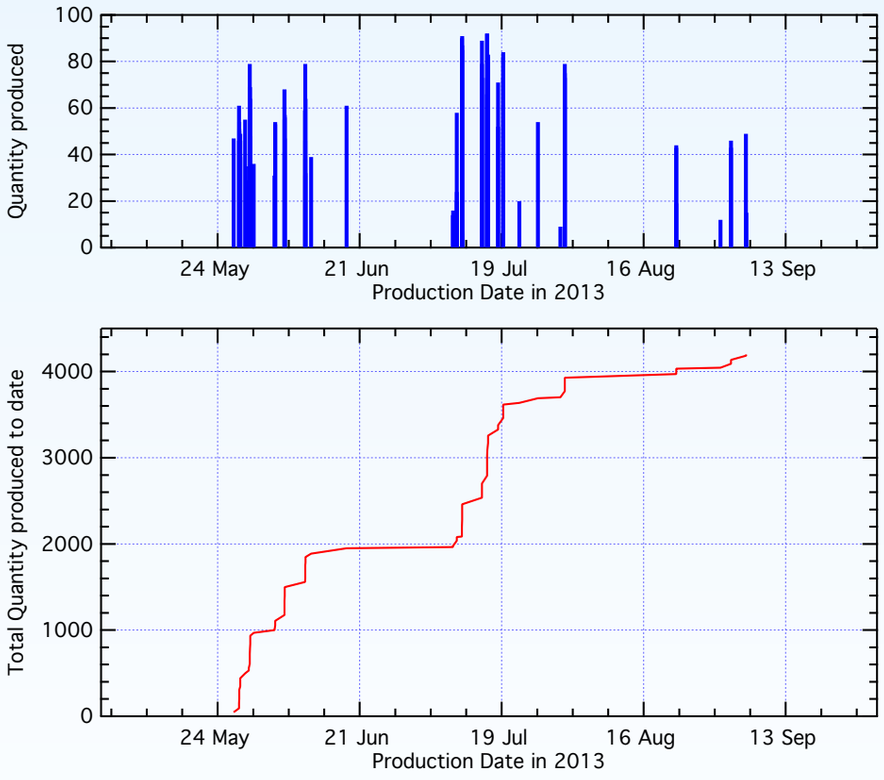


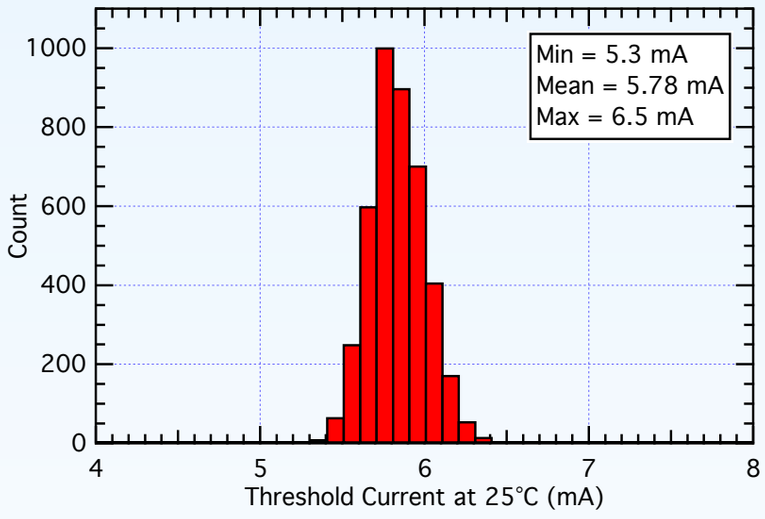


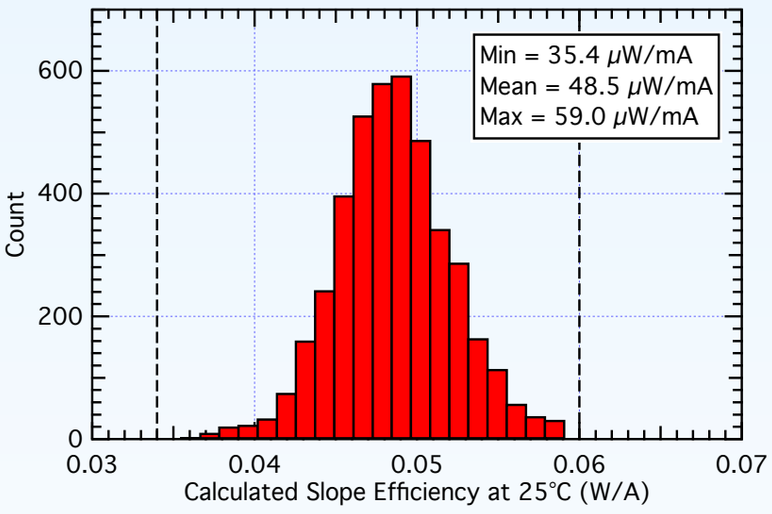
- Fibre clip will be designed by PSI
  - Pending choice of optical connector and its mechanical specification, both choices of connector have been conceptually shown to work

