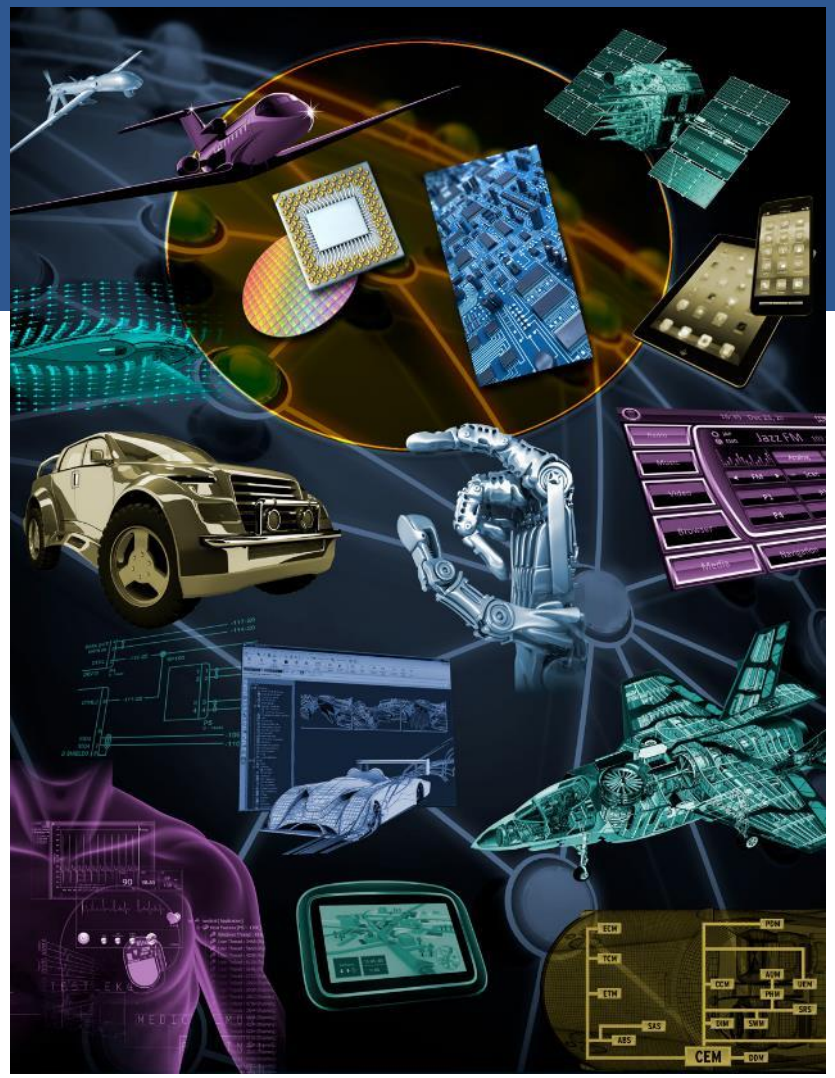



# Ваши возможности в разработке электронных систем

Денис Лобзов

Менеджер по дистрибьюции

Российское представительство

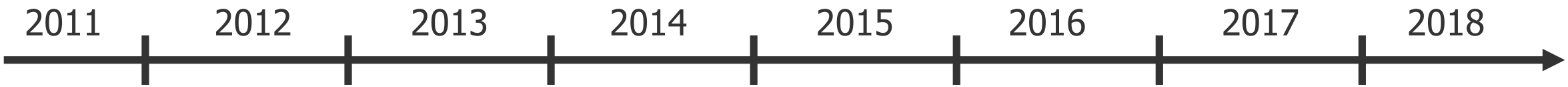
Ментор Графикс

Ноябрь 2018

Mentor®
A Siemens Business

# Integrated Photonics

## Mentor's History




**Educational**

SI-EPIC

CMC MICROSYSTEMS

webinar

webinar edX

webinar

webinar

webinar edX AIM ACADEMY

**Consortiums**

OPSIS

plat4M

NANOELEC.

cea leti

AIM photonics

**Photonic Software Partners**

lumerical

Acquired by Synopsys PhoeniX Software

LUCEDA PHOTONICS

VPIphotonics

Optiwave



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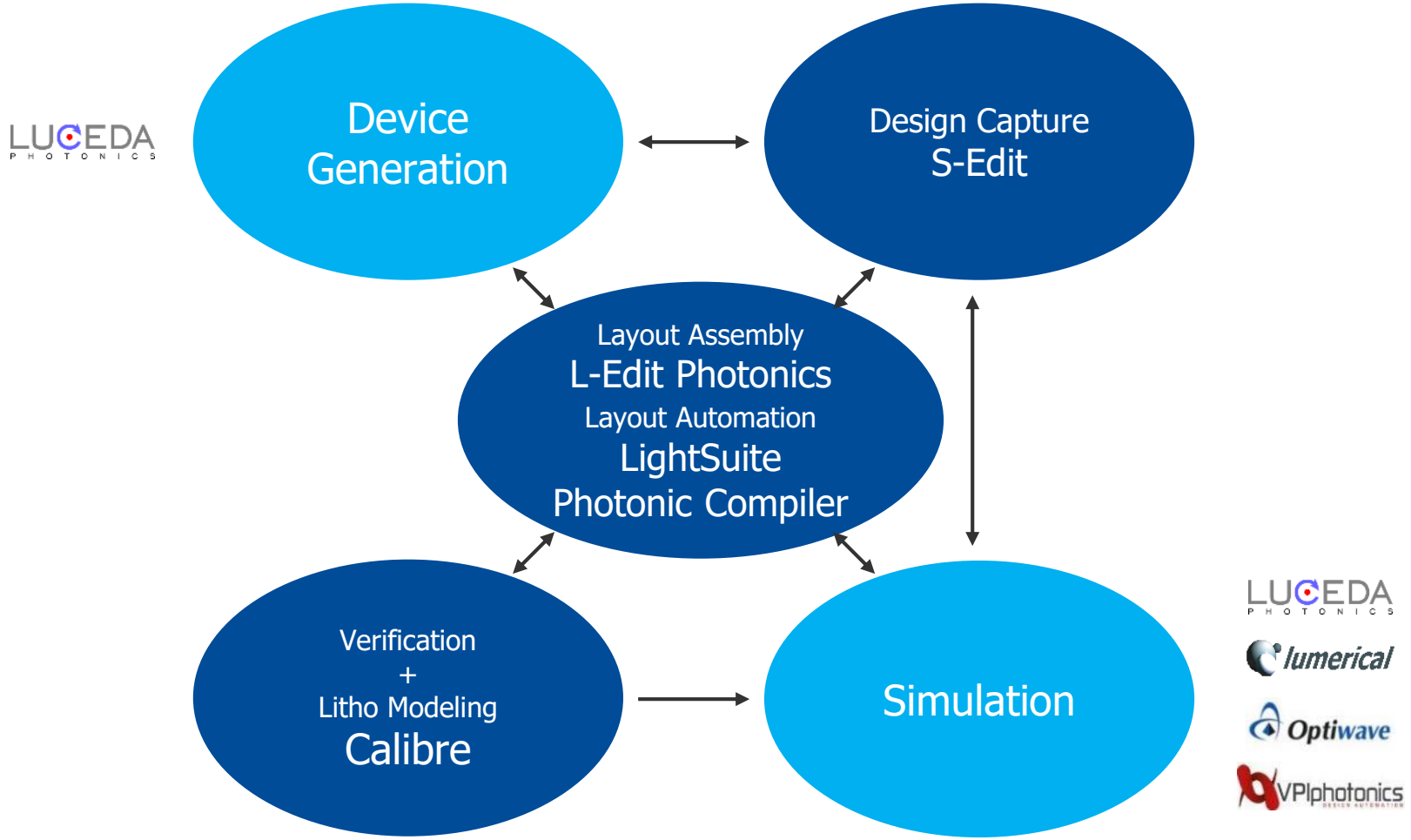
# Integrated Photonics Design Flow



