Photonic Integration in New-Generation FTTH Networks

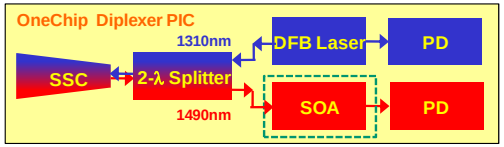
China Optoelectronic Industry Conference (COEIC)

Sept. 7, 2009, in Shenzhen, China

ONECHIP PHOTONICS

Company Snapshot

- **OneChip Photonics**
  - Manufacturer of optical transceivers
  - Unique in-house technology and designs based on **Photonic Integrated Circuits** (PICs)
- **First products:**
  - Bidirectional transceivers for FTTx PON



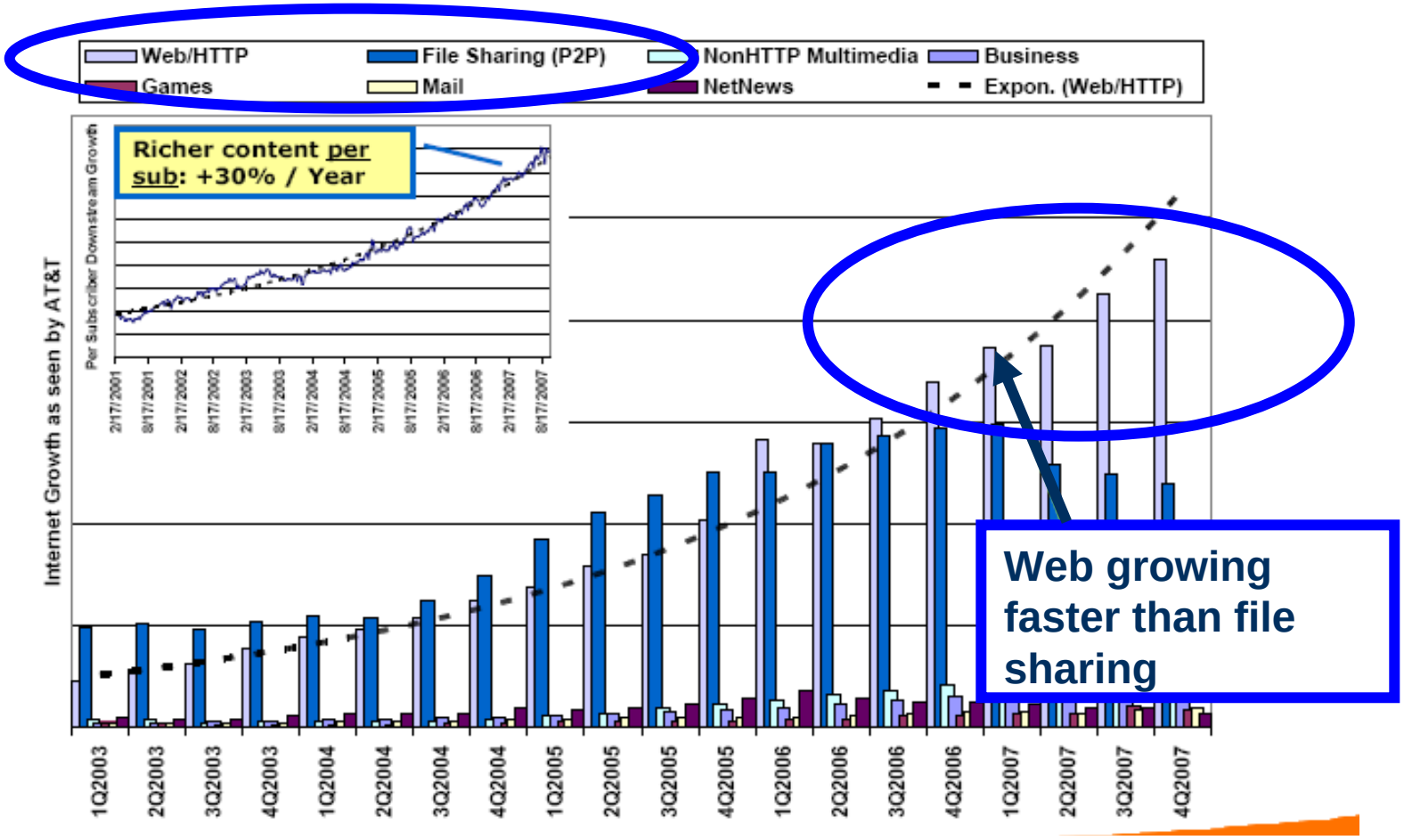
- **Value proposition:**
  - The next frontier of optical transceiver cost reduction and unprecedented scalability in volume manufacturing, based on disruptive technology