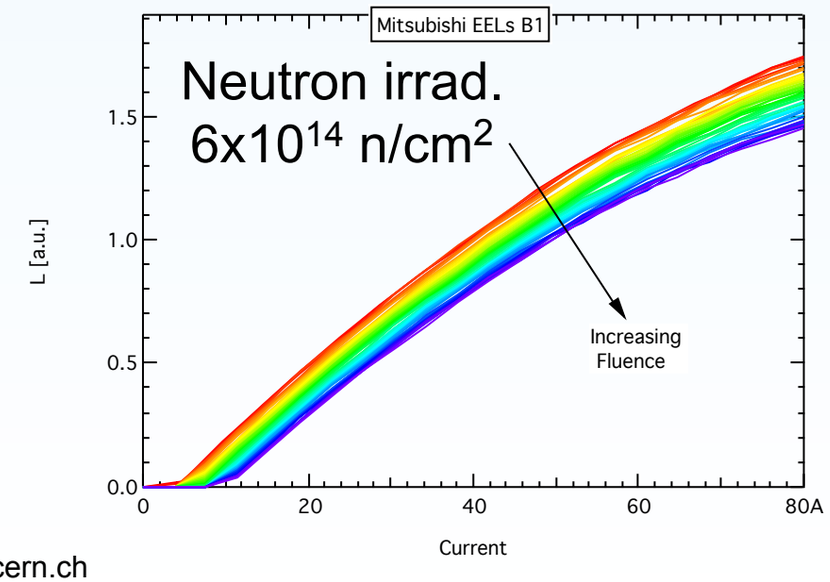
Laser Procurement

- Early laser procurement launched due to product obsolescence
  - PRR held in Dec. 2012
- All Devices delivered, production report in EDMS
  - CMS-TK-QC-0051







