

PUTTING LIGHT INTO YOUR CHIPS: HETEROGENEOUS INTEGRATION OF InP PHOTONICS

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EPIC Online Technology Meeting on Hybrid Photonics Integration, September 18th, 2023

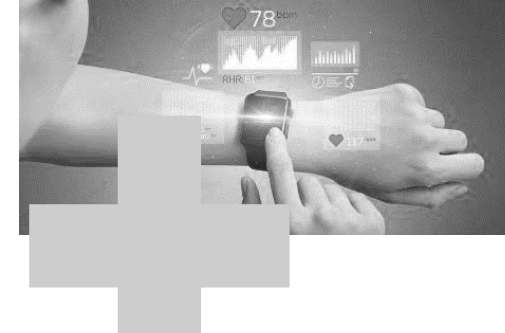
GLOBAL CHALLENGES REQUIRE NEW TECHNOLOGIES



**MASSIVE POWER CONSUMPTION
IN DATA- AND
TELECOMMUNICATIONS**



**NEED FOR FAST AND SAFE SENSORS
FOR ASSISTED AND AUTONOMOUS
MOBILITY**



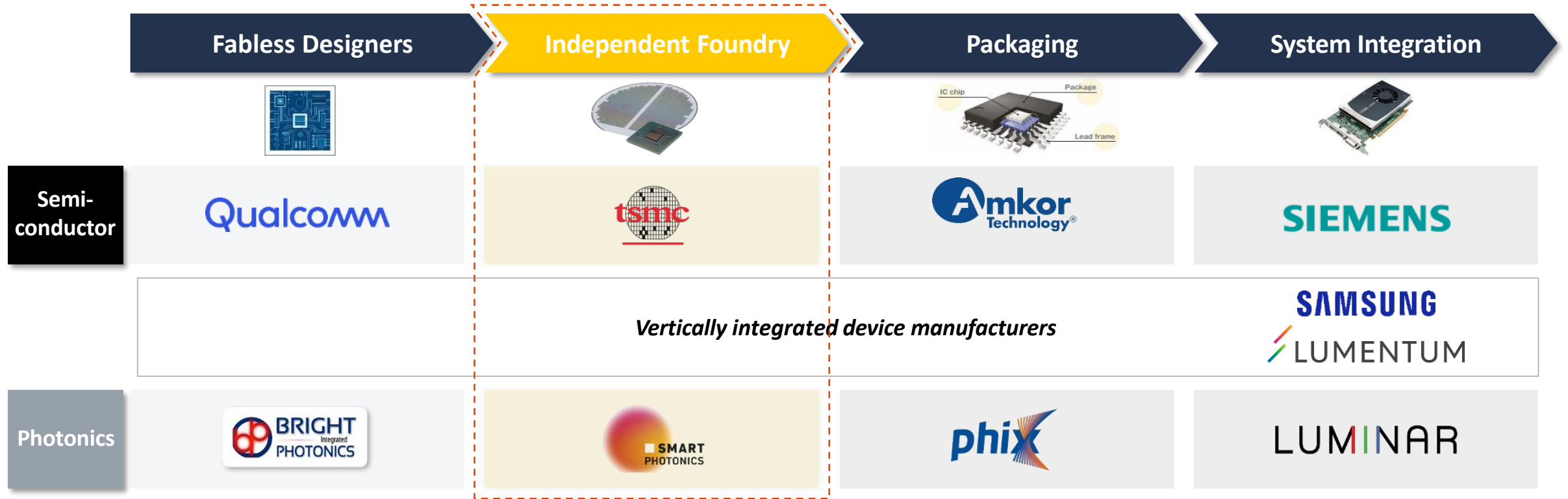
**RAPIDLY RISING COST OF
HEALTHCARE**

LIGHT
instead of electrons

PHOTONIC INTEGRATED CIRCUIT

Integrating multiple components
on a **SINGLE CHIP**

MANY PARALLELS WITH ELECTRONICS



Same equipment

