



100G Ethernet Technical Feasibility & Reliability Support for WDM SMF PHY Approaches

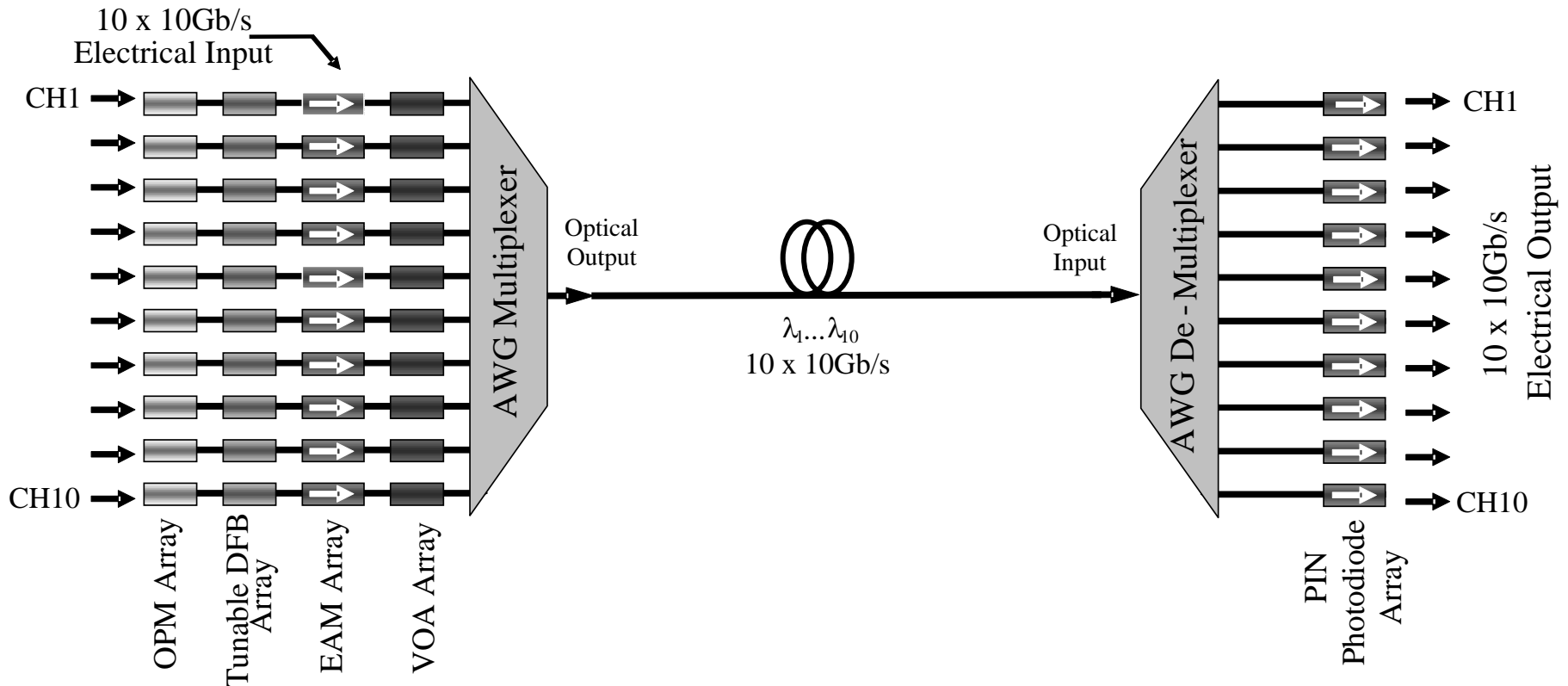
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Discussion Objectives

