Pluggable Interconnect Technology FOR Electro-Optical PCBs

Research and Development Synopsis

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Messe München

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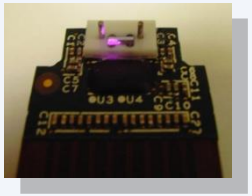
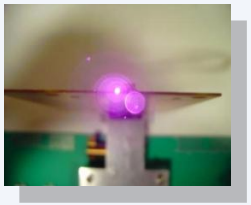
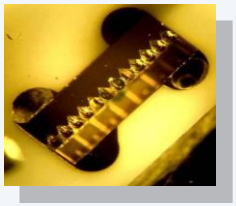
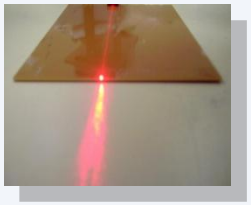
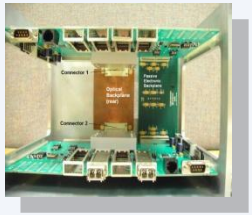
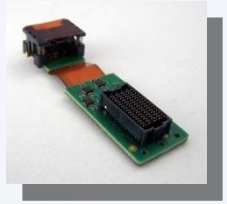
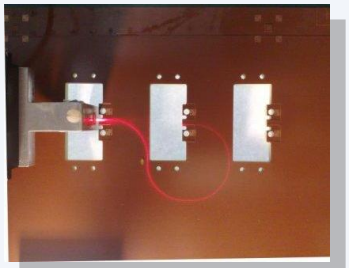
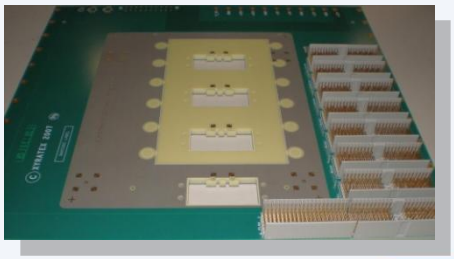
Overview

- Research objectives
- Commercial design benefits of optical waveguides
- Optical backplane connection architecture
- Electro-optical backplane design
- Active pluggable optical connector
- Demonstration assembly





Data storage systems increasing in complexity, density and speed

Storage demand increasing

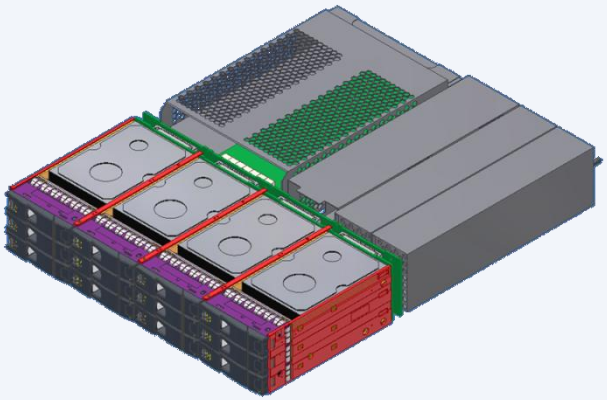
- Manage more storage
- Increased complexity

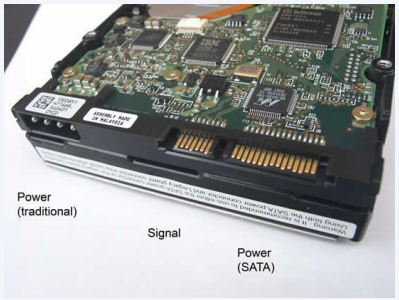
Data rates increasing

- Data access speeds:
  - ***3 Gb/s SAS → 6 Gb/s SAS***
  - ***10 Gb/s Gigabit Ethernet***
  - ***12 Gb/s SAS***

Disk sizes decreasing

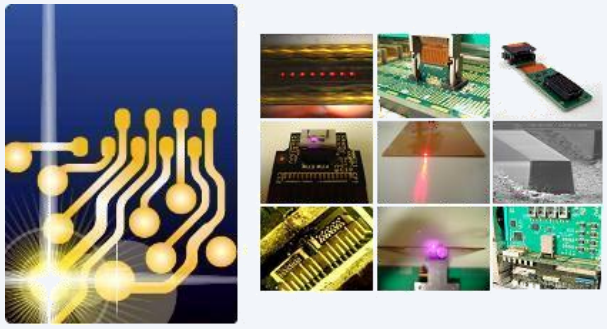
- 3.5” → 2.5” → 1.8” → 1”
- Increased system density

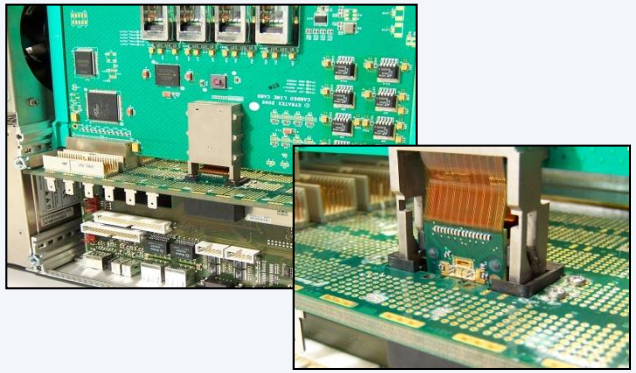




Key Research Objectives

- Investigate optical PCB technology
- Identify technology challenges
- Develop optical PCB and connector technology
- Integrate OPCB backplanes into storage systems
- Drive commercial proliferation



