Common Optical Link

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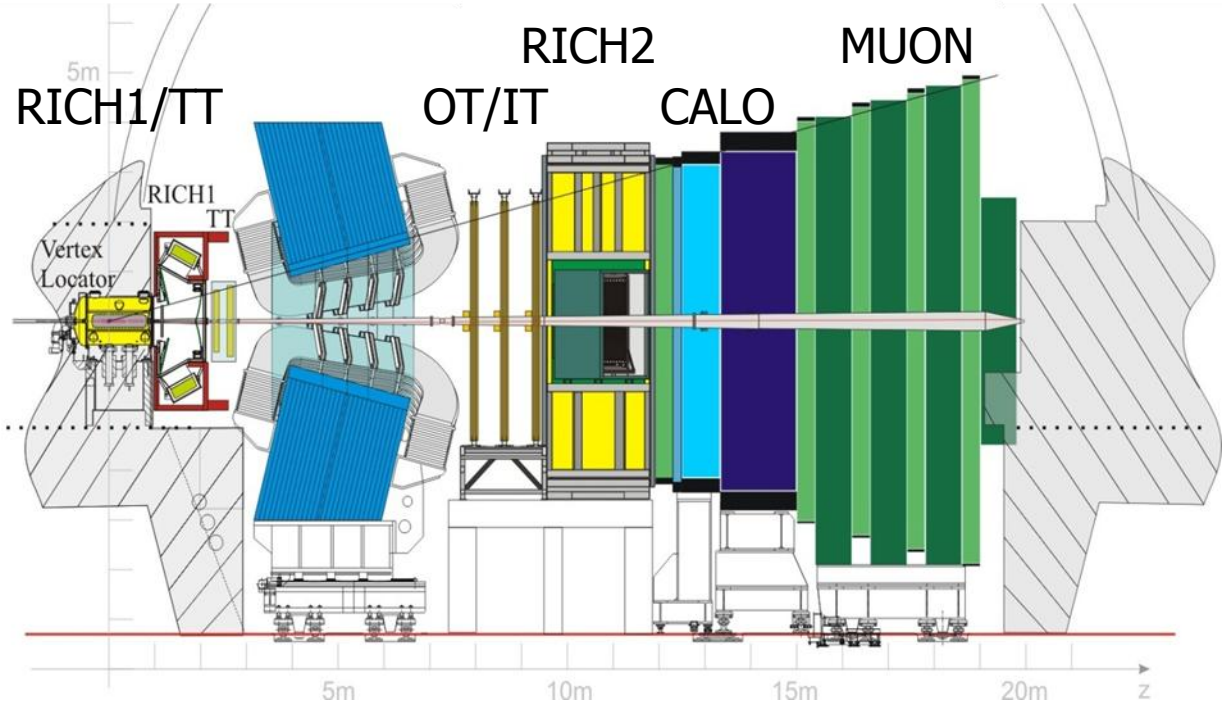
16th February 2012

