

Coexistence, Not Replacement: How Co-Packaged Optics Reshapes the Transceiver Market

Comparing pluggable, near-package, and co-packaged architectures across performance, serviceability, and cost

Executive Summary

Hyperscale AI training and inference clusters are pushing per-accelerator bandwidth toward 1.6T and 3.2T, and switch ASIC I/O toward 100+ Tbps. Pluggable optical transceivers — the industry's dominant interconnect for two decades — face a hard physical ceiling: SerDes reach, faceplate density, and power-per-bit no longer scale at the pace AI fabrics demand. Co-Packaged Optics (CPO) answers this by moving the optical engine onto the switch or accelerator substrate, cutting electrical loss and power draw. But CPO does not replace pluggables outright — it redraws where each technology wins. This paper outlines the technical differentiation between pluggable, CPO, and near-package (OBO) architectures, identifies the applications and buyers driving each, and frames where a transceiver-focused supplier remains structurally relevant through the transition.

Market Drivers

- **Bandwidth scaling:** AI cluster bandwidth is compounding faster than electrical SerDes reach improves per generation, pushing power and reach budgets to their limits.
- **Power ceiling:** At 200G/lane and beyond, DSP-based retiming inside pluggable modules consumes a growing share of total switch power — CPO removes much of that overhead by shortening the electrical path.
- **Faceplate physics:** 112G/224G SerDes lanes have shrunk usable reach to centimeters, making the distance from ASIC to front panel the dominant loss budget in the link.
- **Ecosystem momentum:** Hyperscalers and merchant silicon vendors (Broadcom, NVIDIA, Marvell, Cisco) are now shipping or sampling CPO-based switch platforms, validating the architecture at production scale.

Technology Differentiation

Dimension	Pluggable Transceivers	Co-Packaged Optics (CPO)	Near-Package / OBO
Electrical reach	~10-15 dB channel, front-panel	<3 dB, ASIC-to-optics on substrate	~5-8 dB, optics on-board near ASIC
Pluggability / field service	Hot-swappable, independent lifecycle	Fixed to switch/XPU; board-level RMA	Module-level swap on some designs
Power efficiency (pJ/bit)	Baseline (DSP-heavy at >100G/lane)	30-50% lower; reduced/retimed SerDes	Moderate improvement over pluggable
Faceplate density	Constrained by connector/thermal limits	Very high; escapes faceplate bottleneck	High; partial faceplate relief
Repair / yield risk	Low — module fails independently	High — optical fault can scrap ASIC package	Medium — localized but board-attached
Maturity / ecosystem	Mature, MSA-standardized, multi-vendor	Early; OIF/CPO Consortium standards forming	Emerging; fewer standards, custom designs

Optical I/O Architectures

How the electrical path from ASIC to fiber shortens across three architectures

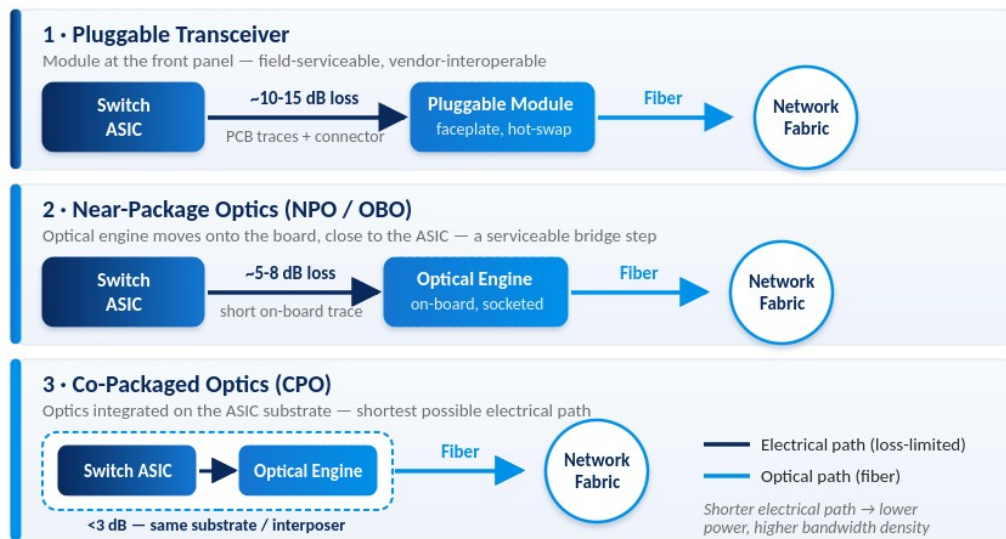


Figure 1. Signal-path comparison across pluggable, near-package, and co-packaged architectures [1][2].

Target Applications

- **Pluggables remain optimal for:** 400G/800G ZR/ZR+ metro and DCI links, enterprise and campus networking, and any deployment requiring vendor interoperability, hot-swap serviceability, or brownfield upgrades of existing switch fleets.
- **CPO is purpose-built for:** Leaf-spine and rail-optimized fabrics inside AI training clusters, next-generation Ethernet/InfiniBand switch ASICs (51.2T and beyond), and Wafer-Scale Engine (WSE) style accelerator packages where the optical I/O must sit within microns of the compute die.
- **Near-package optics (OBO) fits:** Mid-range accelerator boards and switch line cards where full co-packaging is not yet qualified but faceplate and power budgets are still tight — a transitional architecture through 2027-2029.

