



Phoenix Software . .

. . enables the easy and cost effective realization
of integrated photonic chips and systems





What is an integrated photonics chip?

A Photonic IC (PIC) combines several optical and/or opto-electrical components within a single chip, manufactured with fabrication processes alike electronic ICs

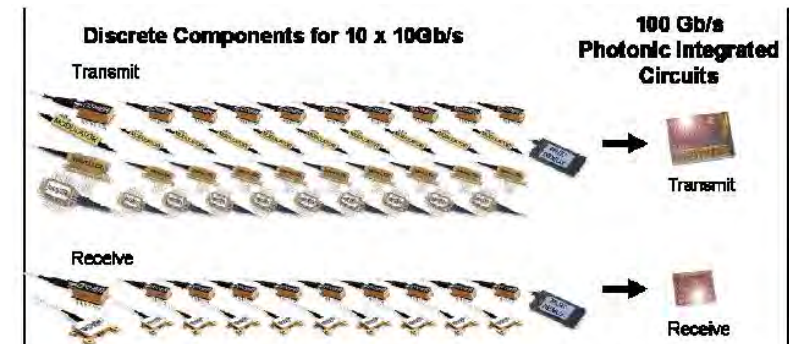
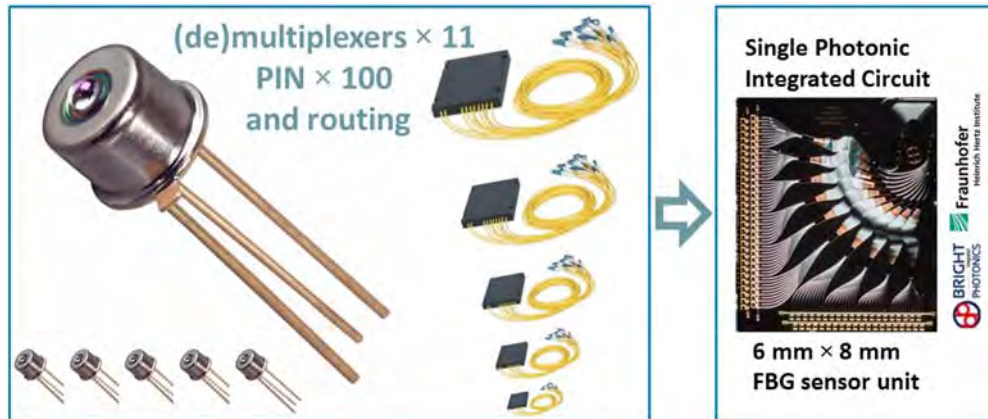


Figure 7: Infinera's InP photonic integrated circuits include a 100Gb/s transmit PIC and 100Gb/s receive PIC that together implement a 100Gb/s DWDM system.



Why Photonics?

Integrated photonics will replace/join electronic devices and systems

- **Micro electronics approaching a ceiling in achievable performance**
 - Speed limitation: maximum achievable speed of CMOS based micro electronics: 100 Gb/s
 - Power consumption (pJ/bit): telecom and data-communication infrastructure at this moment already consumes 3% of total electrical power generated and grows exponentially
- **Photonics enables future performance requirements for communications**
 - 2015: Micro electronics technology realizes 48 Gb/s/channel
 - 2015: Photonics technology based demonstrator realizes 256 Tb/s/fiber
 - 2020: Market demands 1 Tb/s/channel
- **Photonics technologies enable disruptive solutions with huge market impact**
 - Telecommunication and data communication show exponential growth since 1990 (growth factor: 1.8/year)
 - Life-sciences, automotive, industry, internet of things, machine-to-machine communication, 5G network, ...

We believe the industry passed the tipping point for volume production of integrated photonics



Company Overview

PhoeniX Software has been shaping the Photonics industry for years

Timeline

- 1991** BBV Design & BBV Software
- 1996** Twente MicroProducts – Design & manufacturing of MEMS, microfluidics and integrated optics
- 2000** Acquired by Kymata to develop AWGs - Today part of Kaim
- 2003** PhoeniX Software formed to focus on software tools for micro and nano technologies
- 2005** Intro of Photonic Building Block Platform, integrating mask and simulation engines
- 2008** Introducing PDKs for microfluidics and photonics, now support 30+ PDKs
- 2013** Co-founded PDAFlow Foundation and silicon photonics group at Si2
- 2015** Secured Institutional Venture Investment to accelerate growth
- 2016** Collaboration with leading PDA and EDA suppliers