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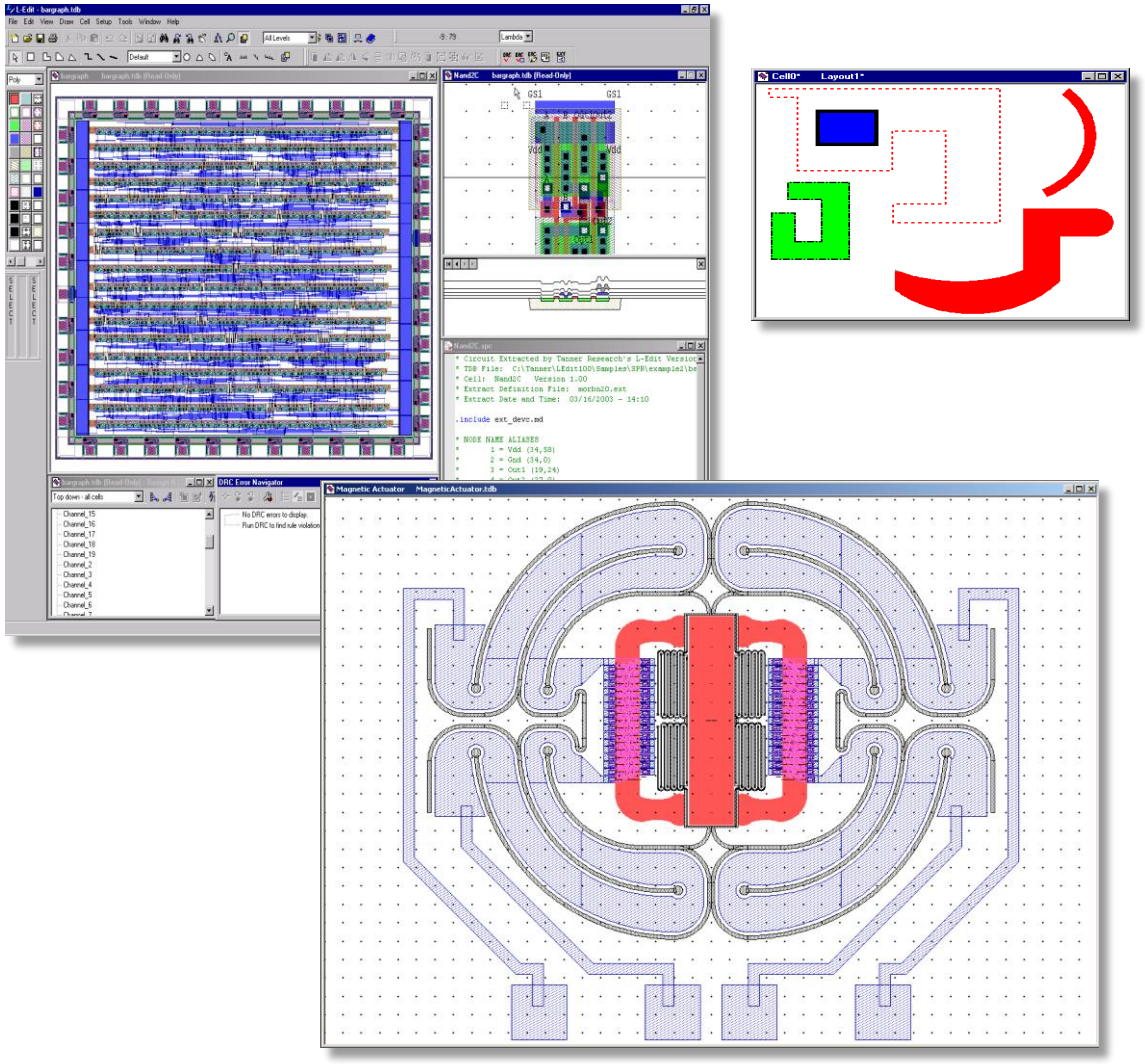
# INTEGRATED PHOTONIC MANUAL LAYOUT

