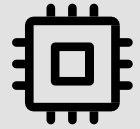


INP PHOTONICS INTEGRATED CHIPS FOR THE AI AND DATACENTER ERA

Gunnar Stolze
SMART Photonics, NL



SMART PHOTONICS InP FOUNDRY



Next generation Integrated Photonics, actives + passives



Independent PDK foundry enabling fab-less photonics innovation



Strong European ecosystem, Global customer base



Building to become the global leader in Integrated InP Photonics



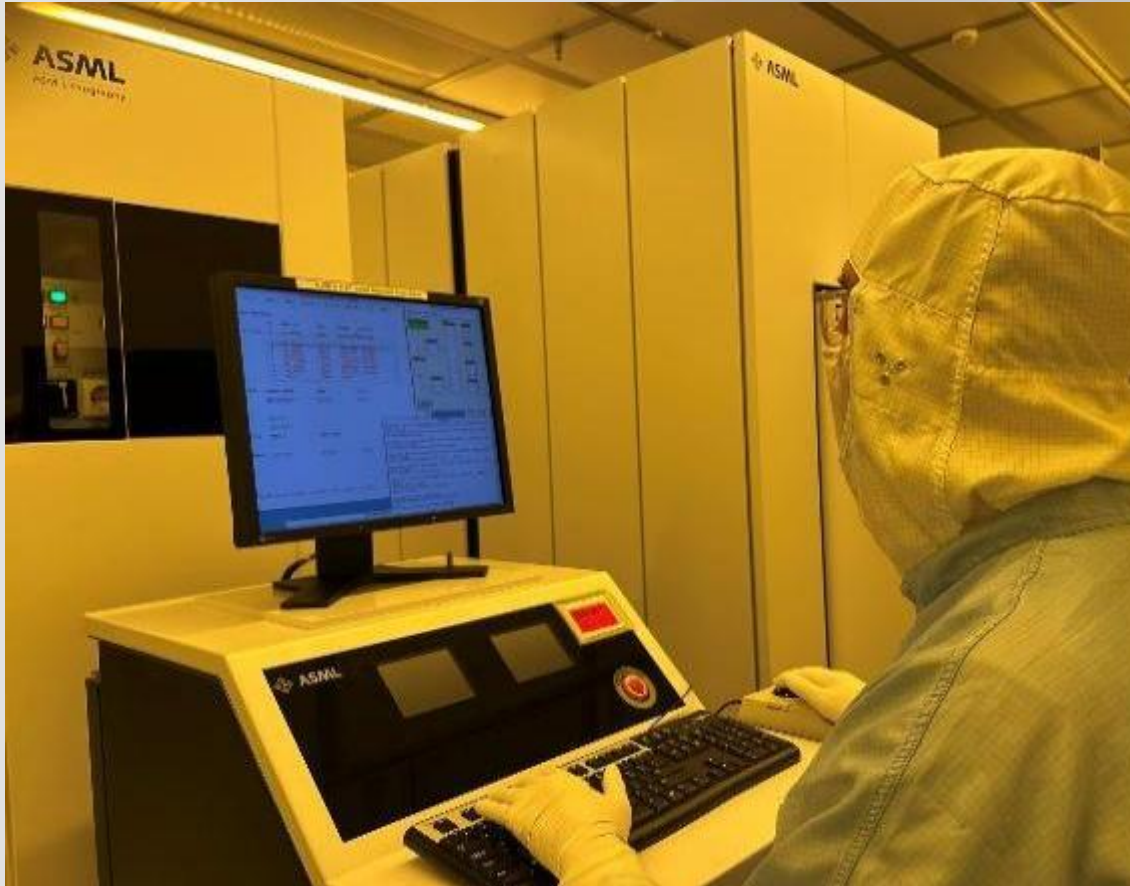
Enabling the Fabless InP Integrated Photonics Ecosystem

SMART PHOTONICS InP FOUNDRY

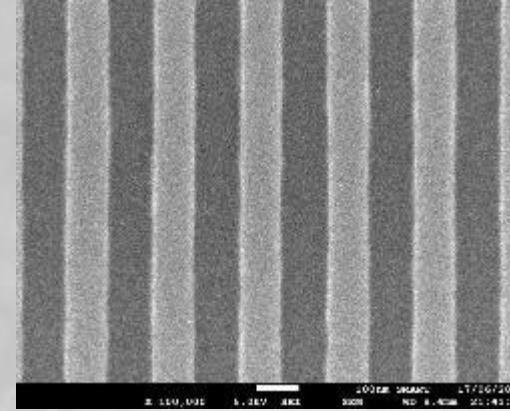
PIC supply chain



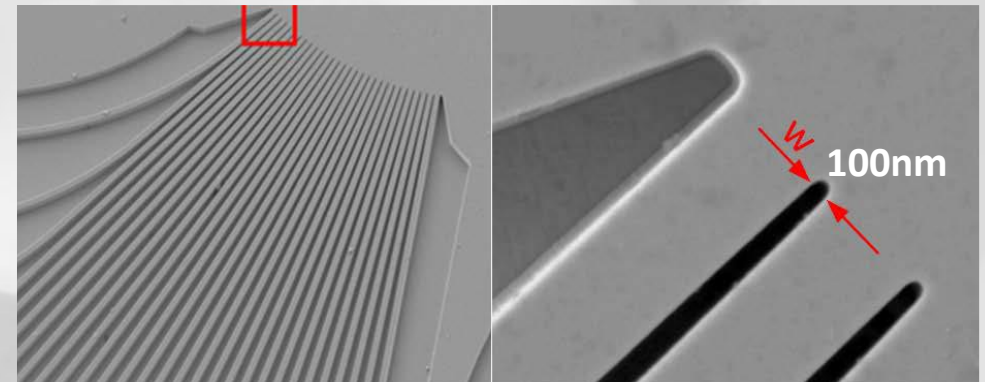
PIONEERING DUV LITHOGRAPHY FOR PHOTONICS



