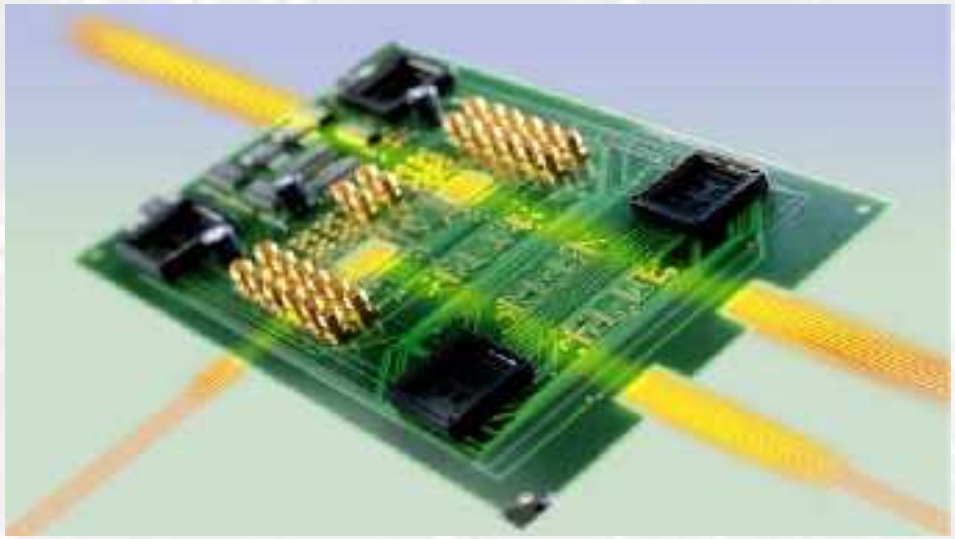
Electro-optical circuit boards

Tobias Lamprecht, Felix Betschon; vario-optics AG, Heiden



SLN Workshop „Optical Interconnects“
Rüschlikon, 28.10.2010

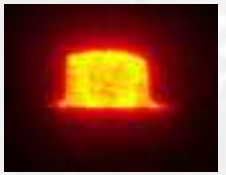
vario-optics ag

Outline

- *Introduction*
- *Planar polymer waveguide technology*
- *Demonstrators, prototypes and pre-series*
- *Conclusions*

History

2002
- Varioprint starts development of EOCB technology



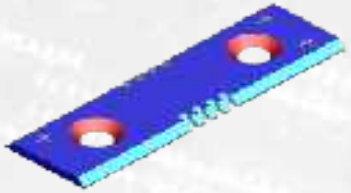
2004
- Clean Room installation
- Patent filed for light coupling concept

2005
- Electro- Optical Circuit Board (EOCB) demonstrated (SMT)

2006
- Establishing EOCB fabrication processes
- Successful EOCB development projects

2007
- Winner of the „Swiss Technology Award 2007“
- EOCB demonstrator at the Hannover Fair

2008
- Automated Assembly of electro-optical components (FAPS Uni Nürnberg)



