Collaboration of system, module and connector vendors results in CPO breakthrough to enable broad adoption of CPO for AI systems.

Tom Palkert

System Engineer, Samtec

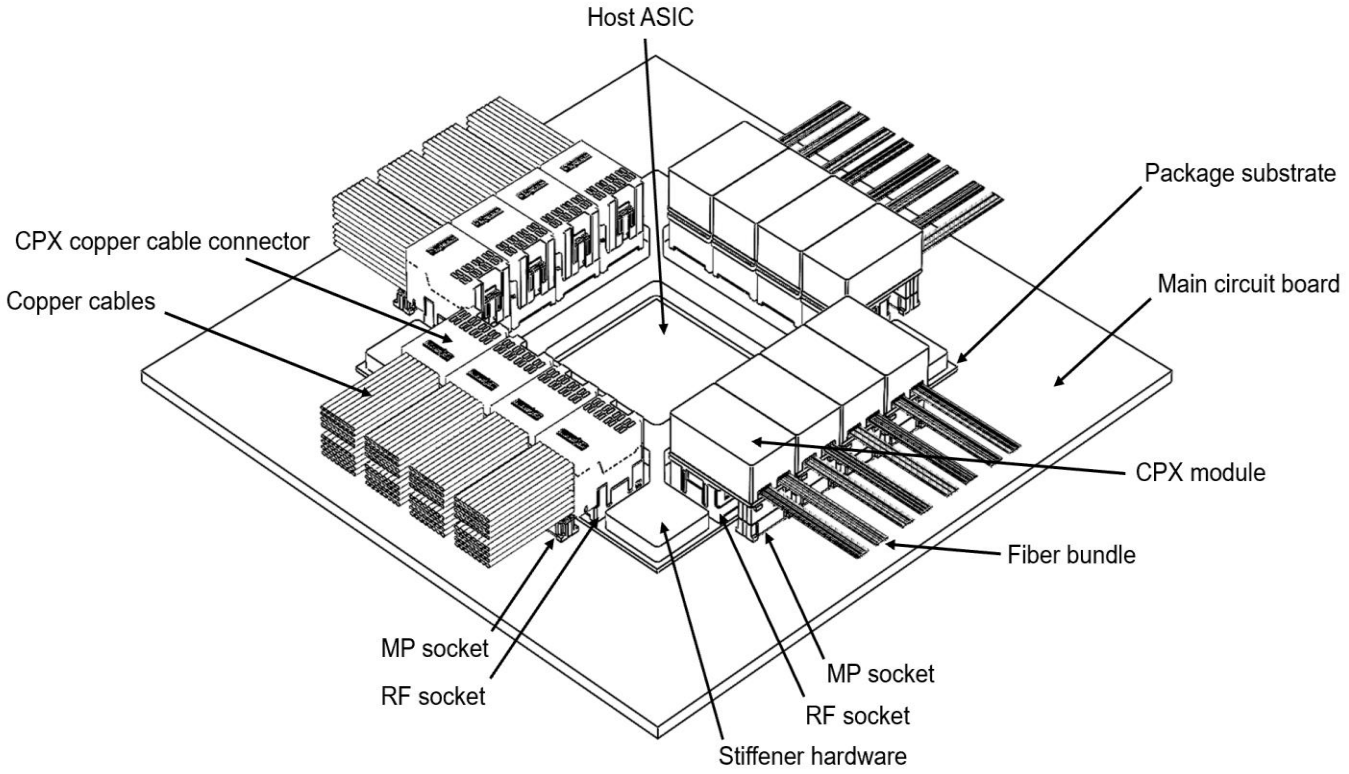
Founding member OpenCPX MSA

What did we do?

- The requirements for broad adoption of Co/Near-packaged Optical (CPO/NPO) solutions in next generation AI systems have proven difficult to achieve in past system designs and has limited the deployment of large scale CPO/NPO based AI systems.
- Samtec, Ciena, Coherent, Terahop, Marvell, Molex joined together to solve these problems with a unique design.
- This presentation will show the results of the joint work of the OpenCPX MSA to provide a CPO/NPO solution for AI that provides a high density, high bandwidth, field replaceable, copper compatible solution for AI interconnects.