High precision & fast DUV Lithography for HV



GRATING – PITCH 200nm



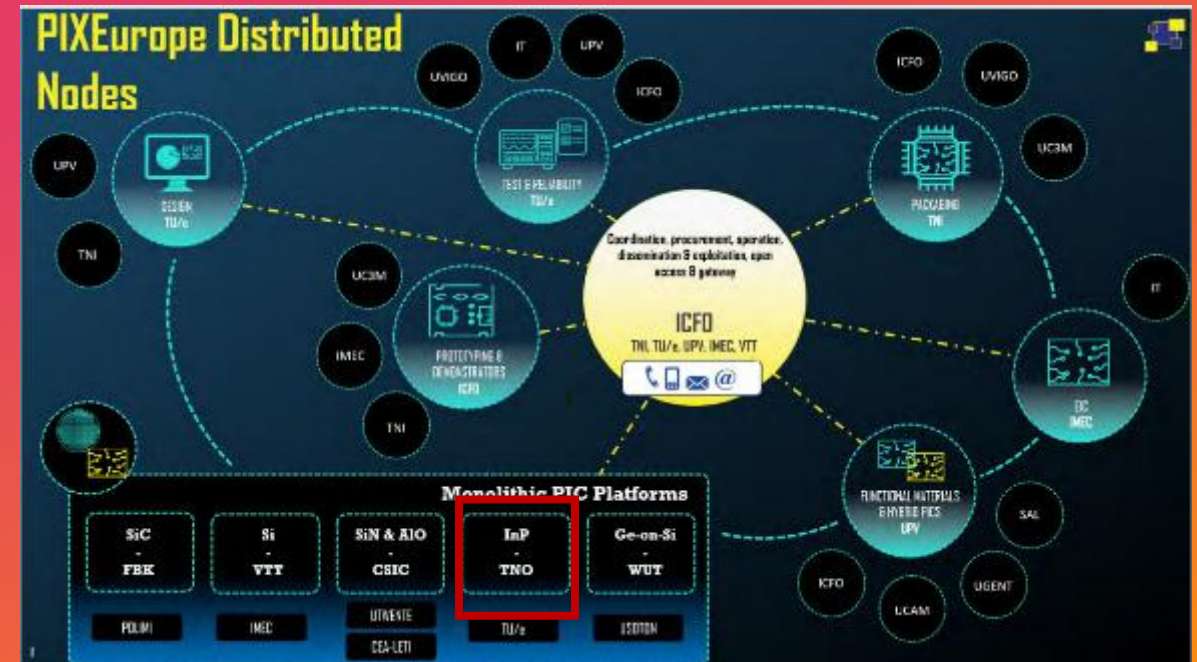
HIGH RESOLUTION AWG

SMART PHOTONICS InP FOUNDRY

From current 4" Line

- ✓ 5,000 4" wafers capacity
- ✓ ISO 9001 certified production
- ✓ 2,100m² ISO6 production facility