2009
- Spin-off vario-optics ag

Mission Statement

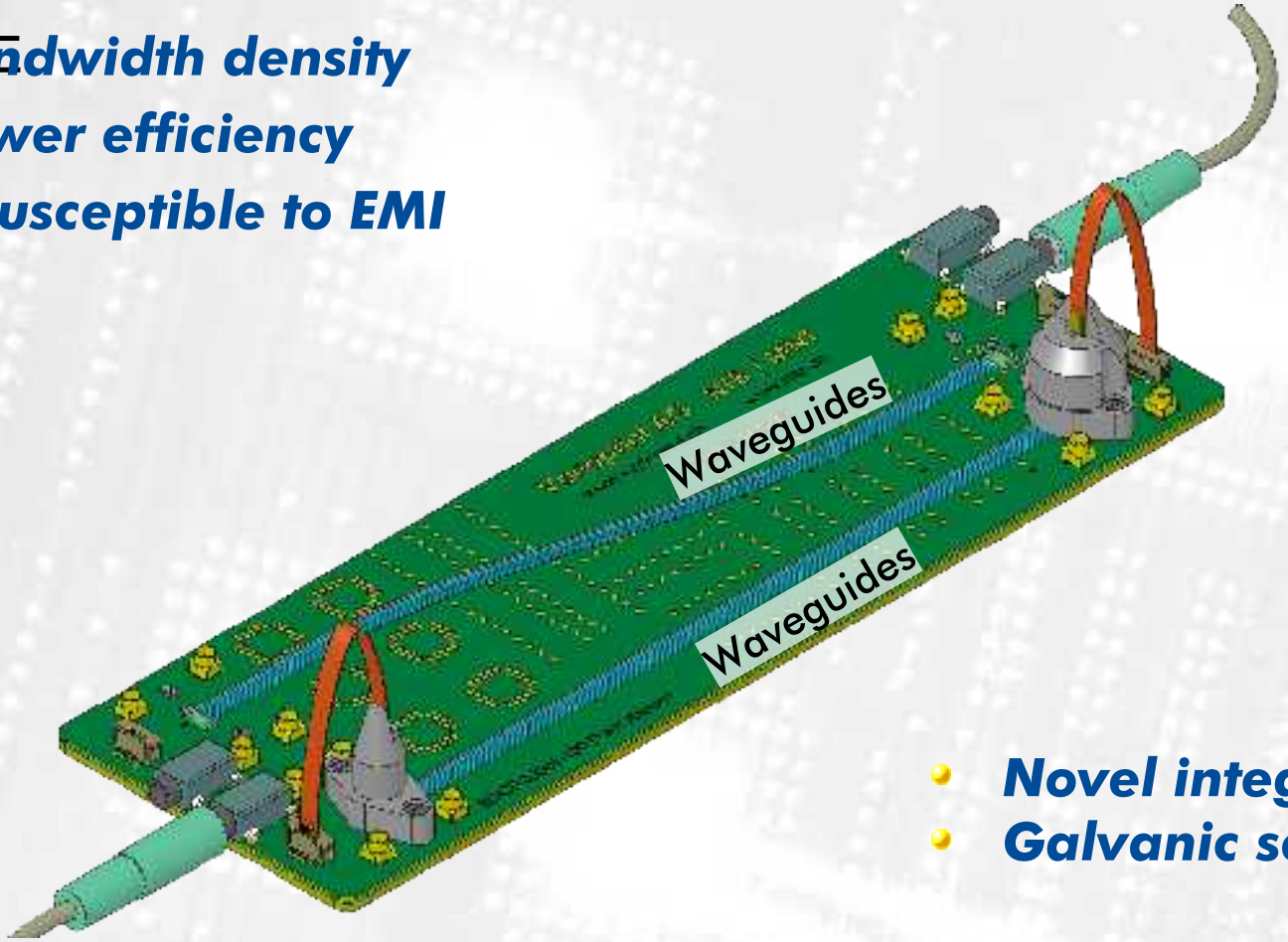
- *Development of production technologies for electro-optical printed circuit boards (EOCB) and optical solutions*
- *Manufacturing of electro-optical functional models, prototypes and small to medium series*
- *Providing engineering services to customers*

Targeted Markets

- ICT (Information and Communication Technology):
  - Computercom
  - HPCS (high performance computing) / Super computing
  - Datacom – switches, servers, storage devices
- Optical sensors and light delivery
  - Industrial and consumer electronics

