

A generic foundry model in photonics / Low-cost access to photonic IC technology

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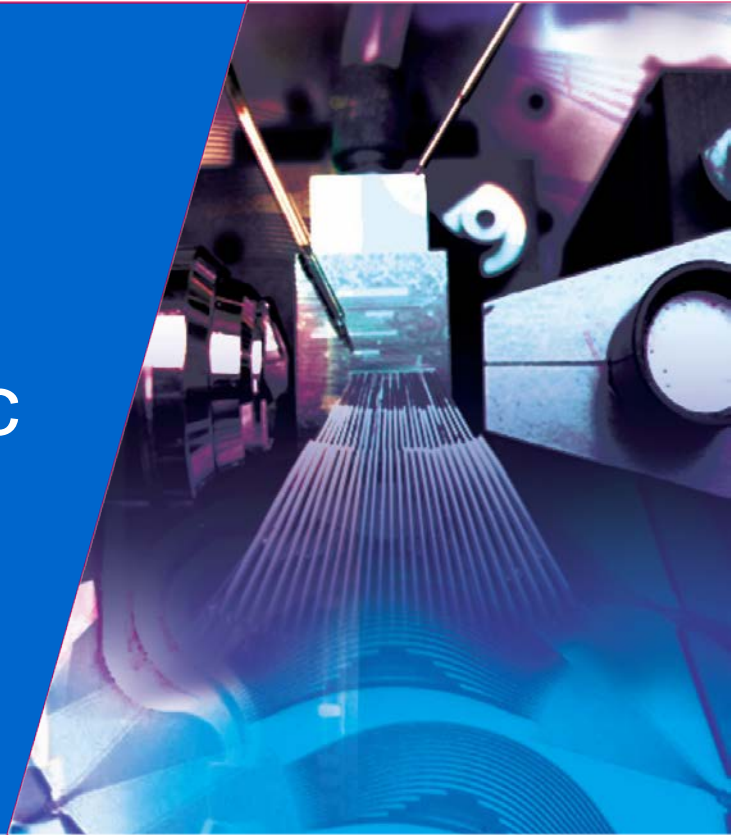
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A Generic Foundry Model in Photonics