OneChip Company Profile

- Manufacturer of optical transceivers based on unique single (InP) chip Photonic Integrated Circuit (PIC) technology
- Founded and incorporated in Canada in November 2005
- Headquartered in Ottawa, Canada
- 53 employees
- Technical team has many years of experience designing transceivers and PICs (Nortel, Bookham, MetroPhotonics, etc.)
- Venture funded by leading Canadian and U.S. investors
- Custom in-house designs with outsourced manufacturing
- Ownership of core technical expertise, key Intellectual Property (IP), and patents

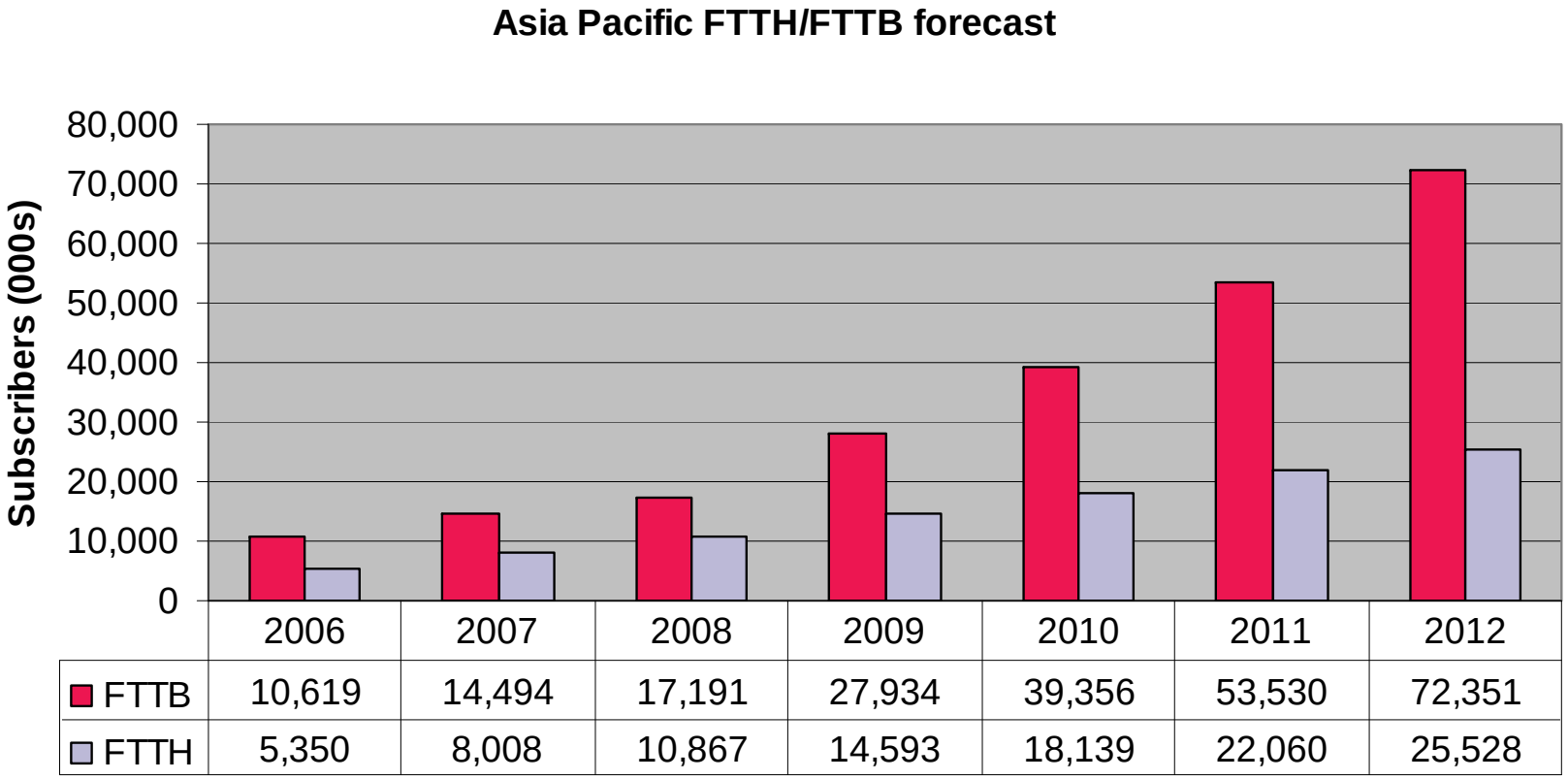
Overview & Market Drivers

Relentless Growth of Bandwidth Demands



Source: K. Cambron, AT&T Labs, CIPS

Asia Pacific FTTH/FTTB Forecast

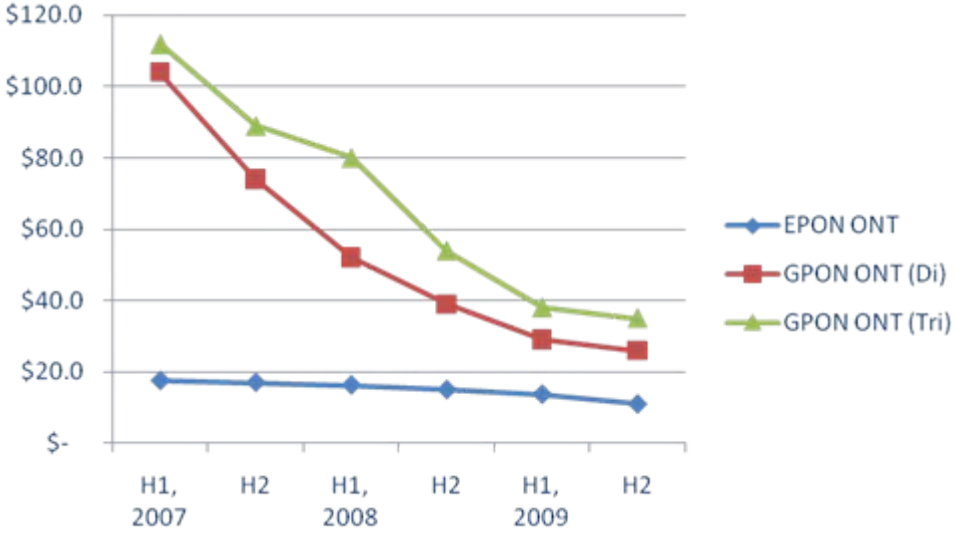


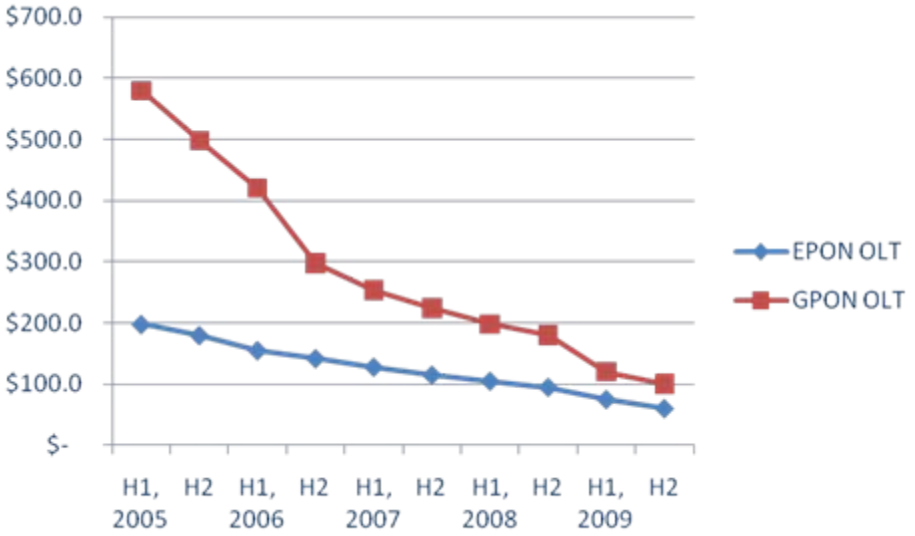
	2006	2007	2008	2009	2010	2011	2012
FTTB	10,619	14,494	17,191	27,934	39,356	53,530	72,351
FTTH	5,350	8,008	10,867	14,593	18,139	22,060	25,528

