Emerging Optical Interconnect Technology for the Cloud

Erin Byrne, David Nidelius, Jessica Carlsson, Nenad Lalic, Nicolae Chitica, Phil McClay, Alan Bucher, Michael Tryson, Thomas Giunta

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Considerations for Embedded Optical Module Implementation: Suppliers

- ✓ Benefits of embedded optics
- ✓ Overcoming barriers to adoption of embedded optics
- ✓ Establishing an ecosystem to support embedded optics

Benefits of Using Embedded Optics

On-board optics gaining mainstream appeal

High Performance Computing	Servers	Ethernet Networking & Switching	Routing	Telecom Cross Connect

Why Use Embedded Optics?

- Increased Port Density
- Fabric Interconnect
  - Chassis to Chassis for Clustering
- Optical Backplane interconnect
  - Overcome routing distance challenges
  - Meet cooling performance needs
  - Alternative to copper cable bulk, weight

Designing in Embedded Optics

Applications beginning to proliferate for embedded optics

High Performance Computing	Servers	Ethernet Networking & Switching	Routing	Telecom Cross Connect

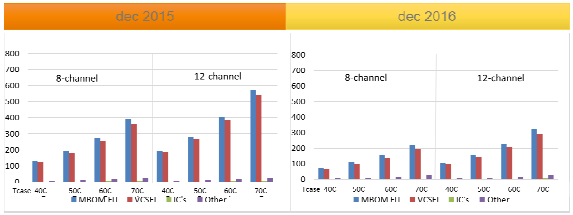
On-Board Optics Requirements:

- Low power consumption (< 2W/100G)
- Small footprint
- Flexible placement and routing
- High reliability
- Integrated on-board components
- Multi-rate, multi-protocol
- Multi-sourcing

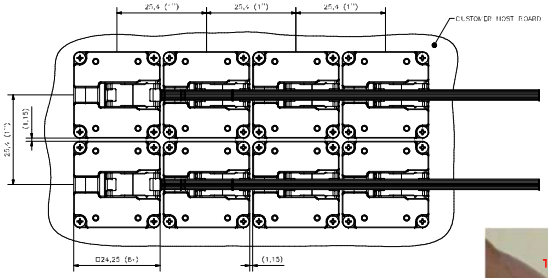
Primarily used for intra-system optical interconnects today

Overcoming Barriers to Adoption

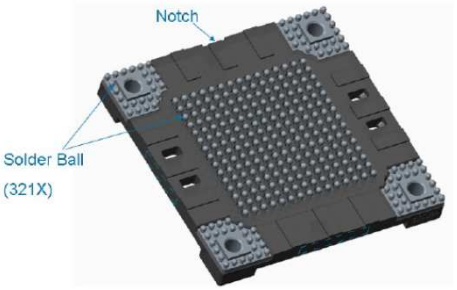
“I have to pull the whole board to replace a module”



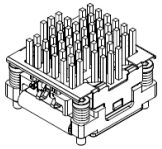
“How do I route the fibers?”

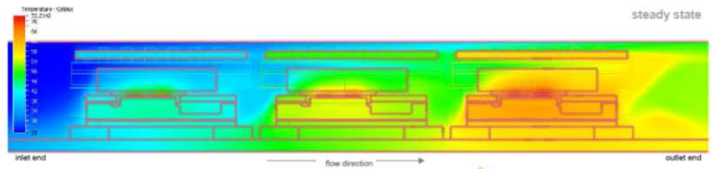


“How do I process my boards through SMT?”