Advantages of Optical Interconnects

- Bandwidth density
- Power efficiency
- Insusceptible to EMI



- Novel integration concepts
- Galvanic separation

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- ***Planar polymer waveguide technology***
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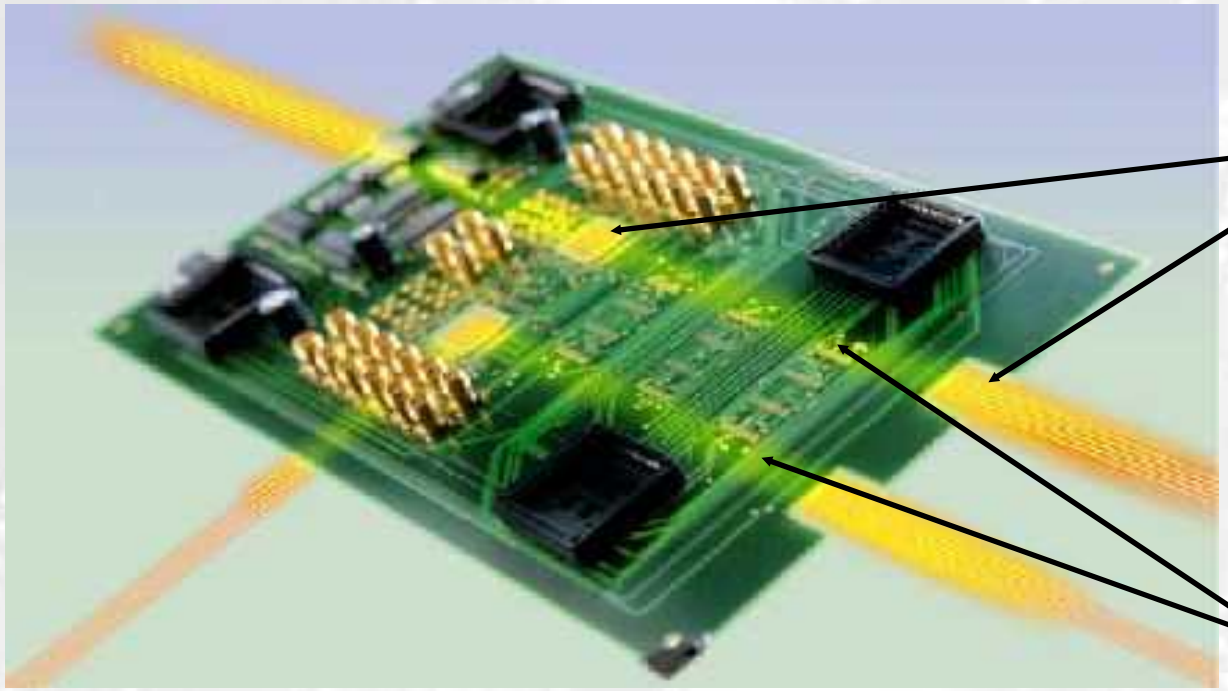
Polymer Waveguide Technology

