Versatile Link Status Report

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With input from

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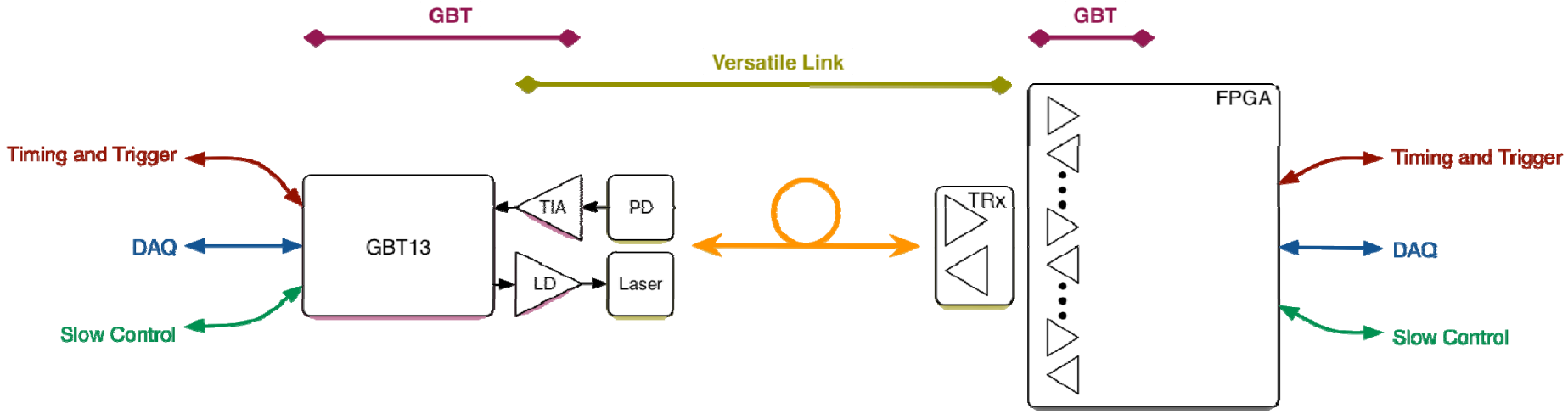
Versatile Link Project Description

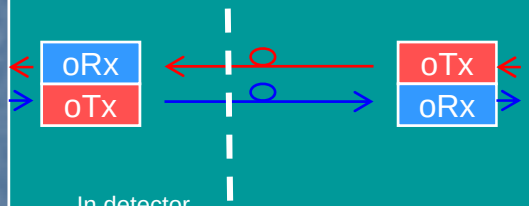
- Optical Physical layer linking front- to back-end
- Bidirectional, ~5Gbps
- Versatile
  - Multimode (850nm) and Singlemode (1310nm) versions
  - Point to Point and Point to Multipoint architectures
- Phase 1: Proof of Concept based on tentative specifications