What is the Promise of CPO/NPO

- Reduced link flaps
- Lower power
- Improved signal integrity
- Improved mechanical connections
- Support for:
  - DAC, ACC, AEC, Optical (SMF and MMF)



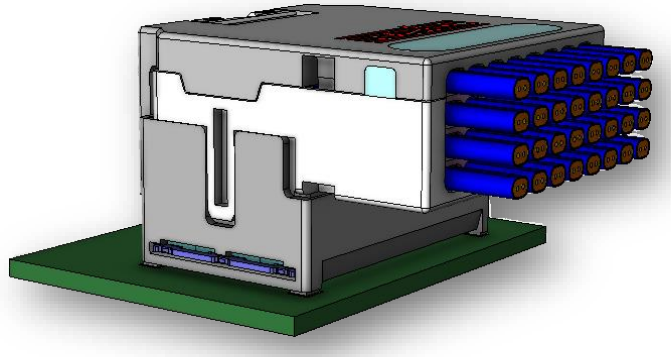
Support for Optics

- SMF Optics:
  - Silicon Photonic modulators with External laser
  - Integrated Lasers
  - WDM
  - Multicore fiber and Expanded beam connectors
- MMF Optics
  - 2D micro VCSEL and PD
    - Coherent: ECOC 2026
  - Direct mod VCSEL
  - Multicore fiber



Support for Copper

- DAC:
  - Flyover cable to adjacent ASIC
  - Flyover cable to front panel pluggable module
  - Flyover cable to front panel DAC cable



- Active Copper (ACC/AEC):
  - Integrated Analog amplifier
  - DSP copper module
  - RF conversion cables



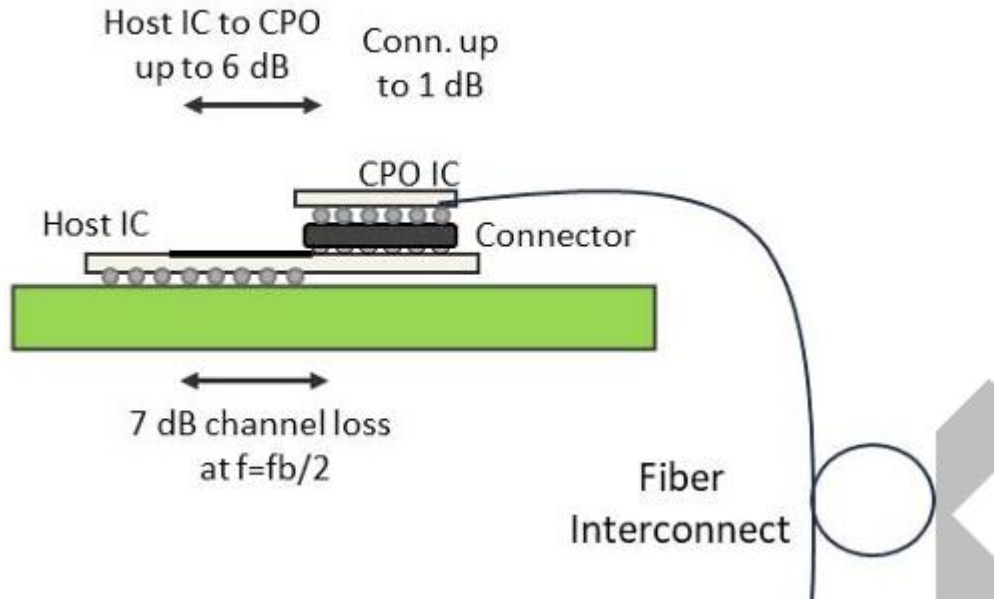
Reduced Link Flaps:

- From Meta OCP 2025:
  - 15M device hours for CPO: Unserviceable failures >15M MTBF
  - 2M for 2x400G pluggable: 0.55M MTBF
- From Meta/Broadcom OFC2026:
  - 36M device hours with FEC bin <4 (75% of ports)
- From Oracle (ECOC 2026)

- Why does CPO/NPO have much better reliability and reduce link flaps?
  - Reduction in mechanical complexity (compared to pluggable)
  - Reduction in number of DSPs in the path (Reduced Latency)
  - Reduction in host channel length/Insertion loss
  - Reduction in host trace ‘discontinuities’ (number of vias, BGA escape etc)