EOCB – Building Blocks

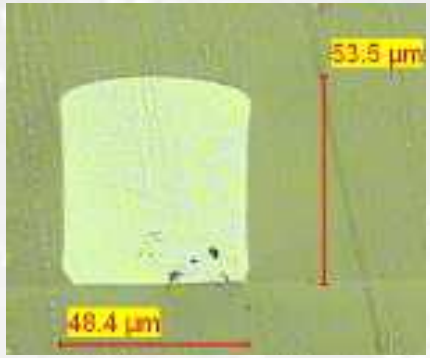


Optical ports:
Vertical coupling mirror
Edge connector

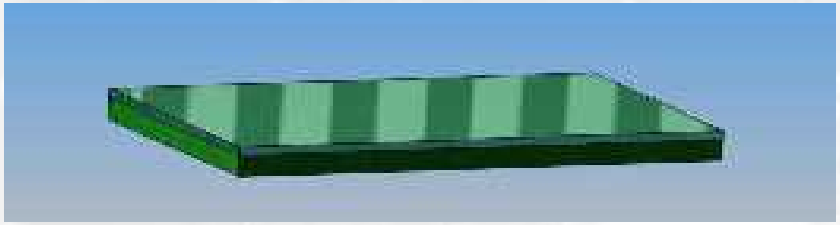
Waveguides

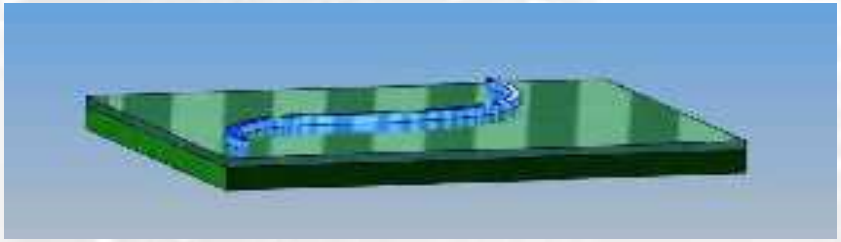
Polymer Waveguide Technology

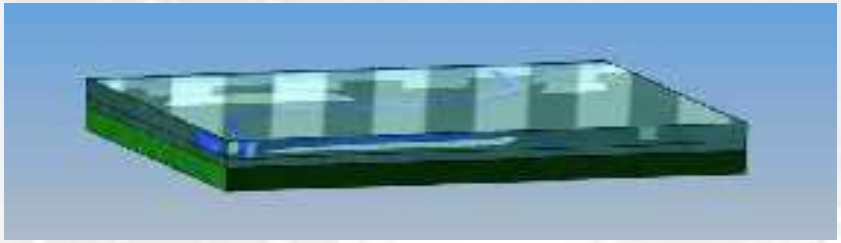
	Status:
Dimension:	50 x 50 µm² - 500 x 500 µm²
Numerical aperture:	0.33
Optical attenuation:	0.05 dB/cm [850nm]

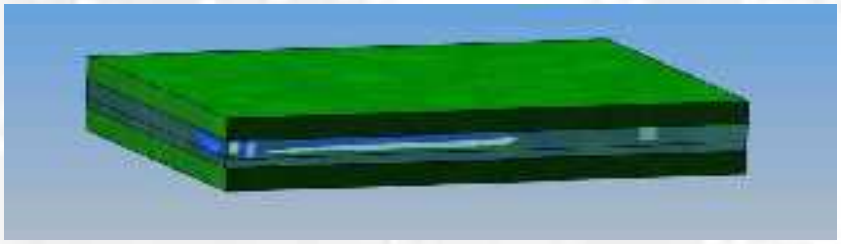


Fabrication Process









Lower cladding
- Deposition
- UV-Curing

Core layer
- Mask photolithography
- Laser direct Imaging

Upper cladding
- Deposition
- UV-Curing

Lamination

Panel-based Manufacturing

Challenges

- High temperature & high pressure
- Harsh environments
- Mechanical stress

Advantages

- Large area
- Batch process

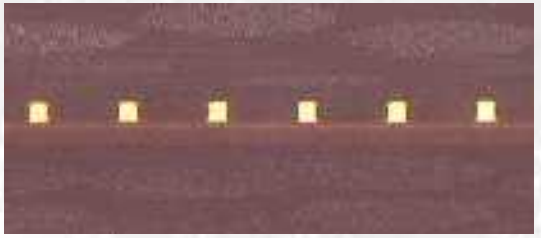
Polymer Waveguide Technology

- **Planar waveguide fabrication**

Splitter
Combiner

Crossings

Taper
Lense structures



Laminated

Optical Ports

Function: Connection to optical elements

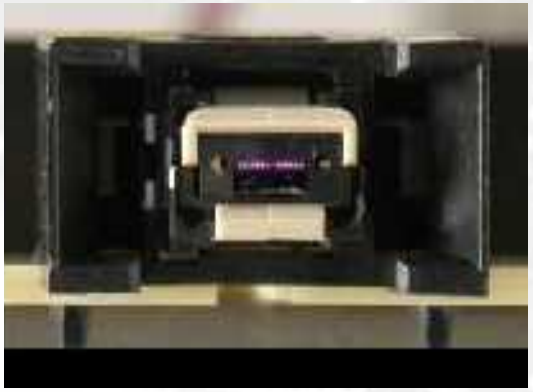
- Optical engine / optical subassemlby
- Backplane / Fiber bundle