Workpackage Allocation

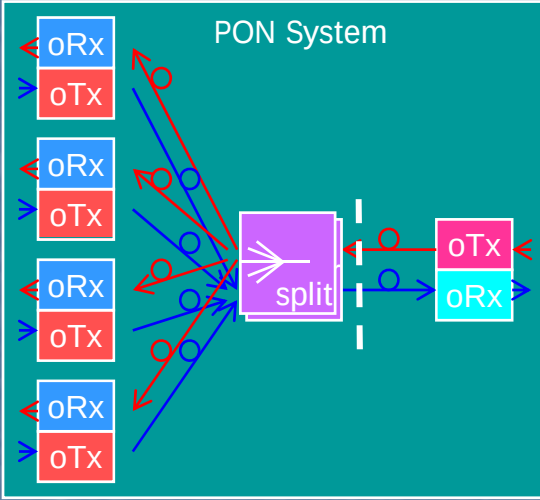
Project Management

WP1.1
P2P System

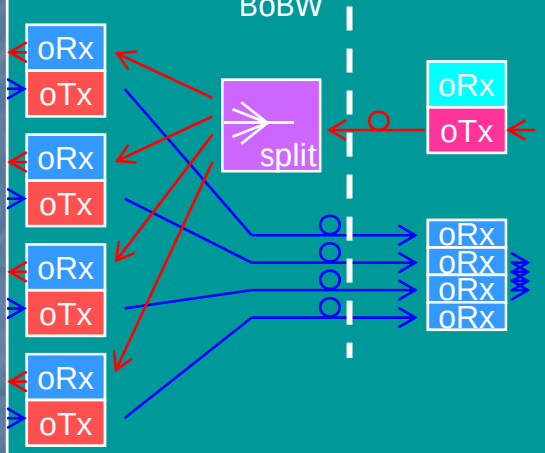


SMU

WP1.2
PON System



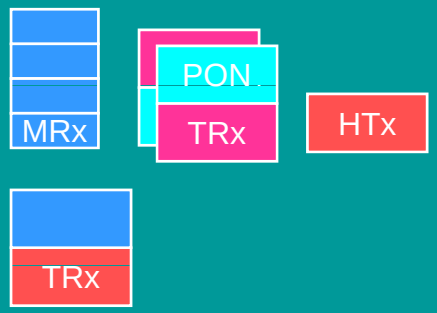
WP1.3
BoBW



WP2.1
Front End Components

CERN

WP2.2
Back End Components



Fermilab

WP2.3
Passive Components

Oxford

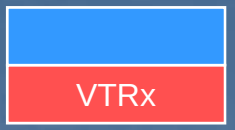
Deliverables and Timescales

Phase 1: Proof of Concept based on tentative specifications

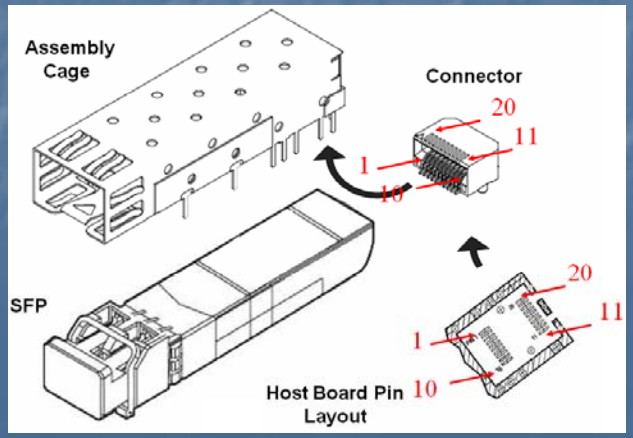
- Deliverables:
  - a tentative specification based on past experience
  - a non-exhaustive portfolio of components meeting (even partially) the tentative specification (SM and MM, P2P and P2MP)
  - a front end TRx prototype package
  - test bench(es) for components and systems
  - preliminary irradiation test results
  - preliminary functionality test results for components and systems
  - a set of recommendations for phase 2.
- Timescales:
  - 18 months for phase 1 (Sep 09)
  - Phase 2 to be defined after 12 months (Apr 09)
- *Phase 2: Feasibility Study*
  - *Detailed specifications based on user requirements*
  - *Components and Variants Shortlist*
  - *VTRx package definition and fabrication*
  - *Systems and Architectures Demonstration*
- *Phase 3: Production*
  - *Specification freeze*
  - *Market Survey*
  - *Pre-Production*
  - *Qualification*
  - *Production*

WP2.1 status report, CERN

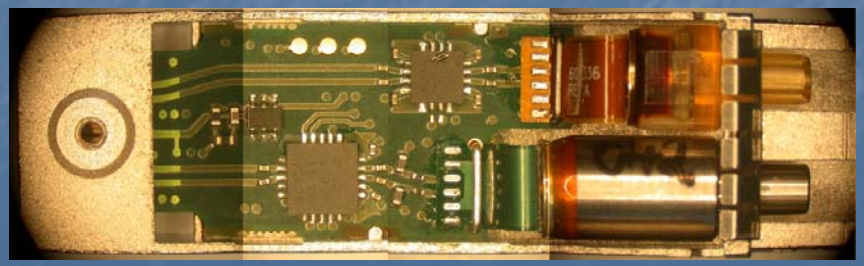
a) VTRx Customisation



- Bi-directional Module with connector interface
  - Based upon an acknowledged standard
  - Work with Industrial partner early-on
- Low Mass & Volume
  - Minimize material, avoid metals
- Non-magnetic, capable of operating in a magnetic field
  - Requires replacement of ferrite bead used in laser bias network
- MM 850nm & SM 1310nm versions