# Layout Assembly
## L-Edit

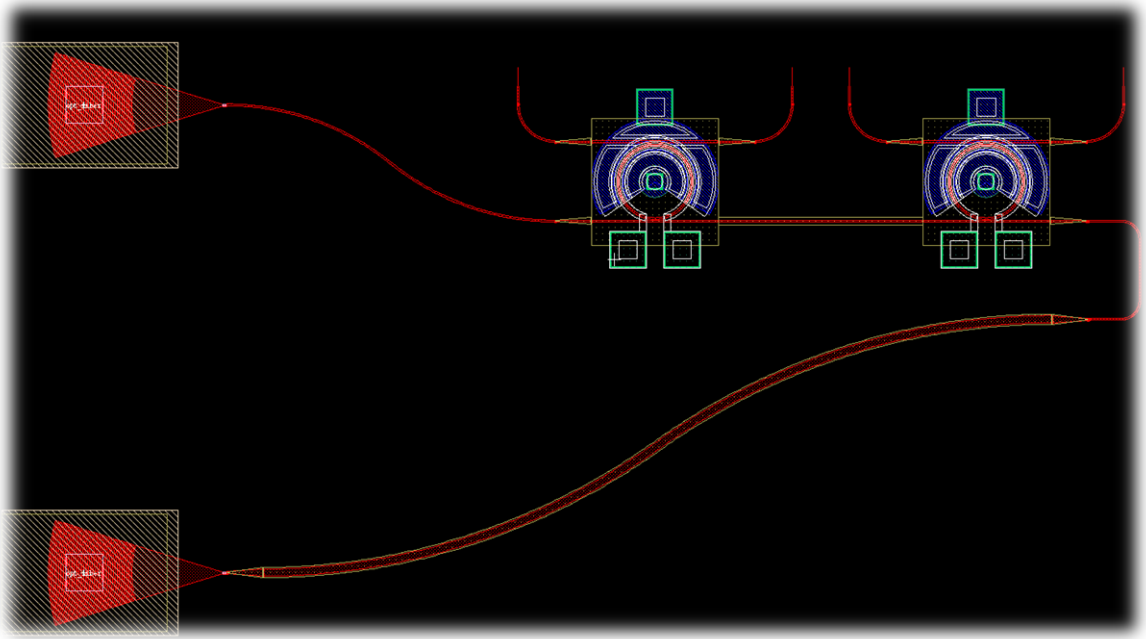


- The only featured layout editor developed specifically for MEMS, IC design and now integrated photonics
- Easy to use, easy to install, programmable physical layout engine with true curvilinear support
  - Full function layout editor with Schematic Driven Layout
  - Built-in support for curvilinear shapes
  - dynamic scripting capability
  - OpenAccess
  - iPDK support
  - Interfaces to all MGC physical and electrical verification tools

# L-Edit Photonics

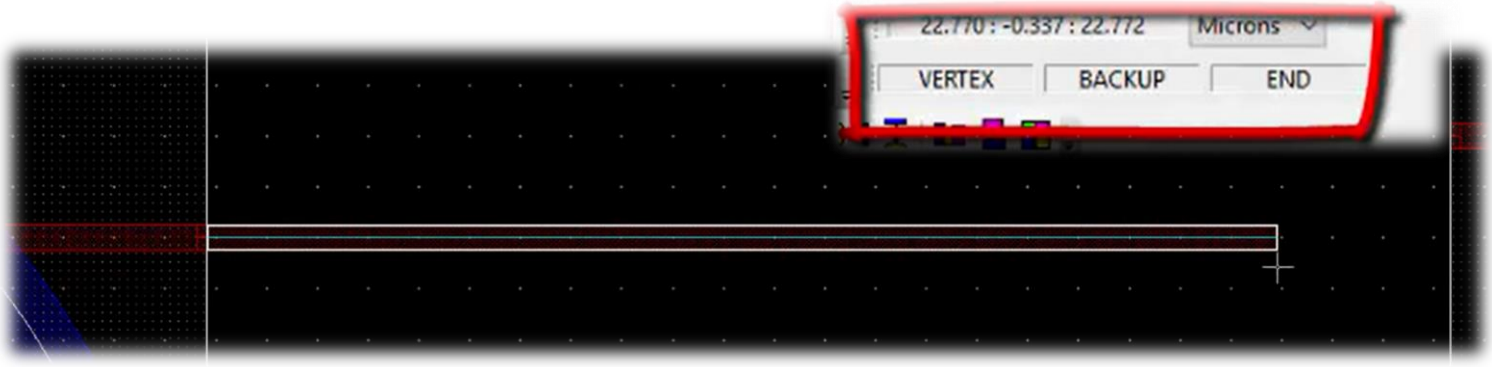
## Manual Layout for Integrated Photonics

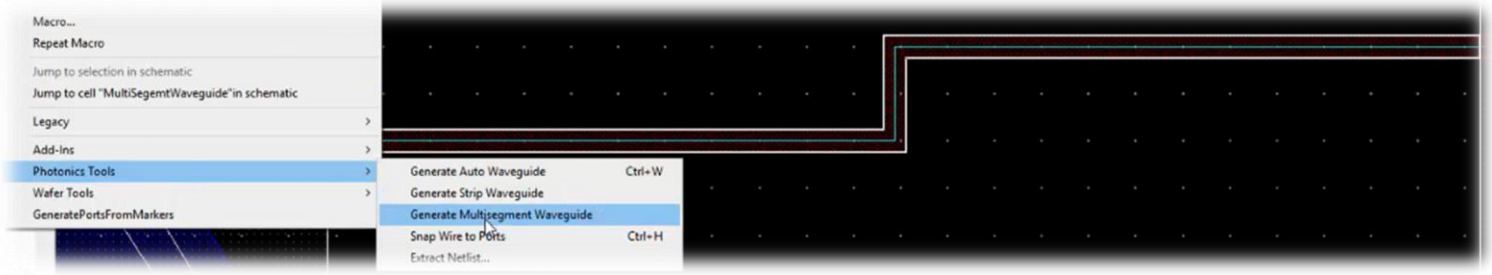
- Stand alone photonic design with L-Edit
- Focused on layout centric design flow
  - Schematic optional
- New functionality added to L-Edit
  - Waveguide creation and editing
  - Crossing insertion
  - Exports simulation netlist