Types of optical ports:

- Edge connectors
- Vertical coupling mirrors
- Custom specific connector / coupling devices

Connector

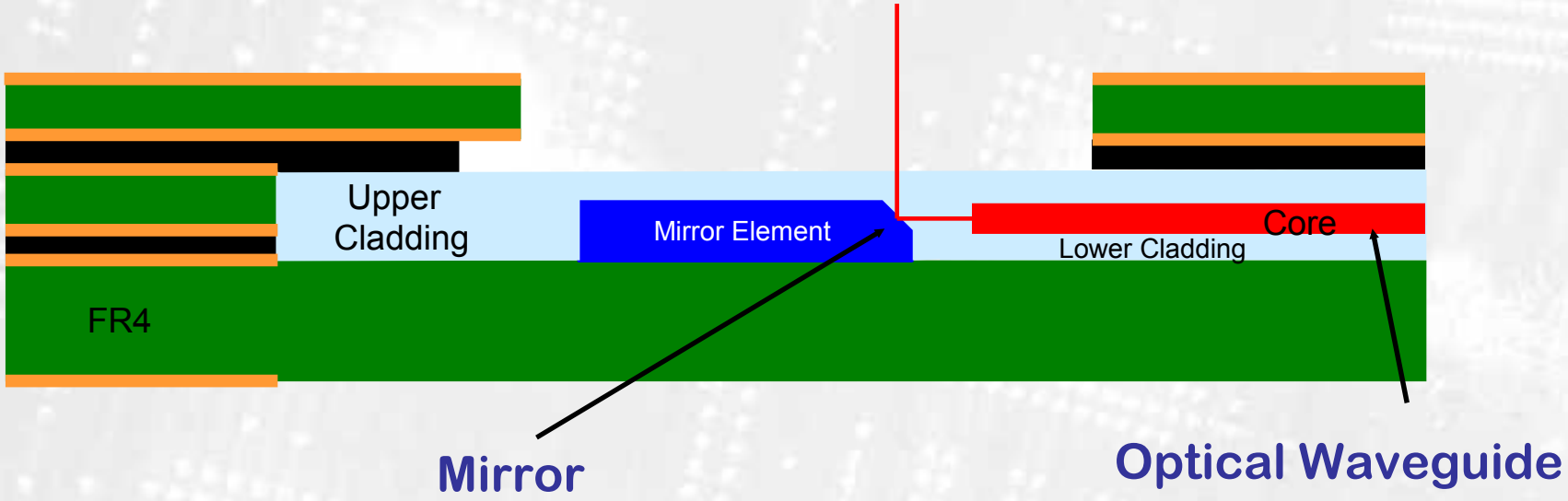
- *Connector system basing on MPX-standard*
- *Passive alignment concept*
- *Rigid flex electro-optical circuit boards*
- *12 waveguides (50µm x 50µm)*