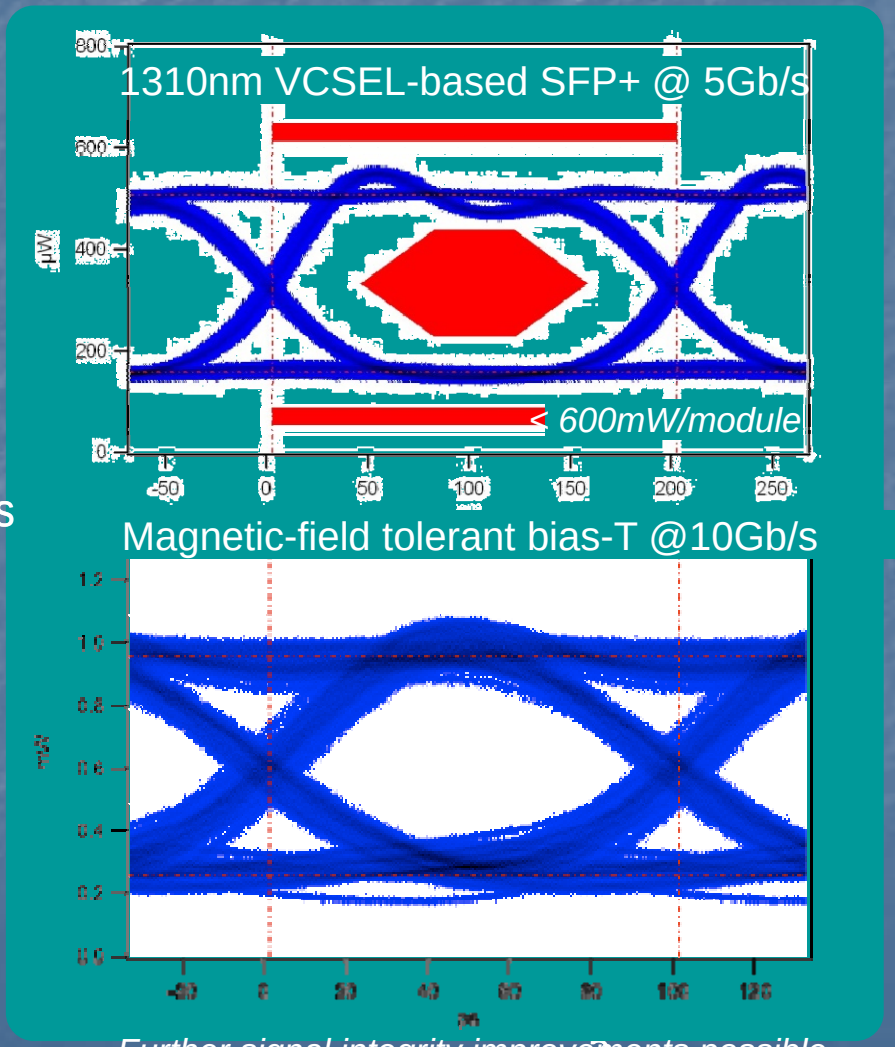


- Work-plan
  1. Identified potential industrial partner
  2. Test commercial parts of the type we would like to customize (SFP+)
     - ✓ Evaluated standard 850nm and 1310nm SFP+ modules in early 2008
     - ✓ Evaluated VCSEL-based 1310nm SFP+ modules in mid-2008
  3. Customize package to meet HEP need
  4. Ask for CERN-specified parts to replace standard ones
     - Laser Driver, TIA
     - Laser (VCSEL or EEL), PIN photodiode

