Si-Photonics Packaging : Development and Challenge

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ASE Group
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EPIC Online Technology Meeting on Co-packaged Optics

ASE in the Electronics Value Chain

ASE Group Service

Engineering Test

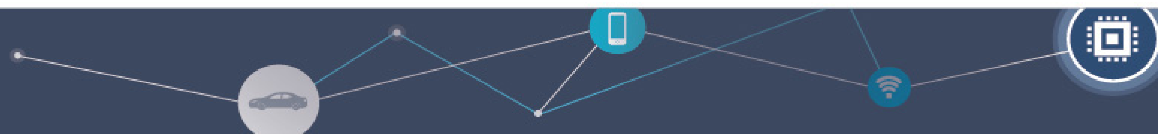
{Bumping, Assembly, Wafer Sort, Component Test Substrate}

{Module Design, Module Assembly Module Test, Component Sourcing FAE Support}

(System Design, System Assembly System Test, Software Development, Logistics Product Marketing, Sales & Support)

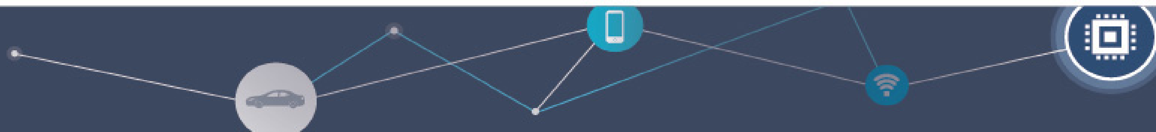
ASE Quick Facts:
Established: 1984
Employees: 100K+
Global Facilities: 19
FY 2019 revenue: US$13.38B

ASE GROUP



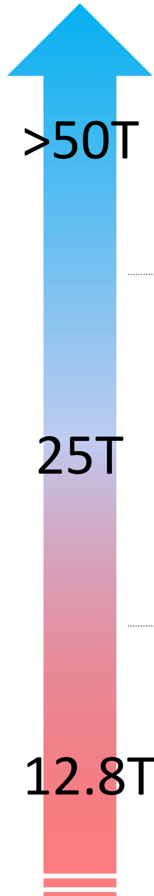
Key Discuss Area Today

- SiPh Overview: Switch & Optics Integration Evolution
- Typical SiPh Engine Packaging Structure
- Co-Packaging Optics Challenges
- Consolidate Supply Chain for Cost Reduction & Toolbox