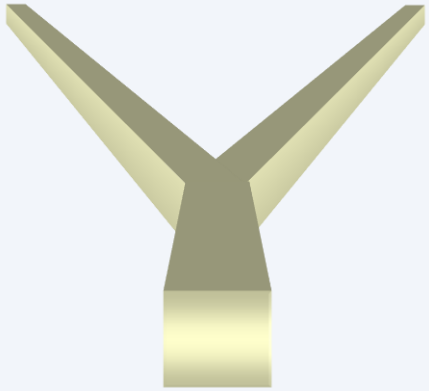


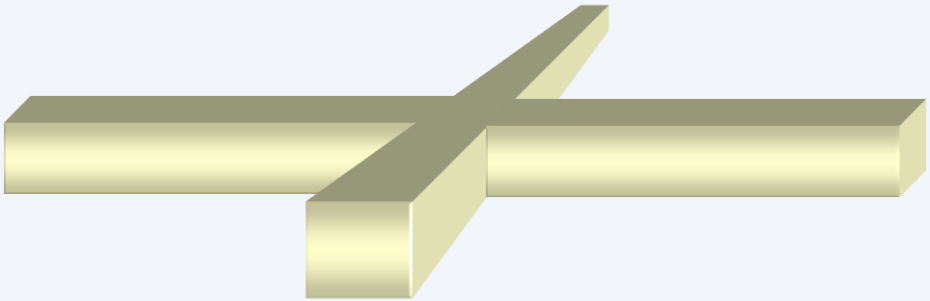
Splitters

- 1 – n signal power splitters possible
- n determined by loss budget

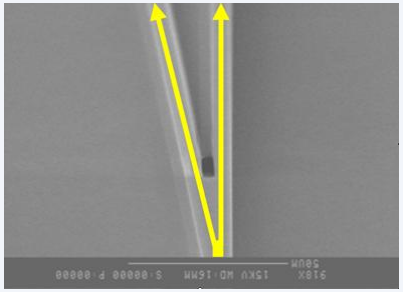
Crossovers

- Trace crossovers possible on same layer
- Different crossover angles possible

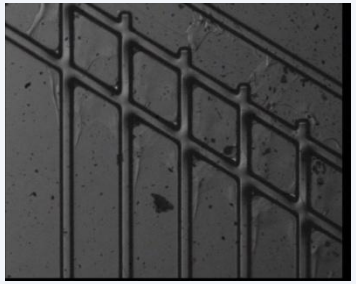


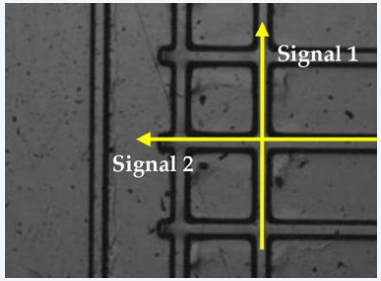


Source: IBM Zürich



Source: Exxelis

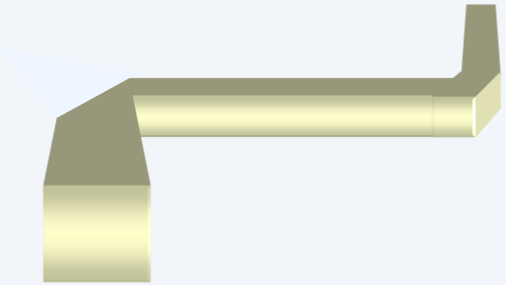




Source: Exxelis

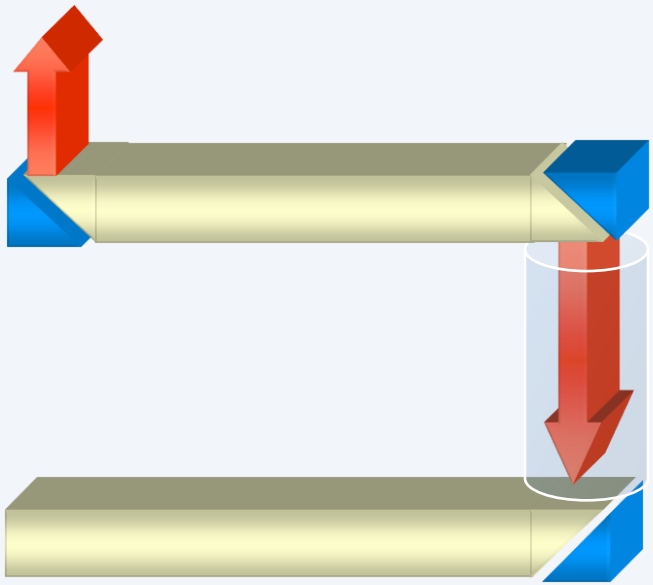
Right Angled bends (in-plane)

- ❑ Avoids minimum bend radius restrictions
- ❑ Allows high density routing solutions



Right Angled bends (out-of-plane)

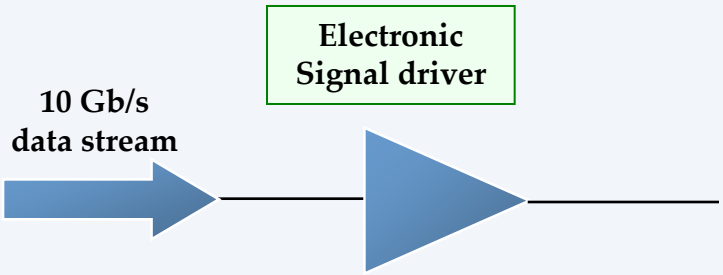
- ❑ Eases optical signal insertion / extraction
- ❑ Optical vias possible

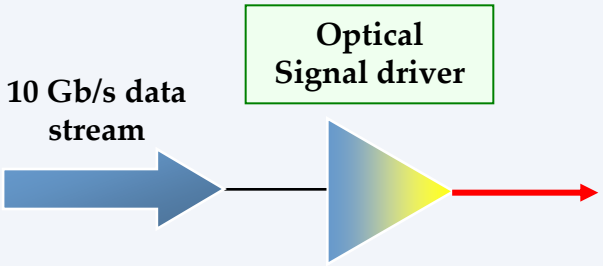


High speed optical signal drivers require less power

- Comparison of photonic drivers with high speed electronic signal drivers:
  - *Altera PowerPlay to simulate XAUI interface against*
  - *Current power consumption specs for VCSEL, VCSEL drivers, photodiodes, TIA/LA*

57% power reduction in high speed signal drivers @ 10 Gb/s





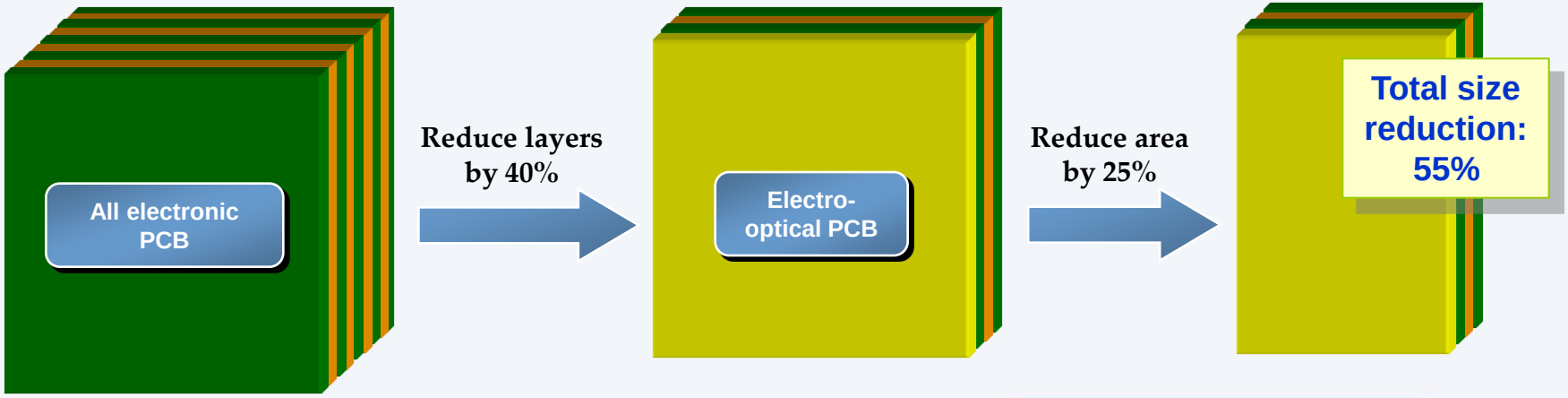
Size and Weight Reduction in Optical PCBs