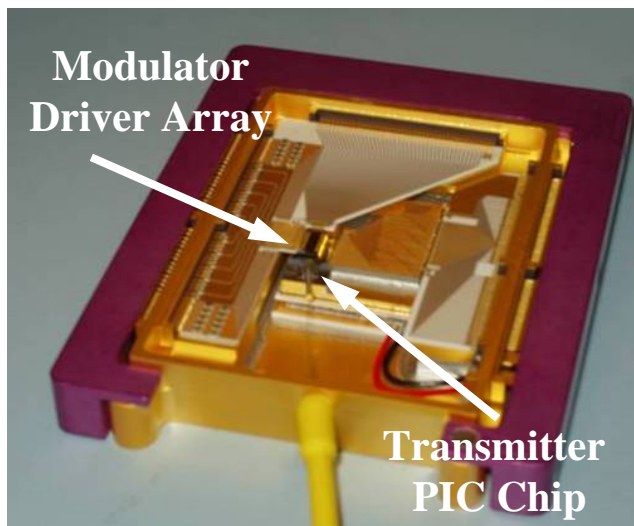
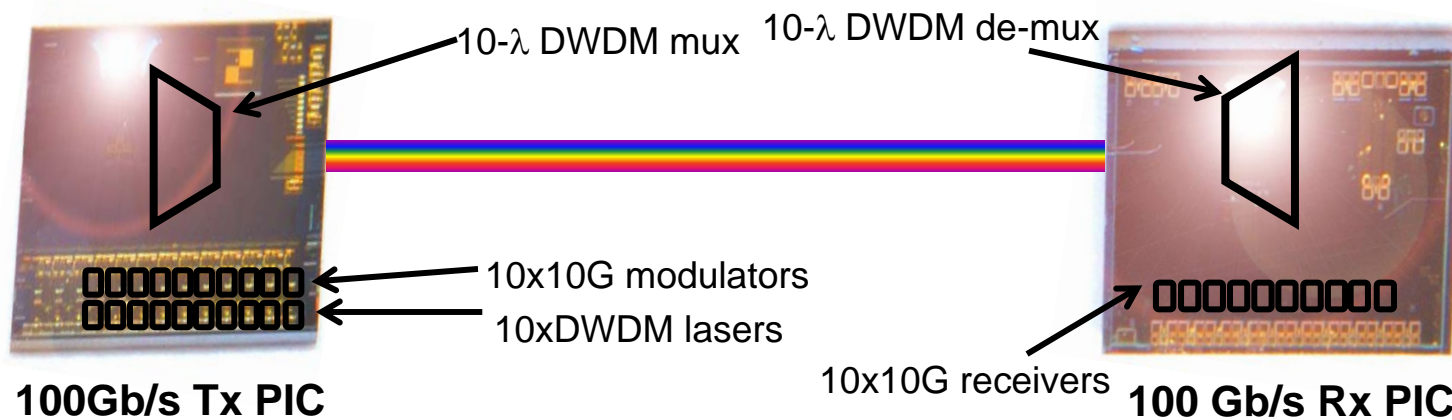
- Provide demonstrable, supporting material for the 4 areas of the Technical Feasibility criteria for multi-channel DWDM PHY approaches
 - **Technical Feasibility:**
 - Demonstrated system feasibility
 - Proven technology
 - Confidence in reliability
 - Reasonable testing
- Specifically – the straw man Technical Feasibility criteria slide (ref. Law_01_0107):
 - Vendors have presented data on the feasibility of the necessary components for 100 Gb/s Ethernet. Proposals, which either leveraged existing technologies or employed new innovative technologies, have been provided.
 - The reliability of Ethernet components and systems can be extrapolated in the target environments with a high degree of confidence. Presentations demonstrating this have been provided.
 - For a SMF PHY, will present actual reliability data for 100G modules in use, in a related communication field (long-haul transport)