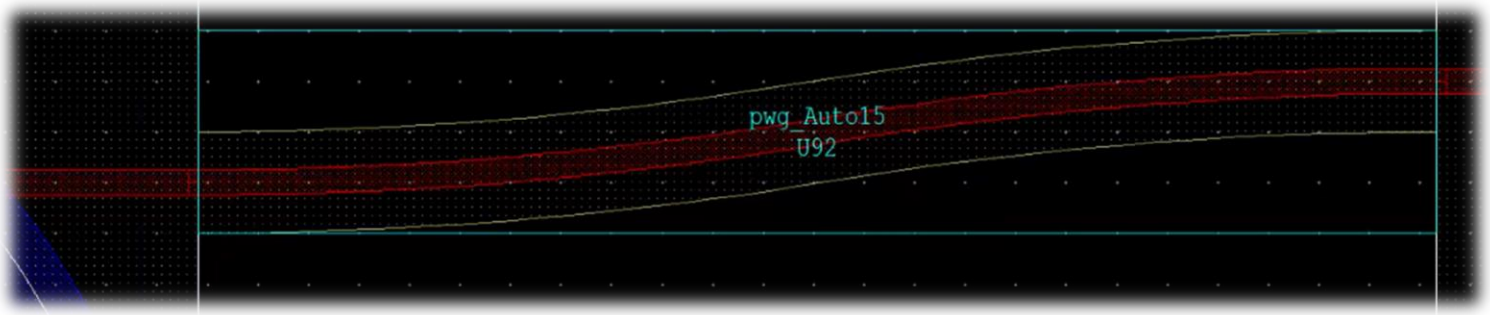


# Layout Assembly

## Interactive Waveguide Routing



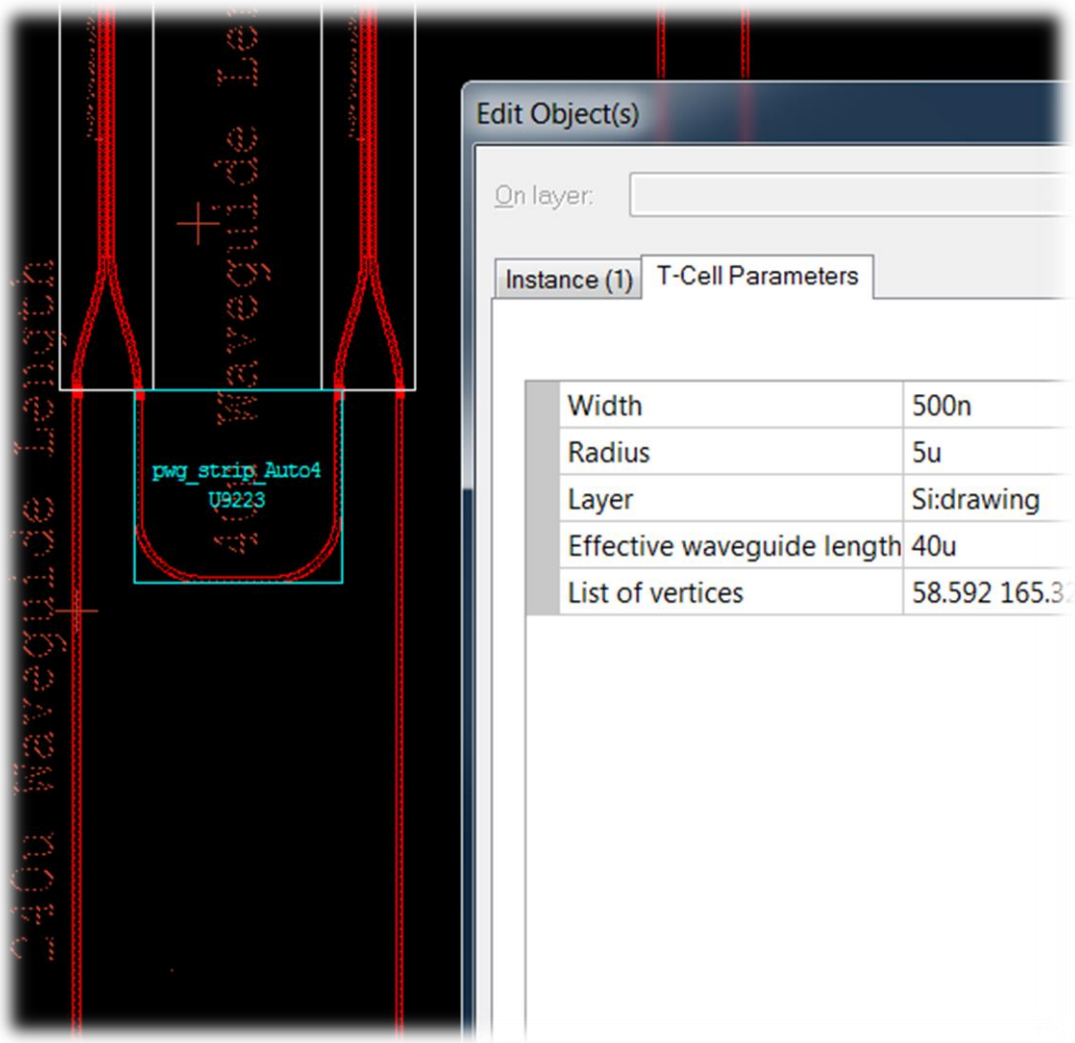




- Route waveguide wires interactively in L-Edit
  - Users have complete control of wires
  - Alignment to pins
- Waveguide conversion
  - Menu, hotkey driven
- Completed waveguide
  - Configurable
  - Supports multiple waveguide types