Expanding to 6" InP Line



TNO innovation
for life

PhotonDelta

INP PICS ADDRESS VARIOUS END MARKETS

DATA CENTERS AND AI CLUSTERS



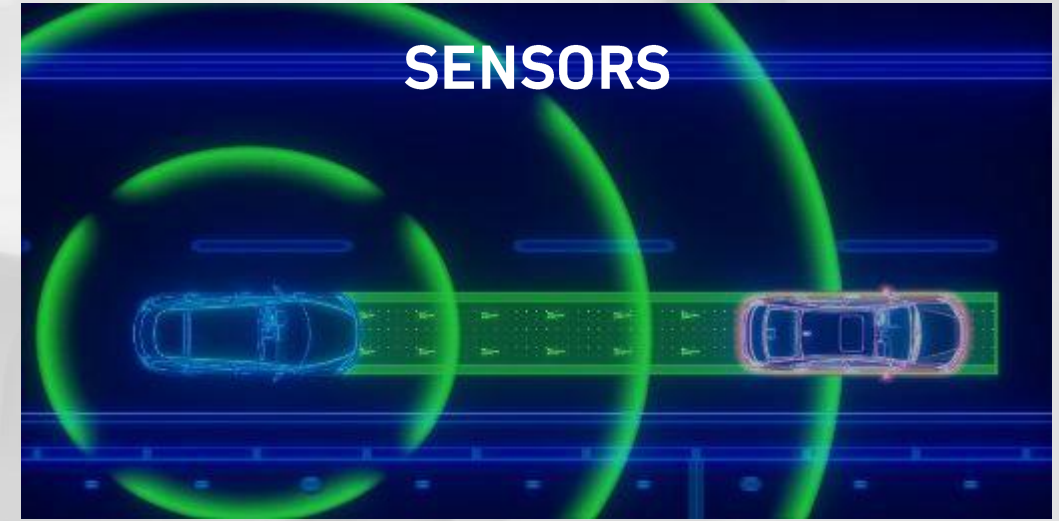
TELECOM NETWORKS



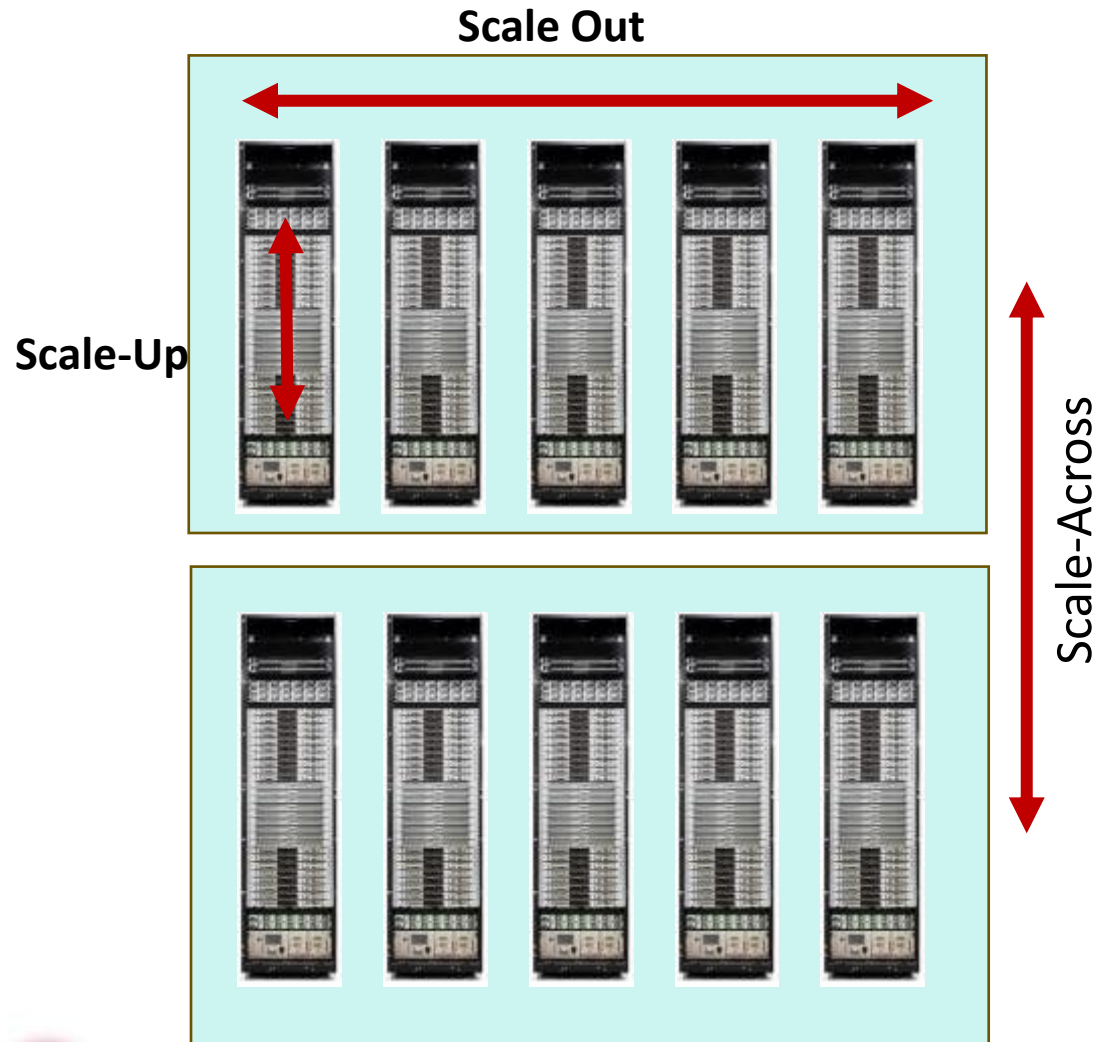
FTTx - HIGH SPEED PON



SENSORS



DATACENTER: SCALE-UP, SCALE-OUT, SCALE-ACROSS

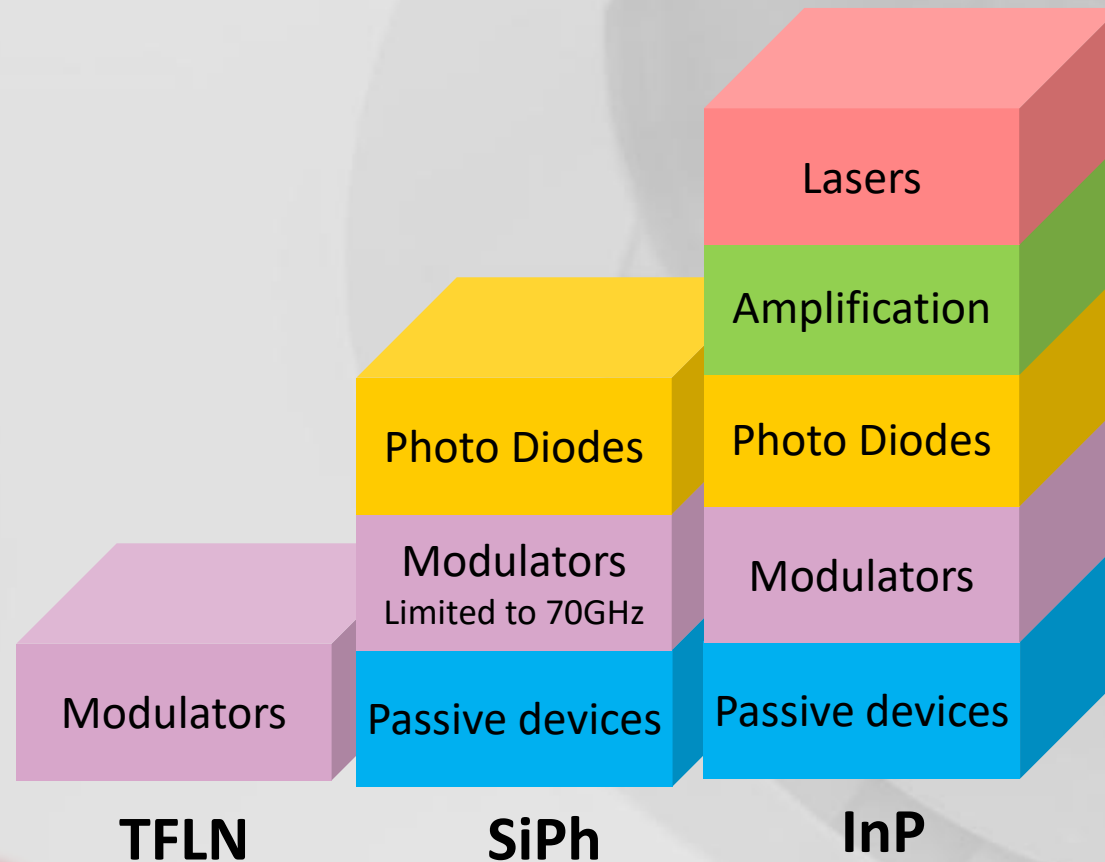


Requirements to Data Center scale

- Increase Link Speed
- Reduce Energy Consumption
- Minimize Downtime – Reliability
- Reduce footprint