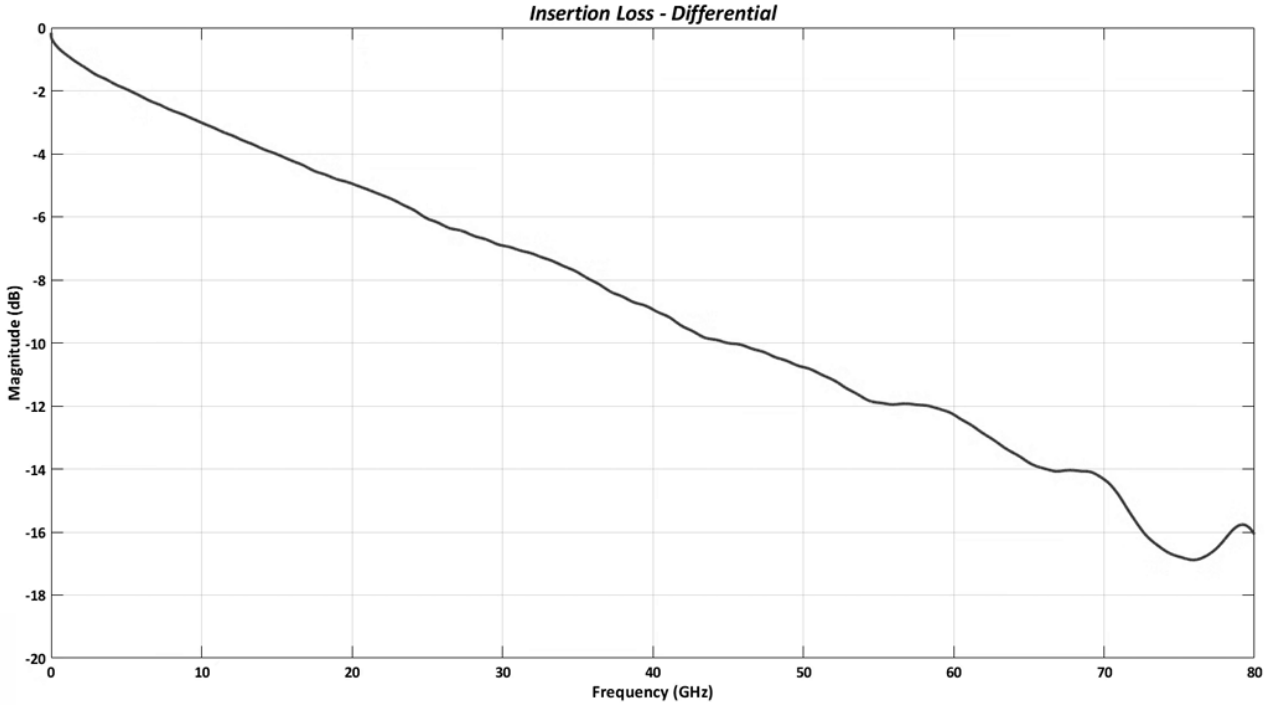
Lower power CPO/NPO:

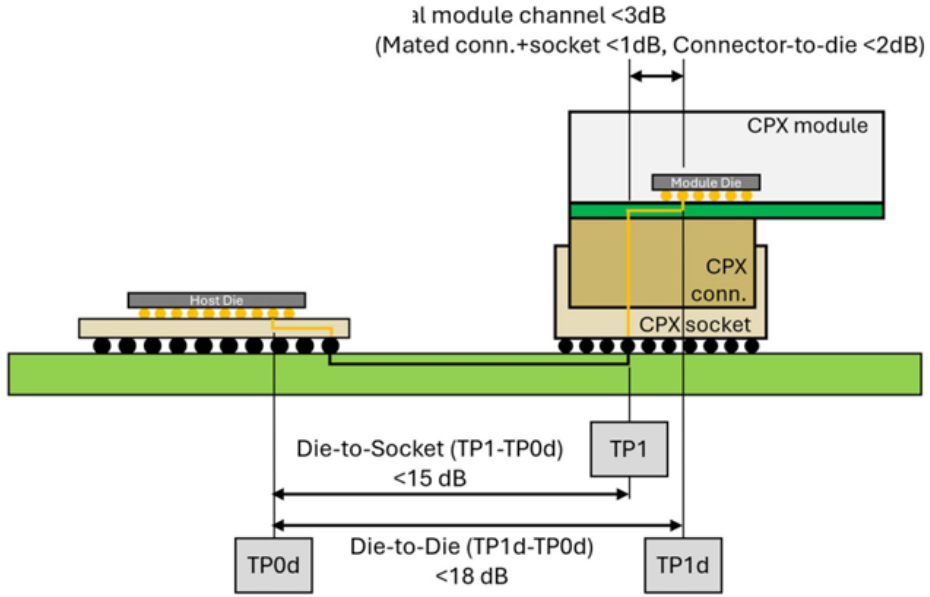
- Reduced trace length/Insertion loss allows a Linear electrical interface
  - No DSP
- CPO/NPO saves 65% vs DSP pluggable (OFC2026 M4B.6)
  - Silicon photonics: 3.8 pj/bit
  - VCSEL: 1-1.9 pj/bit



Improved SI:

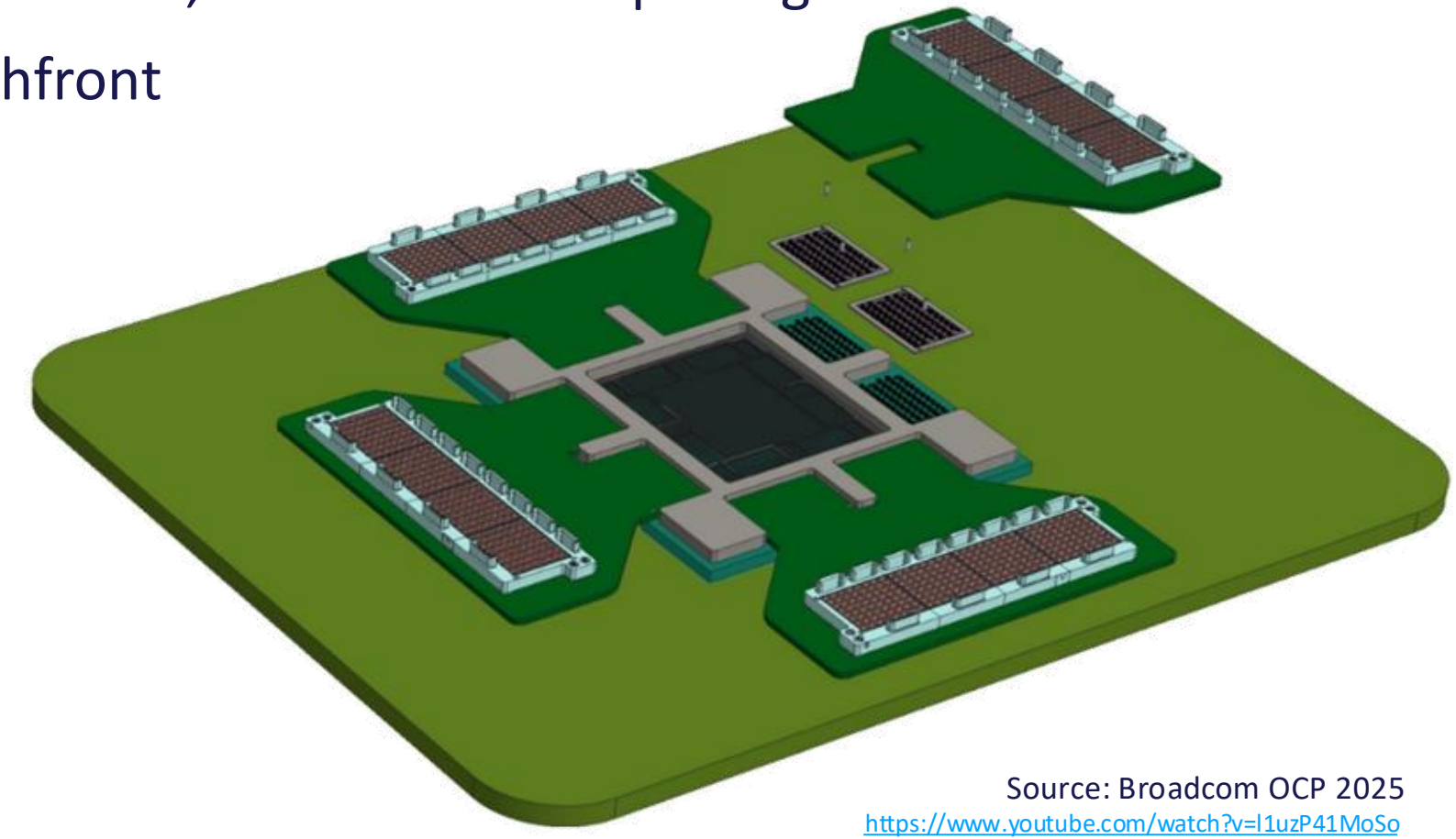
- No BGA escape, No front panel pluggable connector, No AC coupling cap.
- Reduced trace loss: Shorter host channels: 15 dB vs 32 dB
- Improved ERL (8.5dB for pluggable vs 10 dB for CPO)