# Layout Assembly

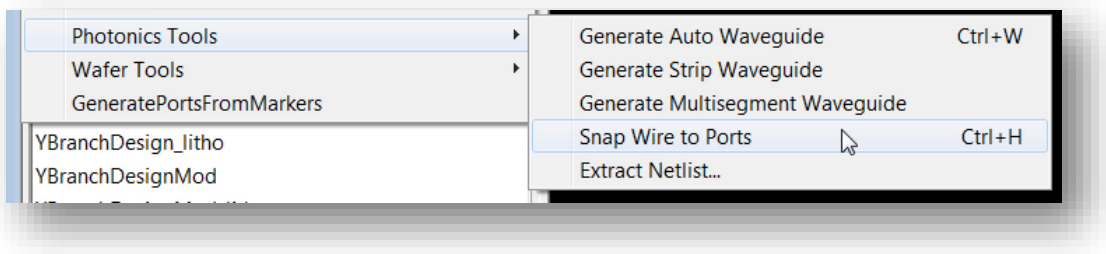
## Edit Waveguide Parameters



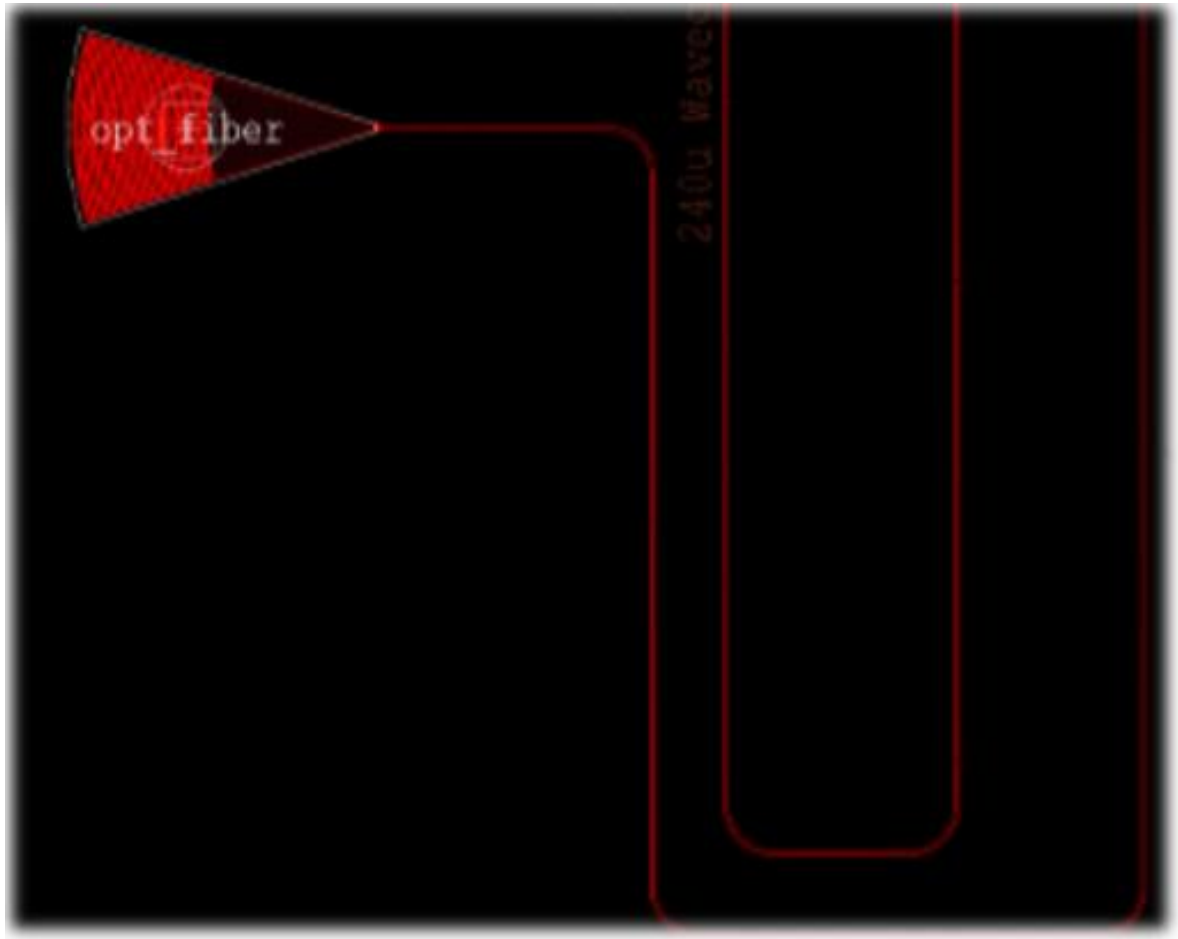

- Edit waveguide parameters including the effective length
- Enables designers precision control over coherent waveguides to perform MZI based design

# Layout Assembly

## Snap Waveguide Wire to Ports



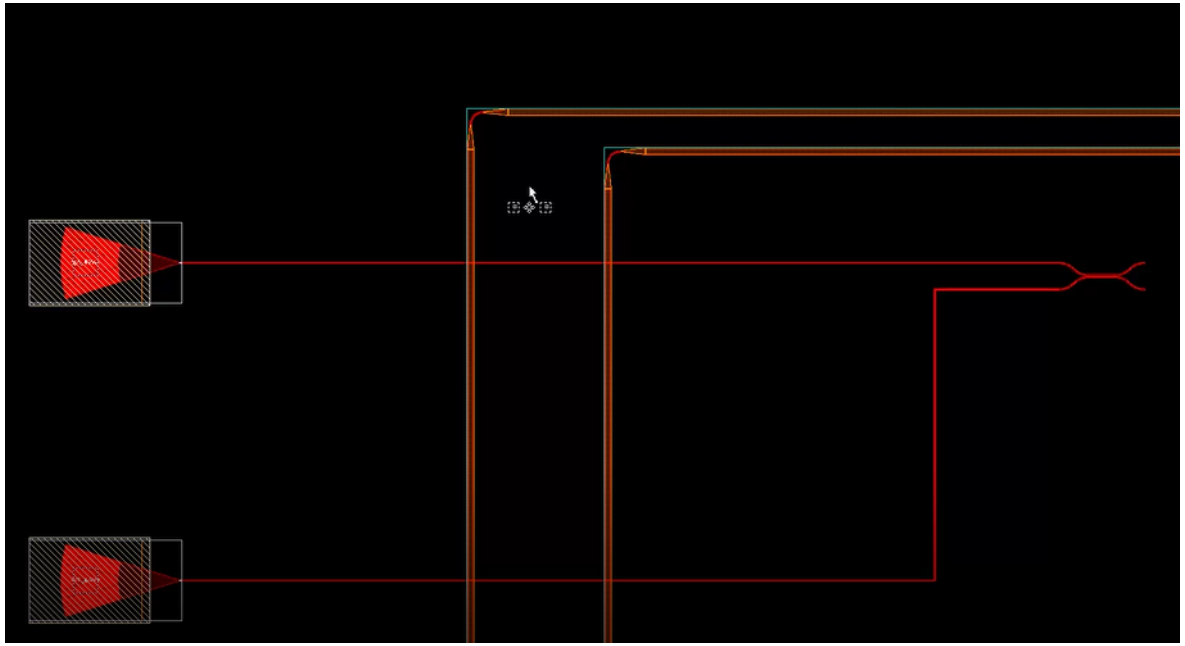

- Precision snapping to optical pins
- Key benefits
  - Enables minor layout edits
  - Ensures a perfect waveguide to device connection
- Accelerated using hotkeys
  - *Control+W* - Convert waveguide to wire or wire to waveguide
  - *Control+H* – Snap waveguide wire to pins