PCB thickness reduction

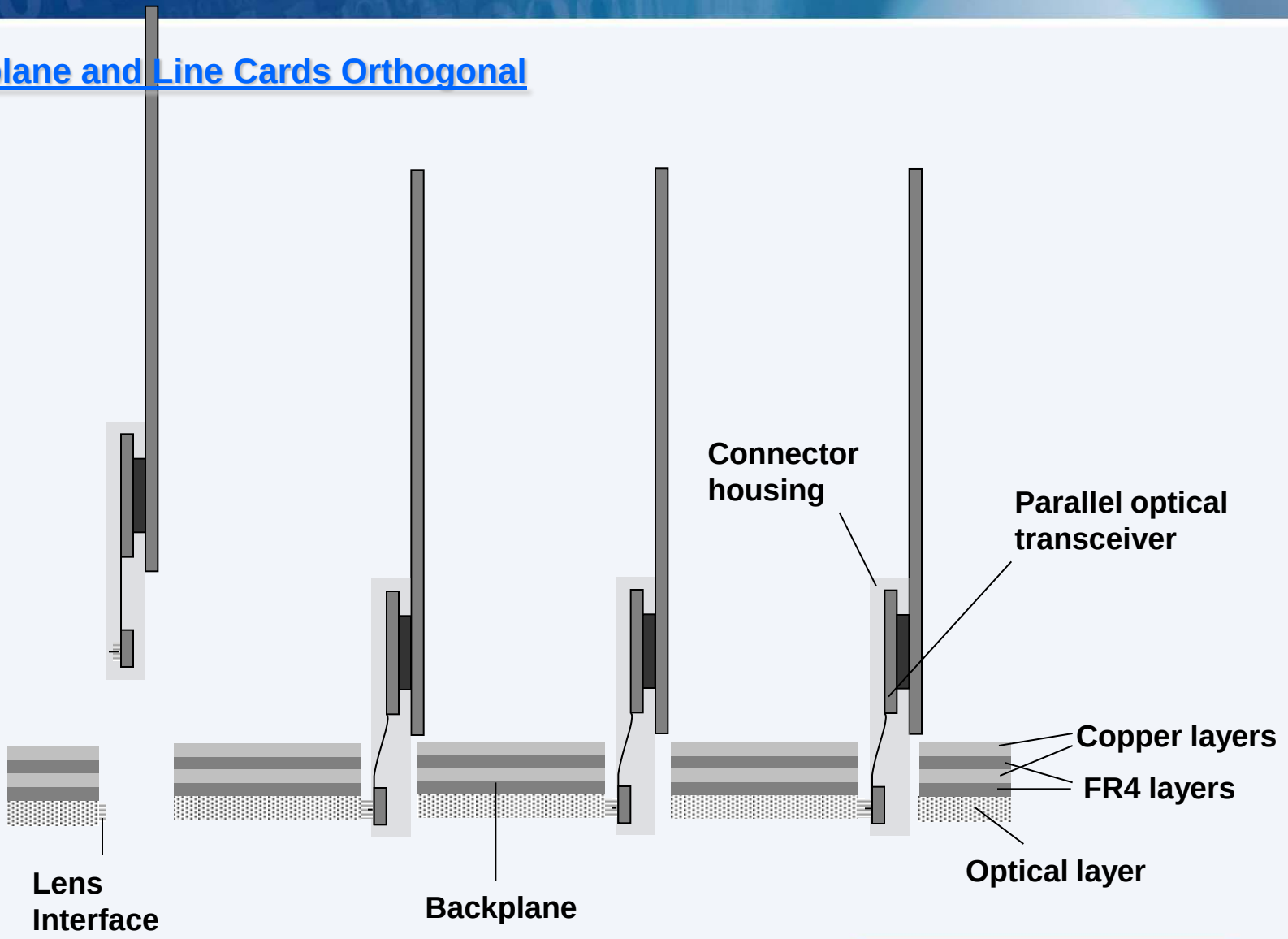
- Higher density and crossover solutions allow:
  - Reduction in PCB layer count
  - At least 40% reduction in thickness

PCB area reduction

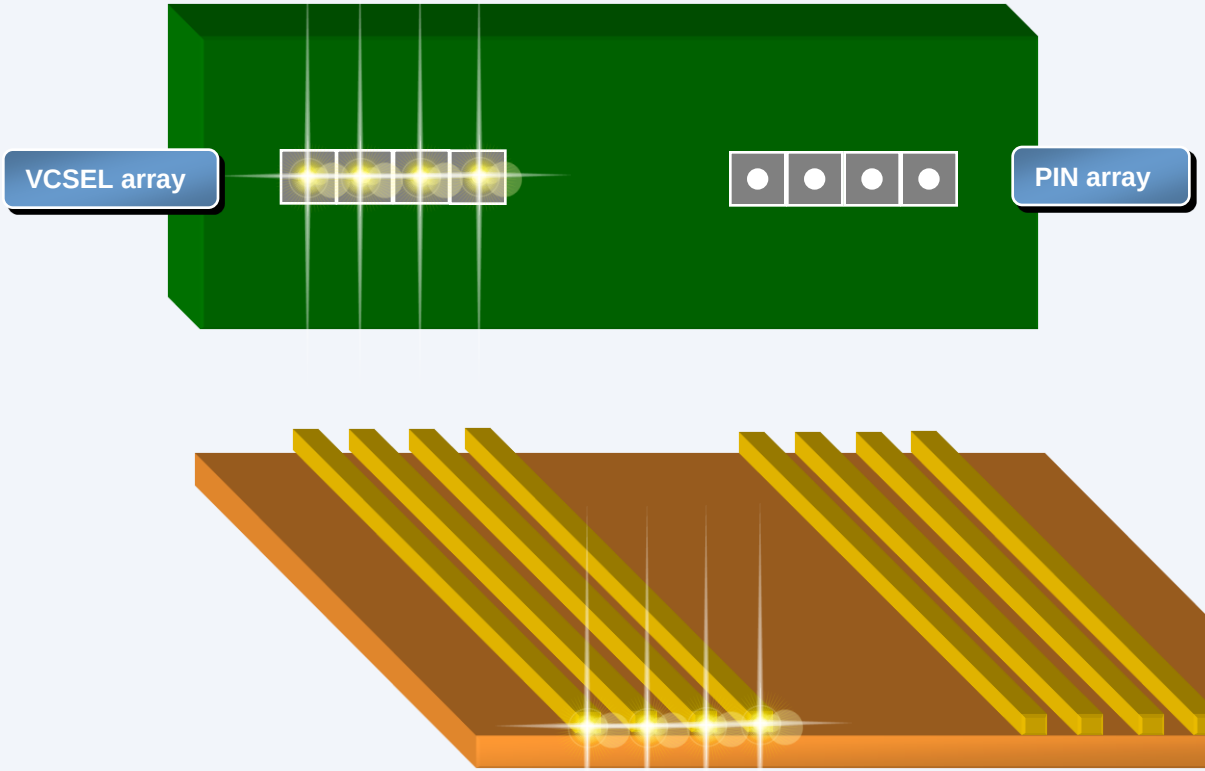
- Increased bandwidth density allows:
  - Reduction in functional area of I/O
  - At least 25% reduction in board area