Source: Ovum, May 2009

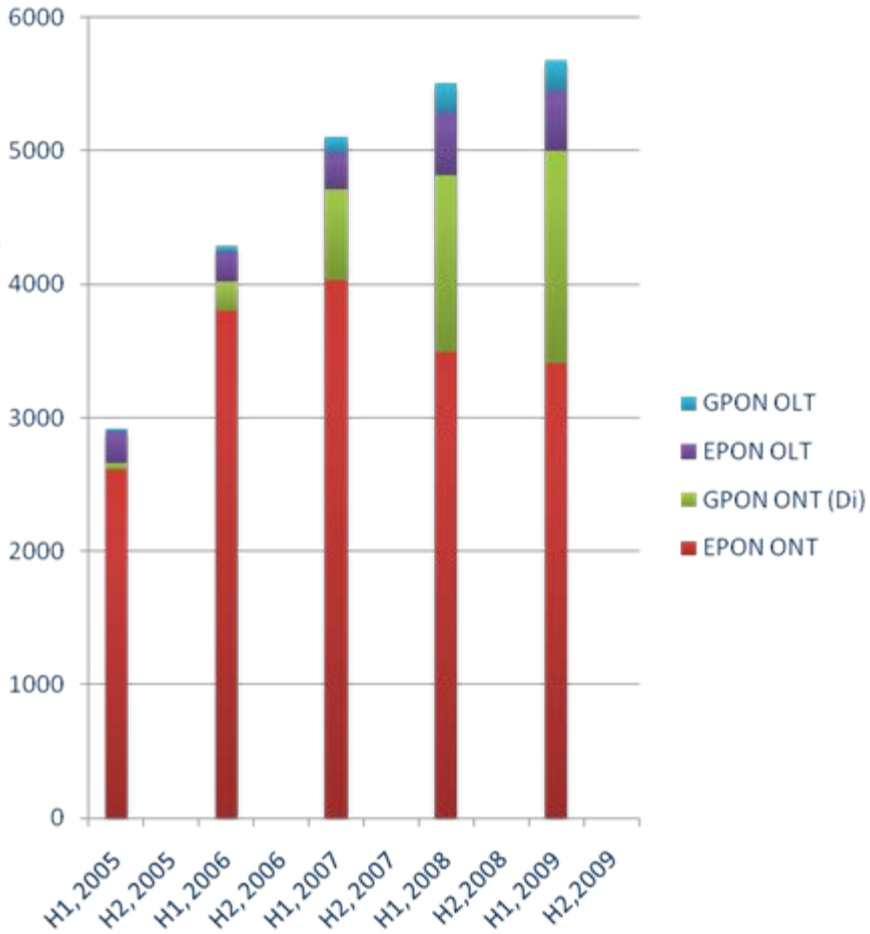
Price vs. Volume (2005-Present)

ASP ($USD)





Volume (000)



The Way Forward

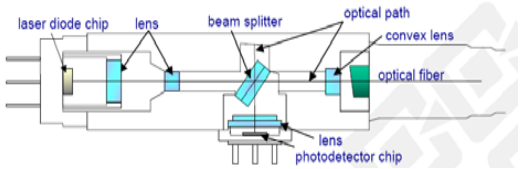
- Short reach EPON transceivers already have been cost optimized to below U.S. $15 price
  - BUT those transceivers can only meet low-end performance requirements. More costly transceivers are required for longer range EPON, 2.5G EPON, GPON, 10G PON
  - Most transceiver designs use discrete optics designs
- PON system vendors are hoping/expecting GPON and longer reach optics price reductions to stimulate deployment
- Breaking the current cost/performance barrier will require new technology and a new approach
  - The “rule breaker”

PIC technology is the rule breaker

Comparison of PON Transceiver Design Approaches

Discrete Optics

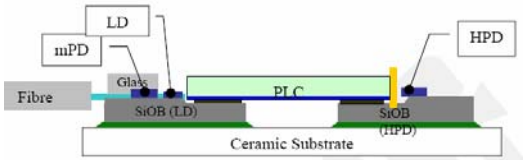
optics assemblies from off-the-shelf discrete components



- discrete actives and passives
- up to 20 parts to assemble

Planar Lightwave Circuit

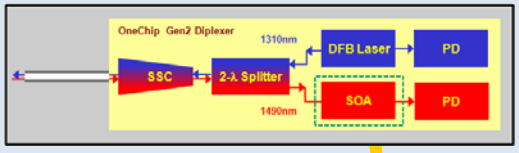
hybrid integrated SiO_2-Si based PLC (only passive)



- discrete actives
- up to 10 parts to assemble

OneChip approach

Photonic Integrated Circuit (passive & active)