LHCb overview



+TFC system

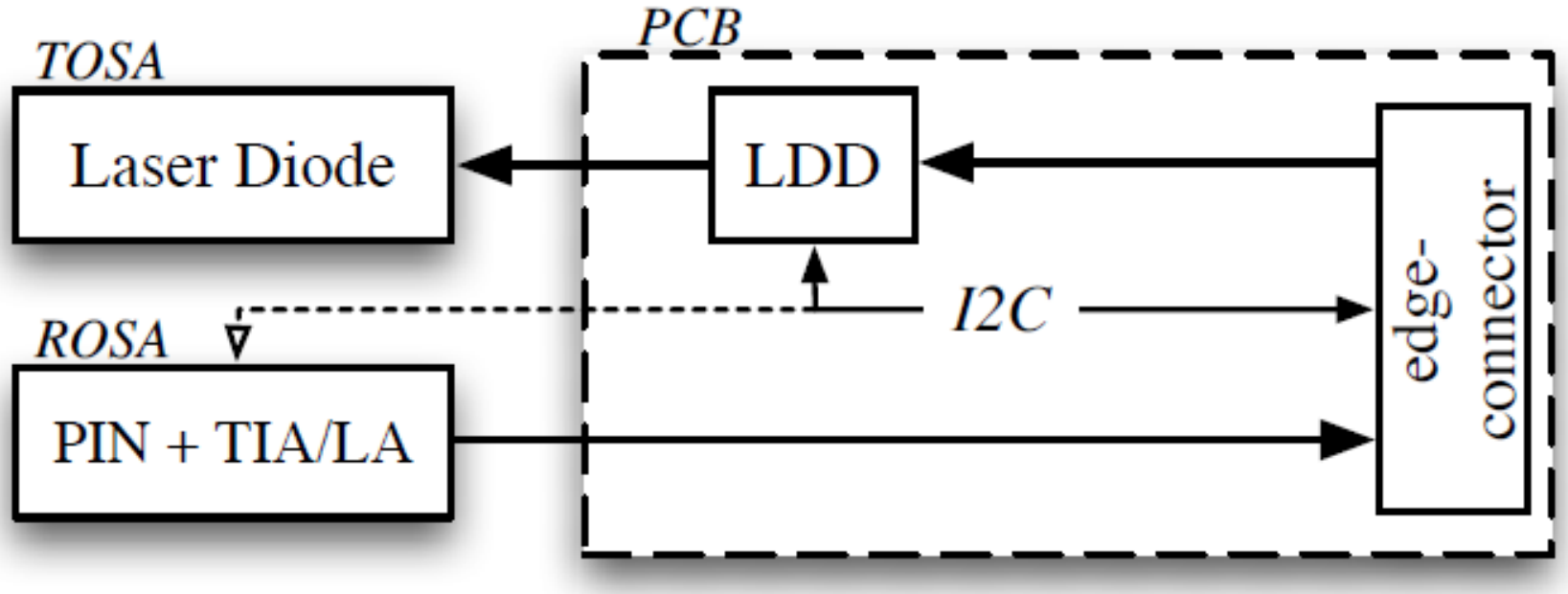
Current LHCb optical links

- 1.1 MHz readout O(6000) links
  - +40 MHz L0 trigger readout O(2000) links
- GOL @ 1.6 Gb/s serializer + laser driver
- VCSEL
  - ULM photonics
  - SMA 850nm MM
- Or Agilent 12-way transmitter HFBR-772B
- Agilent 12-way receivers HFBR-782B
  - TLK2501 de-serializers
- MM-fiber 125/50 μm
  - FO-networks, DRAKA etc.
- TFC system SM fiber @ 160 Mb/s

LHCb 40 MHz upgrade links

- 40 MHz for the entire detector
  - O(12000) links
- GBT @ 3.2Gb/s t.b.d.
  - Data + TFC + ECS
  - FPGAs with fast link I/O in low rad regions
- Versatile link
  - Transceiver 850nm MM
  - Dual transmitter 850nm MM
  - Transceiver 1310 nm SM (anyone?)