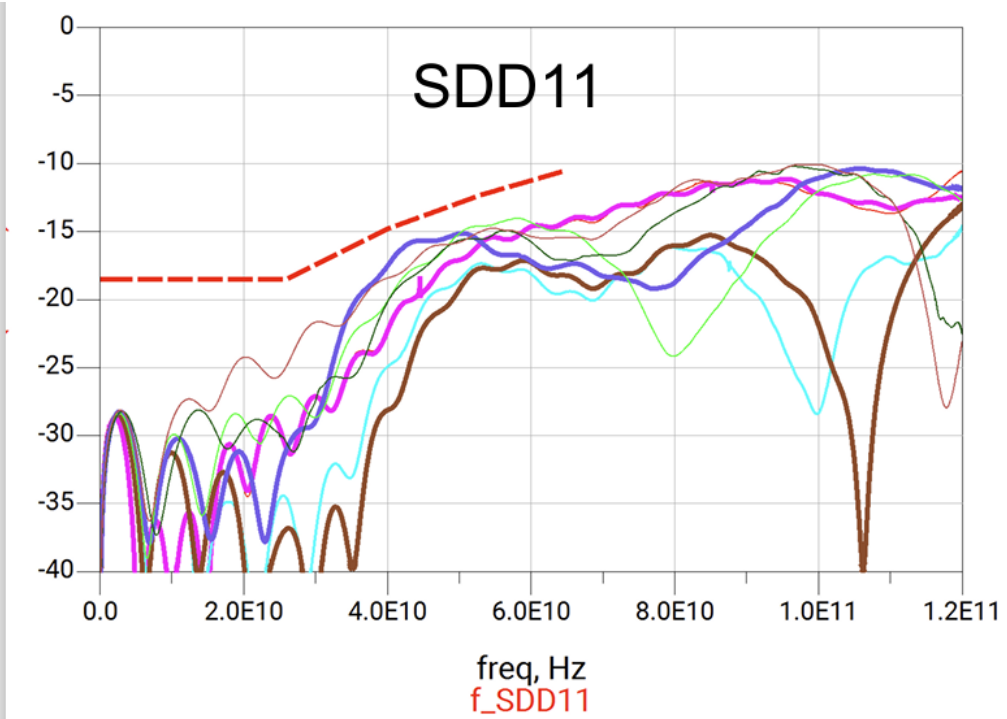
NPO substrate design

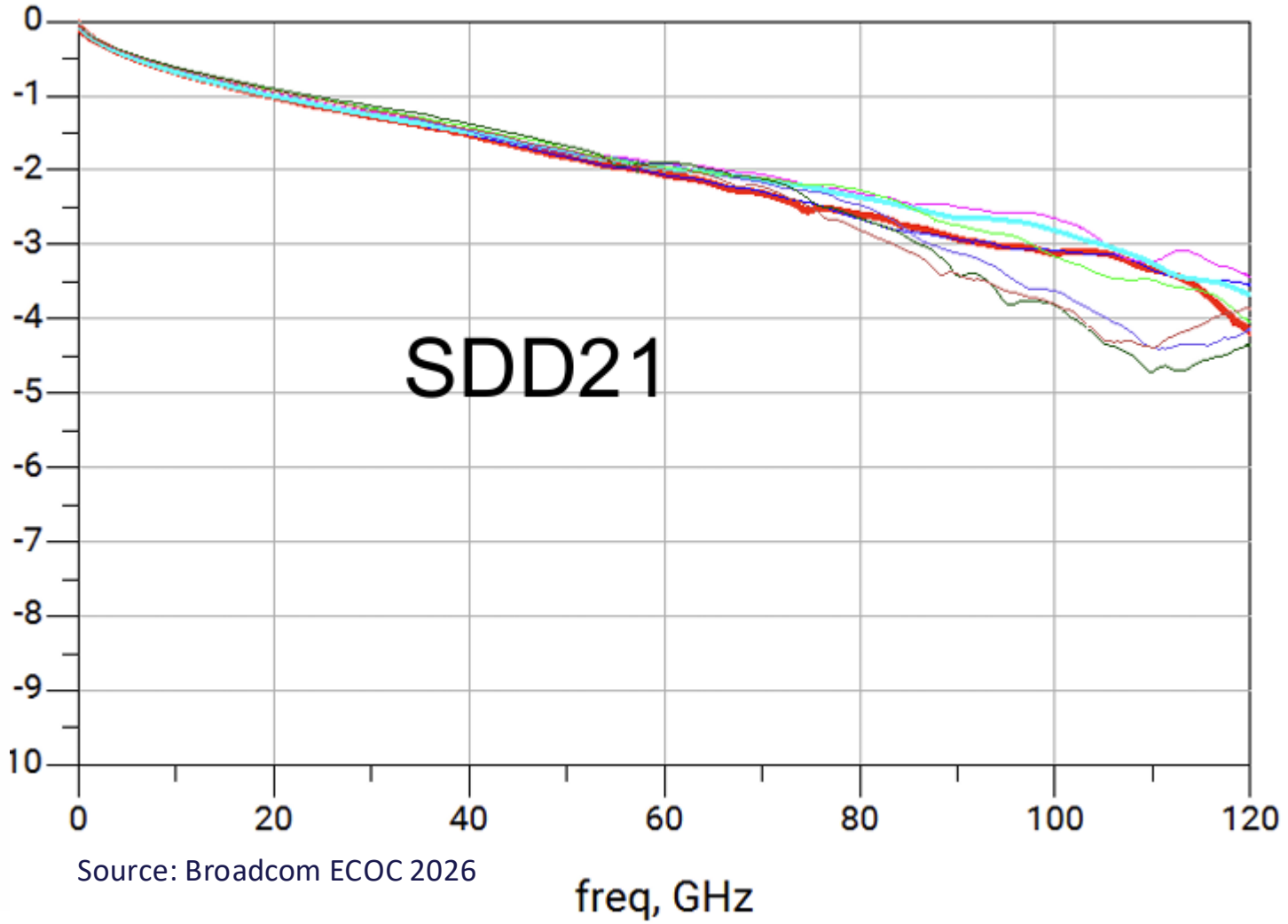
- IL of substrate material is lower loss, lower cost than package
- Fan out supports larger beachfront
- Improves cooling efficiency
- Linear interface still works
  - IL <15-18dB
  - (See next slide for SI)