INP ADDRESSES DATACENTER CHALLENGES

Photonic Building Block Library

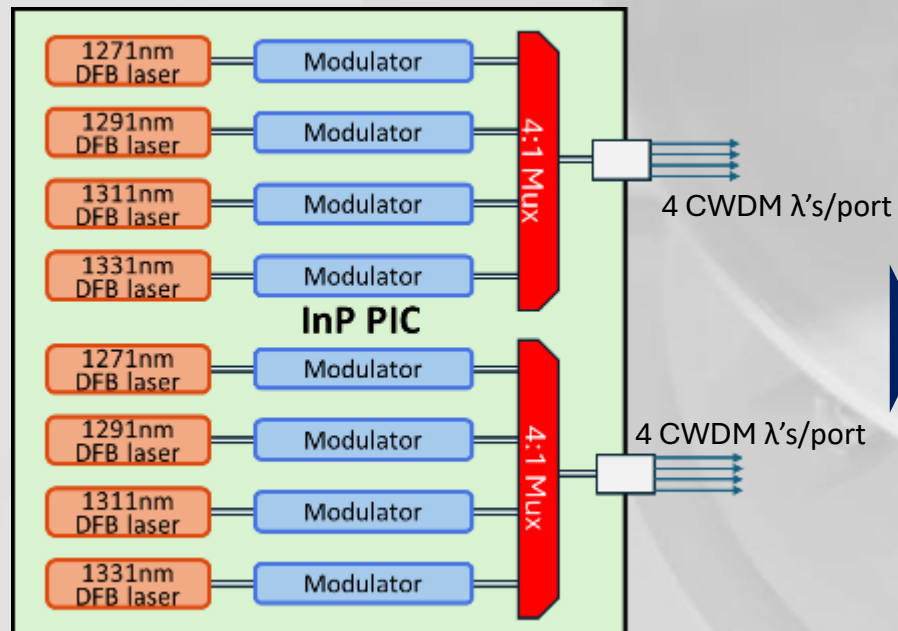


InP and Integration

- Link Speed to 3.2T
- Eliminate Interface Losses
- Higher Shoreline Density
- Increase Bandwidth / Fiber
- Increase Bandwidth / Footprint
- Reduce Power / Bit