100Gb/s Integrated DWDM Tx & Rx PICs

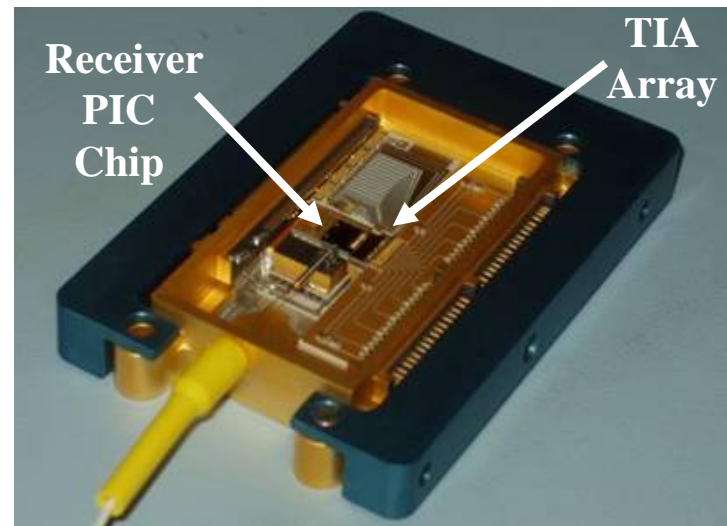


- Photonic Integrated Circuit (PIC) technology
- DWDM ITU grid in the C-band (1530-65 nm)
- Integrated in Tx & Rx modules for use in DWDM optical transport systems

100Gb/s DWDM Modules: Tx & Rx PICs & Silicon PMD Components



100Gb/s Tx Module



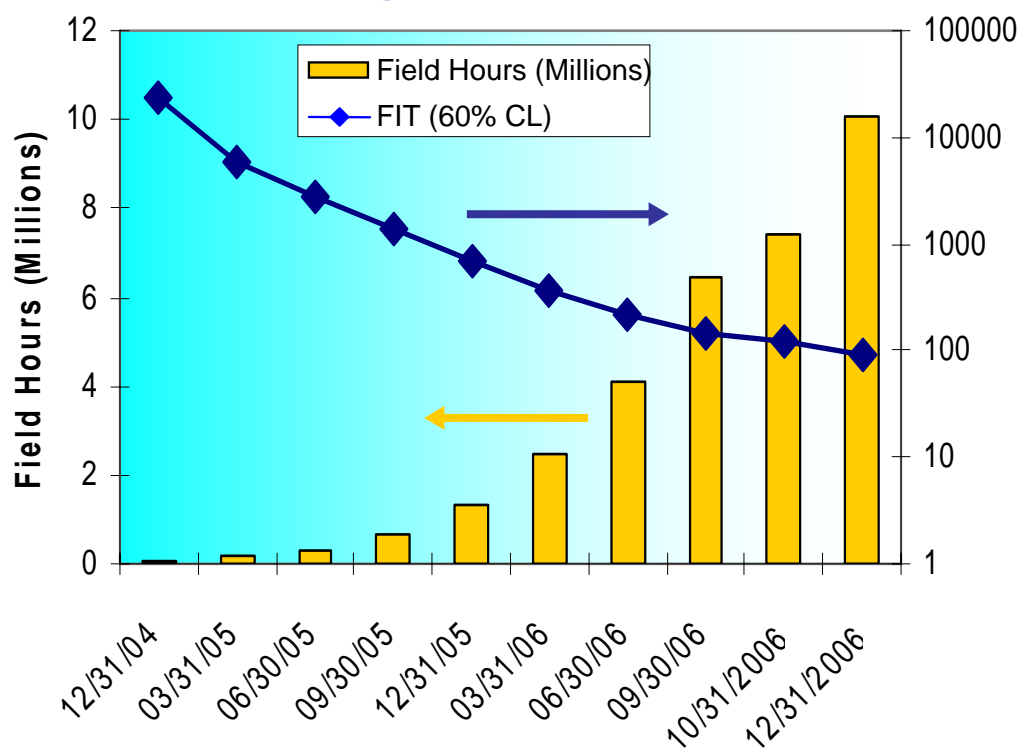
100 Gb/s Rx Module

Proven & Deployed Technology

- 100G SMF integrated modules developed for DWDM transport equipment
- Systems have been successfully deployed in carrier networks worldwide, beginning in 2004
- Facilitating 100G technology & manufacturing approaches have been broadly disclosed for peer review:
 - Data presented in numerous industry papers & journals and at related conferences
 - E.g. LEOS, OIDA, OSA/OFC, ECOC/APOC, SCTE,...