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Facts

- Pioneer in the development of Photonics Design Automation tools
- Over 20 years of experience in micro and nano technology design, manufacturing optimization and design automation
- 300+ customers have used Phoenix Software tools for the design of MEMS, microfluidics and photonic ICs
- Leadership role in the creation of front-to-back photonic design flows and co-founder of PDAFlow Foundation
- 300+ ICs designed using OptoDesigner and fabricated at multiple Photonic foundries MPW programs over the last 3 years
- 500+ tape-outs supported by OptoDesigner (including commercial designs) over the last 3 years
- Located in the Netherlands with a highly skilled staff of 31
- Privately held with Venture Capital funding



Setting the scene: photonics vs electronics

Photonic IC design requires a fundamentally different approach

Integrated Photonics has “RF-like” behavior *(telecom C-Band = ~193THz)*

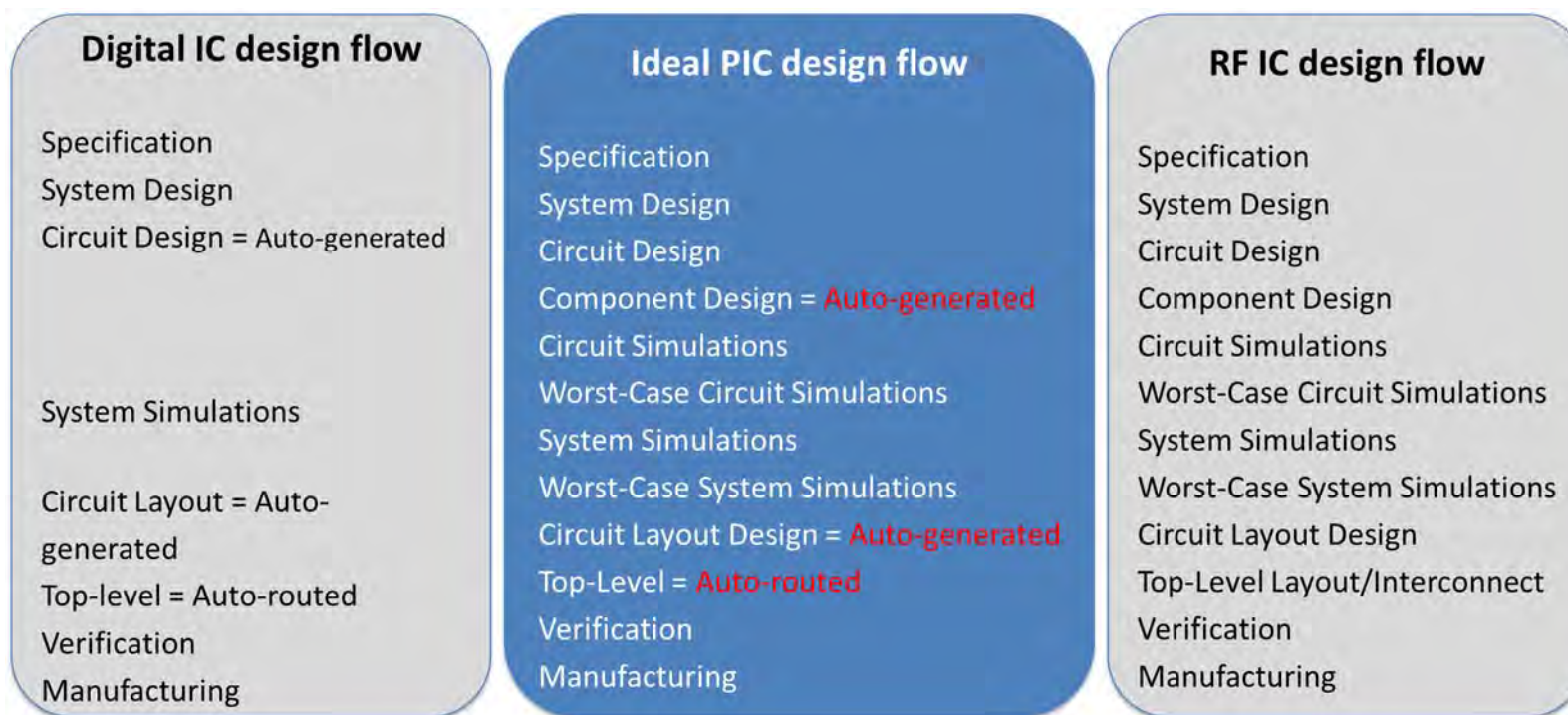
- Wide variety of materials and technologies
 - Wafer material: Silicon, InP, SiN,; Integration: Hybrids, 2.5D/3D stacking, SiP;
 - Typical line-widths: 0.15 – 4 micrometer and 10’s – 1000’s components per chip
- High sensitivity to process and temperature variations
- Need for dedicated simulation routines
 - For circuit and physical simulators
- Requires accurate and flexible definition of curvilinear shapes
 - Control of phase relations
 - Minimize losses and cross-talk