Tyco Electronics

c-lab

Vertical coupling mirrors

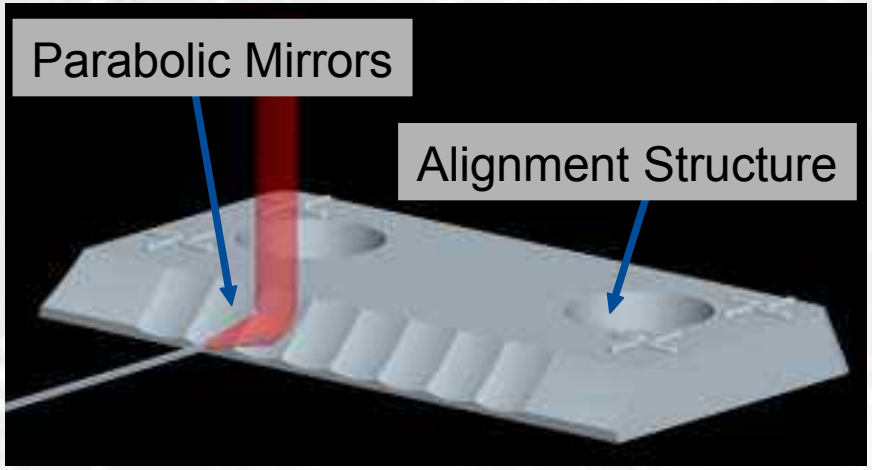


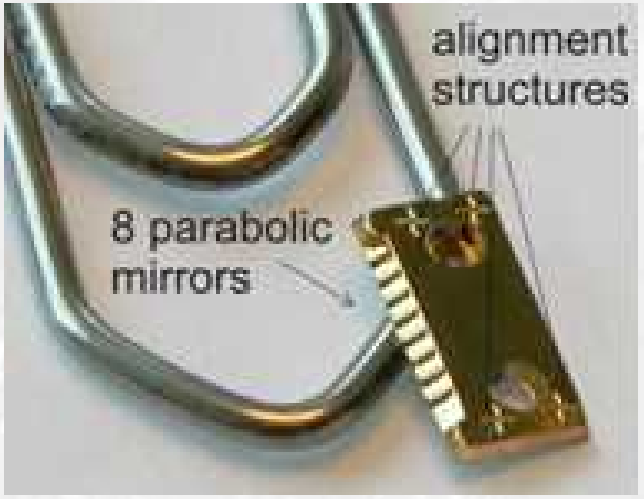
- *Injection molded mirror*
- *90° light beam deflection*
- *Embedded in the optical layer*

Coupling Mirror