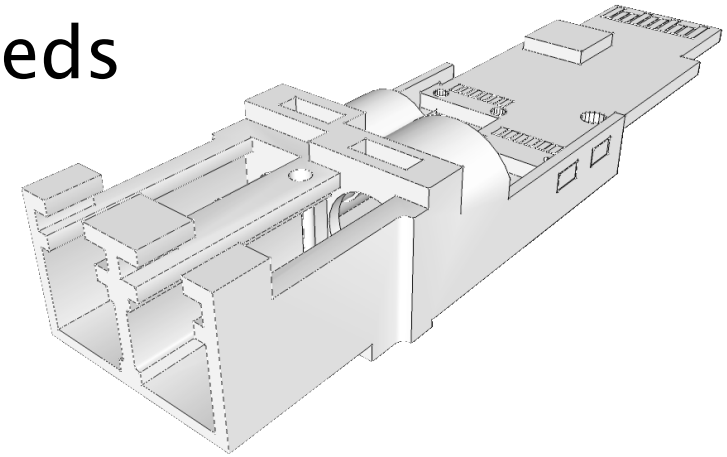
Versatile link transceiver



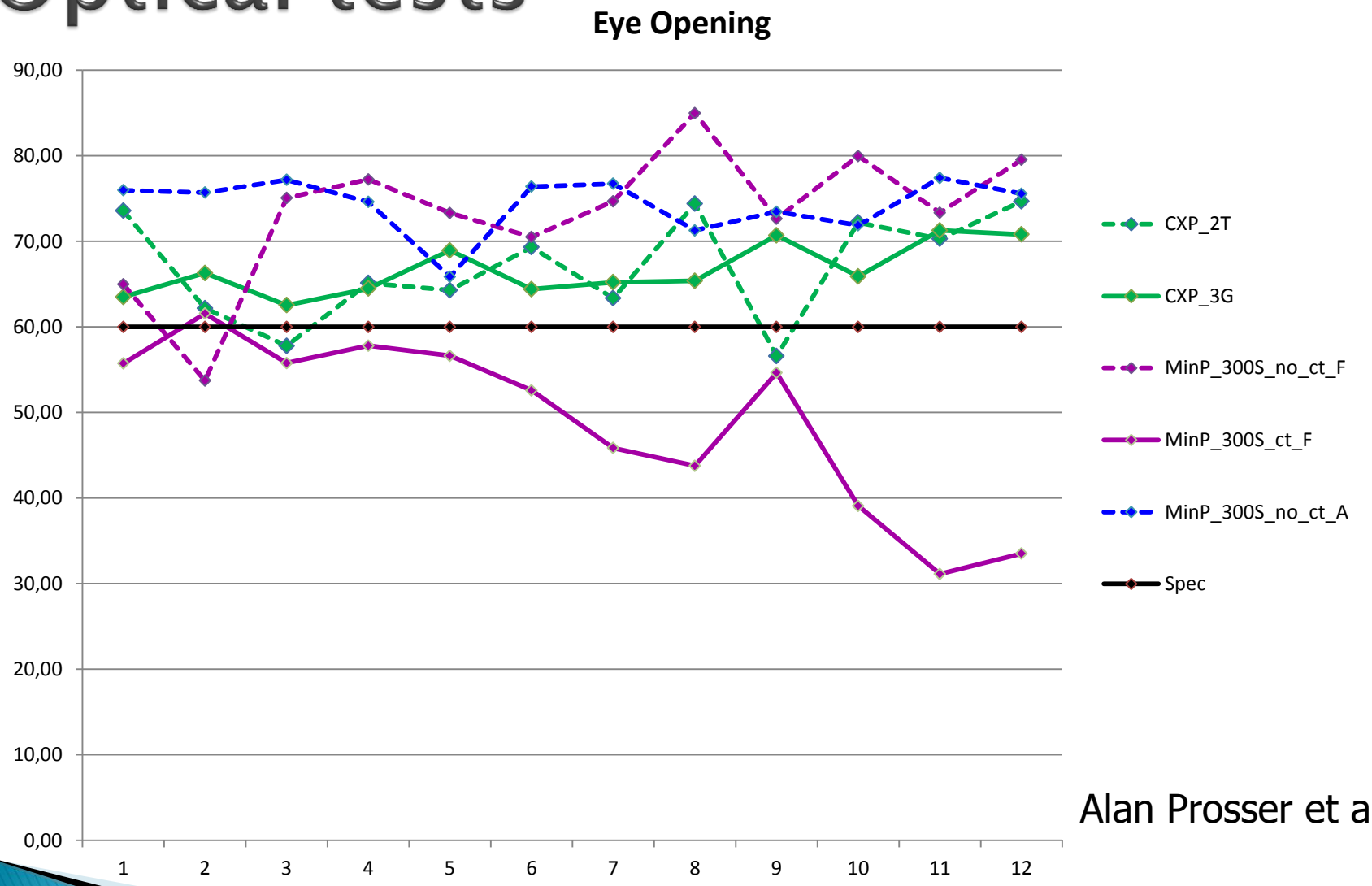
- Transmitter Optical Sub-Assembly (TOSA)
- Laser Diode Driver (LDD)
- Limiting Amplifier (LA)
- TransImpedance Amplifier (TIA)
- PIN photodiode