- no discretes
- all functions in one part

Key Advantages

Technical

- Smallest footprint
- NO active alignment
  even at 10G!
- Optical alignment for life
- Robust (e.g. vibration resistance)

Most Advanced

Economic

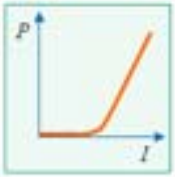
- Simplified production process
- Fully automated production
- Highest production scalability
- No dependence on active optical component lead times
- Standard production processes mean reliable supply

Lowest Price

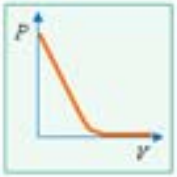
PIC Building Blocks

ACTIVE BUILDING BLOCKS

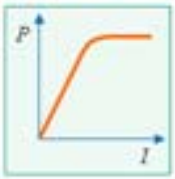
distributed feedback laser



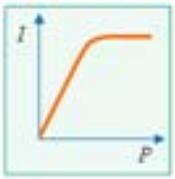
electroabsorption modulator



semiconductor optical amplifier

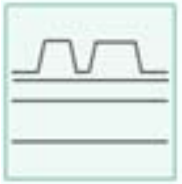


waveguide photodetector

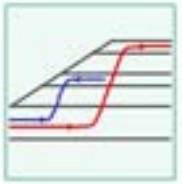


PASSIVE BUILDING BLOCKS

laterally-tapered spot-size converter



directional coupler – mode converter



vertical wavelength splitter

planar wavelength division (de)multiplexer

PICs for Access

PRODUCTS

DESIGNS

TECHNOLOGY

PICs for Access

PON	WDM PON	Towards 100GE
• ONU diplexer	• RSOA CO diplexer	• 1 x10G receiver w. optical pre-amp
• ONU diplexer w. optical pre-amp	• RSOA CO diplexer w. opt pre-amp	• 1 x10G DFBL-EAM transmitter
• OLT diplexer	• RSOA ONU diplexer	• 10 x10G receiver w. optical pre-amp
• OLT diplexer w. optical pre-amp	• RSOA ONU diplexer w. opt pre-amp	• 10 x10G WSEC-EAM transmitter

Design & Fabrication Building Blocks

Integrated Passive Waveguide Devices

- spot-size (mode) converter
- waveguide Bragg grating
- vertical wavelength (λ) splitter
- planar wavelength division (de)multiplexer

Integrated Active Waveguide Devices

- distributed feedback laser
- broadband PIN photodetector
- semiconductor optical amplifier
- EA optical attenuator / modulator