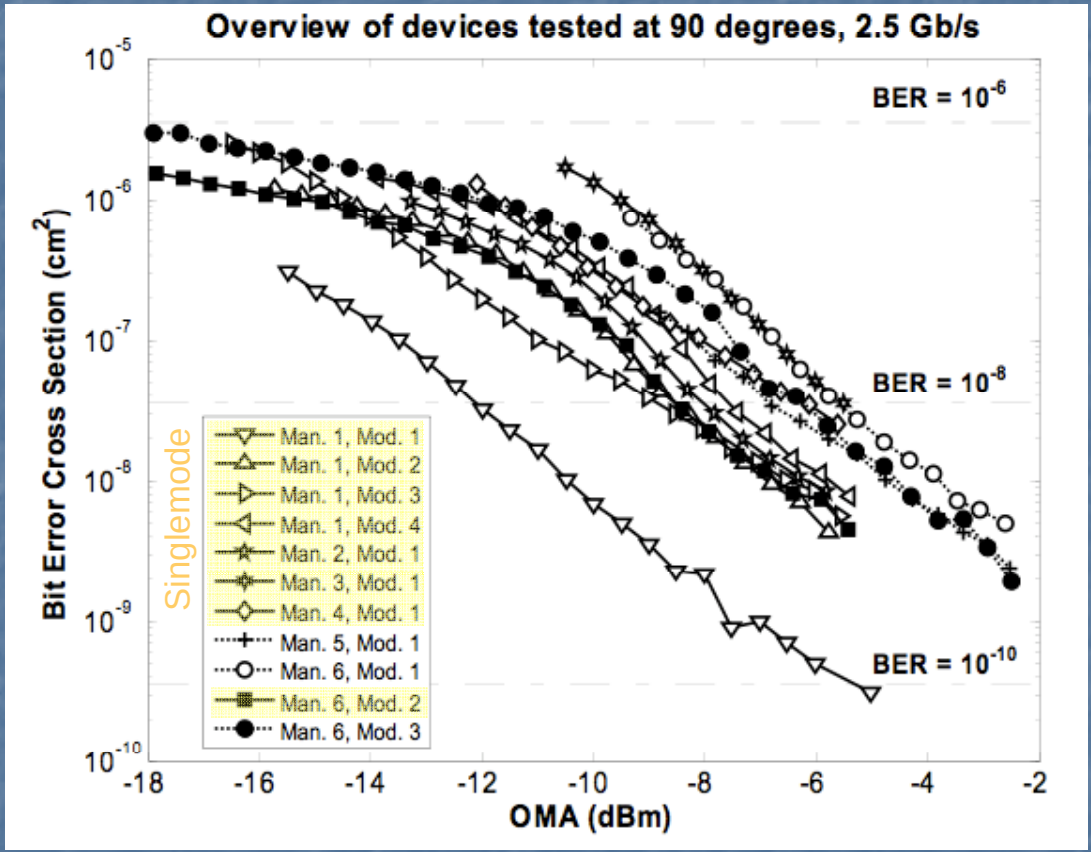


b) Functionality Testing

- Major effort has been put into evaluating commercial SFP/+/XFP transceiver modules
- Functionality testing broken down into three parts
  - Power Consumption
  - Transmitter portion
  - Receiver portion
- Testing of currently available modules has led to starting to define detailed performance specifications & methods
- For details, see presentation by Luis Amaral



c) Radiation Testing SEU



- Very Similar overall trend
  - ROSA (solid symbols) not much worse than bare PINs
  - Several orders of magnitude difference in response between devices
- BER independent of Data-rate
- Burst Errors observed
  - max. 10-bits long in PINs
  - max. 00's bits long in ROSAs
  - Error correction mandatory
- Plans:
  - Total Fluence testing of Laser, PINs and possibly TIAs and Laser Drivers in early 2009