Versatile link status

- Common R&D almost complete
  - VTRx and later VTTx
  - Optical tests
  - Mechanical tests
  - Irradiation of active and passive components
  - Environmental test
  - System tests (BER etc.)
- Some tests exceed LHCb needs
  - …but might proof useful



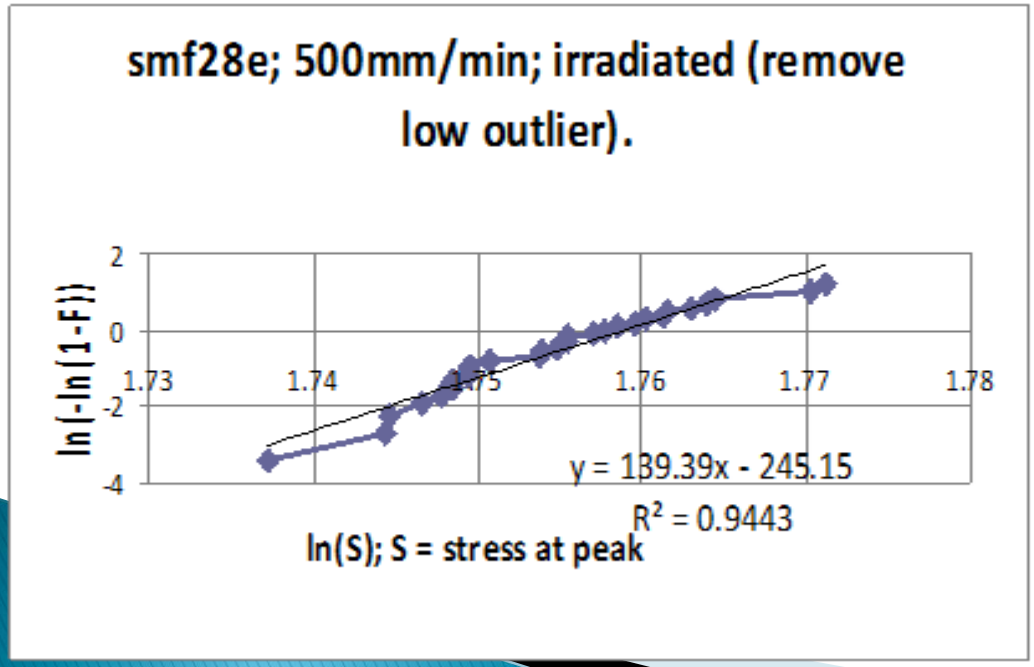
Optical tests

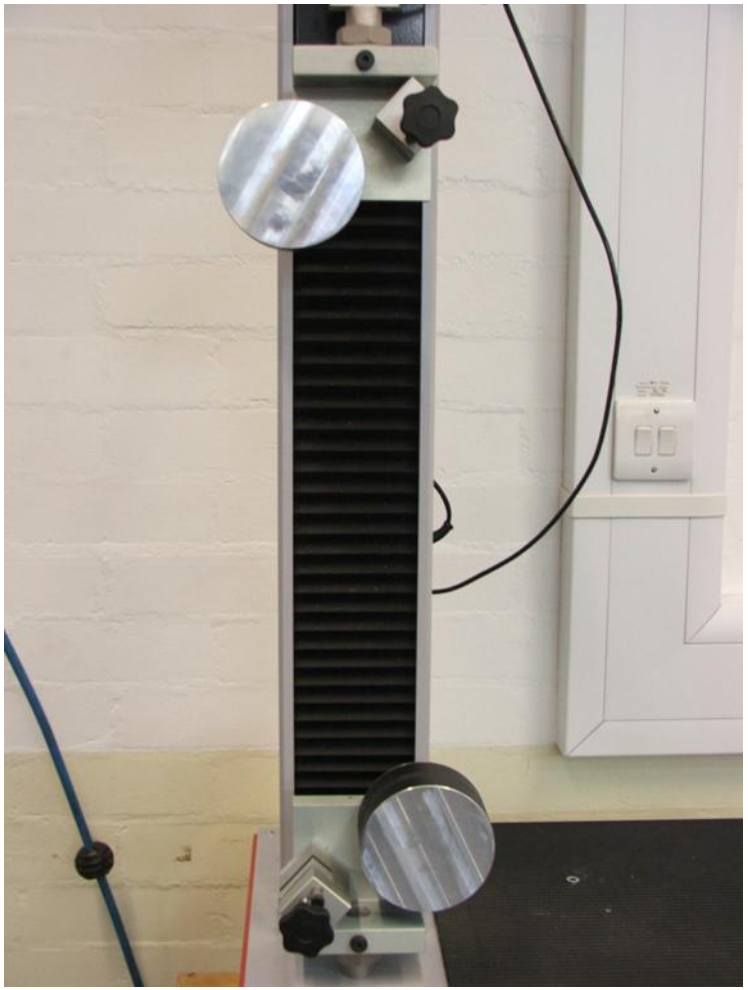


Alan Prosser et al.

Mechanical fiber stress test