As a result, traditional EDA tools have difficulties coping with Photonic IC design requirements



Phoenix Software introduced Photonic Synthesis

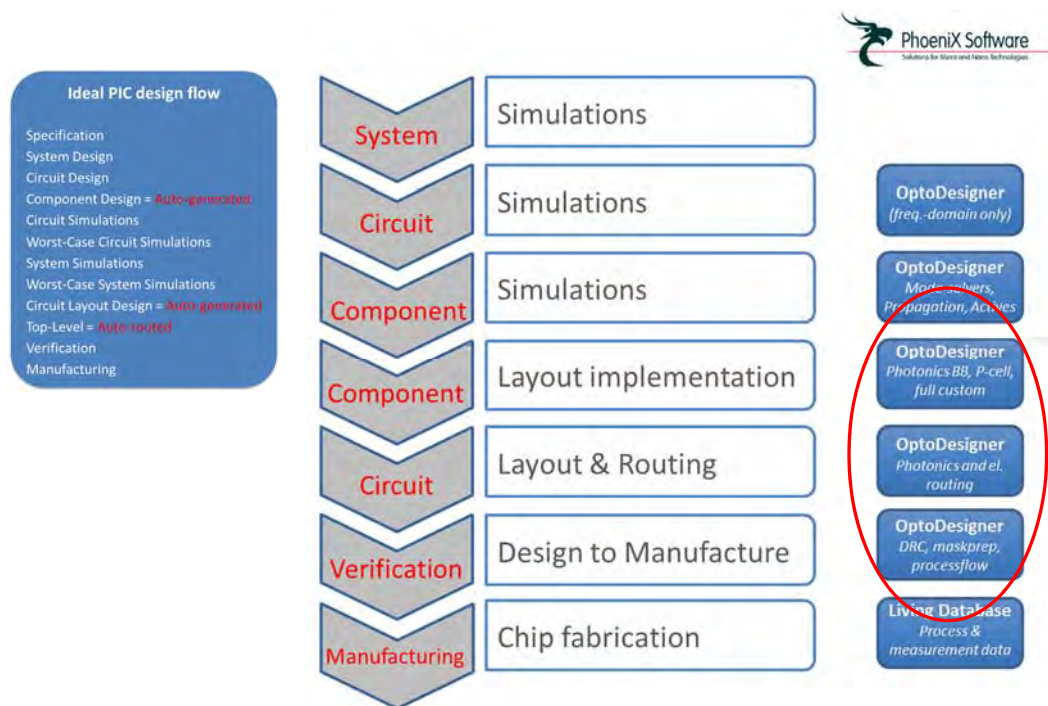
Improving quality and efficiency of Photonic IC design





Phoenix Software's Photonic IC design flow

Integrated design flow from concept to manufacturing



- Unique position in the software landscape, sole provider of the physical implementation part of the design flow
- Working together with other PDA vendors to create fully integrated design flows
- EDA interfaces developed upon request from top 3 vendors for co-design of electronics and photonics, verification and layout implementation



Phoenix Software's commercial products

Suites, bundles and modules for non-traditional semiconductors

OptoDesigner

Photonic Chip & Mask Layout

- Object oriented & parametric layout
- Design Rule Checking (DRC)
- Adv. Connectors & routing
- Mask Prep & Assembly

Third Party Interfaces

- Cadence Virtuoso PDA Link
- Mentor Graphics PDA Link
- VPI PDA Link
- Synopsys R-Soft PDA Link
- Lumerical INTERCONNECT PDA Link
- ASPIC PDA Link

Photonic Mode Simulators

- Advanced mode solvers
- Thermo & Electro optic simulator
- 3D ring resonator simulator
- Stress-optic simulator

Photonic Propagation Simulators

- Zone & FAST
- 2D Eigen mode expansion simulator
- 2D & 3D BPM simulator
- 2D FDTD simulator

Process Flow Visualization

Integrated Photonics

MaskEngineer

Chip & Mask Layout

- Object oriented & parametric layout
- Design Rule Checking (DRC)
- Adv. Connectors & routing
- Mask Prep & Assembly

FlowDesigner

- Process flow visualization

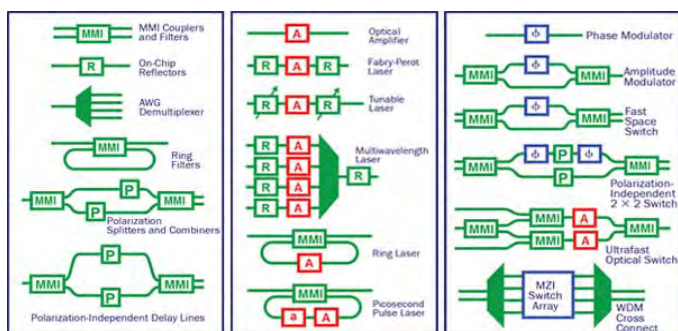
MEMS, Microfluidics, ...