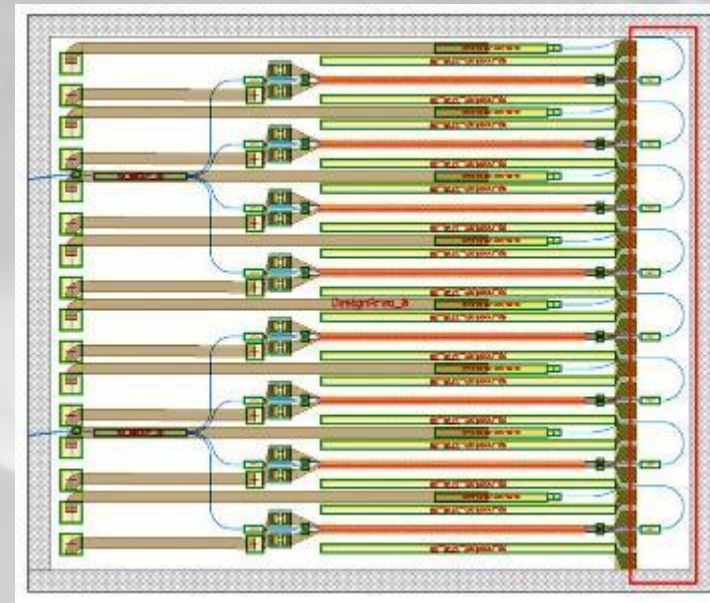
INP PIC FOR SCALE-OUT & SCALE-ACROSS

Functional Design Concept of Photonic Tx



8 lasers, 8 PAM 4 modulators, 2x 4:1 mux

Integrated InP Photonics Chip



~10mm²

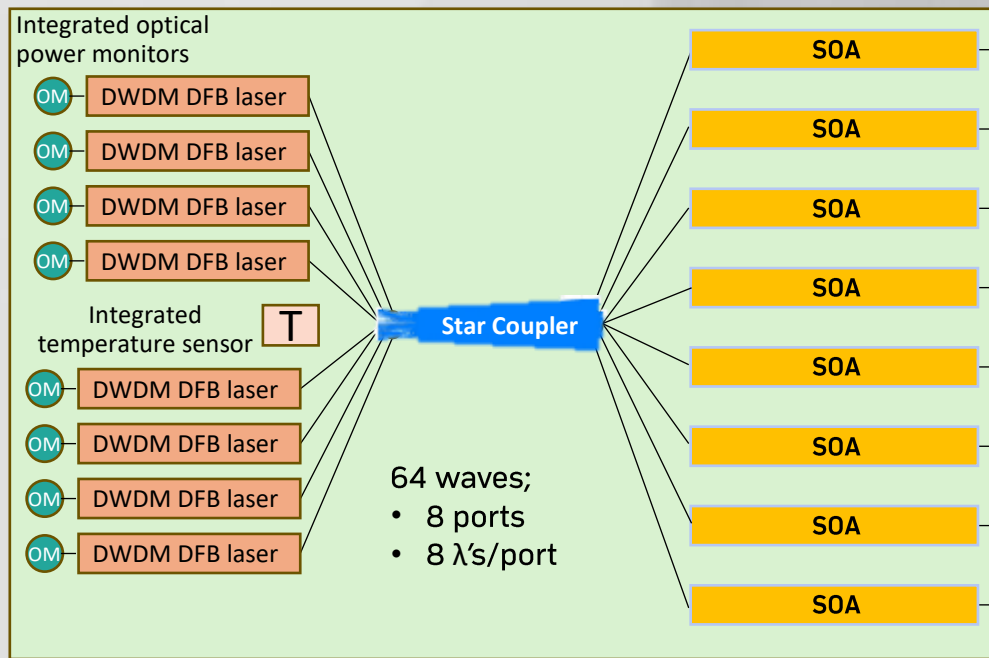
Integrated in End Product



3.2T FR Module

INP PIC FOR SCALE-UP & SCALE-OUT

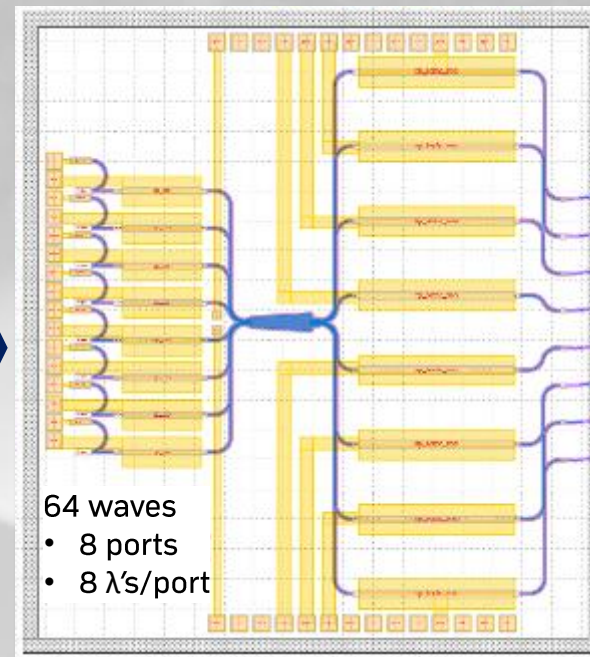
Functional Design Concept of Photonic Tx