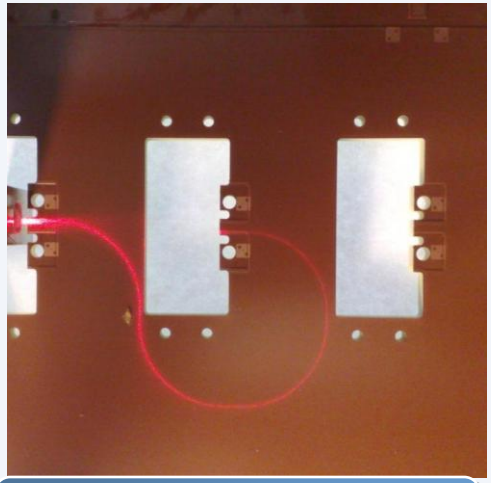


Backplane and Line Cards Orthogonal



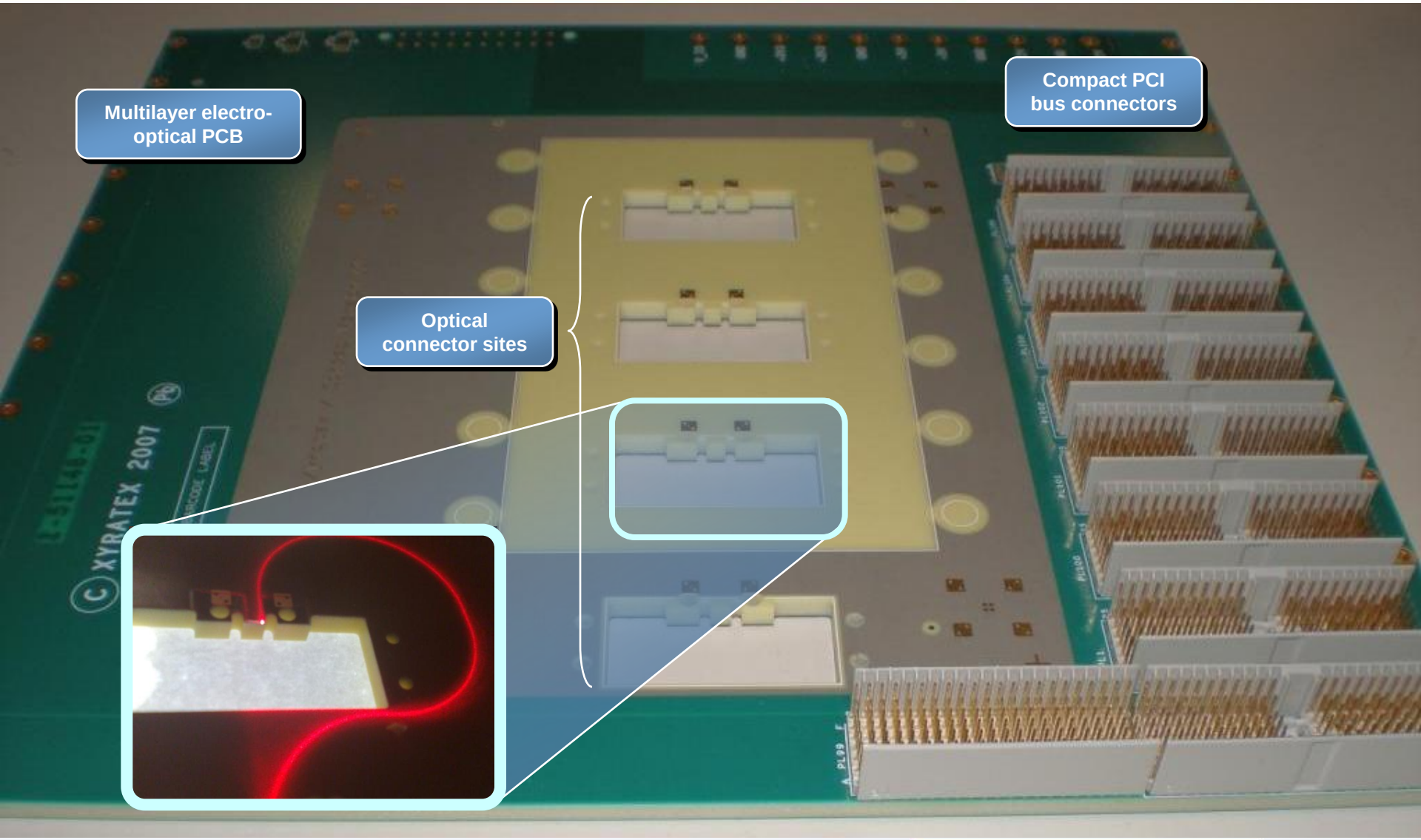
Butt-coupled connection approach without 90° deflection optics





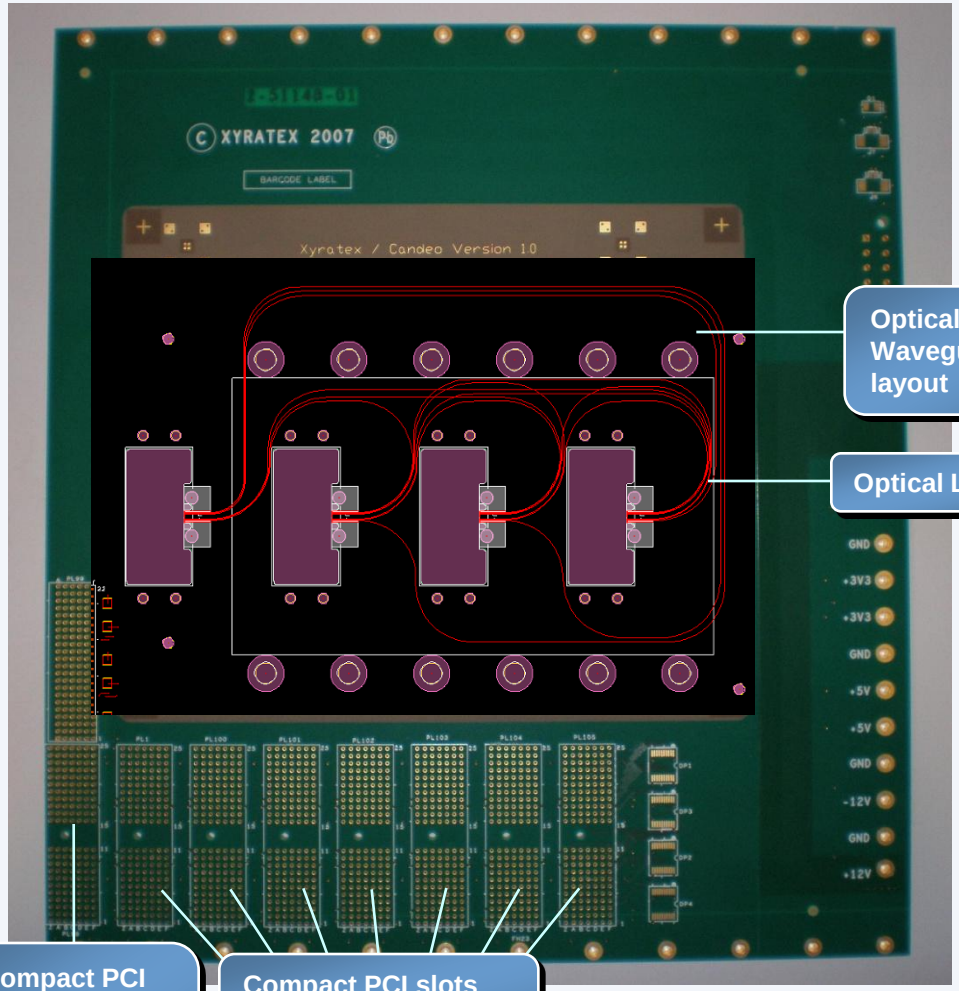
Waveguide illuminated through butt-coupled fibre connection

Electro-Optical Backplane Design



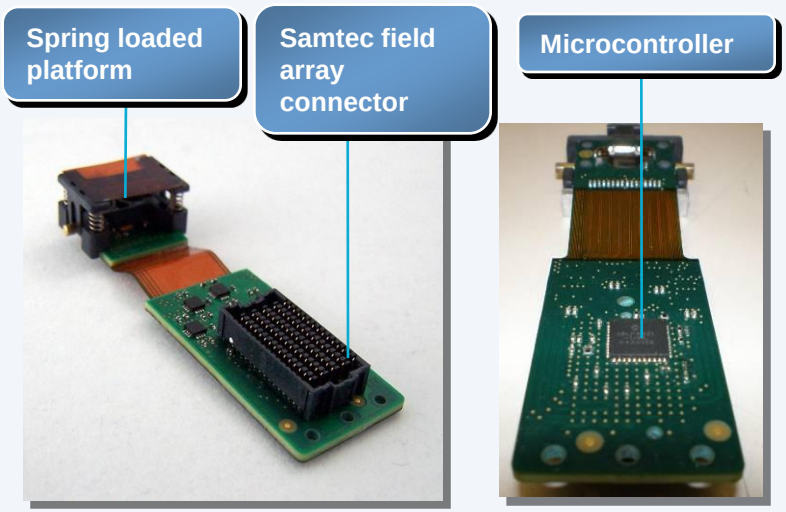
Electro-Optical Backplane

- Compact PCI architecture
- 10 electrical layers for power and C-PCI bus signals
- 1 optical layer for 10 Gb/s traffic
- 4 optical PCB connector sites
- C-PCI slots for line cards