Large-Scale 100G PIC Reliability Data Summary

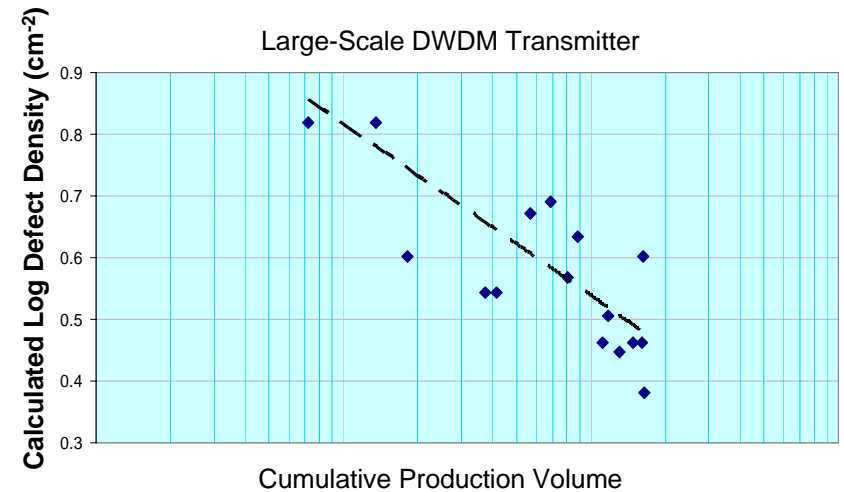
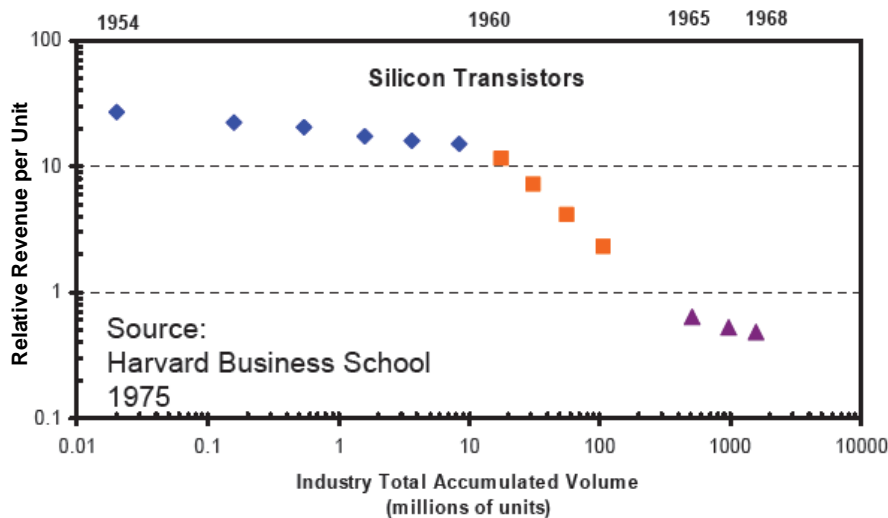
**10,000,000 Hours of Field Operation
(100G Tx + Rx PIC Pairs)
and Counting with Zero PIC Failures**



- **Corresponds to <91 FIT at 60% Confidence Level**
- **Compares to field data from discrete commercial 980nm Pump Terrestrial Chips (74 FIT @ 60% CL)¹**
- **Represents >600M PIC Element Hours**

1. H-U. Pfeiffer et al, Optical Fiber Conference Technical Digest, pp. 483-484 (2002)

Photonic Integration: Example of Manufacturing & Test Learning Curves



- 100G SMF Ethernet solutions can readily leverage the **industry's* increasing photonic integration activities** – similar to early silicon integration
- Established fabrication & test processes have been developed for integrated 100G electrical and optical products
- Production manufacturing volumes driving well-known efficiencies & learning curves

* Reference: OIDA Micro-packaging presentations, August 30th, 2006

Summary

- Demonstrated data presented from a related communication application (long-haul) for an integrated 100G SMF PHY
- Technical Feasibility criteria items addressed include:
 - Demonstrated system feasibility
 - Proven technology
 - Confidence in reliability
 - Reasonable testing
- While the example photonic & silicon integration solutions are for a 10x10G SMF PHY configuration, confident that similar feasibility & reliability holds for alternate solution configurations (e.g. 5x20G)
 - Processes & materials similar – no major changes anticipated
- This feasibility, reliability & manufacturability data is for a monolithic integration approach; and for completeness it would be beneficial if similar existing (e.g. 10GE) material would be brought forward for the discreet & hybrid implementation alternatives