Target Customers and Users

- **Buyer segment 1** — Hyperscale cloud and AI infrastructure operators (design-in decisions for both CPO switches and high-volume pluggable procurement).
- **Buyer segment 2** — Switch and accelerator ASIC vendors integrating optical engines at the package or board level and needing qualified module/component supply for reference platforms.
- **Buyer segment 3** — Telecom, colocation, and enterprise data center operators who will run pluggable-dominant networks for the next 5-7+ years regardless of the CPO transition at the hyperscale edge.
- **Buyer segment 4** — System integrators and network equipment resellers requiring tested, EEPROM-configured, multi-vendor-compatible optics with warranty and QC support — the segment least affected by CPO in the near term.

Key Ecosystem Players

- **Vertically integrated leaders:** Broadcom (Tomahawk/Bailey CPO switch platforms) and NVIDIA (Quantum-X/COUPE-based switches) hold the largest hyperscale design wins to date; Marvell (Teralynx) and Cisco are also shipping or sampling CPO-based switch silicon. TSMC's COUPE and GlobalFoundries' Fotonix are the leading foundry platforms for the optical engines involved.
- **Specialist optical I/O suppliers:** Ayar Labs, Lightmatter, Celestial AI, Ranovus, and Nubis (Ciena) supply fabless optical I/O chiplets and photonic fabrics for switch and accelerator vendors that do not build silicon photonics in-house.
- **Component incumbents adapting:** Coherent, Lumentum, and Marvell supply lasers, optical engines, and components across both CPO and pluggable roadmaps, hedging their exposure as the market bifurcates.

- **NPO / near-package leaders:** Eoptolink, Innolight (Zhongji Innolight), Fabrinet, Accelink, and Hengtong lead near-package optics (NPO/OBO) module production, with NPO positioned by standards bodies (OIF, Open CPX MSA, IPEC) as a serviceable bridge between pluggable and full CPO.

Standardization is coordinated loosely across the OIF, the CPO Consortium, and the Open Compute Project (OCP), with Ayar Labs, Lightmatter, and Ranovus among the active contributors to interoperable optical chiplet and NPO mechanical specifications.[3][4]

Strategic Positioning

CPO will not displace pluggable transceivers on any near-term horizon — it will bifurcate the market. The top tier of AI-scale switch and accelerator I/O migrates to CPO and near-package architectures over the next 3-5 years, while the much larger installed base of enterprise, telecom, metro, and general-purpose hyperscale networking continues to run on pluggable optics, sustained by their serviceability, multi-vendor interoperability, and lower qualification risk. A transceiver-focused supplier's opportunity is therefore twofold: continue serving the large and durable pluggable market with quality-assured, cost-competitive modules, while monitoring CPO-adjacent opportunities — component supply, test/QC services, and near-package module variants — as that segment matures and standardizes.

Adoption Roadmap

- **2026-2027** — 800G/1.6T pluggables (DR8, 2xFR4) ramp in volume; first CPO switch platforms (51.2T-102.4T) ship to a small number of hyperscale early adopters.
- **2027-2028** — CPO standards mature under the OIF and CPO Consortium; near-package (OBO) designs bridge accelerator boards that cannot yet qualify full co-packaging.
- **2029-2030** — 3.2T-class fabrics deploy with CPO as the default for the top switch/accelerator tier; pluggables consolidate around 800G/1.6T as the durable volume tier for the broader market.



Figure 2. Directional illustration of volume bifurcation between pluggable and CPO/NPO tiers — not a market forecast.[5]

Conclusion

The surge in CPO adoption marks a segmentation of the optical interconnect market, not an end to pluggable transceivers. For suppliers, the winning posture is to remain the reliable, cost-effective backbone of the pluggable segment — which will remain the largest by volume for years to come — while building visibility into the CPO ecosystem's component and services layer as it scales. Suppliers with strong sourcing, quality control, and module-configuration capabilities are well positioned to serve the pluggable core of this market today, with a clear line of sight into adjacent CPO-era opportunities as that segment matures.

References

- [1] SemiAnalysis, "Co-Packaged Optics: Scaling with Light" (2026).
- [2] Hengtong Group, "OFC 2026 Optical Modules: What's Real, What's Next" (2026).
- [3] IDTechEx, "Co-Packaged Optics (CPO) 2026-2036: Technologies, Market, and Forecasts."
- [4] LightCounting, "Co-Packaged and Near-Packaged Optics (CPO/NPO)" (July 2026).
- [5] Mordor Intelligence, "Co-Packaged Optics Market Size, Growth & Trends" (2026).
- [6] Future Markets Inc., "The Global Co-Packaged Optics Market 2026-2036."
- [7] DataIntelto, "Near-Packaged Optics Market Research Report" (2026).