Parallel Optical Transceiver

- Small form factor
- Quad transceiver
- 10 Gb/s per channel
- Microcontroller with I^2C interface

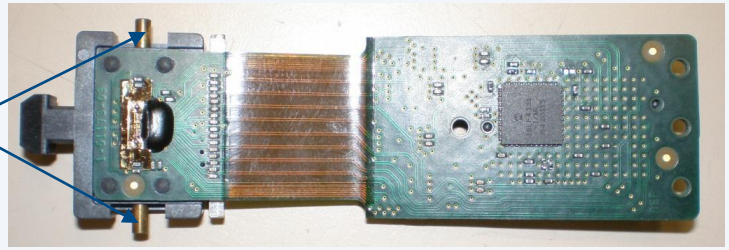


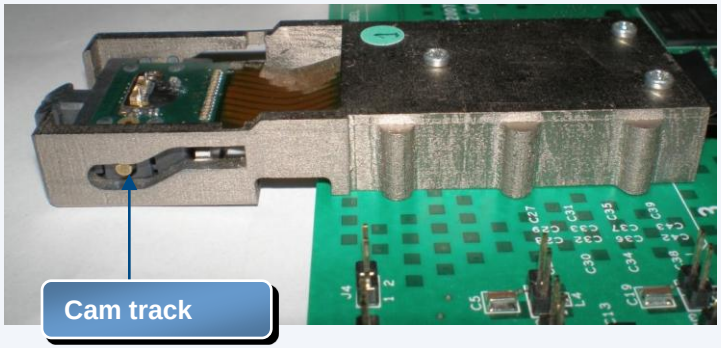
Backplane Connector Module

- Automated connector mechanism
- High precision alignment

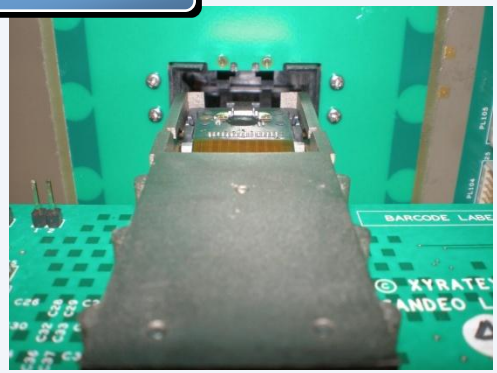
Engagement process

- Optical transceiver interface floats
- Backplane receptacle “funnels” connector
- Cam followers force optical interface up
- Optical transceiver lens butt-couples to backplane lens