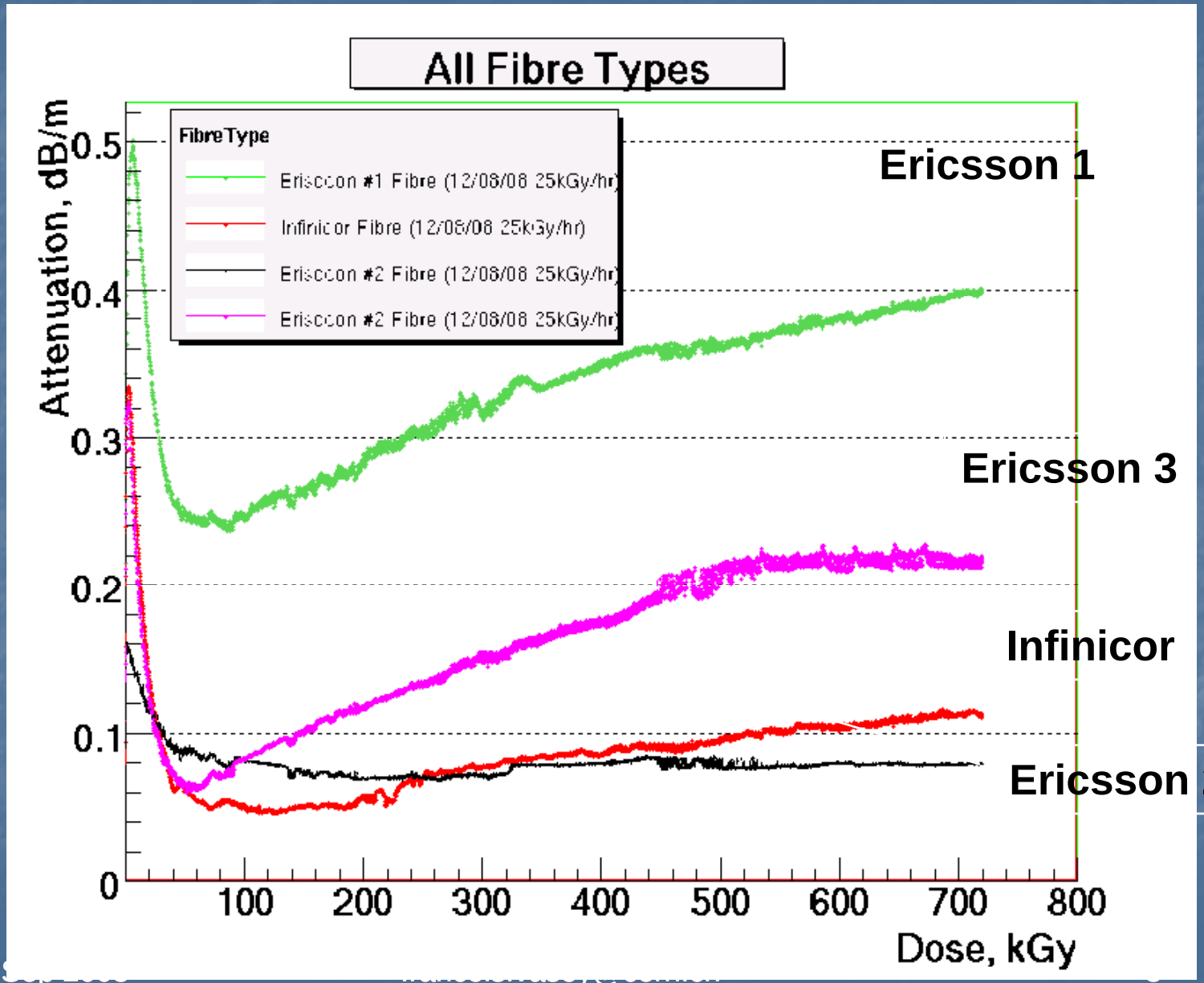
- 60MeV protons at PSI
  - Flux 10^8p/cm^2/s (1-2 orders of magnitude above SLHC Tk/Pix)
- Multiple device types from multiple Vendors, also with integrated TIA (ROSAs)

WP2.3 status report, Oxford

a) Radiation tests of passive components
- Irradiated up to **700 kGy**
- 4 **multi-mode (MM) fibres** @ 850nm
- 1 **single-mode (SM) fibre** @ 1310nm (SMF28)
- MM fused taper **splitter**
- SM PLCC splitter
- MM and SM LC-LC **connectors**