PDK & Photonic Building Block Support

Phoenix Software supports the vast majority of accessible foundries

- More Than 30 PDKs Developed
- For Various Technologies
 - Si/SOI
 - InP/III-V technologies
 - TriPlex and other SiO₂/SiN technologies
 - Polymers, silica, ...
- Including libraries of both passive and active photonic building blocks



Foundries with MPW access



Packaging Templates

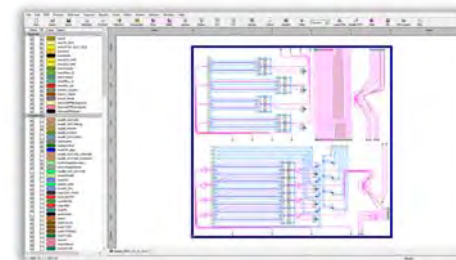




OptoDesigner, photonic IC design suite

Chip and mask layout

- Native curvilinear and all angle design
- Complete parametrized library for photonic elements, components and devices
- Photonic Synthesis based on technology parameters and design intent
- Verification, DRC and Routing (electrical, optical, constraint based, ...)



Photonic simulations

- Circuit simulations (by ASPIC or internal), Mode-solvers and Propagation simulations (BPM, EME, FDTD)

Flexible Import and Export capabilities

- Interfaces with circuit tools from Synopsys, Filarete, Lumerical, VPIphotonics and Photon Design
- Integration with CleWin and EDA tools from Mentor Graphics and Cadence
- Raith e-beam writer export (FBMS)

Easy to use GUI including powerful domain specific scripting

- Efficient, fast and mature

Compatible with Process Design Kits (PDKs)

- 10+ photonics foundries offering MPW services are available, also packaging templates



Phoenix Software Global Footprint

Phoenix Software Global Footprint



- Customers in 34 countries
- Transitioning to a more direct sales model in Europe and North-America
- Sales agents and distributors in Asia
- Developing co-sell arrangements with strategic partners



Photonic Design Training by Phoenix Software

One of the most respected training curriculum in the eco-system

- Investing in our future growth by education
 - *“One of the biggest challenges is finding qualified designers” – Leading Photonic IC company*
- Yearly more than 10 training sessions in Europe, North-America and Asia
- 1000+ have attended Phoenix Software workshops and training courses on Photonic IC manufacturing and design

“With 5 days of training, a MSc level EE can create a manufacturable design within weeks”



Why People Use Phoenix Software

- We have been supporting 100's of MPW-designers and vertically integrated organizations getting started with PIC design
- More than 25 years photonics design and tools expertise, available through excellent customer support
 - Our support is valued by our customers with a 9.1 out of 10
- By using our Photonic Building Block platform and PDKs, design times have gone down to weeks instead of months
- PDK set-up time for OptoDesigner takes hours to days, not weeks to months
 - We help our customers with training and support, including configuration and set-up of design libraries and design flows
- Using OptoDesigner and the Phoenix Software team saves time and money and decreases risk



You are welcome!



10th Annual February Training

Since 2007, every February, at our Headquarters in The Netherlands
Using an integrated design flow to create Proces Design Kit in OptoDesigner.
Meeting experts from Phoenix Software and partners from foundries and
design houses.

(February 20 – 24, 2017)



Summary

- **PhoeniX Software**
 - develops solutions focusing on design for manufacturability
 - provides world-class training and support to photonic IC designers
 - has a history going back to 1991 in integrated optics and photonics
 - serves more than 300, majority commercial, customers worldwide
- **OptoDesigner**
 - is the dominant commercial tool for photonics layout generation
 - provides physical simulations and layout in one user friendly environment
 - includes photonics verification and design rule checking
 - interfaces with world-class circuit simulators
 - enables EDA tools with mature and dedicated photonic design capabilities
 - gives access to 10+ MPW photonic foundry PDKs



How to engage

- Contact us for a free trial, including web-sessions
- Contact us to partner
- Contact us for global training programs



<http://www.phoenixbv.com>

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