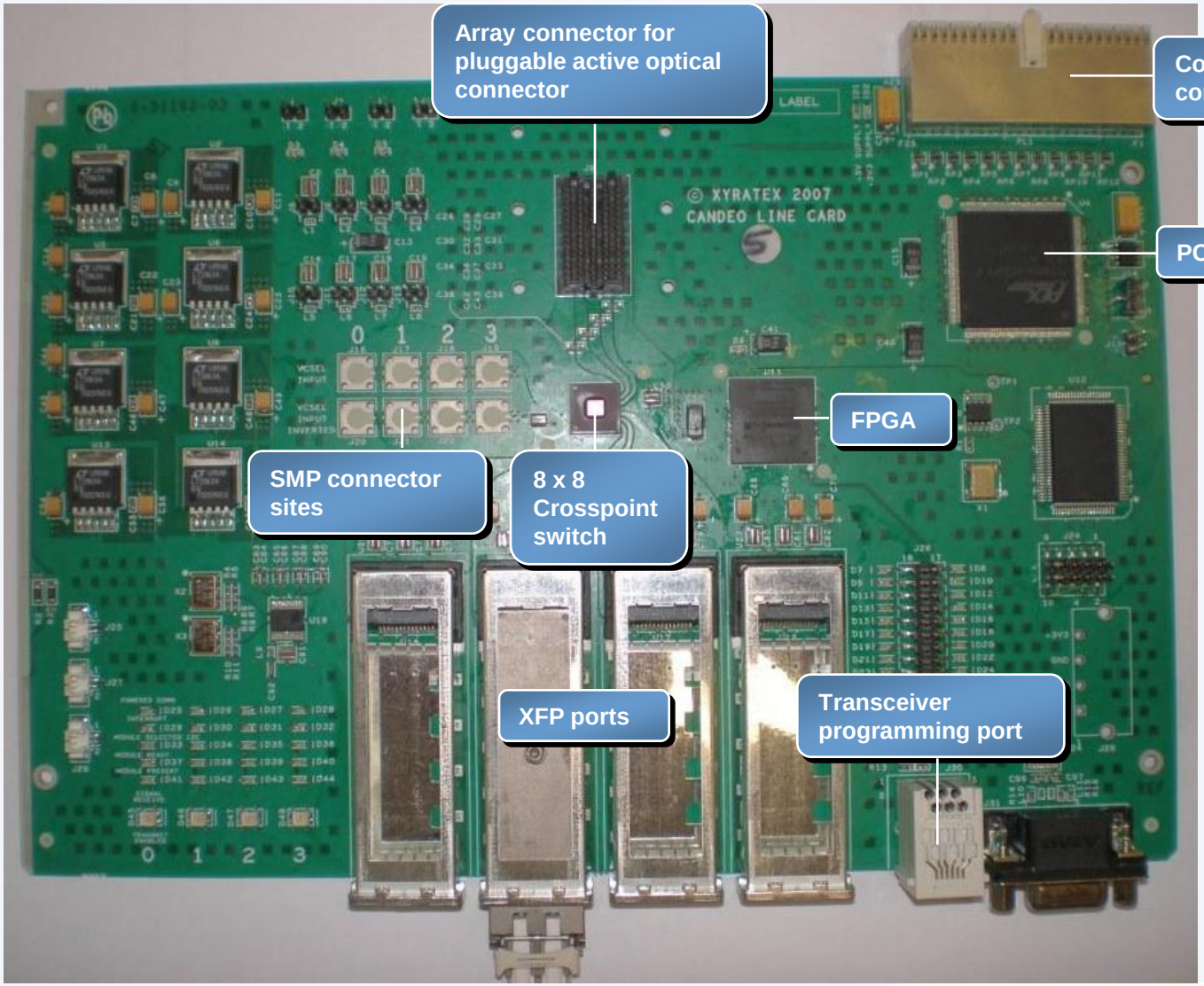


Undocked

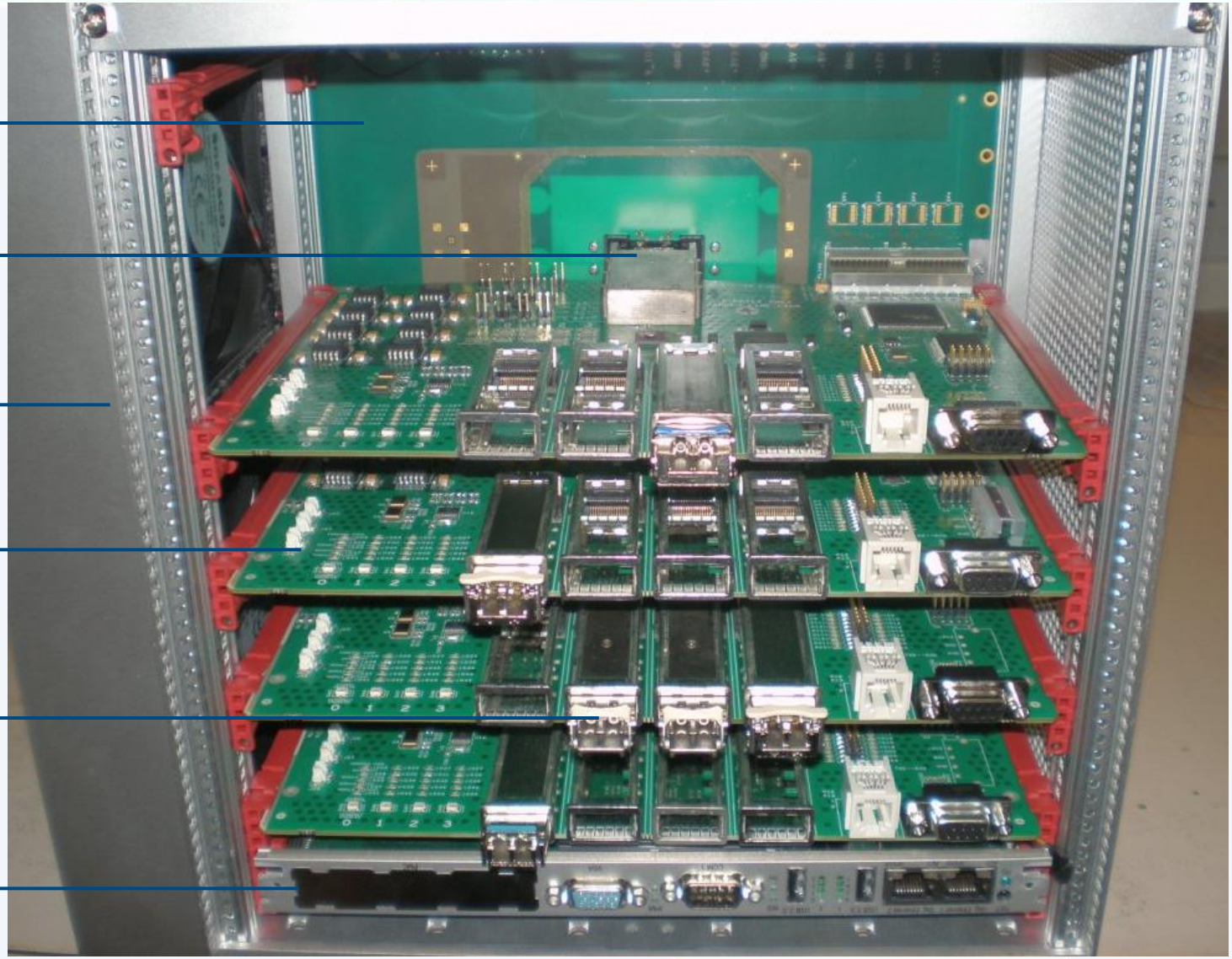


Docked

High Speed Switching Line Card



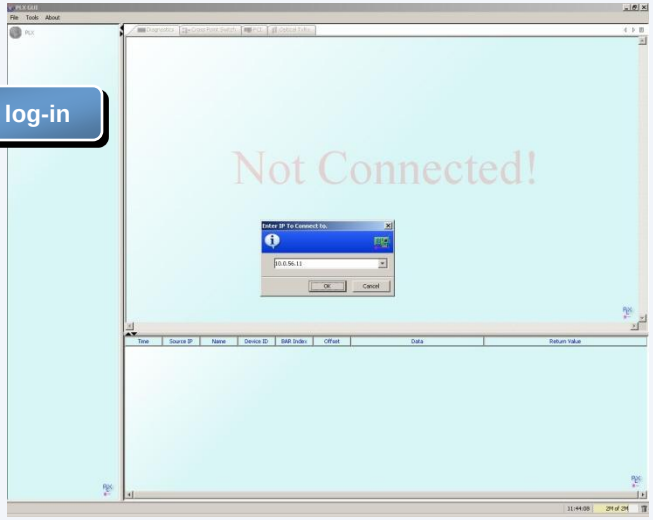
Demonstration Assembly



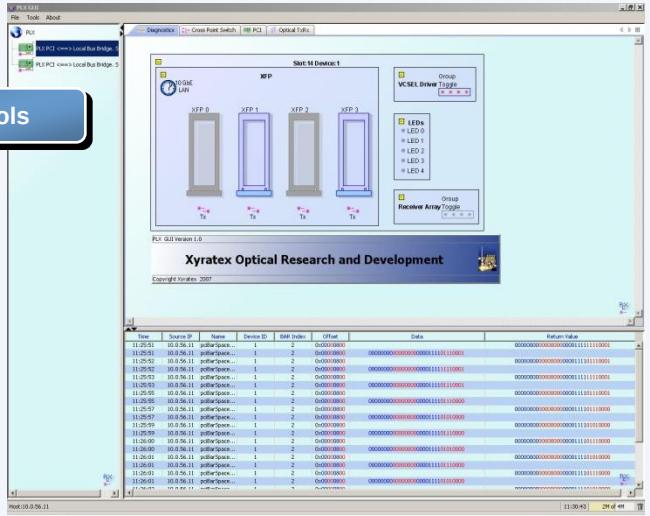
GUI control interface

- Remote admin
- XFP control
- Crosspoint switch configuration
- Full transceiver control (VCSEL/PIN settings)
- Selectable between any line card in system

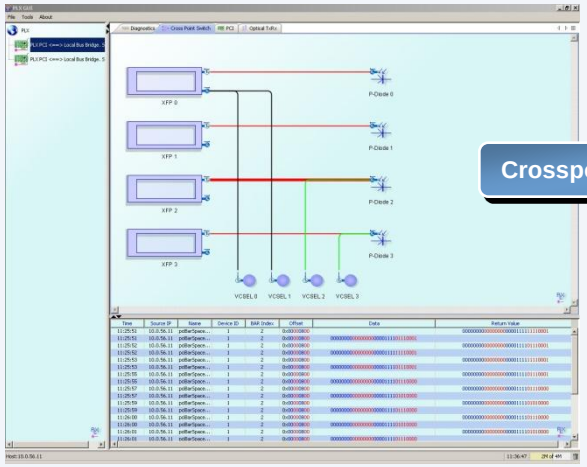
Remote log-in



XFP controls



Crosspoint Switch control



Optical Research and Development Activities

Storlite Project

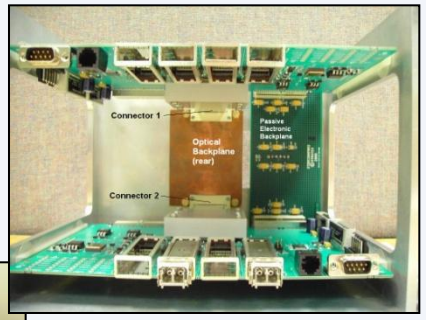
Academic – industrial collaboration project