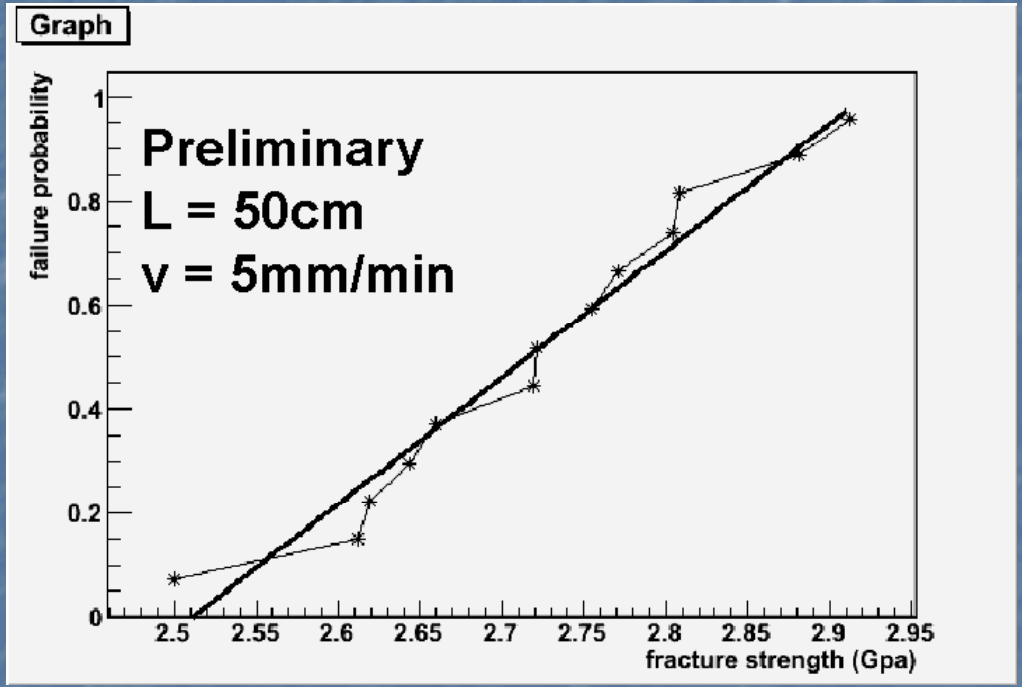
- Preliminary results (details see T. Huffman's talk)
  - 2 MM fibres and 1 SM fibre candidates
    - Survey of market for more MM fibres will continue
  - Need more splitter tests
  - Connector candidates identified
- **Overall: Very good progress made.**

MM fiber irradiation test



b) Tests of mechanical properties of fibres started

- Until now un-irradiated SMF28

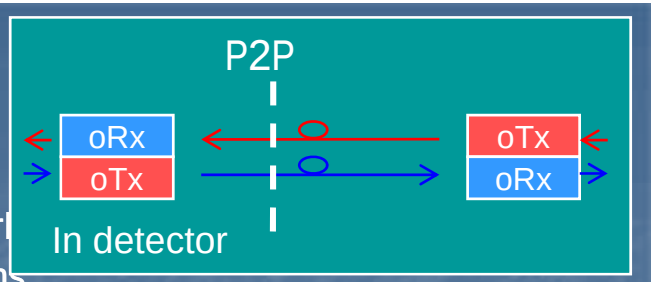


- **Next test irradiated fibres**

c) Plans for the next six months

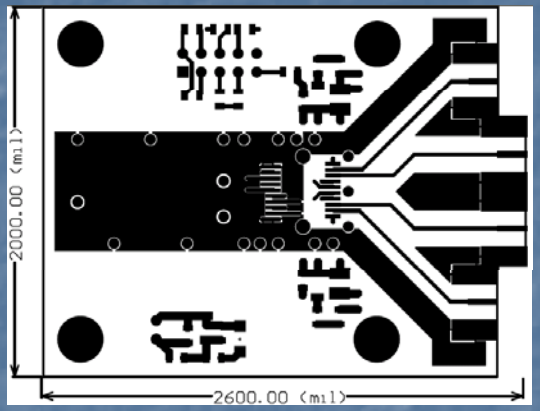
- Continue **market surveys**
  - fibres
  - splitters
- Prepare next **gamma radiation test**
  - fibres at low and high dose rates
  - Splitters→ passive tests
- Setup **environmental tests** for fibres, splitters and connectors
- Continue **mechanical tests**