Low-cost access to Photonic IC technology

Meint Smit



TU / **e**

Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

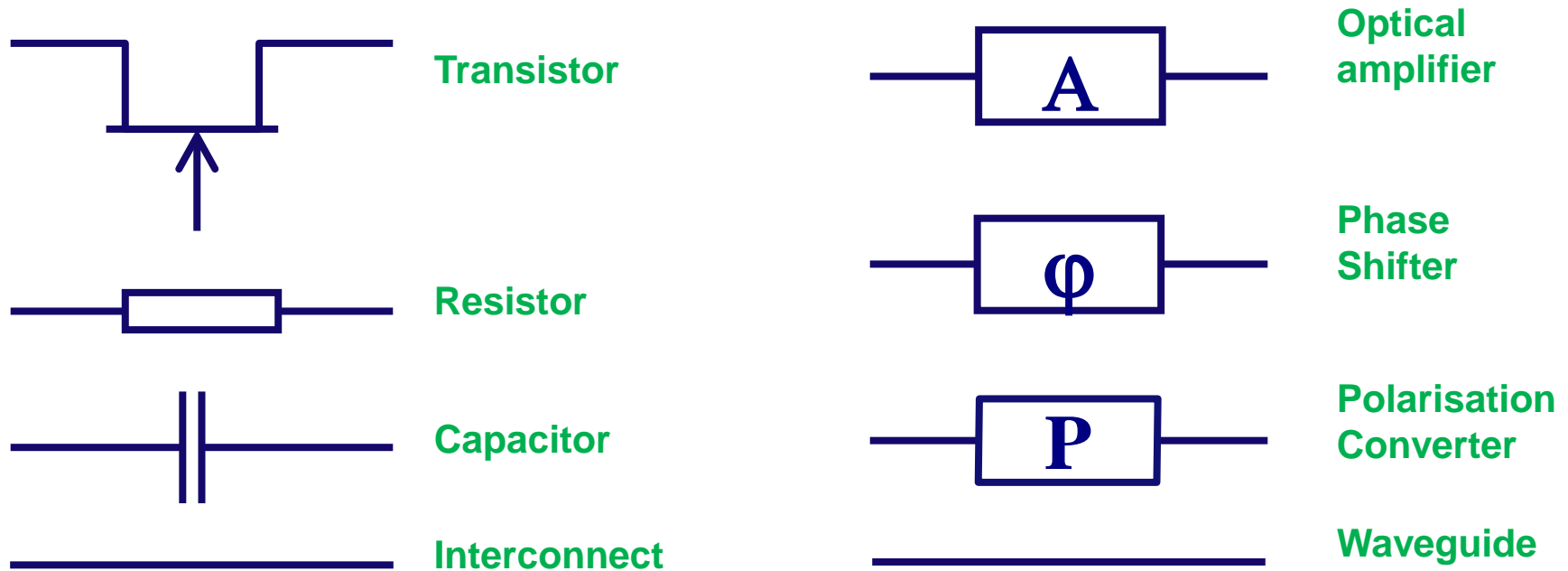
Outline

- **Generic Integration Technology**
- **A Foundry Model**
- **Present status and prospects**

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- **Generic Integration Technology**
- **A Foundry Model**
- **Present status and prospects**

Generic Integration philosophy

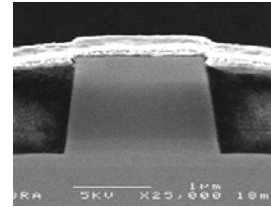
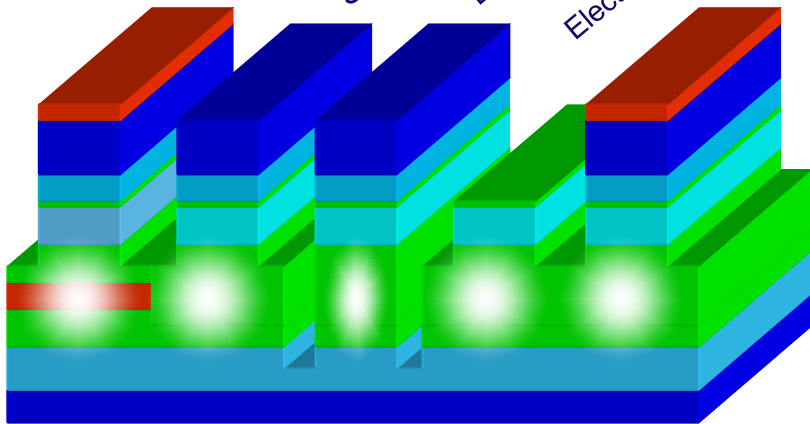


Electronic integration

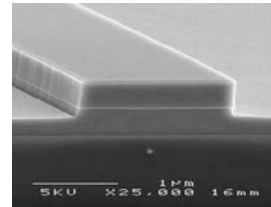
Photonic integration

Basic building blocks in the COBRA process

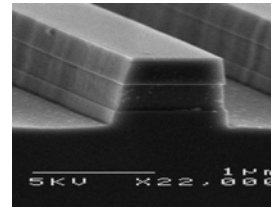
SOA (gain sections)
 Shallow etched waveguide
 Deep etched waveguide
 Electrical isolation section
 Phase modulator



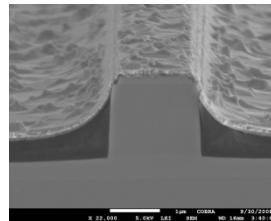
SOA



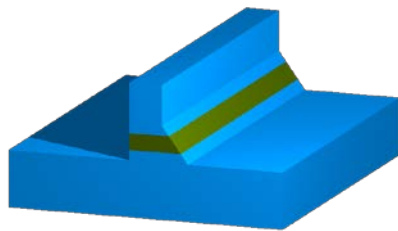
Shallow etched waveguide



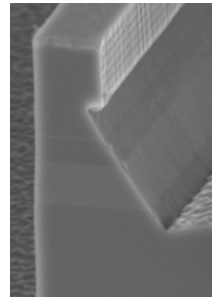
Deep etched waveguide



Phase Modulator



Polarisation converter



Tunable DBR grating

What can you make with these Basic Building Blocks?

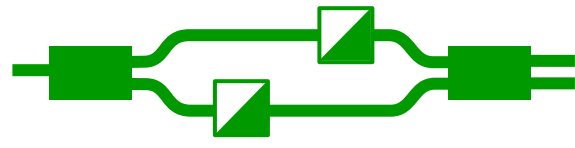
All kinds of passive devices ...