Vertical Coupling Mirror

- 8 mirrors / 500μm
- Injection molded with alignment features
- Metal coating





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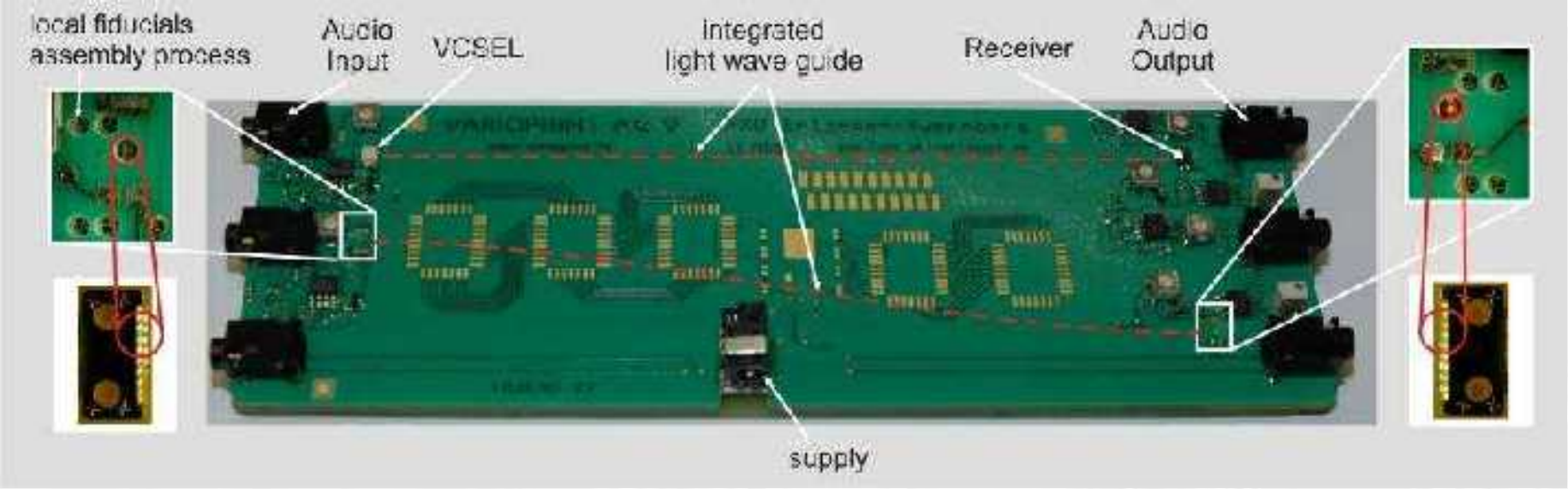
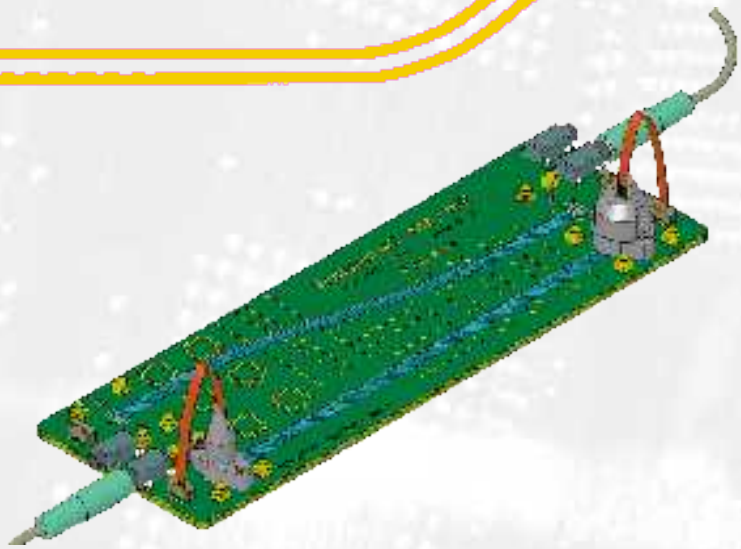
Data-Link Demonstrator