WP1.1 status report, SMU

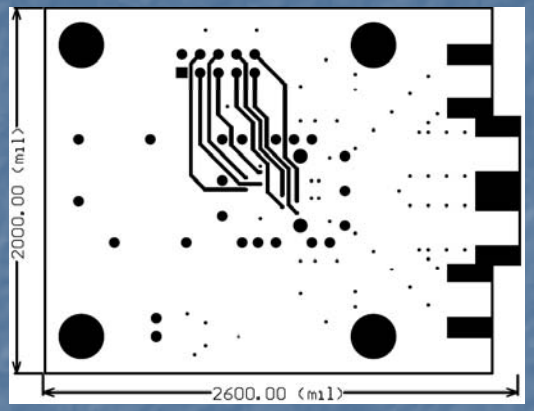


- Deliverables in phase 1:
  - Development of architecture demonstrators for P2P networ
  - Development of test bench(es) for components and systems
  - Development of test procedures.
- The status:
  - SFP+ is chosen as candidate for Versatile Link standard (by Versatile Link group).
  - SFP+ carrier board has been designed and fabricated. With a loop-back (oTx to oRx via fiber) configuration, a 10 Gbps optical serial link has been demonstrated with AFBR-700SDZ (10Gb, 850 nm) from Avago.
  - Equipment is in place for 10 Gbps tests:
    - 12Gbps BERT.
    - 20GHz real-time scope with 8GHz differential probe.
    - O/E module with 12GHz bandwidth.
    - Sampling scope with 10GHz optical, 50 GHz electrical input modules.
  - New collaborator (IPAS) has been added to this work package.
- The plan for the next 6 months:
  - With equipment in lab, and commercial transceivers, a full P2P network of 10 Gbps will be demonstrated.
  - With Stratix II GX programmed as the BERT (signal generator and bit error rate checker), a portable 6 Gbps test bench will be developed.
  - Tests will be carried out with the 12 Gbps BERT and with Stratix II GX based test bench. Testing procedures will be studied and defined through this process.

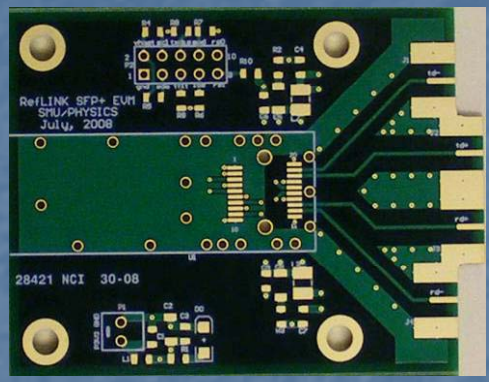
The SFP+ carrier board for 10 Gbps signal