Similar economies of scale and cost-down

Similar margins for tech leader with volume

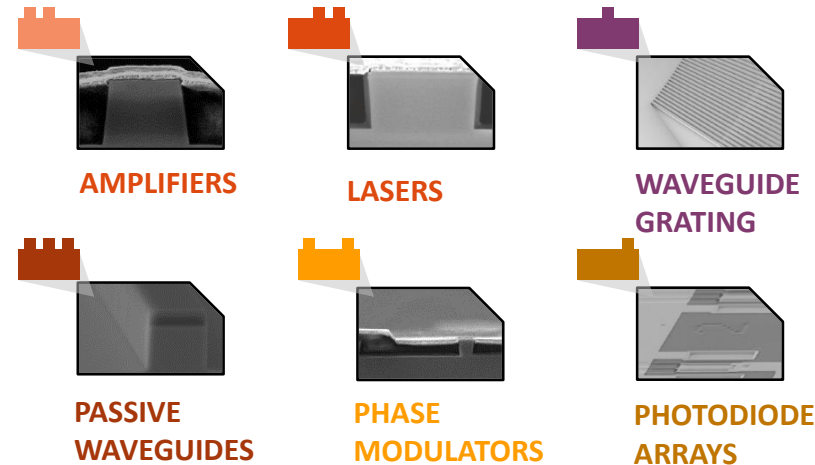


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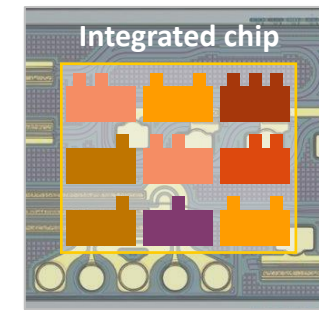
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SIMPLIFYING COMPLEXITY: PDK

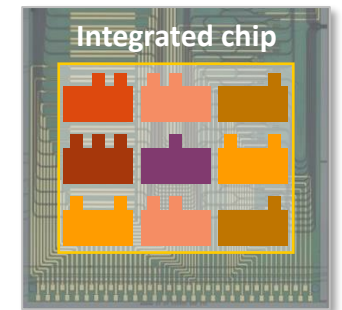
PROCESS DESIGN KIT (PDK) TOOLBOX Process know-how and building block performance



DATACOM CHIPS



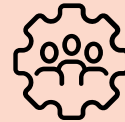
SENSING CHIPS



50+
Proprietary
building blocks



10+
Years of
refining PDK



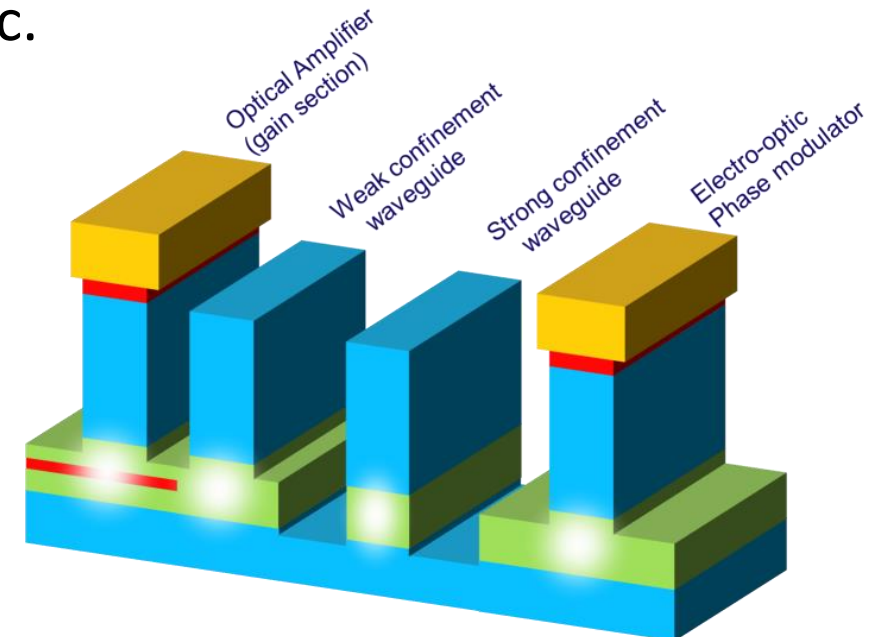
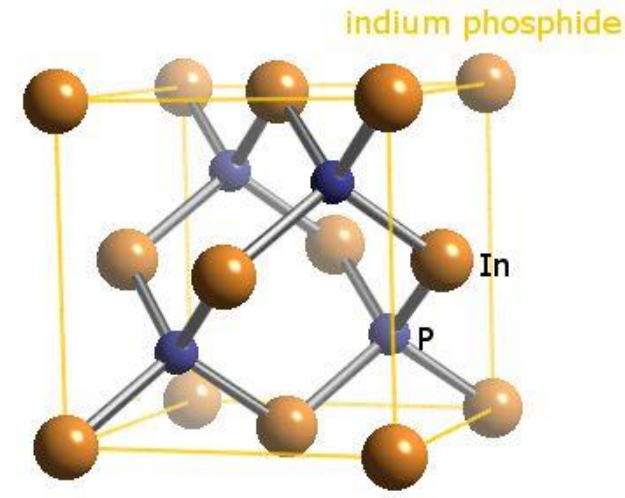
20+
Issued and pending
patent families