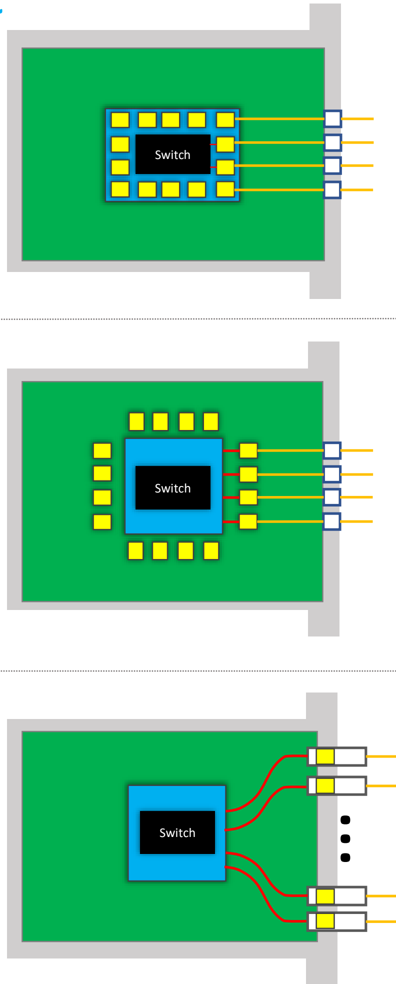


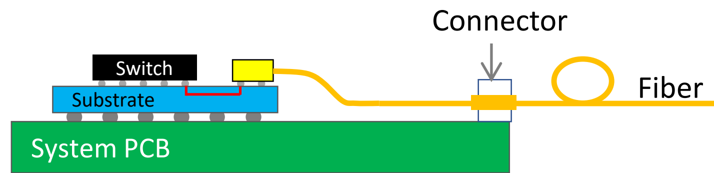
Switch & Optics Integration Evolution

Higher bandwidth
Lower power
Lower Cost



Optical Engine Data Rate

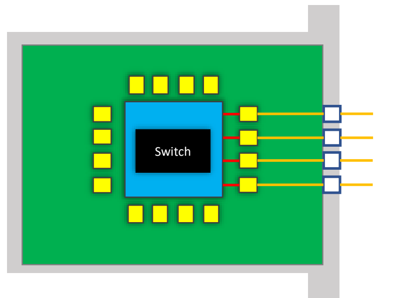


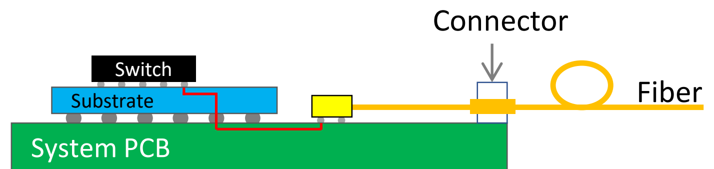


Co-Packaging Optics

PKG Solution?

>1.6Tbps

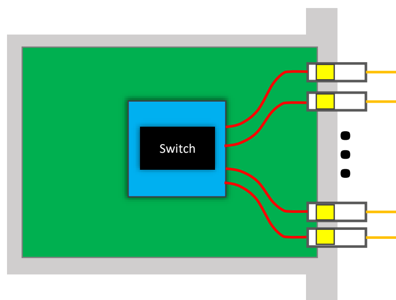


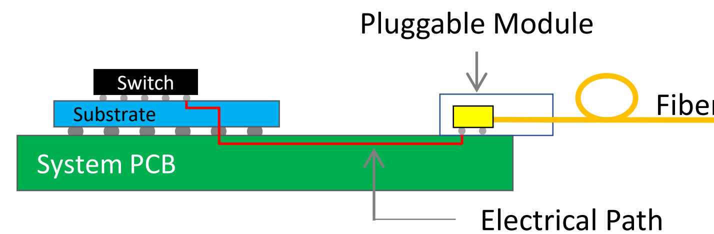


On-Board Optics

PKG Solution?

400Gbps
~1.6Tbps





Pluggable Transceiver Optics

QSFP-28
QSFP-DD
OSFP

100Gbps
~400Gbps

Top View

Side View

Typical SiPh Engine Packaging Structure

SiPh Engine

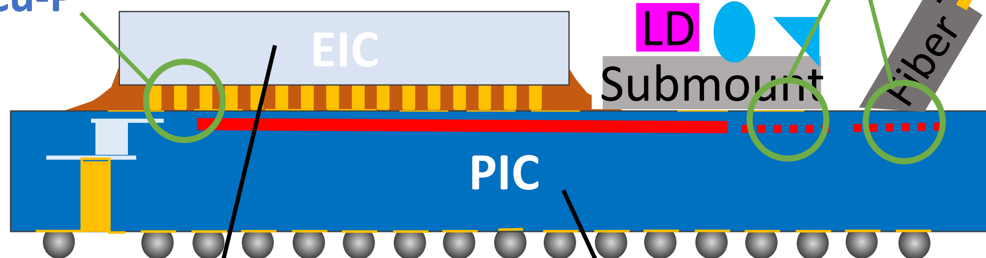
Switch-SiPh Co-packaged

- Embedded , Discrete or remote
- WLCSP with hermetic PKG
-<1um LD D/A on Sub mount (AuSn)
- Lens/ rotator placement (KOH pit)