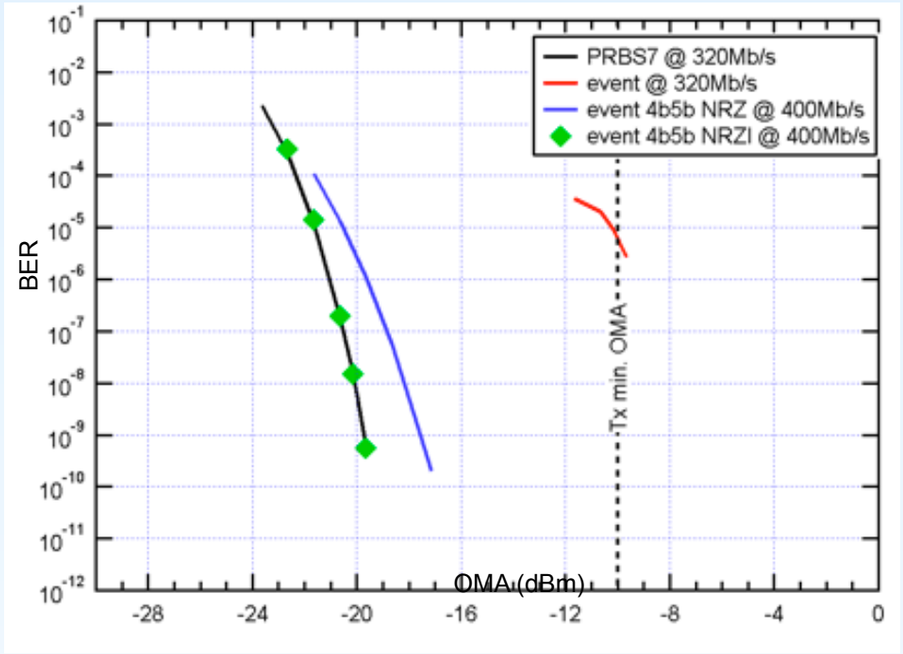


DOH production

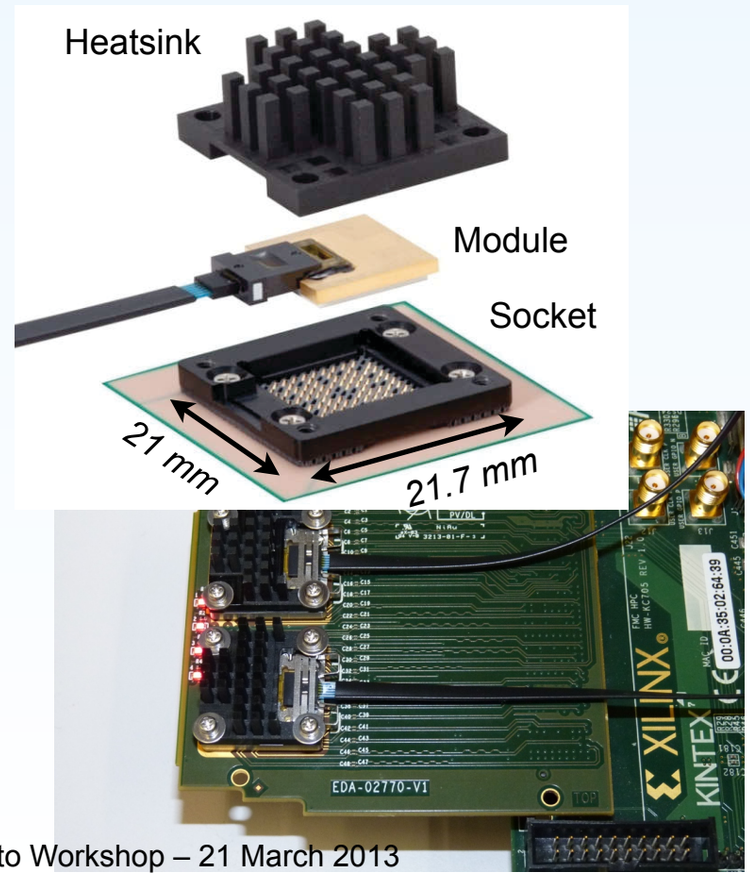
- Re-producing the existing design
  - Two flavours: TkDOH and PixDOH, differing in Rx40 variant
- Lasers available from previous production
- Photodiodes being sourced from previous vendor
  - Using fibre patchcords from previous production
  - Pre-series delivered and currently being qualified
- Pre-series of DOHs being assembled
  - Doing this in-house at CERN
  - Having to re-learn old techniques
- Quantities defined by final FPIX control architecture choice
  - 8 (FPIX) + 8 (BPIX) TkDOH [fixed]
  - 96 (FPIX) + 64 (BPIX) PixDOH [TBC]

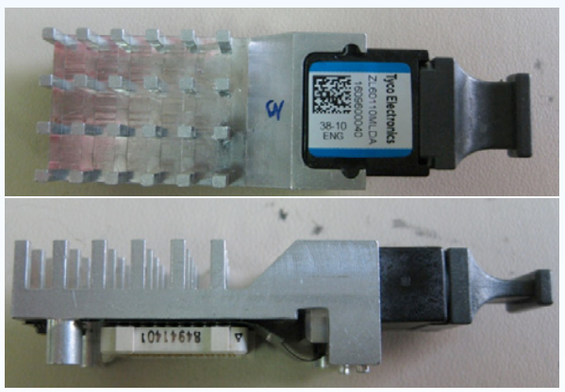
Back-end Components

- Proposed and validated line-balancing with 4B/5B NRZI encoding
  - Implemented in TBM
- Two vendors identified for supply of receiver modules