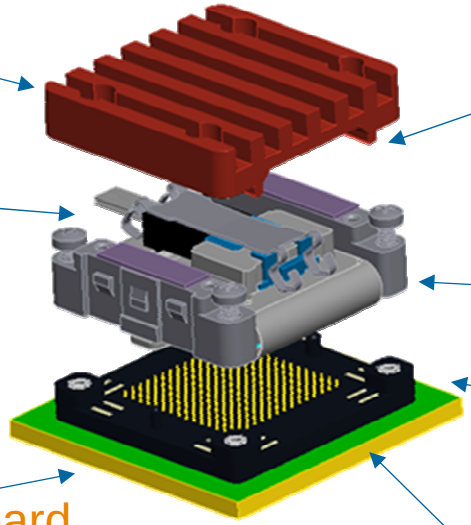
“How do I manage all the heat?”





“Optics is too expensive” ?

Embedded Optics Create Unique Packaging Challenges & Opportunities



Custom heat sinks

Optical interface choice

No through holes on host board

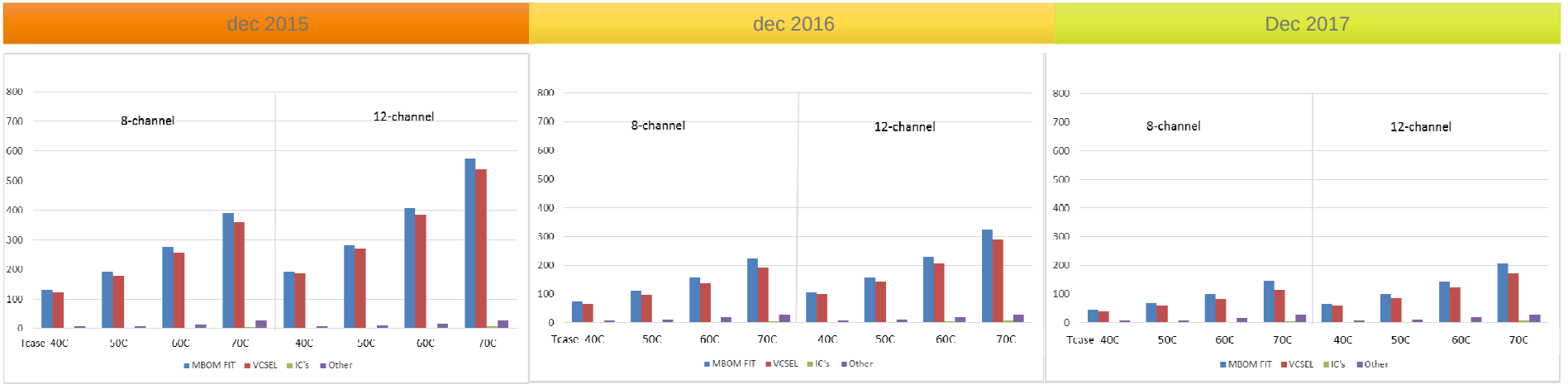
Aligning fiber management with air flow strategy