N=8 DFB lasers

M=8 outputs, each with a SOA to boost power to desired level

Integrated InP Photonics Chip

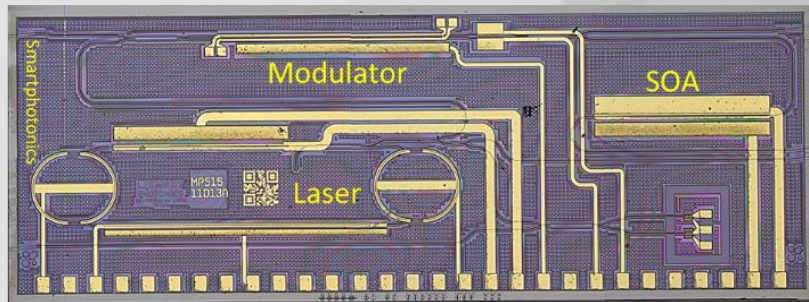


Integrated in End Product

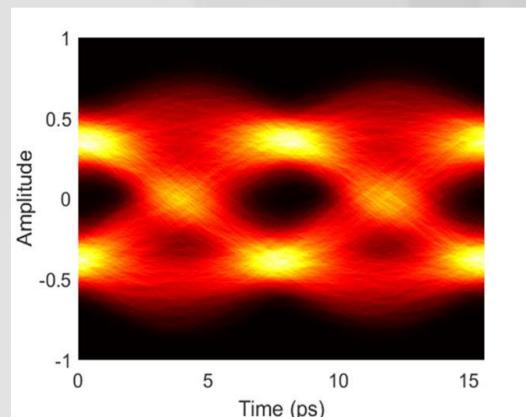


ELS Module
64 CW-WDM channels
8 ports, 8 λ 's per port

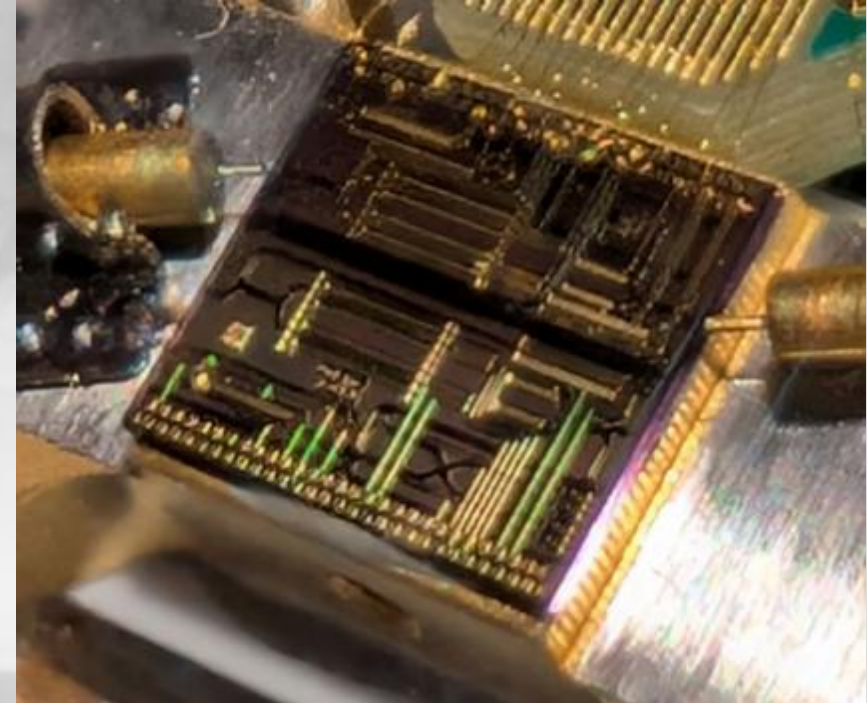
INP PIC FOR SCALE-ACROSS



**Monolithically Integrated Design
Coherent / Coherent Lite Optics (Tx)**



128 Gbit/s



**Realized Monolithic PIC in
test environment**

ROAD TO 3.2T DR/FR AND BEYOND

200GHz+

SMART Photonics Modulator technology

Silicon Photonics modulators

Next Generation

3.2T: 400G/lane: 120 - 135GHz

Limit of Silicon Photonics modulators

Emerging

800G/1.6T: 200G/lane: 60-70GHz

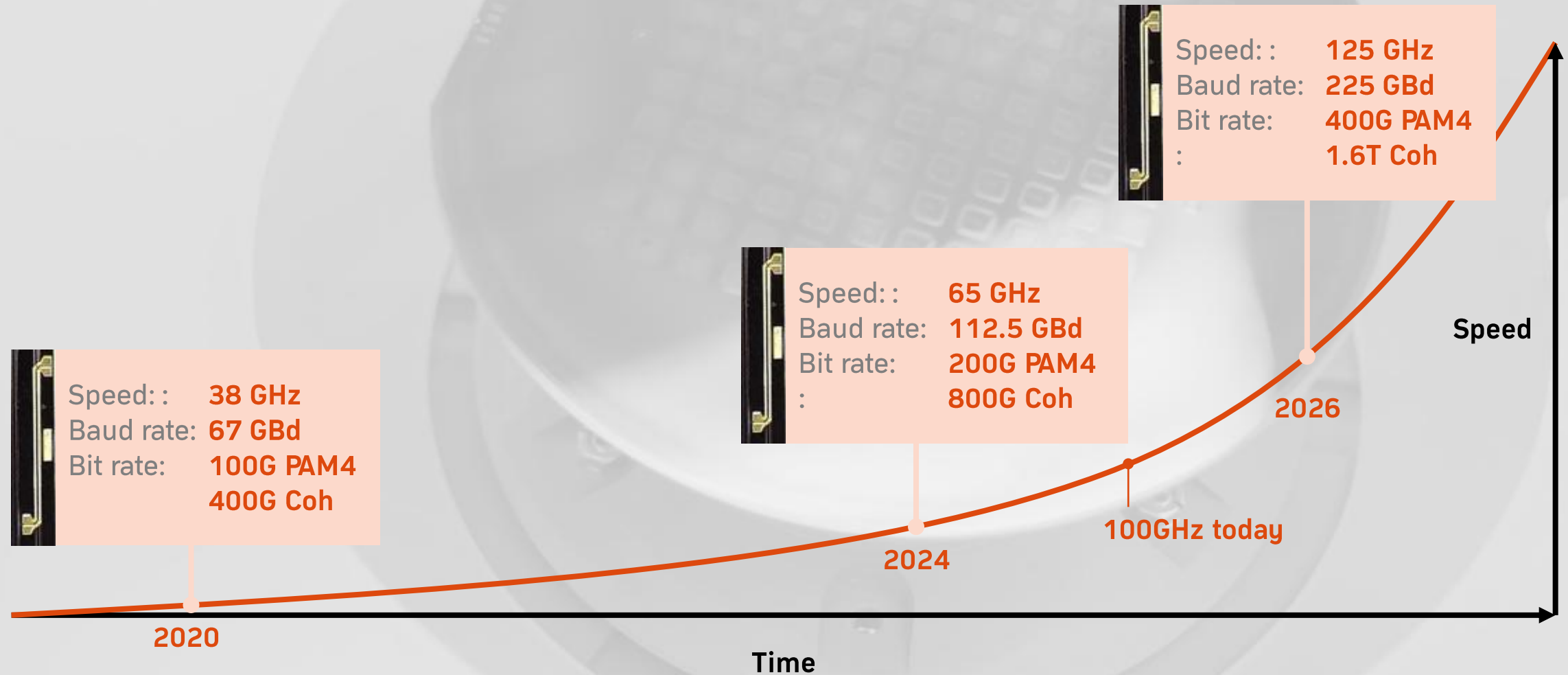
Production

400G/800G: 100G/lane 30 - 35GHz

100G: 25G/lane 8-9GHz

System level PAM4 Modulator BW Requirements by Generation

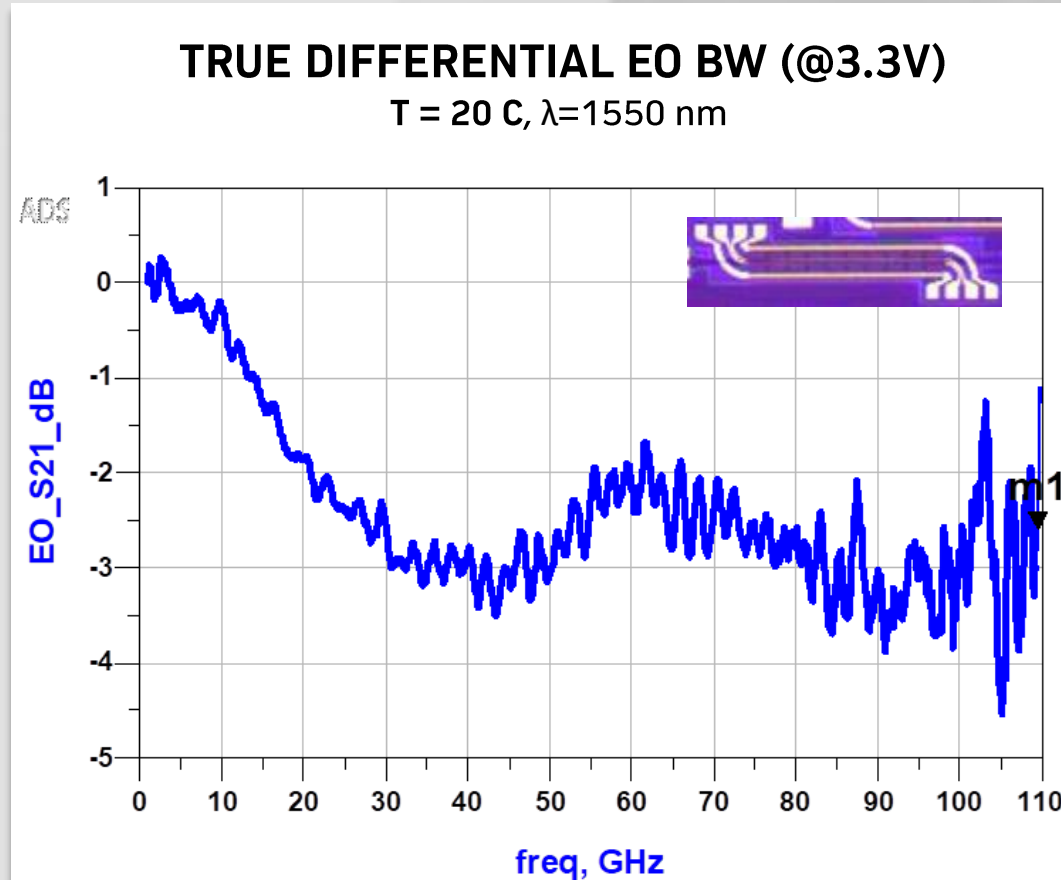
INP - FUTURE READY BUILDING BLOCKS



Modulator speed increasing to 125 GHz enabling 400G/lane PAM4 and 1.6T Coh

INP HIGH SPEED MODULATOR

CIOE / ECOC 2025 premier



InP Modulator designs to 110GHz+

- Enables 400G/lane PAM4 modulators for 3.2T
- Small size: <1mm in length
- Monolithic or heterogeneous integration