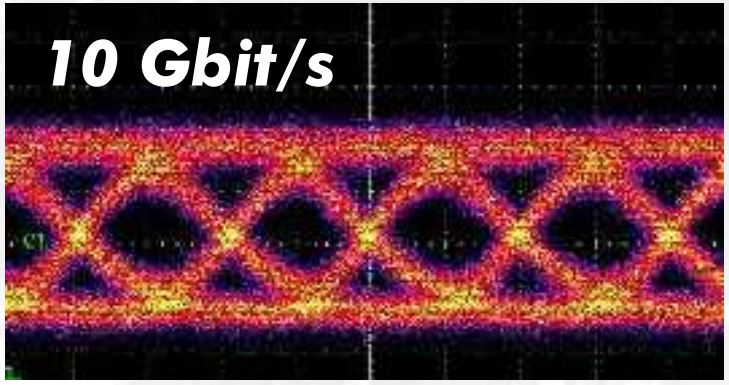
- *Automated assembly of electro-optical components*
- *Optical transmission of audio signals*



Data-Link Demonstrator

- 8 channels data-link
- Mirrors for vertical coupling
- 10 Gb/s Eye-diagram





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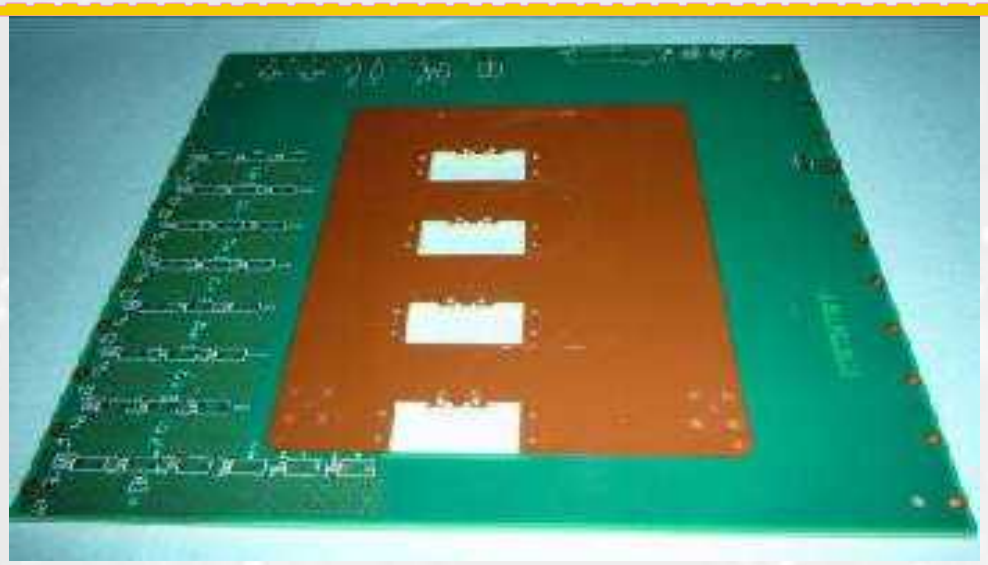
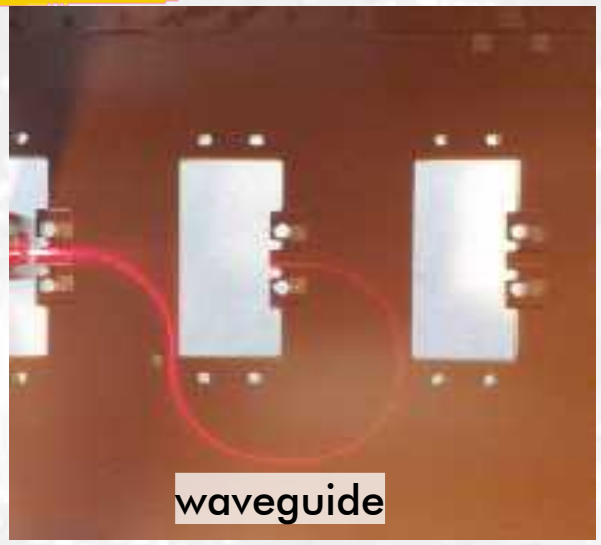
Example Project Optical Backplane





- *Demonstrator for future storage systems*
- *10 electrical layers*
- *1 optical layer*
- *Size of waveguides: 60µm x 60µm*

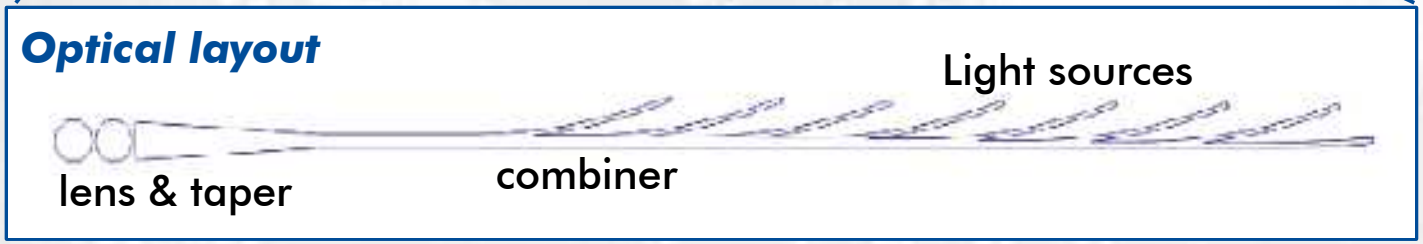
xyratex

IBM

Optical Backplane Demonstrator

- *Daughterboard – backplane system*
- *Connector based on MPX-standard*

Example Project: Optical Sensor



- *Integrated electro-optical sensor for color detection*
- *Optical layer thickness 500µm*
- *Pre-series stage*

Metrohm

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Conclusion

- EOCBs for Optical Interconnects
  - Planar polymer waveguide technology
- EOCB production capabilites
  - Compatible with PCB fabrication
  - Cost-efficient processes

The Future is Bright!