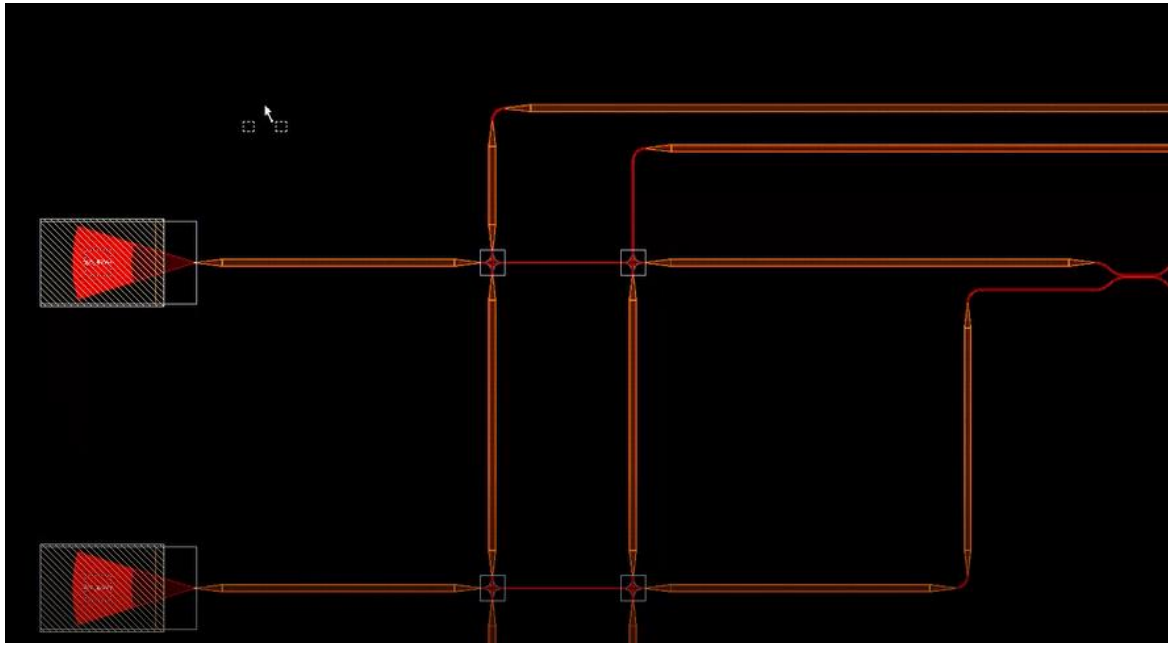


# Layout Assembly

## Waveguide Crossing Insertion

- One or multiple crossings are inserted from the PDK with a single command

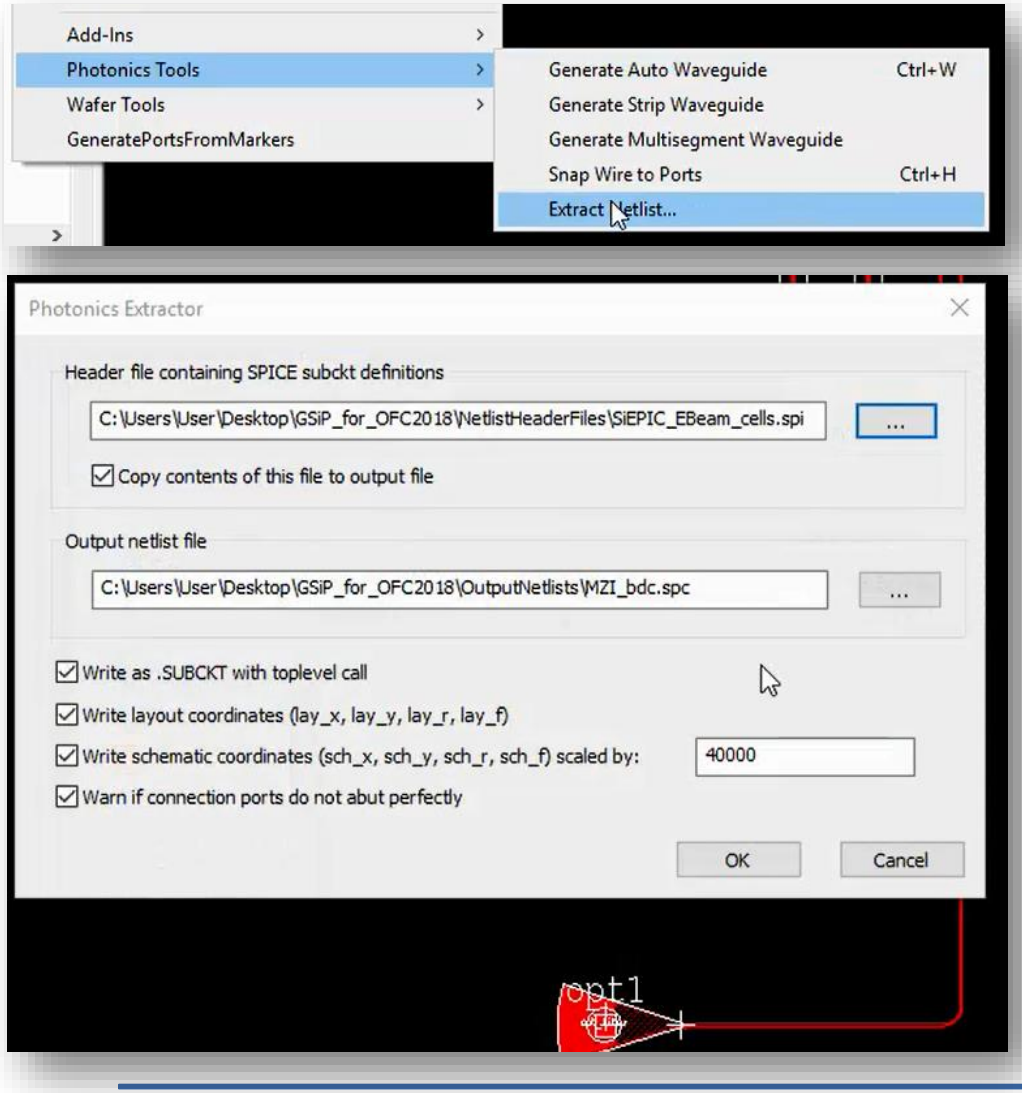




# Layout Assembly

## L-Edit Photonic Creates Simulation Netlist

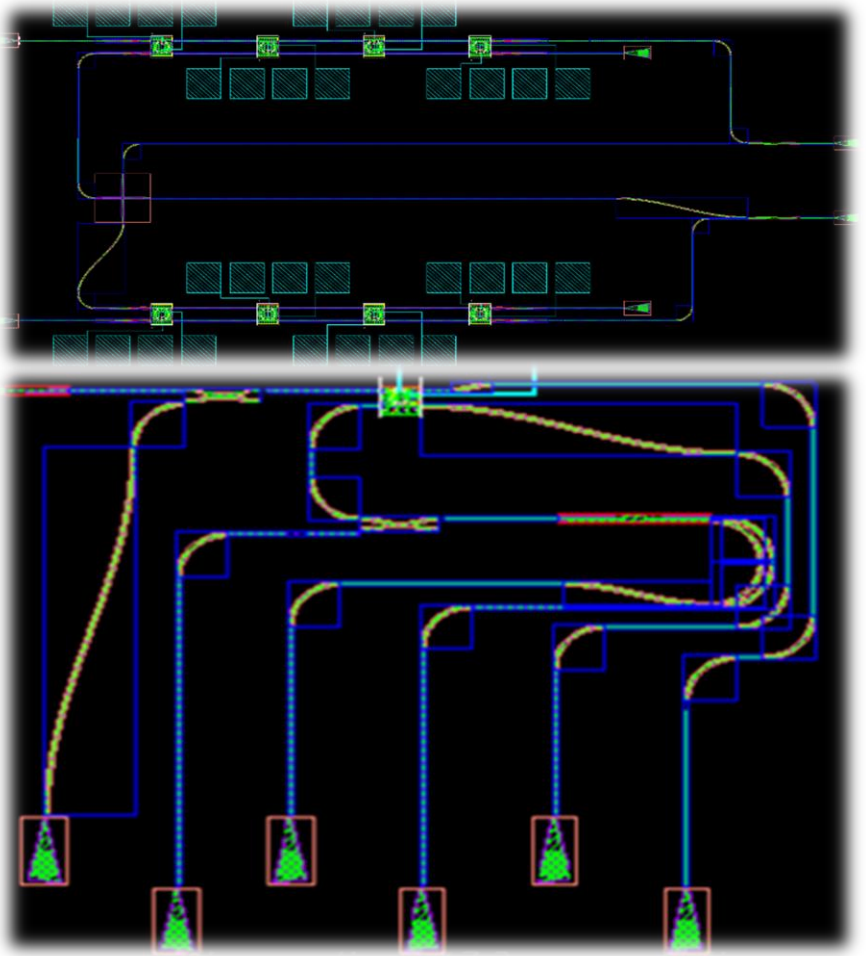
- Generate netlist based on layout design connectivity directly from L-Edit Photonics
- Supports both optical and electrical ports
- Early check to user to ensure precision optical connections
- Supports our photonic simulation partners
  - Luceda
  - Lumerical
  - Optiwave
  - VPIphotonics