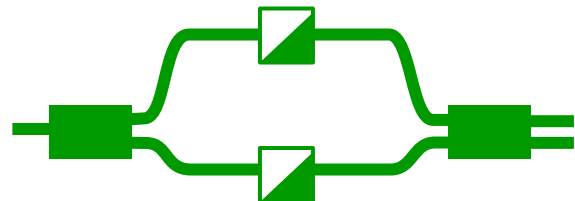
 MMI-couplers and filters

 MMI-reflectors

 AWG-demux

 ring filters

 polarisation splitters
polarisation combiners

 polarisation independent
differential delay lines

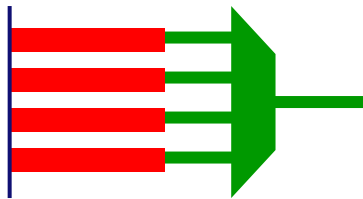
All kinds of lasers ...



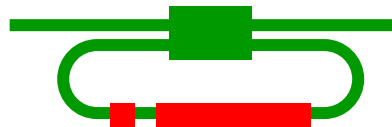
Fabry-Perot lasers



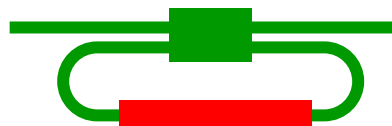
tunable DBR lasers



multiwavelength lasers



picosecond pulse laser



ring lasers

> 25 mW output power
< 100 kHz line width
< 1 ps pulse width

...

switches and modulators ...