- Fiber from Corning and Draka
  - Irradiated
  - Pull test
- John Wilson et al.





Irradiation tests of commercial components

- TI laser driver
  - ONET1101L
  - 10 krad/h
  - Ok. At 900 krad
- 4-channel QSFP
  - AFBR-79Q4Z
  - 10 krad/h
  - Errors from 75 krad

Annie Xiang et al.

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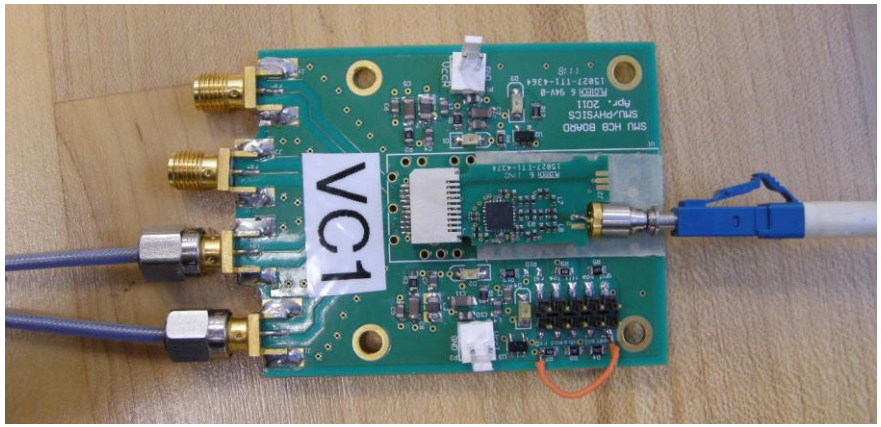
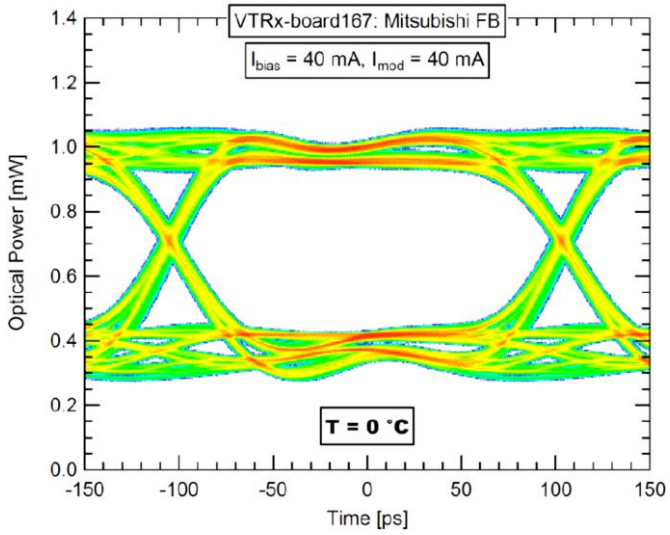