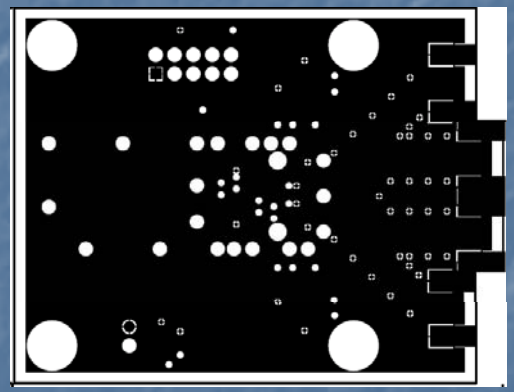


Top Layer

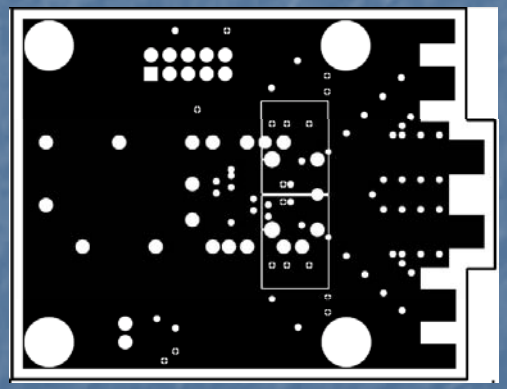


Bottom Layer

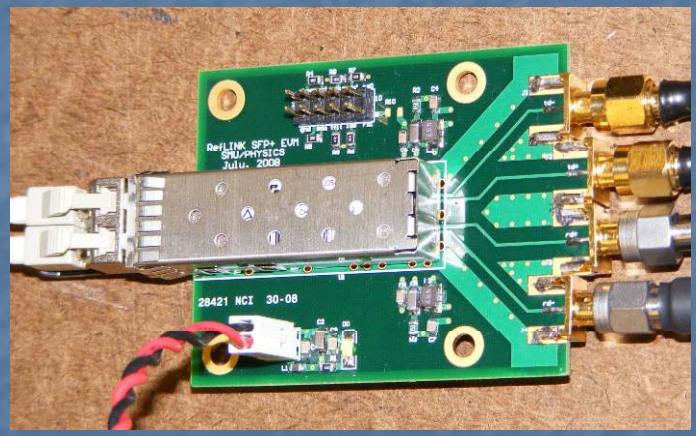




Ground Layer

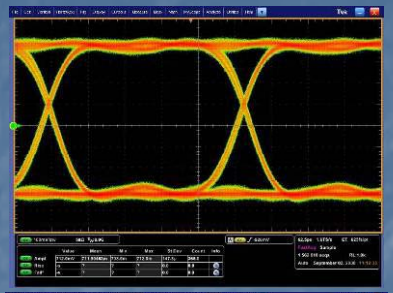


Power Layer

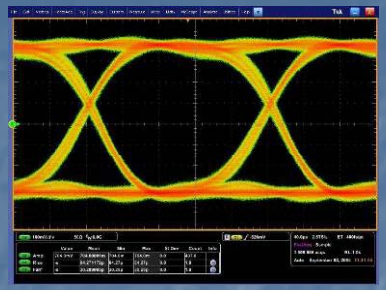


Preliminary test results

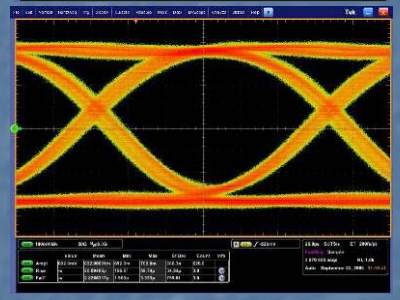
- Eye diagram tests at 3, 5, 8 and 10 Gbps.



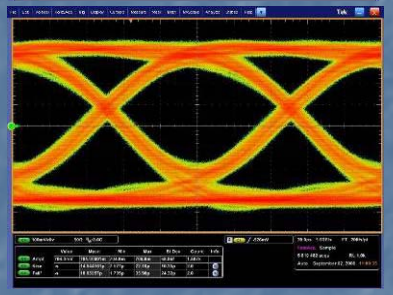
3 Gbps



5 Gbps

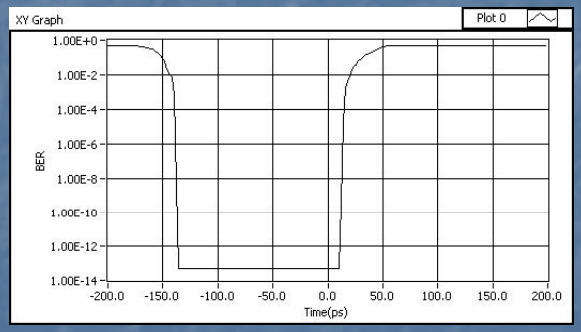


8 Gbps

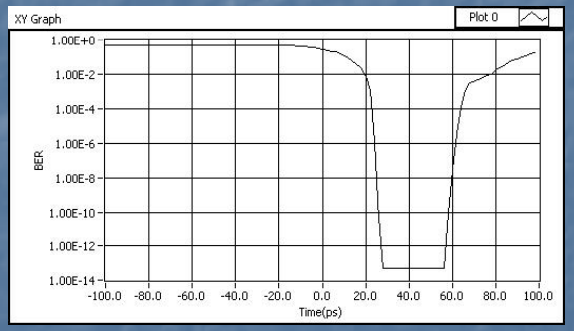


10 Gbps

- BER tests at 5 and 10 Gbps. BER is found to be bettet than 3E-14 at 10 Gbps.



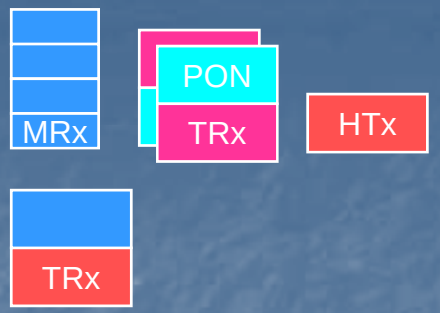
Bathtub curve at 5 Gbps



Bathtub curve at 10 Gbps

- The board works at 10 Gbps, but there are issues that needs more careful studies.

WP2.2 status report, Fermilab



Fermilab Has Joined the Project

- Work Plan Submitted and Approved
- Presentation at Project Meeting (14-9-2008)

3 Month Plan

- Document and Communicate Test Strategy
  - Components
  - Procedures
  - Equipment

6 Month Plan

- Procure Samples of Selected Components
- Test Lab Configuration
- Begin Testing Following Documented Procedures

Conclusion

Phase 1: Proof of Concept based on tentative specifications

- Status after 6 months:
  - a tentative specification based on past experience
  - a non-exhaustive portfolio of components meeting (even partially) the tentative specification (SM and MM, P2P and P2MP)
  - a front end TRx prototype package
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