Wafer scale economics and performance

- Mature, high-volume manufacturing
- More integration lowers cost and losses
- InP linearity and integration delivers performance

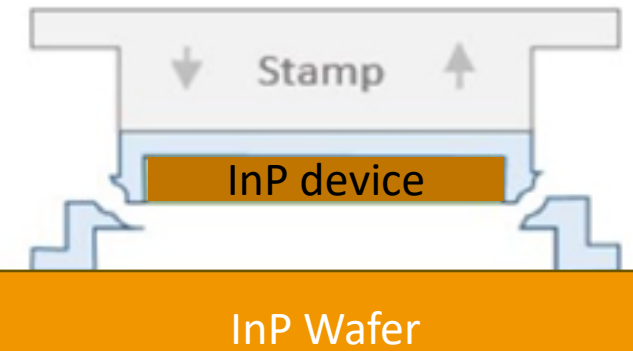
Integration of Photonics / Electronics

- Advantage in Impedance matching
- Advantage in RF (RDL) connections

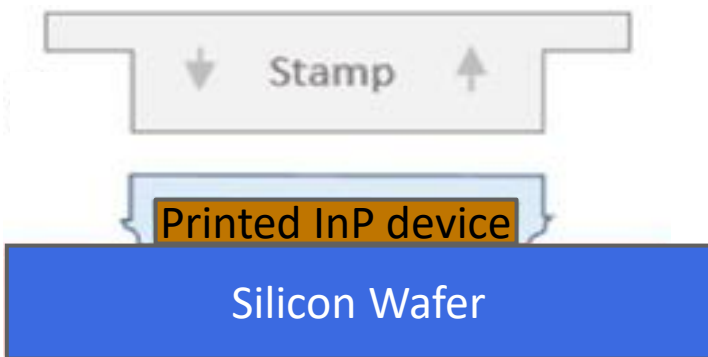
MICRO-TRANSFER PRINTING – INP TO SIPH INTEGRATION

Stamp
simultaneously
transfers multiple
coupons

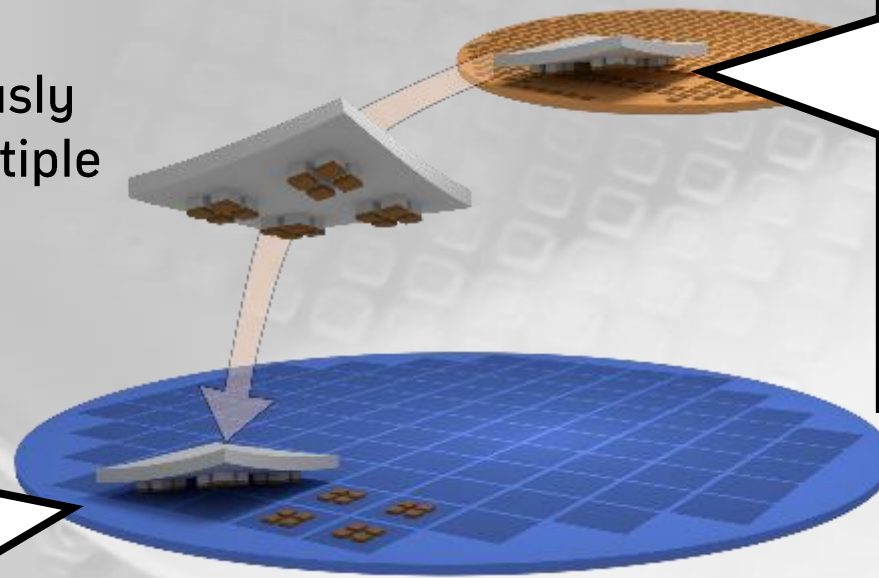
Coupon pick-up



Printing on target wafer



- 100's of InP device per "print" on SiPh wafer
- 30 seconds per print cycle
- Up to 100K devices heterogenous integrated per hour



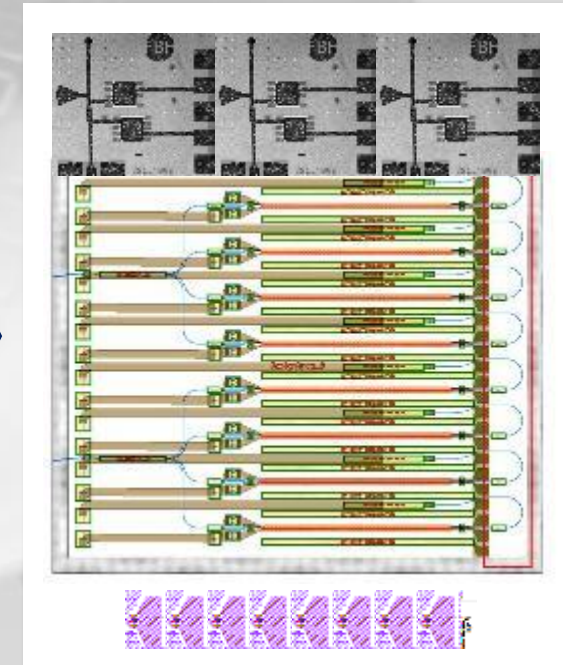
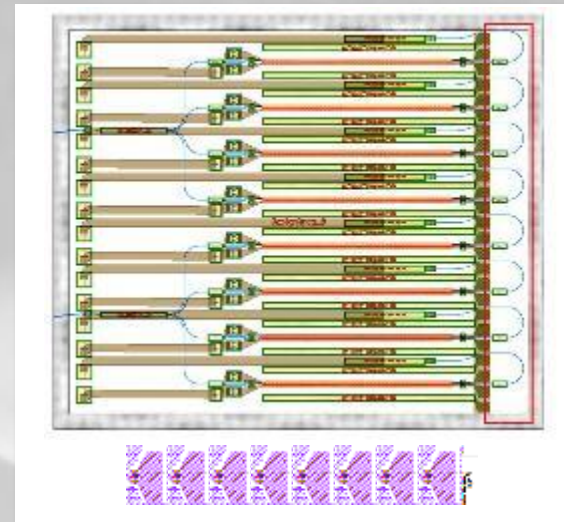
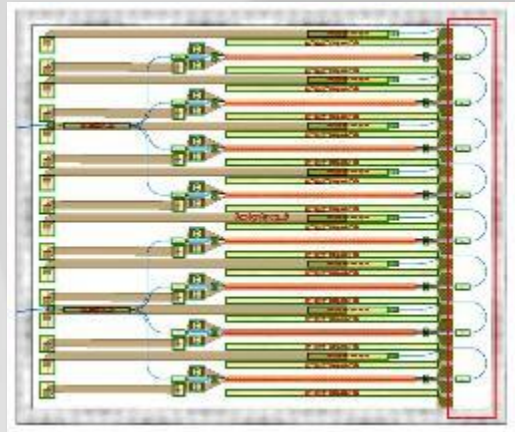
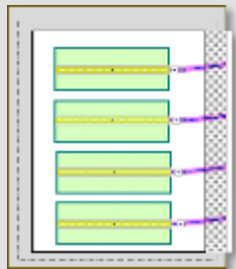
OUTLOOK - PHOTONICS & ELECTRONICS INTEGRATION