Materials, Integration Platform & Wafer Fabrication Processes

Materials: Standard

InP and related III-V semiconductors

Platform: Proprietary

Multi-Guide Vertical Integration in one epitaxial growth run

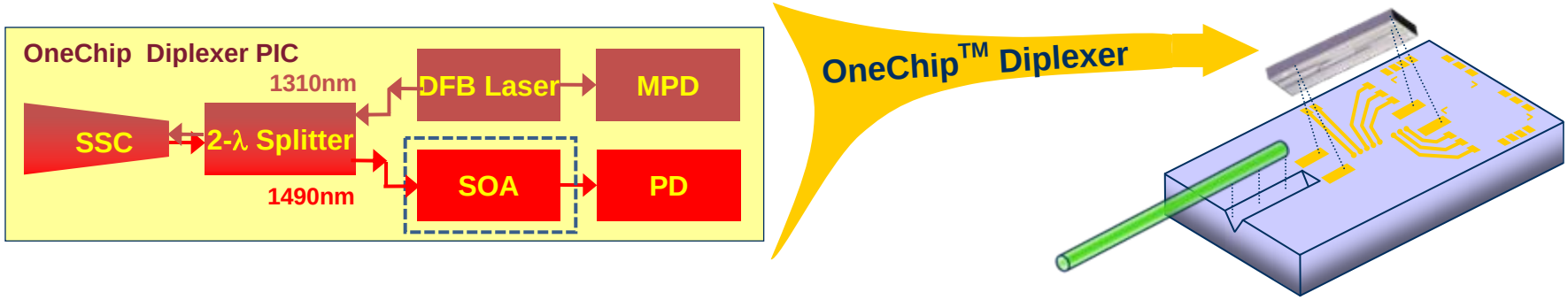
Fabrication: Standard

stepper litho; ICP/IRE/wet etch; passivation; planarization; metal

Automated Mounting on Silicon Optical Bench

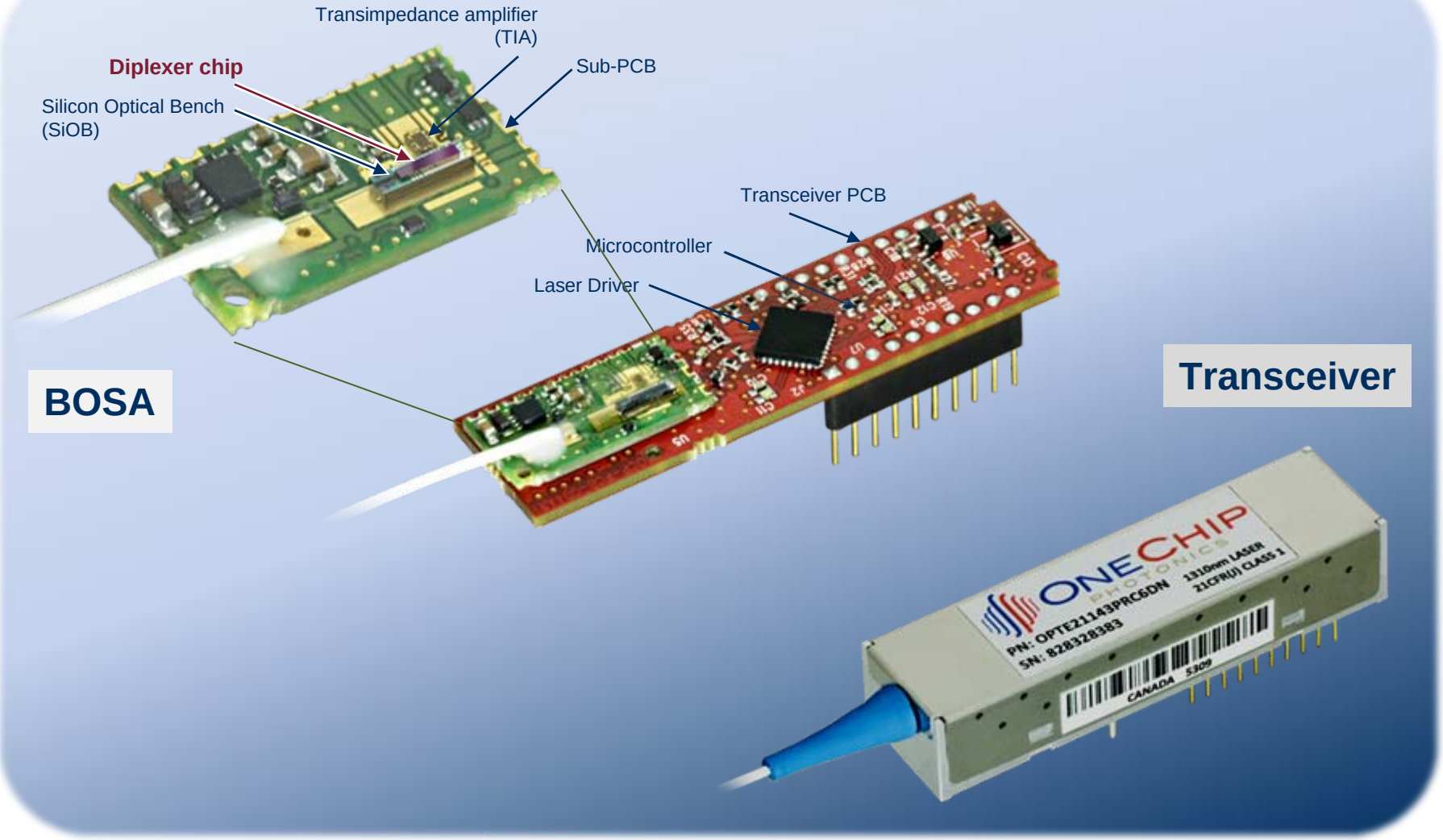
InP (Indium Phosphide) monolithic PIC (Photonic Integrated Circuit) provides all the optical functions require by ONT in FTTH PON

- Optical transmit and receive on different wavelengths
- Wavelength de-multiplexing of incoming / outgoing signals
- Efficient and displacement-tolerant coupling to standard SM fiber



- Designed for automated mounting on a silicon optical bench without requiring active alignment, using industry standard automated assembly process

Facilitating Final Transceiver-Level Integration



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