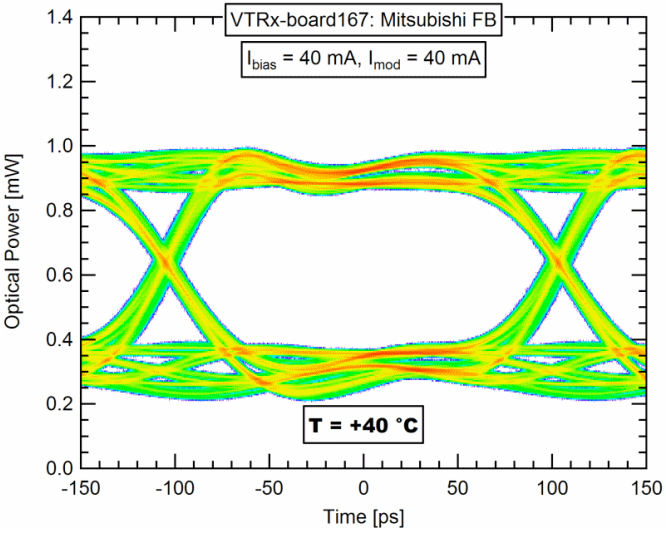
Annie Xiang et al.

Environmental test

- VTRx jitter measurements
  - VTRx 131:
    - ONET1101L & FP TOSA
  - Rx side measurement
  - Temperature testing of VTRx - Eyes

Jan Troska





R&D completion March 2012

VTRx

- Investigate options
  - TOSA SM (VCSEL/EEL)
  - PIN MM-Tk (GaAs/InGaAs)
- Gamma irradiation test
- Neutron irradiation test
- Environmental tests
  - EMI/Crosstalk, B-field, Zthermal
- Opto connector block
  - Variants (printed, molded and machined)
  - Materials
  - Selection
- VTRx flavours
  - Flat connector block
  - VTTx
- GB ASICs test and integration
  - GBLD V4
  - GBTIA V2
  - GBTIARosa V2
- VTRx FMC
- Documentation

Passives

- Cable architectures options and specs
- Cable test procedures
- Tests
  - Fibre pull tests
  - Cable irradiation tests
- Documentation
  - Connector test writeup
  - Microbend test writeup
  - Bandwidth

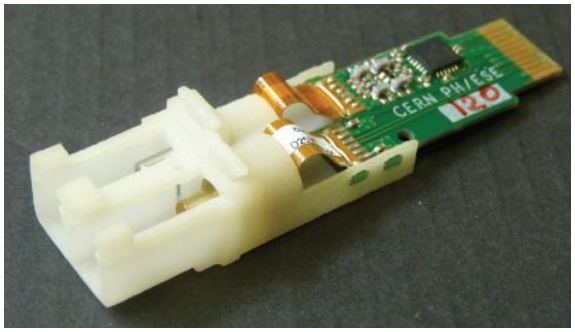
Back End

- Optical engines
  - Survey
  - Characterizati
  - FMCs
- SM Tx
  - High power
  - Arrays
- MM Tx – QSFP
- Documentation