> 40 GHz bandwidth
> 50deg/V.mm



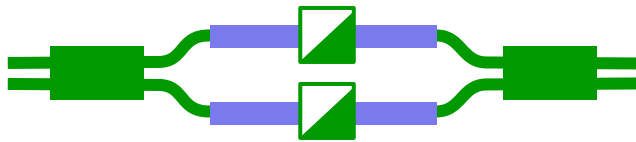
phase modulator



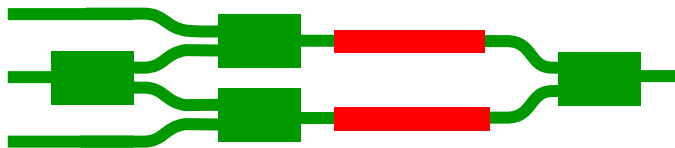
amplitude modulator



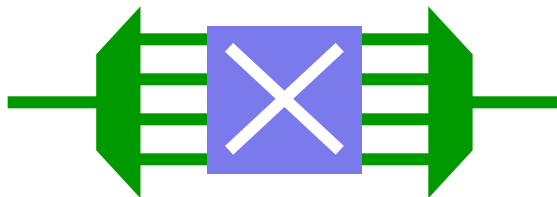
fast space switch



polarisation independent 2x2 switch

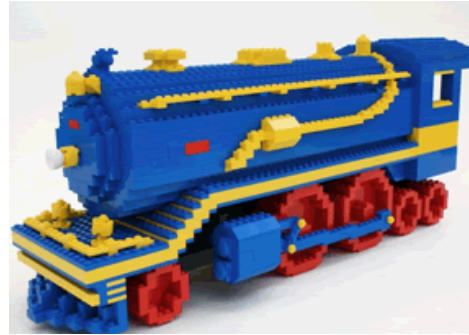


ultrafast switch



WDM crossconnect
WDM add-drop

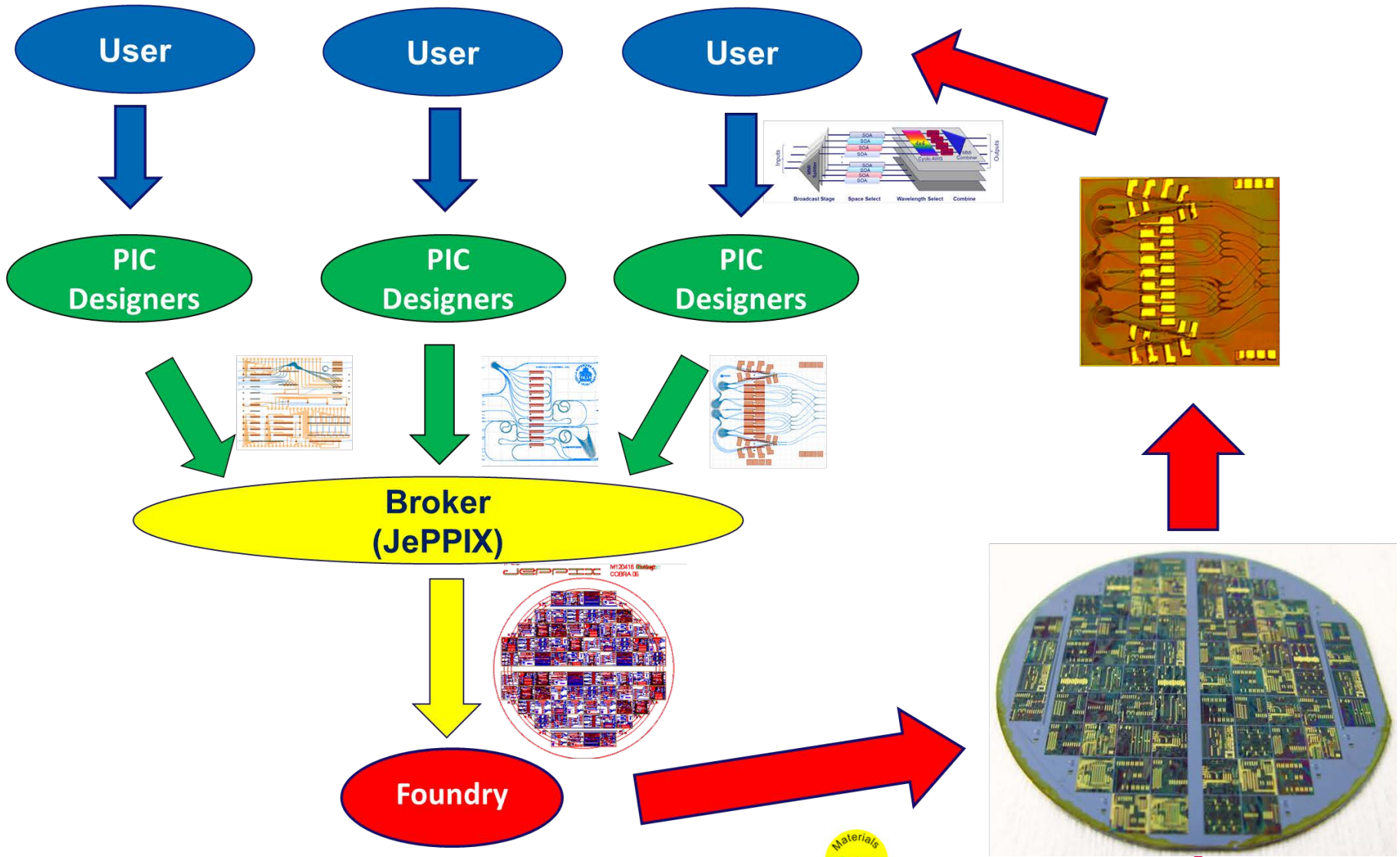
And many other components ...



Outline

- **Photonic Integration**
- **Generic Integration Technology**
- **A Foundry Model**
- **Present status and prospects**

Multi Project Wafer runs

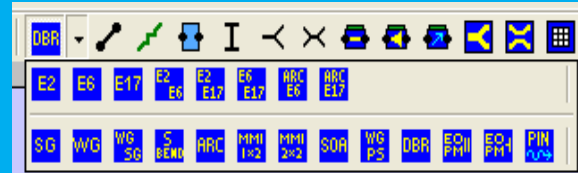


Software and Design Kits

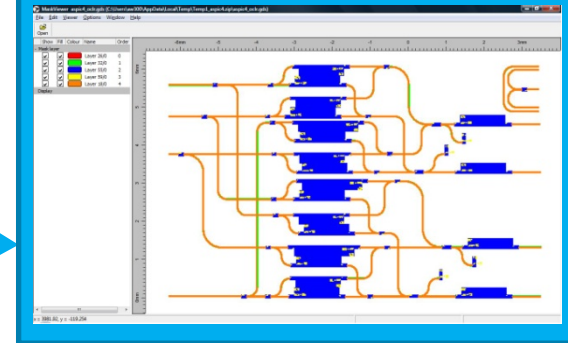
User Design Input



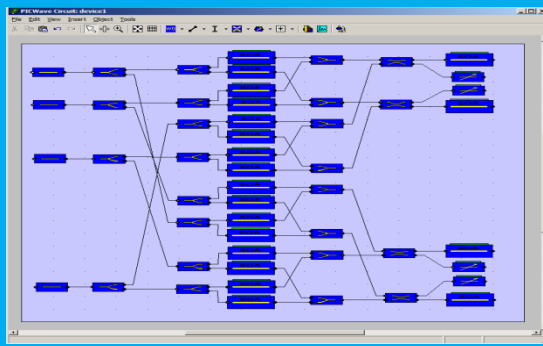
Design Kit
(Building Block Library)