PDKS HELP OUR CUSTOMERS:

- **Customise designs**
- **Leverage experience**
- **Reduce time to market**
- **Leverage infrastructure**

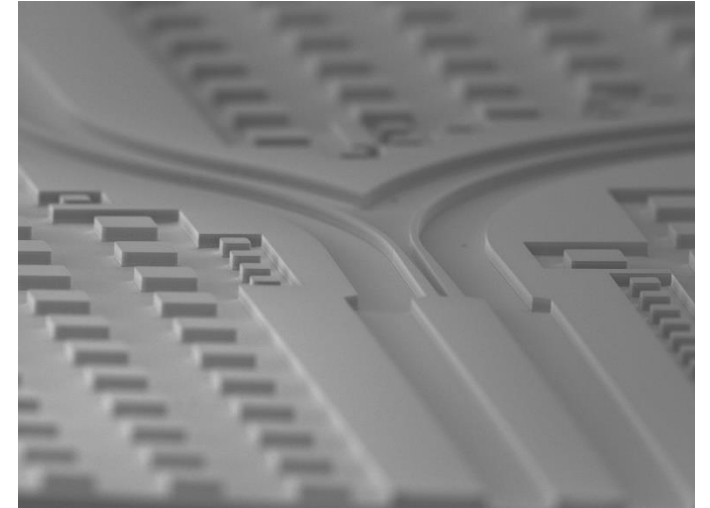
InP IS KEY TO SUCCESS!

- Only material suited for lasers and amplifiers
- Butt-joint integration: no compromise between active and passive components
 - Actives: lasers, amplifiers
 - Modulators: high speed phase and amplitude modulation
 - Passives: connecting waveguides, splitters, etc.
- Full on-wafer electrical testing
- Enabler for low-cost integrated circuits!



INTRODUCTION SMART PHOTONICS

InP PIC Production Line and PDK



- EU based foundry
- Open Foundry – manufacturing services for InP wafers based on customers' designs
- Processes and capacity for supporting customers from prototype to volume