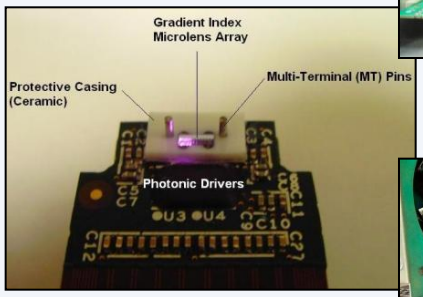
UK government (DTI) funded R&D initiative

Purpose: Investigation of optical backplane system connection system and prototype development

Duration: June 2003 – November 2005

Status: Completed



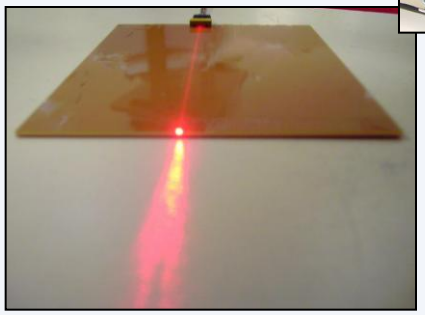


Candeo Project

Industrial collaboration project

Purpose: Commercialisation of optical backplane connection technology

Status: Current



IeMRC OPCB Project

Academic – industrial collaboration project

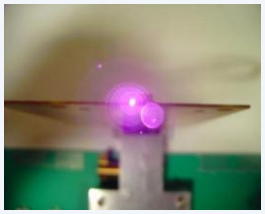
UK government (IeMRC) supported project

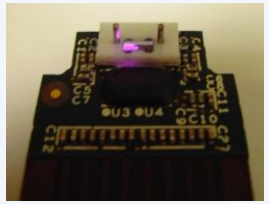
Purpose: Investigation into EOPCB manufacturing techniques

Status: Current

Aim

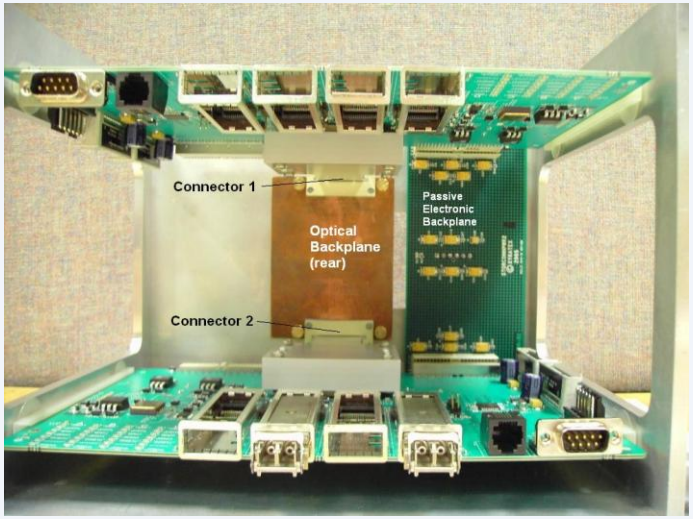
- Investigate optical backplane technology
- Identify key challenges to implementation
- Develop technology solutions





Project Funding

- Part funded by DTI



Status

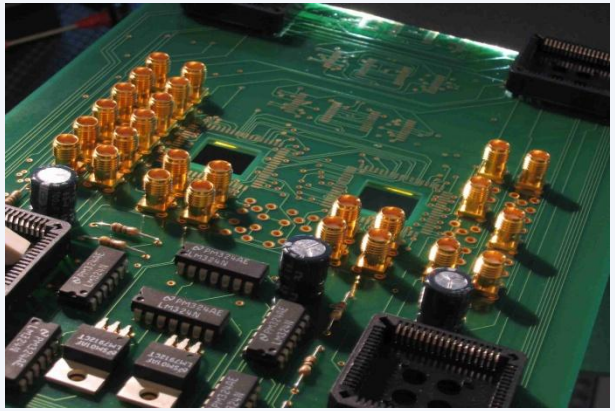
- Completed in November 2005

Partners

xyratex EXXELIS UCL

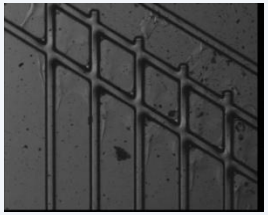
Aim

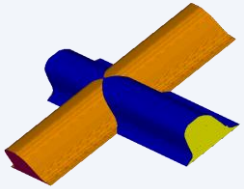
- Investigate multiple methods of fabricating optical waveguides
- Identify most suitable method for mass production of optical PCBs



Project Funding / Status

- Part funded by IeMRC (EPSRC funding body)
- Currently Active



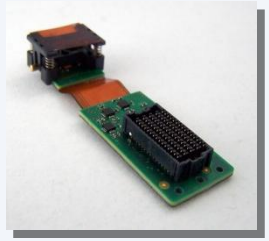


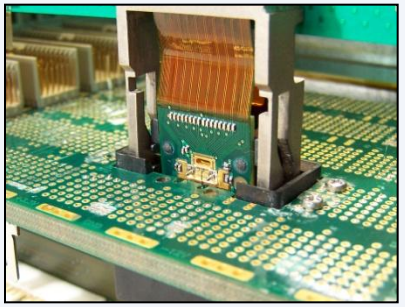
Partners

xyratex · BAE SYSTEMS · cadence · UCL · Heriot-Watt University · Stevenage Circuits · Dow Corning · NPL National Physical Laboratory · EXXELIS · Loughborough University · RENISHAW · xyratex

Aim

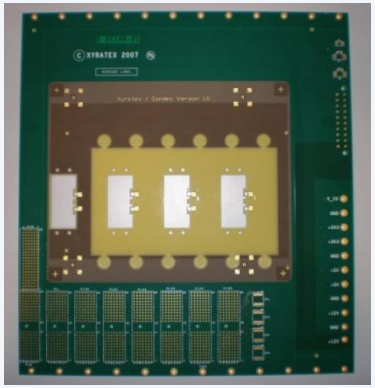
- Commercial development of optical backplane connection technology
- Based on prototypes developed during DTI LINK project: “Storlite”
- System design and integration of OPCB technology





Project Funding / Status

- Part funded by Samtec in **Industrial Collaboration Agreement**
- Currently Active