System

- Explore margins (stressed eyes, temperature,..
- Raise density at backend
- Demonstrate system based on VTTx
- Explore compatibility with higher level system (
- Documentation

Versatile link status



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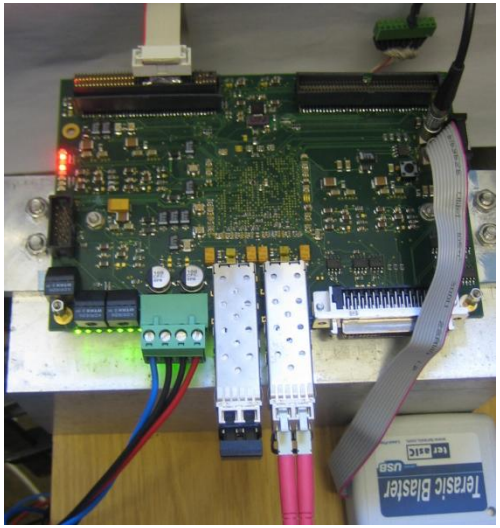
- **Next steps**
  - Tendering +user test systems
  - Custom R&D

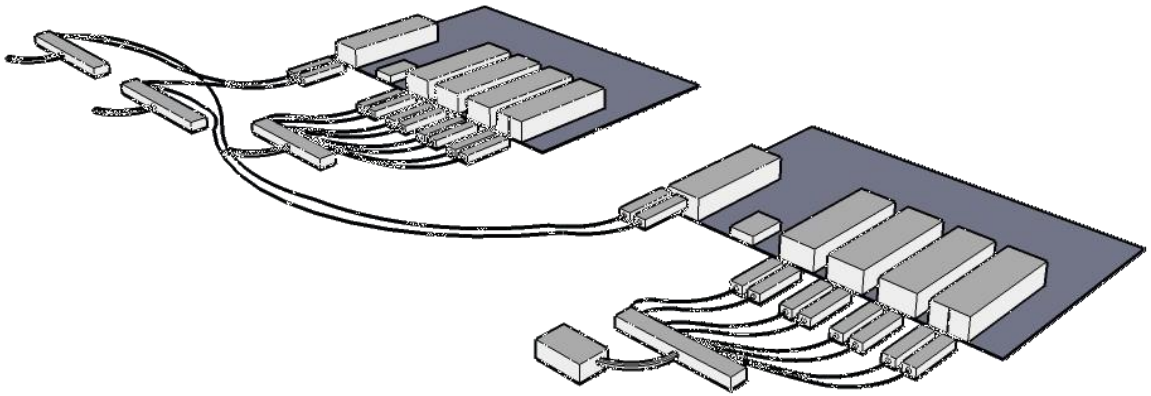
LHCb optical link activities

- Many Institutes started R&D
  - OT example:
    - Altera FPGA based front end at HD (Christian F.)
    - Readout board at Dortmund (Stefan S.)
    - Actel FPGA based front end at NIKHEF (Tom S.)
  - TELL40
    - Marseille
    - Lausanne
- Important to proceed together



Tendering for LHCb

- TOSA MM: 11000
- ROSA MM: 1000
- VTTx MM: 5000 ?
- VTRx MM: 1000
- 12Rx MM: 1000 ?
- Fiber ??



- Specification
- Market survey
- Qualification

Custom R&D

- Detector specific versatile link components and architecture
  - VTRx and/r VTTx PCB
  - Optoblock
  - Assembly vs. reference design
- Low power VTRx
- 10Gb/s opto engine
- Emergency technologies
  - Si photonics …

Summary

- LHCb 40 MHz upgrade
  - extra bandwidth
  - Higher radiation levels
- Versatile link project
  - 5 – 10 Gb/s optical link system
  - Common R&D achieved
  - Most tests concluded
- LHCb versatile link next step
  - System tests by users
  - Tendering
  - Specific implementations