Chiplets (**Today**)

Integrated Tx (**Today**)

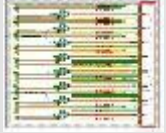
Integrated Tx & Rx

Integrated Photonics & Electronic



Enabling InP PICs for the CPO & AI Era and the future of Coherent optics

SUMMARY



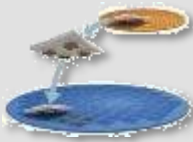
Integration addresses the challenges in Sale Up/ Out / Across



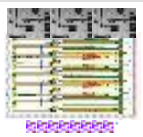
InP enables monolithic integration of actives and passive functions



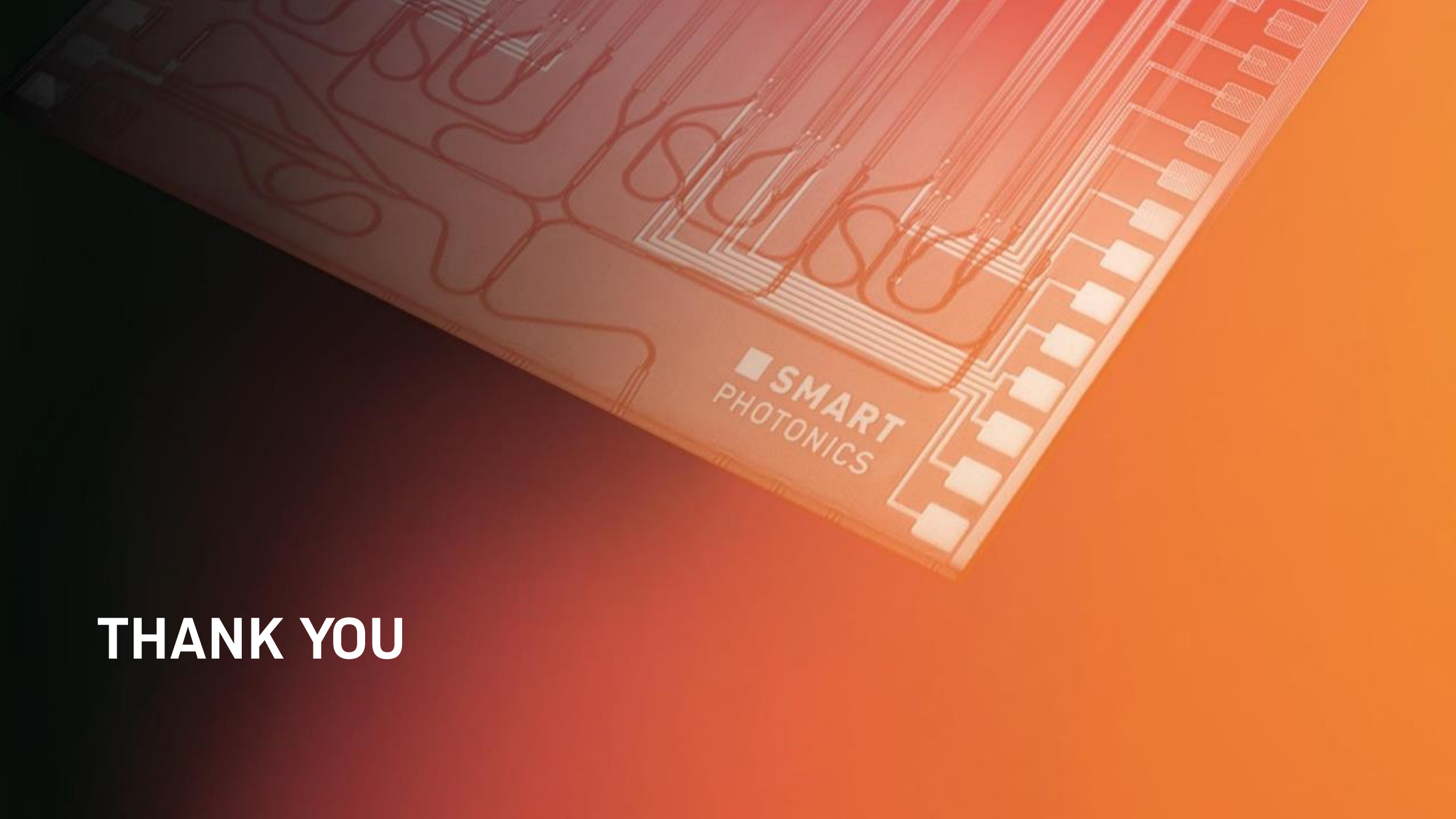
Road to 120Ghz and beyond Modulator speed for 3.2T +



MicroTransfer Printing enables highly efficient parallel integration onto Si



InP allows for integration of Photonics and Electronics components



■ SMART
PHOTONICS

THANK YOU