✓ ***Production***

✓ ***Validated
PDKs***

✓ ***MPW service***



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MULTIPLE PLATFORMS WITH DIFFERENT STRENGTHS

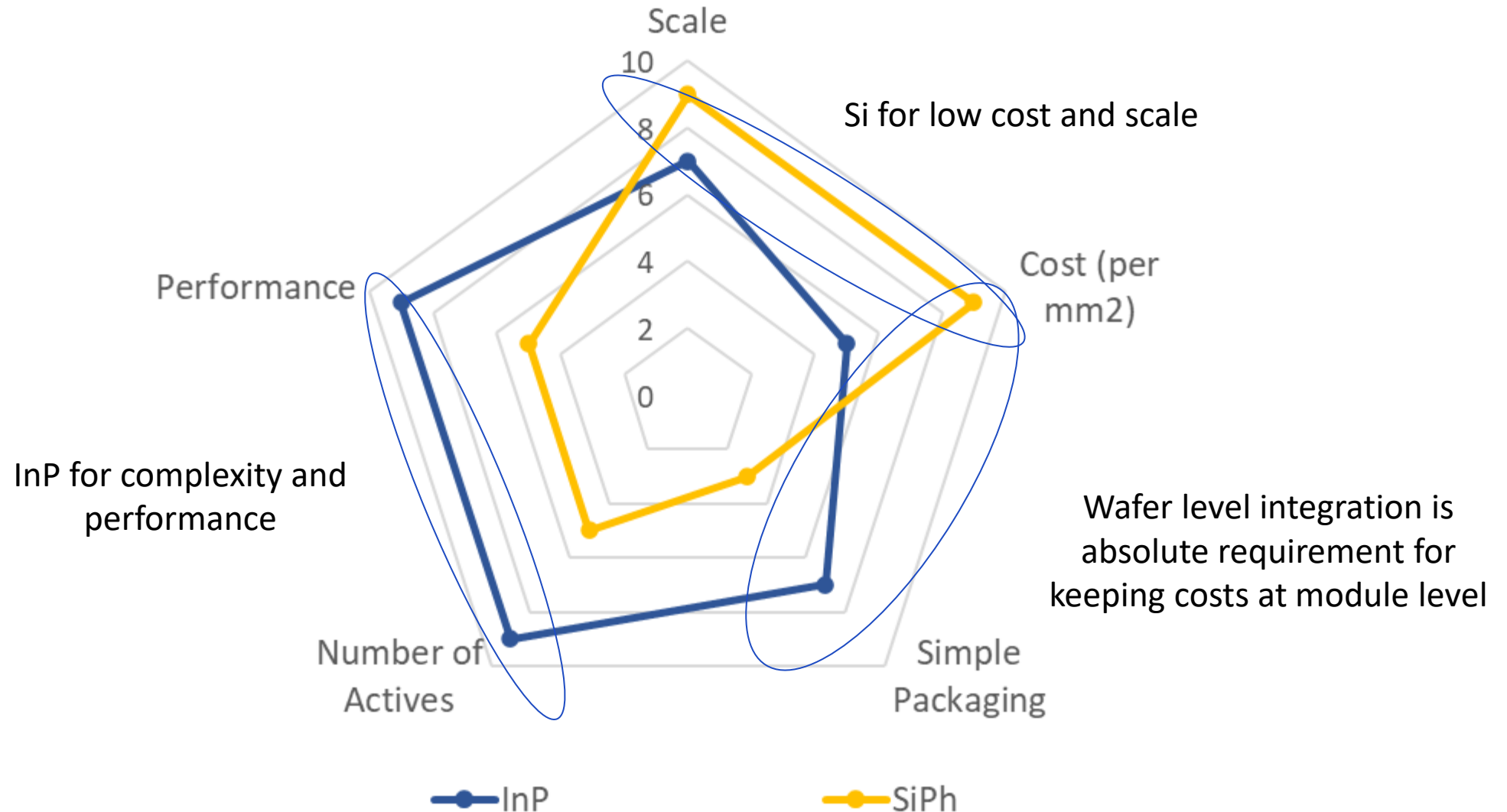
TRANSFER PRINTING: COMBINING BEST OF ALL PLATFORMS

PIC platform attributes	Indium phosphide	Silicon Nitride	Silicon (CMOS) photonics	INSPIRE
Light sources and amplifiers	✓✓✓	✗	✗	✓✓✓
Electrical energy efficiency	✓✓	✗	✓✓	✓✓
Electro-optic speed	✓✓	✗	✓✓	✓✓✓
Optical connect efficiency	✓	✓✓✓	✓	✓✓✓
Optical signal integrity	✓✓	✓✓✓	✓	✓✓✓
Production scalability	✓	✓✓	✓✓✓	✓✓✓
Active device scaling	✓	✗	✗	✓✓
Passive device scaling	✓	✓	✓✓✓	✓✓
Hosting exotic materials	✓	✓✓✓	✗	✓✓✓
Route to 3D integration	✓	✓✓	✓✓✓	✓✓✓

Table 1.1: Attributes of established PIC platforms and the INSPIRE III-V/SiN platform. Red crosses ✗ indicate a platform deficiency, and single yellow ticks ✓ indicate a credible path is an active area of PIC development. Multiple green ticks ✓✓✓ indicate superior performance.