Getting heat out of optical engine

Getting electrical signal out

Ensuring electrical contact with interposer/socket

Random FIT Estimate - MBOM

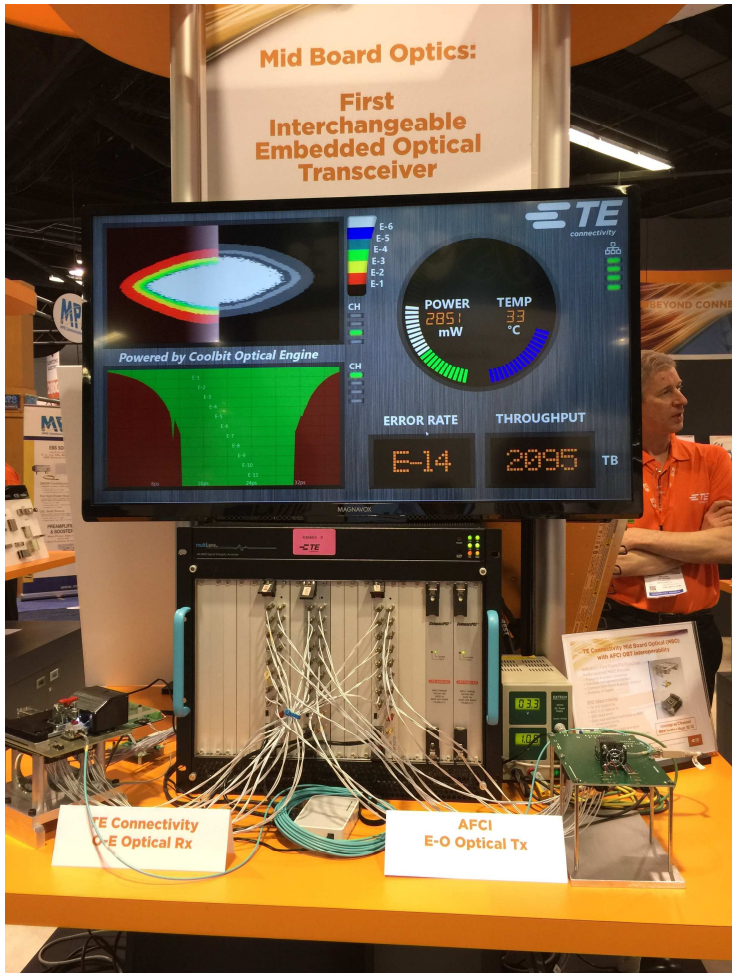


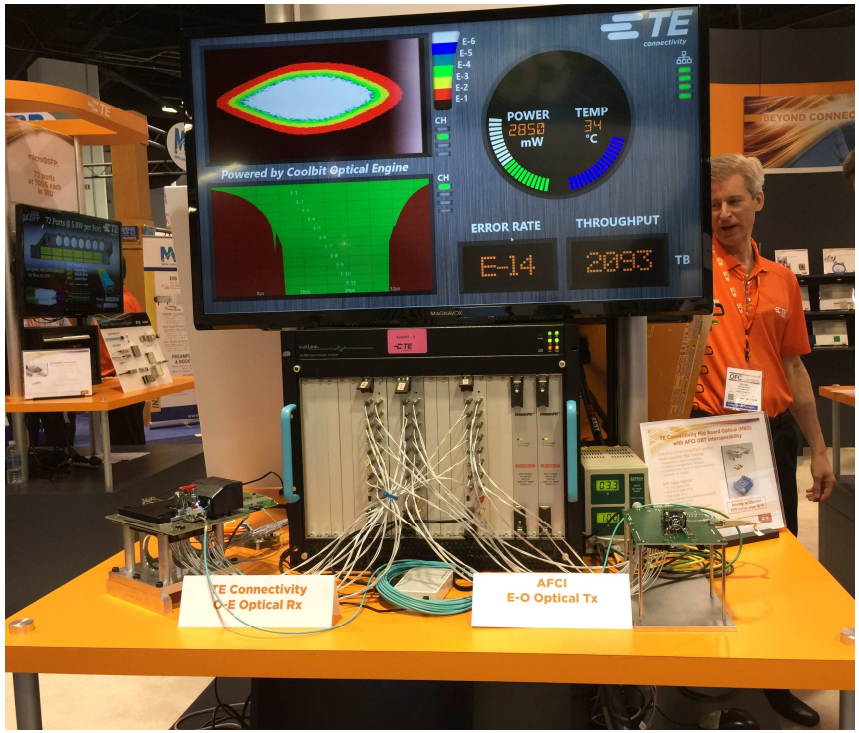
Data based on:

- VCSELs > 19000 channels to date for 4000 hr
- ICs = Scaled FIT estimate from foundry process
- Standard component models SR-332 or field data for other module components
- From 2017 onwards, field data will supersede large-scale direct testing

All new 25G devices require significant life testing at die and module level

Establishing an Ecosystem to Support Embedded Optics





OFC and DesignCon 2016 Demonstrations

- ✓ Socket intermate-ability
- ✓ MBOM intermate-ability

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