# INTEGRATED PHOTONIC LAYOUT AUTOMATION

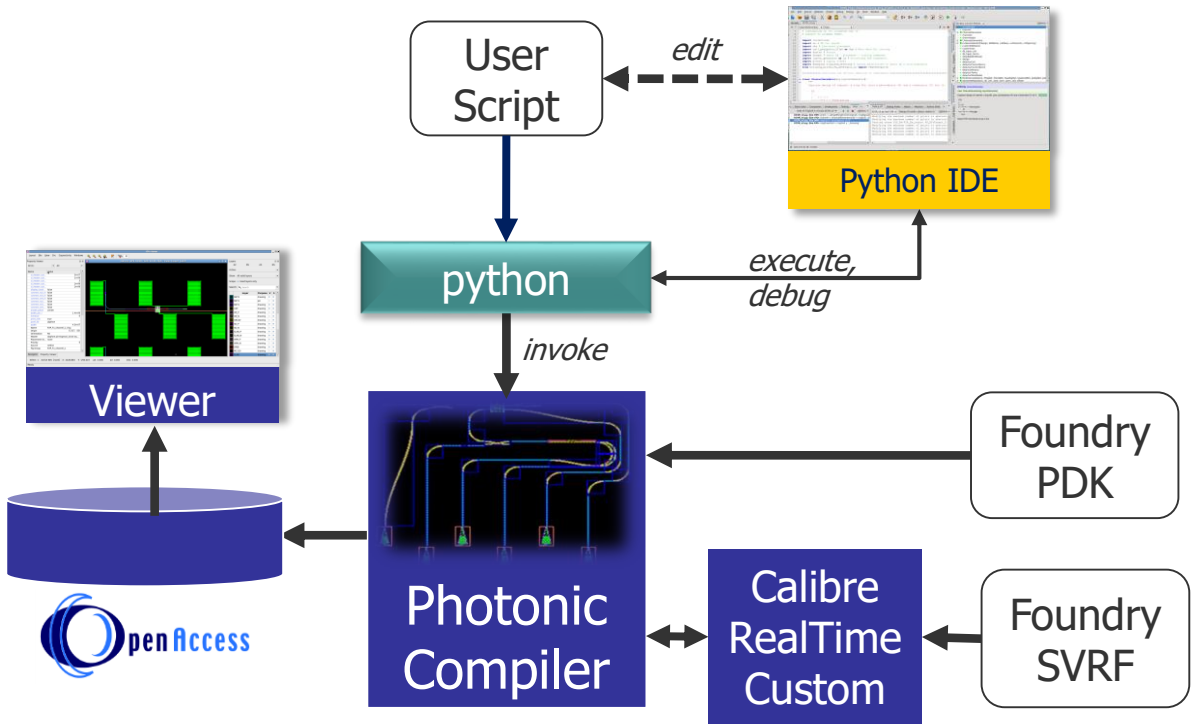
# LightSuite Photonic Compiler

- Industry's first integrated electrical/photonic layout automation tool
- Places components from the foundry provided PDK
- Simultaneous routes both photonic waveguides and electrical nets
- Enables "what if" analysis
- Exports photonic simulation netlist
- Correct by Calibre
  - Requires Calibre RealTime license
- Built on standards
  - OpenAccess
  - Python
  - iPDK

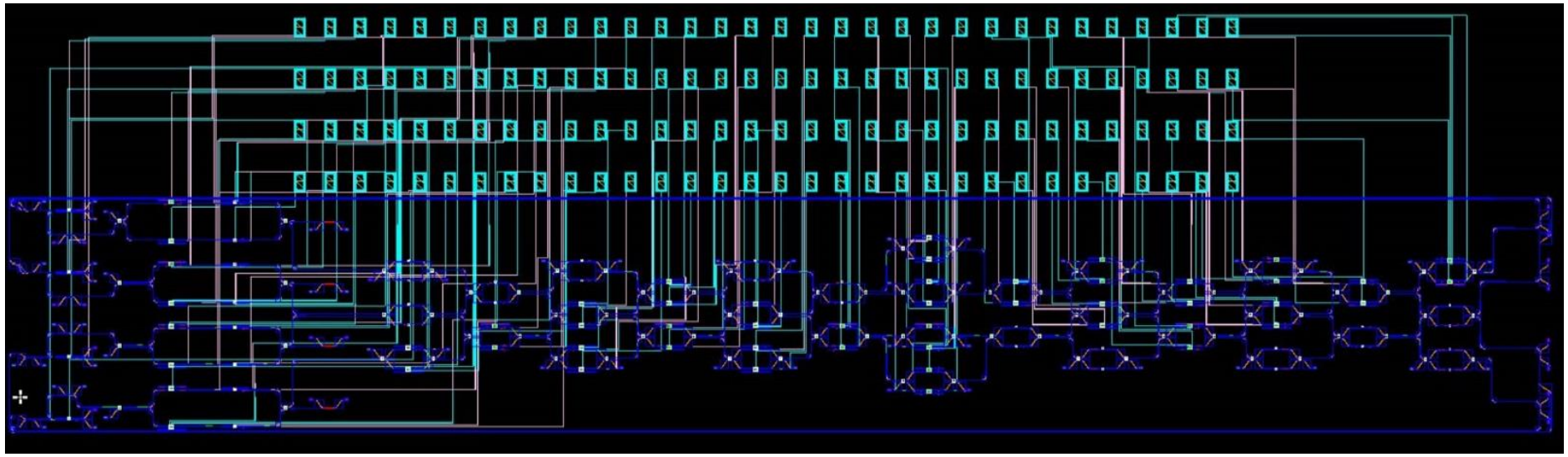


# LightSuite Photonic Compiler
## Design Flow

- "Interactive" use model
  - Photonic Compiler runs and the results seen in the Viewer
  - Script driven
  - User interacts with a Python IDE
- Calibre RealTime Custom runs in the background
- Flow enhanced by an optional 3rd Party IDE such as Wing or PyCharm