Source: Broadcom OCP 2025
https://www.youtube.com/watch?v=l1uzP41MoSo

Substrate signal integrity is excellent





Source: Broadcom ECOC 2026

Reduction in mechanical complexity

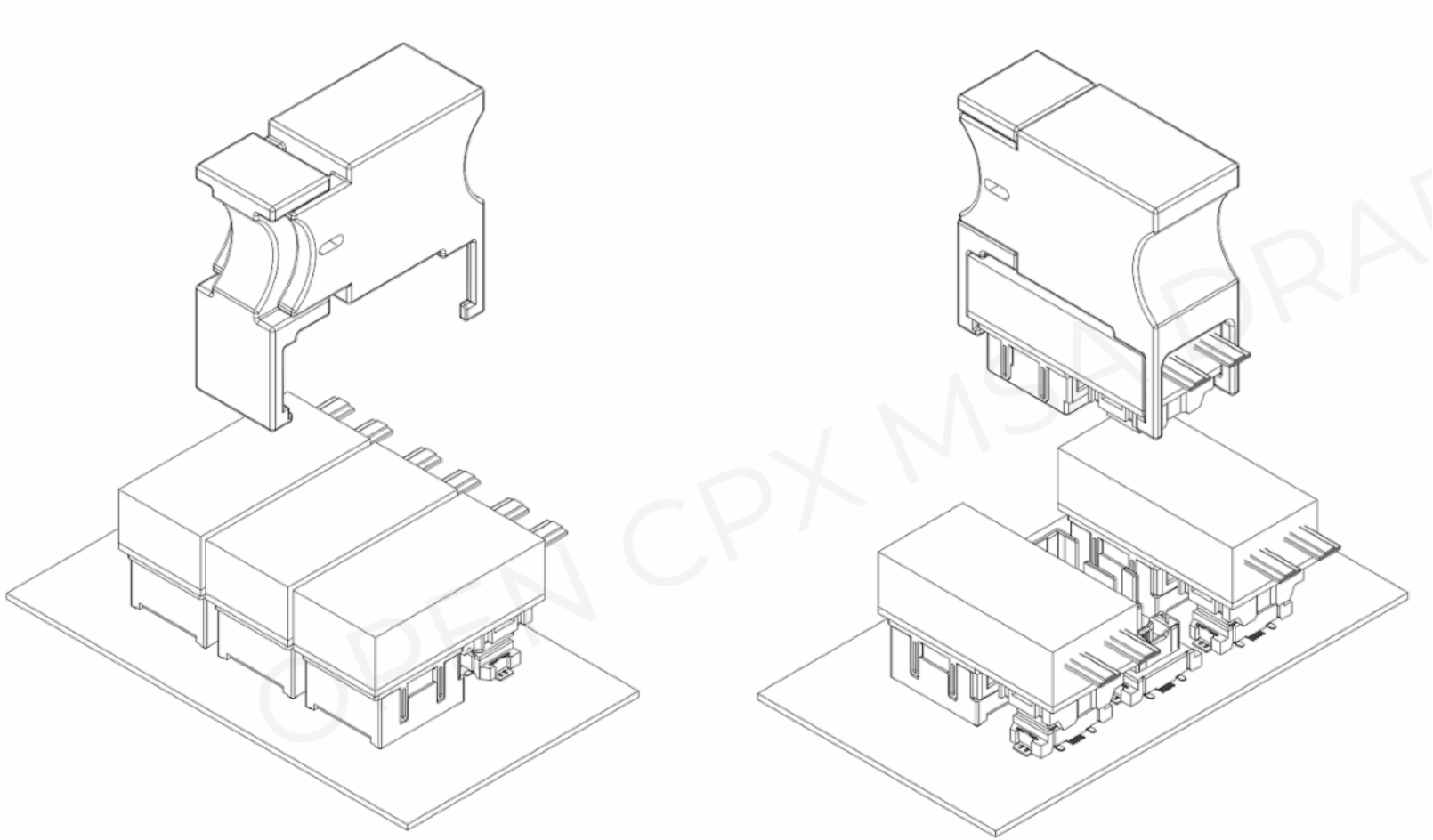
- No cage,
- Low complexity latching mechanism
  - No compression bar
- No sliding module over TIM as required for pluggable
- Samtec Si-Fly HD Co-Package Reflow Process