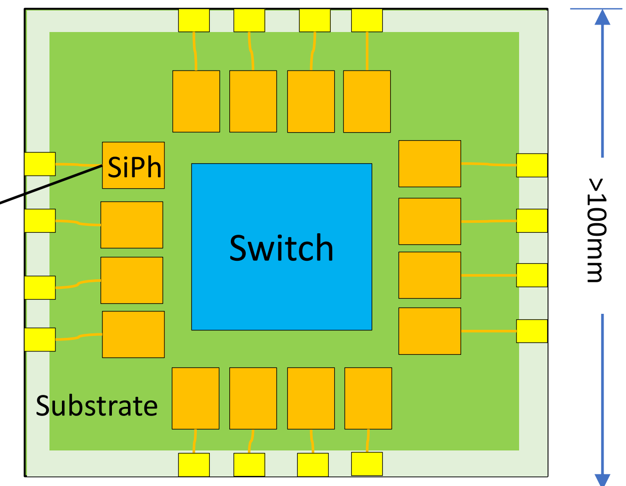
- Single mode fiber (Array)
- Vertical or edge coupling

Active alignment

CoC Cu-P



Integrated on Substrate



- Laser DRV/ PD TIA (65nm)
- DSP/PAM4 (16->7nm)
- All in one or separated

- Si Wave guide /modulator/ MUX/De-Mux
- Grating light coupler
- Integrated SiGe PD
- TSV /high speed connection

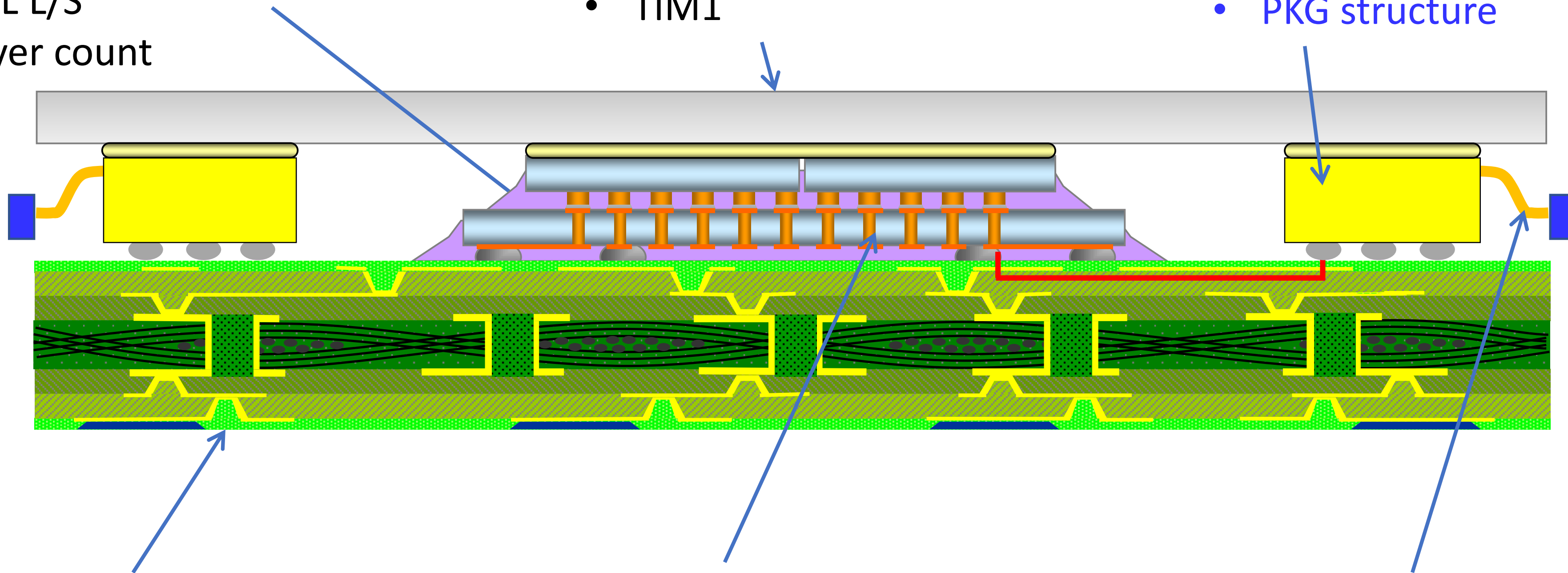
EIC+PIC ASSY → Laser/optics ASSY → Module ASSY/Fiber attach