Mask Generator

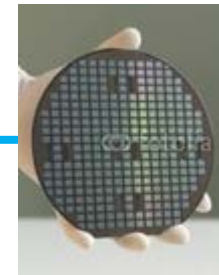
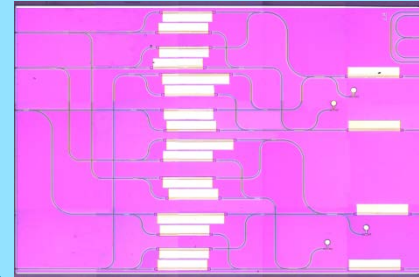


Circuit Simulator



PDAFlow
Open Data
Interchange Library

Chip



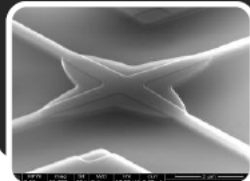
Fab: Oclaro, HHI

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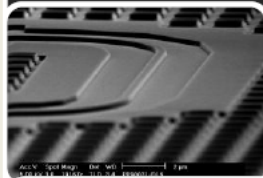
ePIXfab MPW

Standard Passives



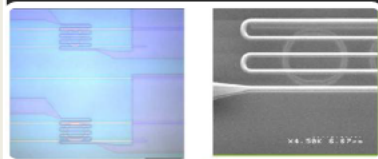
Waveguide devices
Grating Couplers

Advanced passives



Waveguide Devices
High Efficiency Gratings

Heaters



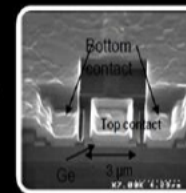
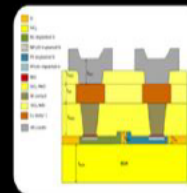
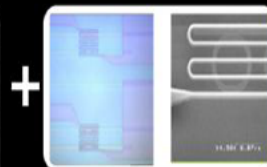
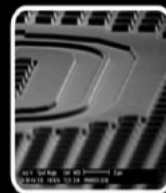
TiN Heaters
Thermo Optic Tuning

Passives

Heaters

Modulators

Detectors



- 4 etch levels in Silicon
- High Efficiency Gratings
- Metal Heaters
- Doped Heaters
- 10Gb/s Modulators
- Faster Possible
- 10G detectors

Full Platform



Mission: develop the technological infrastructure for InP-based foundry operation

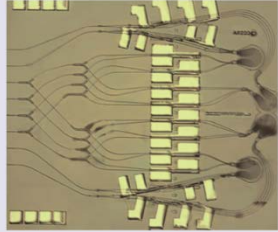
- standardised foundry processes
- design kits, component libraries
- generic packaging
- generic testing

Partners: Europe's leading

- InP chip manufacturers (Oclaro, FhG-HHI, SMARTPhotonics)
- Photonic CAD companies (Phoenix Software, Photon Design, Filarete)
- Equipment Manufacturers (ASML, Aixtron, Oxford Plasma Tech)
- Research Labs (III-V Lab, COBRA-TU/e, Cambridge, Politecnico di Milano)
- **Coordinator: COBRA**