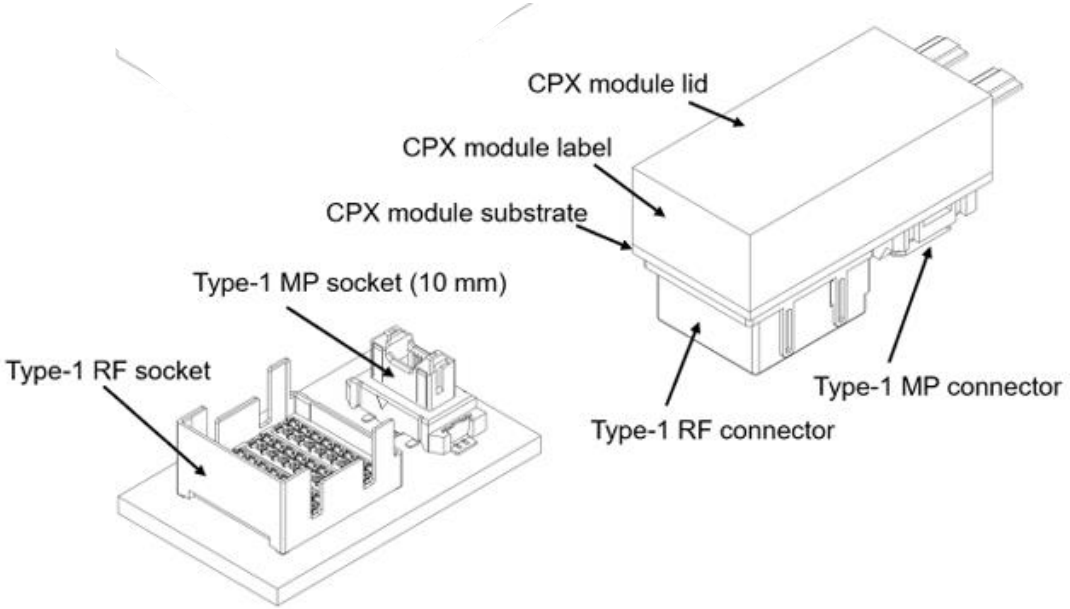
CPX serviceability

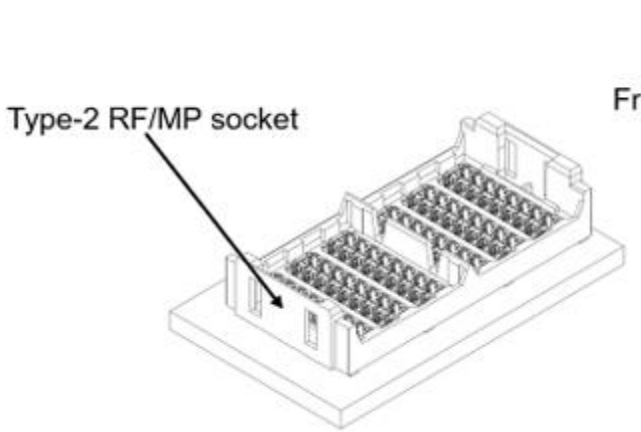
- Removal tool allows service of individual modules