Co-Packaging Optics Challenges

Ultra-high D2D Bandwidth
- Interconnect pitch
- RDL L/S
- Layer count

High Power Solution
- Lid
- TIM1

Optical engine
- Engine size/ Data rate
- PKG structure

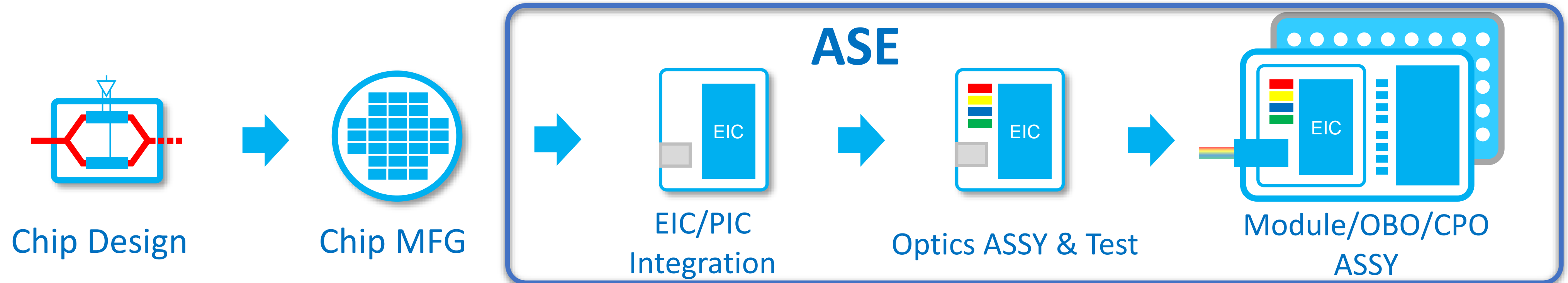


Super Large Package
- Package Warpage
- L2 Reliability

Large Fan-Out / Interposer Size
- Warpage
- Package Reliability

Fiber Attach
- Fiber connector workability
- Warpage/ Thermal stability

ASE Toolbox : Consolidate supply chain to lead to cost reduction



Post-CMOS process
- Cu-pillar bumping
- UBM metallization
- WL dam process
- Oxide etching & DRIE
- Au mirror process
- AuSn process
- ARC film process
- KOH V-groove
- BS Via process
- Fanout process

Wafer Level Assembly
- CoW process
- Wafer level WB assembly
- High accuracy laser attachment
- Optical components placement

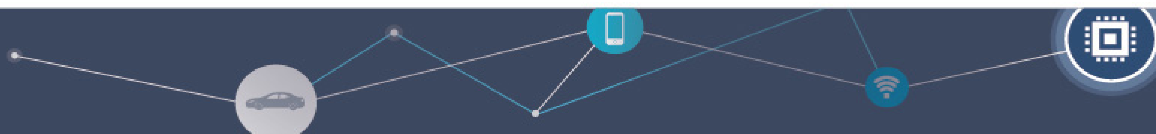
Wafer Level Test
- Wafer sorting
- Probe card design
- Test program service
- WL optical test

Module Assembly
- SMT process
- Substrate level FC/WB
- Encapsulation
- Fiber attachment
- Housing assembly
- Module test

Lab Service
- Electrical/Optical
- Thermal/ Stress
- Material/Chemical/FA

Specific for optical packaging

Thank You



SiPh Optical Engine Roadmap
(Laser/Fiber/PIC/EIC)