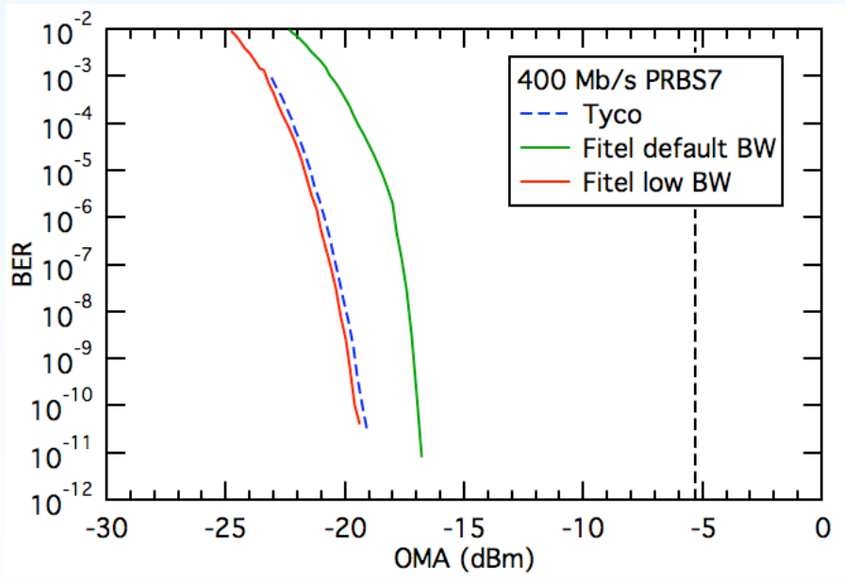


Fitel





Tyco



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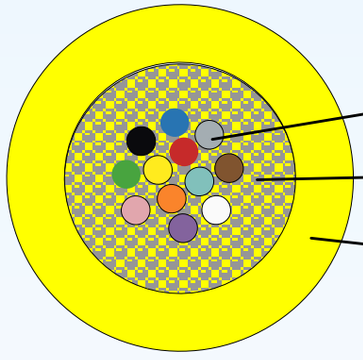
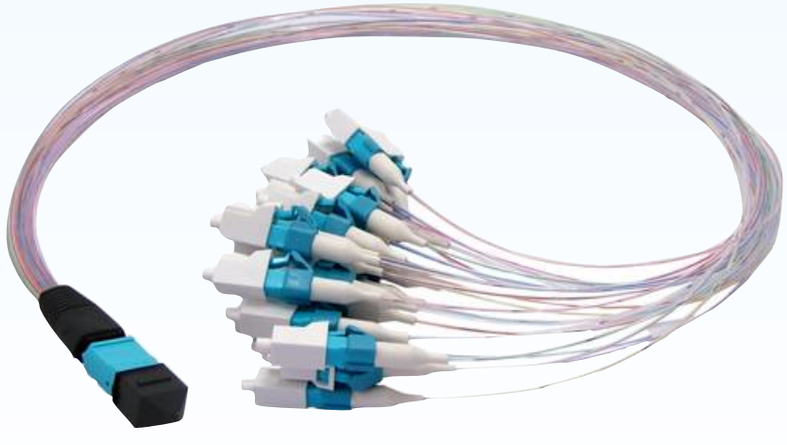
Fibre plant

- Replace PP1 to PP0 with smaller round Cable
- New connectorized fanouts for PP0 to POH

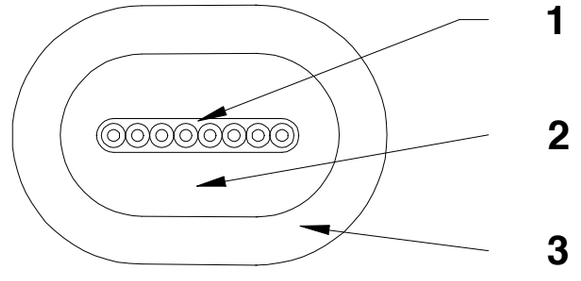


O.D.
≤ 3 mm



	4 fibres	8 fibres	12 fibres
Pulling force during installation (N)	≤ 100	≤ 100	≤ 200
Cable net weight (kg/km)	9	11	15
Factory length (km)	1 or 2	1 or 2	1 or 2
CONSTRUCTION			
1. Acrylate coated fibre ribbon (mm)	1.1x0.32	2.1x0.32	3.1x0.32
2. Strength member: Aramide yarns			
3. Sheath: Polyethylene, flame retardant (mm)	2.3x2.0	3.3 x 2.0	4.3x2.0

Cross section 8 fibres



Summary

- Upgrading an existing system brings a unique set of pre-conceptions and constraints
  - Noble initial goal to change as little as possible
  - Led to poor signal quality and need to re-design new “glue” components
  - Severely constrained in component choice due to installed fibre plant
- System development and tests on-going
  - Focus shifting from Front-end optohybrid design to Back-end component evaluation and system testing
  - Major production of link components in 2015
  - On-track for installation of Pixel Detector in EYETS 2016/17