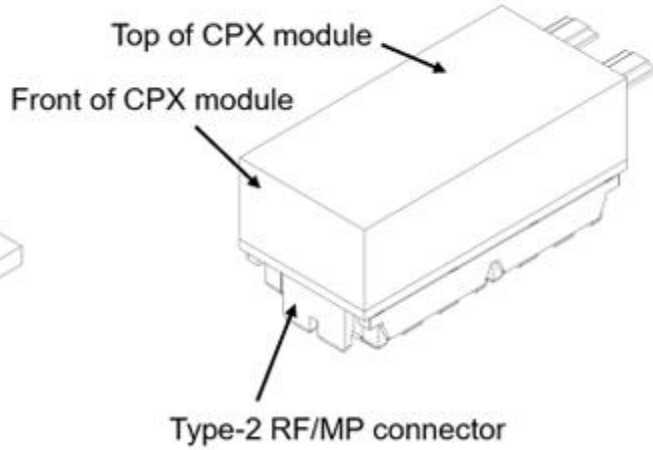


Flexibility for CPO/NPO

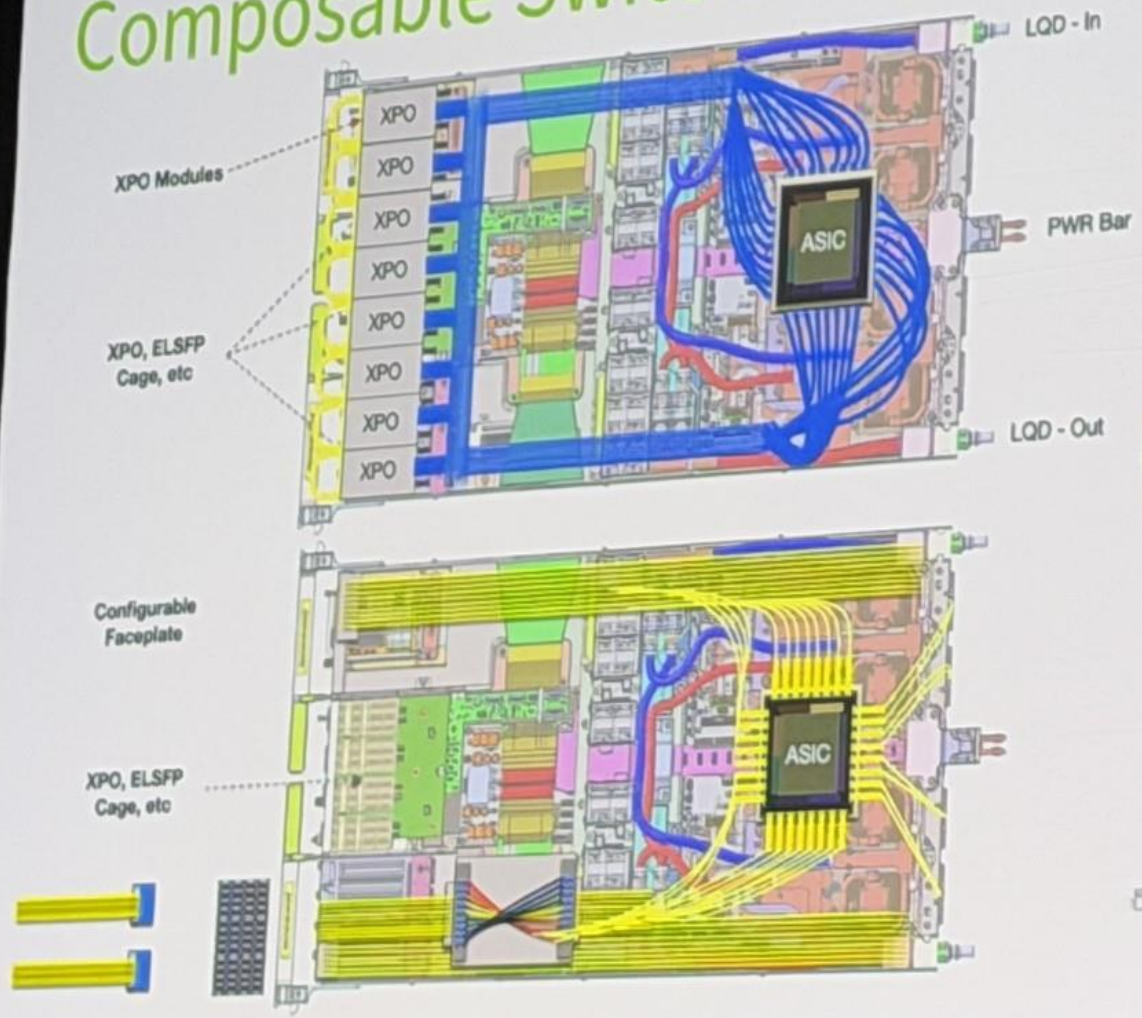
- 2 connector/module types provides separate or integrated power options
- 32 or 36 lane options
- Supports Ethernet, OCI, PCIe/CXL or proprietary interfaces
- Supports Copper or Optics







Composable Switch Trays





- Flyover copper and photonics on one tray.
- 204.8T class: 512 × 400G or 1,024 × 200G ports.
- Faceplate pluggables and CPO under one tray contract.
- 1RU density at 200T and beyond.



Call to Action

- Problem to solve
  - How to use CPX as a platform for Open Silicon Photonics for AI Systems (See Section 5.5)
  - Develop robust compliance test parameters/methods for high density CPO/NPO interfaces
- Timeline fo*r product availability: Q3 2026 (on the show floor)*
- Where to find additional information:
  - Opencpxmsa.org

Thank You!

Thank You