# LightSuite Photonic Compiler
## Example in the Design Flow



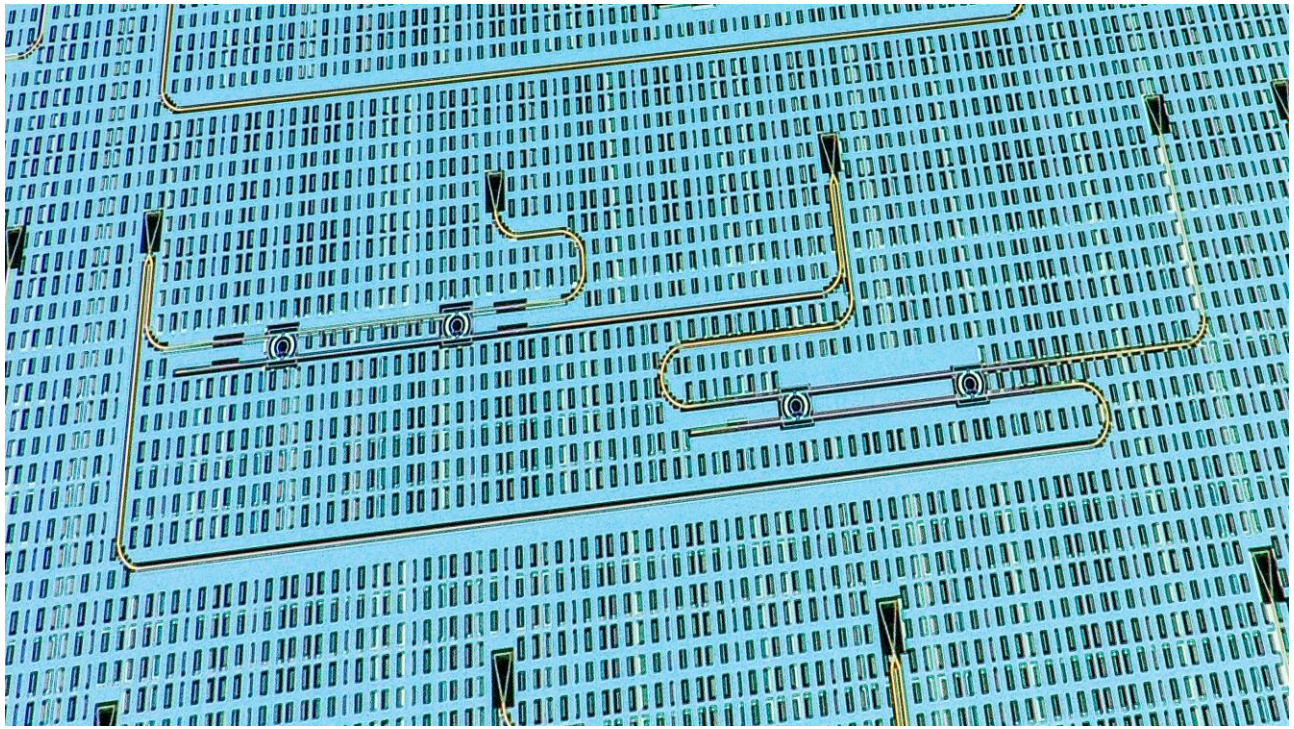
- 9 minutes vs approximately 2 weeks for manual layout
- Close to 400 components
- Placed & routed - DRC clean

# LightSuite Photonic Compiler
## Success Story

Hewlett Packard Enterprise

"LightSuite Photonic Compiler fixes the biggest roadblocks preventing industry-wide adoption of electro-optical design and simulation of photonic chips.
Photonic chips promise amazing performance, but designing circuits today is just too difficult and requires specialized knowledge. LightSuite Photonic Compiler circumvents those challenges and enables scalability. I'm thrilled to have worked with Mentor to develop this tool to make it possible for anyone to design and build photonic circuits as easily as designing electronic circuits."

Ashkan Seyedi, Research Scientist
Hewlett Packard Enterprise





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# PHOTONIC FOUNDRY SUPPORT

# Photonics Foundry Support

- Integrated photonics is moving from research to support by commercial foundry
- Support all photonic technologies: GaAs, InP, and Silicon

## Supported Today

AIM photonics
AMERICAN INSTITUTE for MANUFACTURING INTEGRATED PHOTONICS

TOWERJAZZ

## Work in Progress

amf ADVANCED MICRO FOUNDRY

SMART Photonics
III-V foundry services

DE LA RECHERCHE À L'INDUSTRIE cea leti



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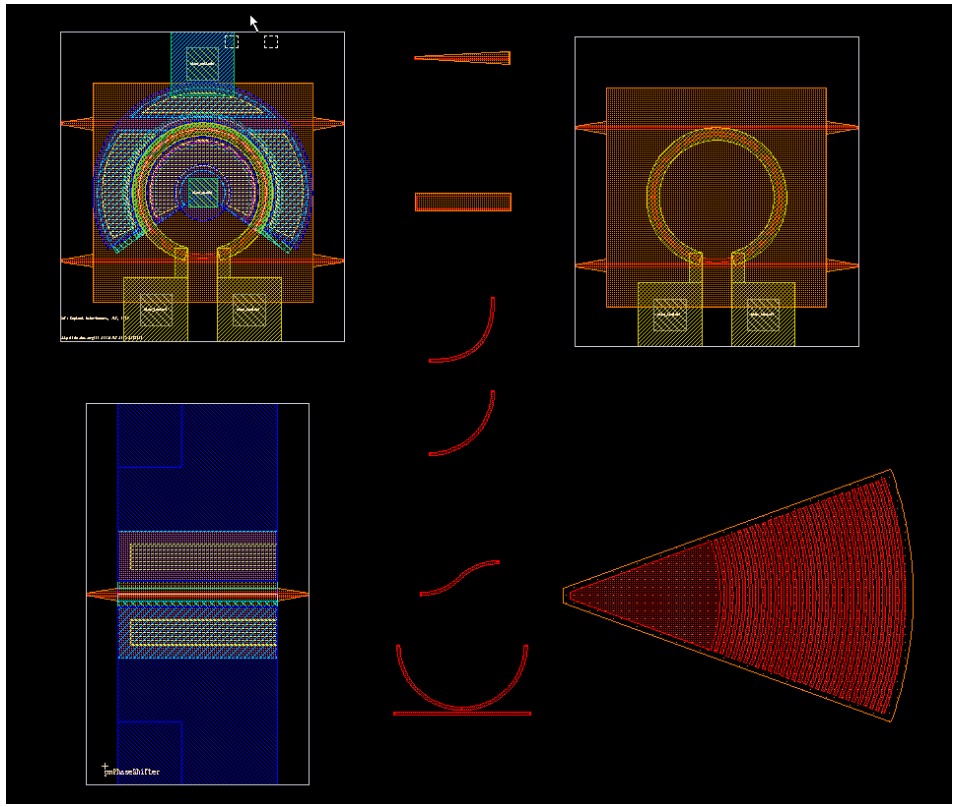
# GPIC PDK

## Generic Photonic PDK

- Passive components
  - Waveguides
    - Bends, Sbend, Sticks, crossings
    - Tapers
  - Y-branches, MMI, directional coupler
  - Grating couplers
- Active components
  - Ring modulators
  - Phase shifters for MZI design
- Need for training and demo's
- Can be used as a starting point for building a PDK



# Integrated Photonics
## Summary

- Mentor is focused on implementation and design capture
  - Stand alone manual layout flow for integrated photonics design
  - Industry's first integrated electrical/photonic layout automation tool
    - Enables "what if" design exploration
      - Too time consuming with manual layout
    - Correct by Calibre
    - Successful teacher customer
- Complete flow with third party providers
- Growing photonics foundry support
  - Mentor PDK
  - iPDK
  - GPIC PDK
    - Foundation for PDK creation

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