Partners

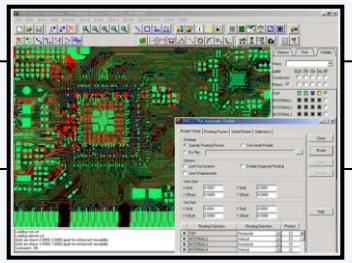
xyratex

samtec

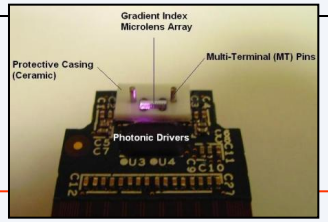
Electro-Optic PCB Development Chain

System Integrator / End user

Design Services Simulation



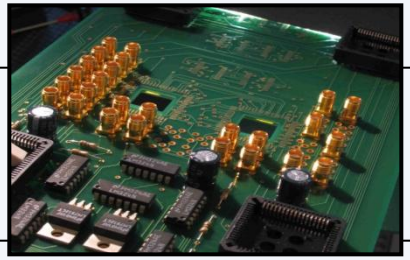
Technology Enablers

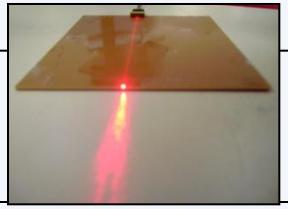


Optical Transceiver

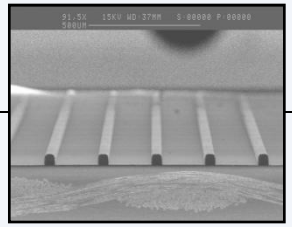
Connector

Electro-Optic PCB Fabrication



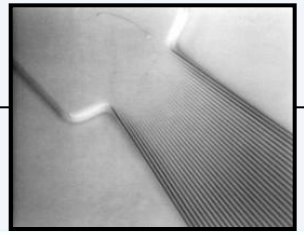


Waveguide / process Characterisation



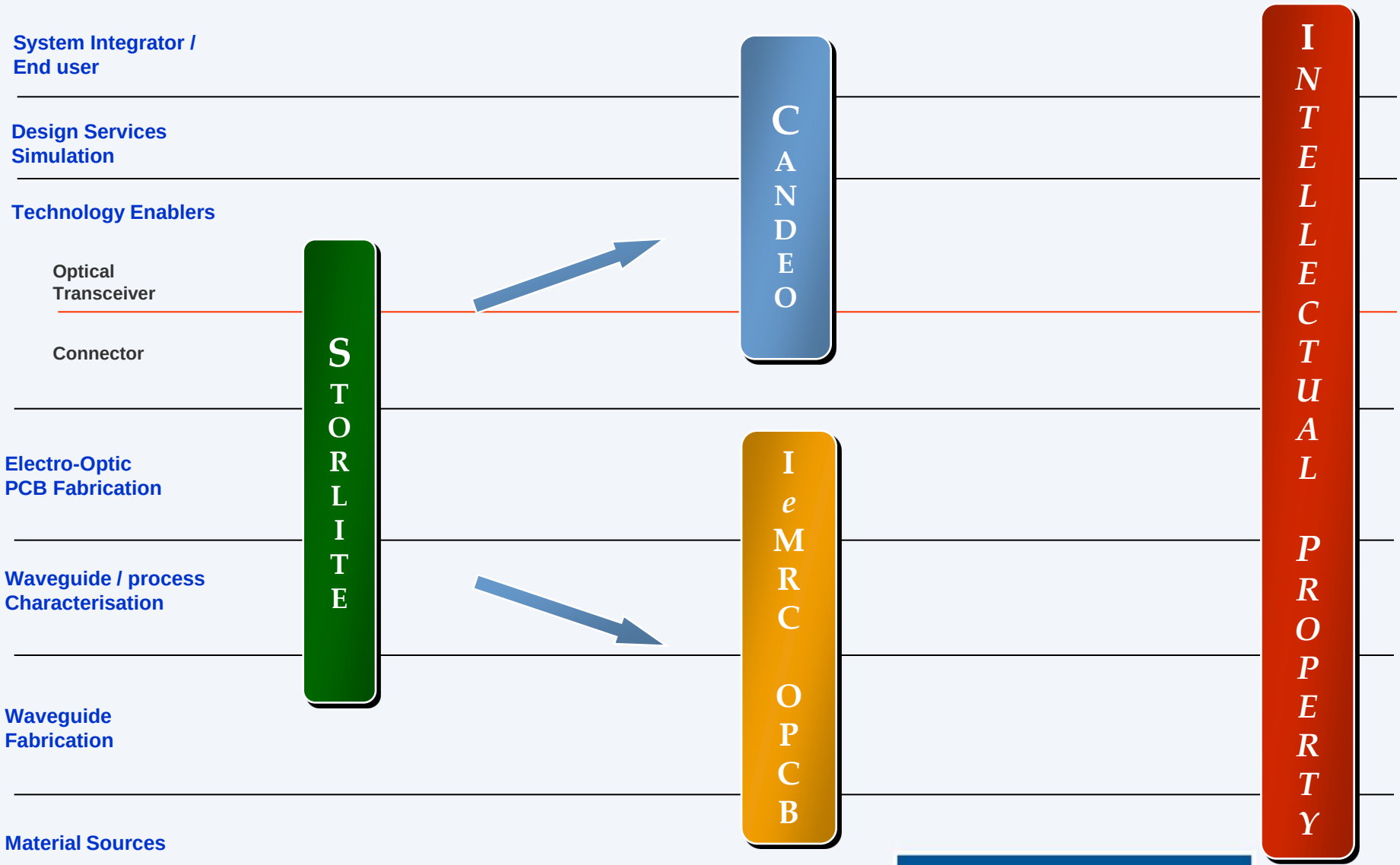
Source: Exxelis

Waveguide Fabrication



Material Sources

Xyratex Presence in Electro-Optic PCB Development Chain



Press Release

Optical Backplane Technology for Drive Arrays
(5th January 2006)

Publications

Design and Application of an Optical Backplane Connection System
(Tec Preview – DesignCon 2007)

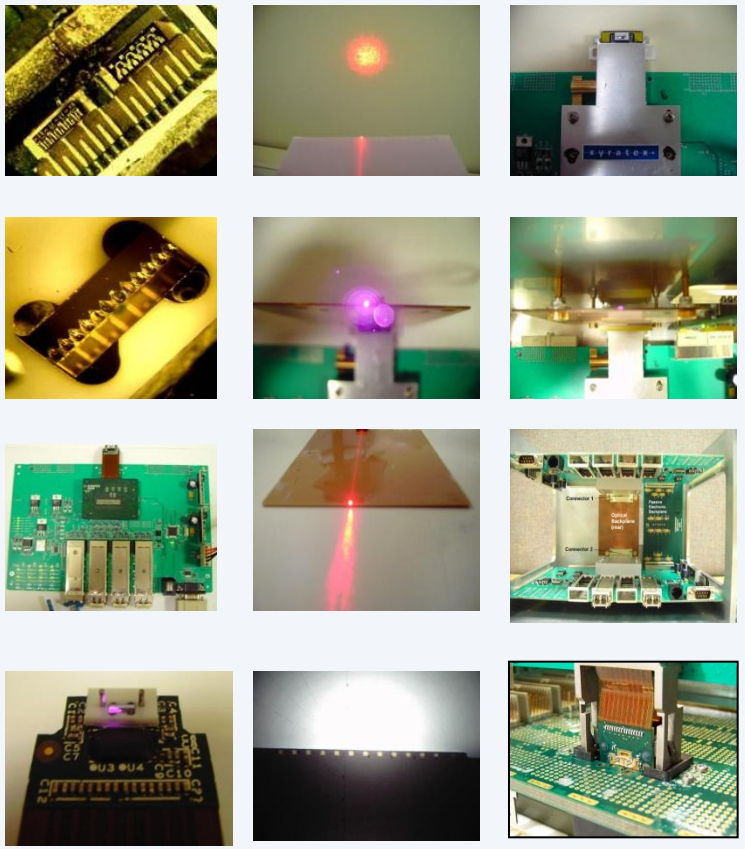
An Optical Backplane Connection System With Pluggable Active Board Interfaces
(Conference paper – OCSN 2006)
(Xyratex white paper – available)

Pluggable Optical Backplane Connector Technology
(Xyratex white paper – available)

www.xyratex.com

Intellectual Property

11 patents / patent applications relating to optical PCB interconnect, communication structures and methodologies



Achievements

- SFF pluggable active optical PCB connector prototype constructed:
  - Transceiver functional, connector mechanically functional
- Hybrid electro-optical backplane designed and constructed
- Full demonstration assembly constructed:
  - Electrically, electronically and mechanically functional
- Software interface designed and functional

Results

- Characterisation results to be available in early 2009

Thank you for your Attention

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