Examples of InP ASPICs

Optical switching

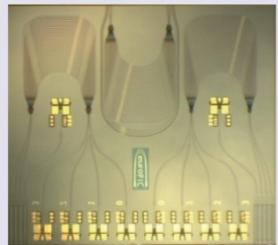


4x4 space and wavelength selective switch

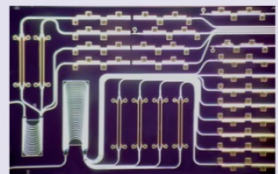


Fast optical switch matrix

Fiber to the home

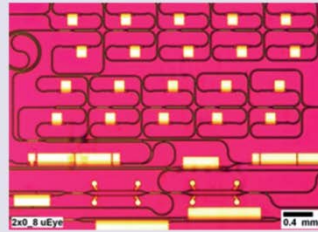


WDM receiver

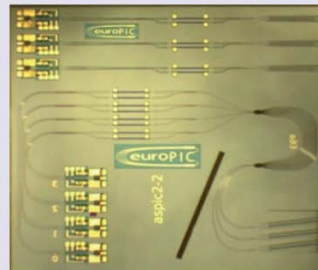


WDM transmitter
Generic Foundry model

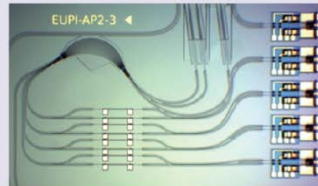
Fiber sensor readout



Brillouin strain sensor readout

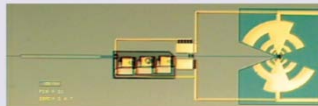


Fiber Bragg Grating readout

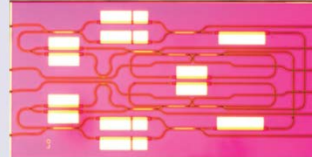


Fiber Bragg Grating readout

THz Optical to RF converter



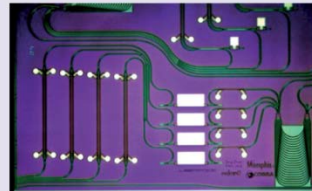
Variety of lasers



Widely tunable ring laser



Variable repetition rate pulse laser



Filtered-feedback multi-wavelength laser

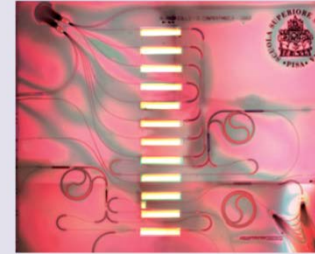


tunable laser with integrated MZI modulator

QPSK receiver



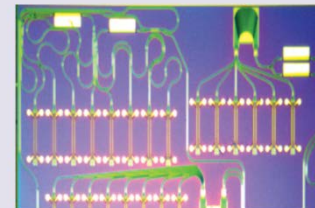
Optical data handling



All-optical regenerator for constant envelope WDM signals

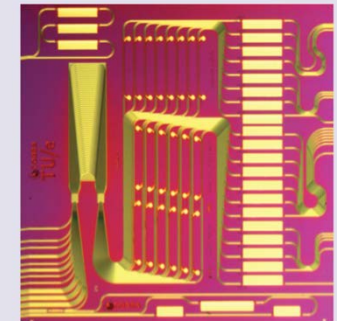


WDM to TDM Trans-Multiplexer

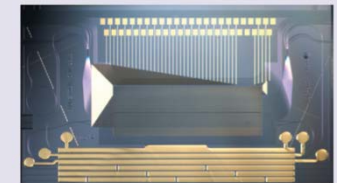


Pulse serialiser

Medical and bio-imaging



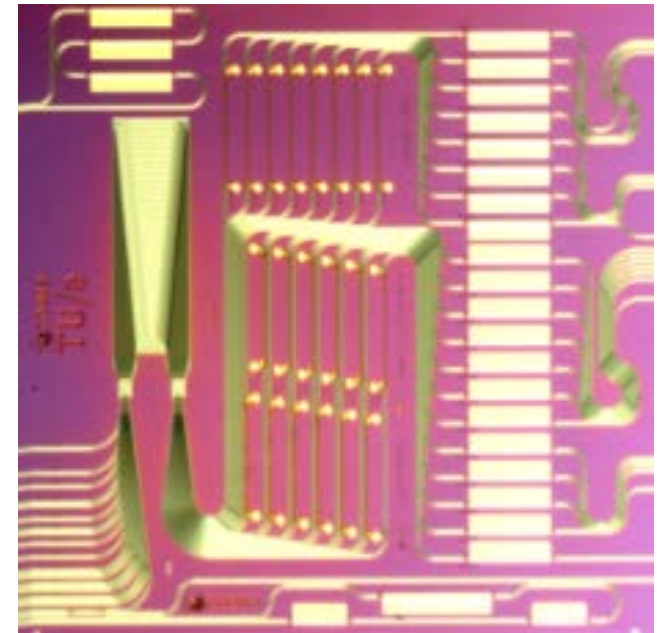
Pulse shaper for bio-imaging



Integrated tunable laser for optical coherence tomography


Chip cost example (pulse shaper)

- **Low cost prototyping:**
 - AWG, 20 phase modulators, 20 SOA's on 6x6 mm²
 - Prototype design in MPW: €10,000 (for ~20 chips)
- **In volume production:**
 - Chip cost < 5 €/mm²
 - < €200 for 36 mm²
- **Discrete components:**
 - Component cost > €20,000



JePPIX Roadmap 2013

**Precommercial
foundry runs in
2013**



JEPPPIX
Joint European Platform for Photonic Integration of InP-based Components and Circuits

The road to a multi-billion Euro market
in InP-based Integrated Photonics

JePPIX ROADMAP 2013

www.jeppix.eu

The COBRA Photonic Integration team



Acknowledgement

EU: EuroPIC, PARADIGM, ERC NOLIMITS

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