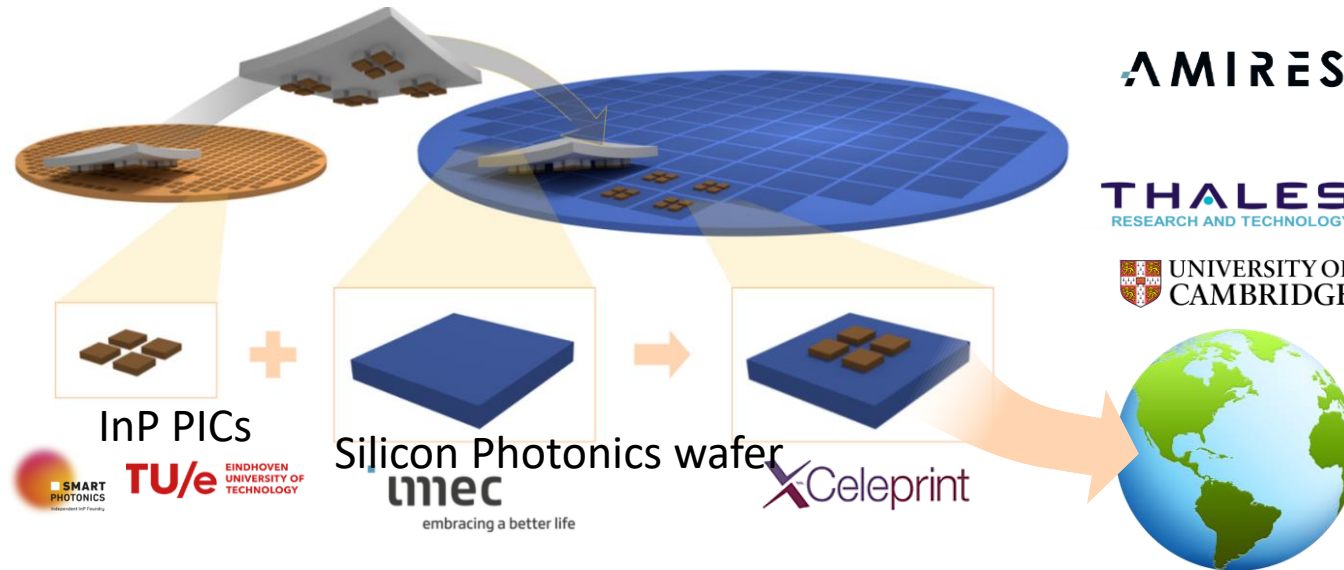


COMPLIMENTARY PERFORMANCE



INSPIRE: TECHNOLOGY DEVELOPMENT

AMBROSIA: UTILISE AND VALIDATE OUR TECHNOLOGICAL ADVANCEMENT



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NEXT STEP: PHOTONIXFAB



- Full EU-based photonics device value chain
- Industrial manufacturing capabilities
- Path to high-volume manufacturing



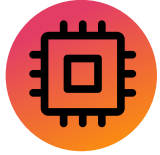
WHAT DO WE NEED FROM THE COMMUNITY?

Applications! – Bring your ideas and convert them into products. Close communication is needed to bring new technologies to the market

We provide the platform; you deliver the applications.

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CONCLUSIONS



Integrated photonics: helps solving major worldwide challenges in large and high-growth markets



The industry has many parallels with electronics and is moving towards a horizontal value chain



Higher application demands drives need for platform integration



Adoption of new integration platforms needs close interaction in the photonics ecosystem



InP based devices play a key role in integrated photonics value chain



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