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CPO and Optical Module Index



Overview

Strategic analysis of the Co-Packaged Optics (CPO) market, tracking the 2026 inflection point for 1.6T modules.

Key Takeaways

Co-Packaged Optics (CPO) integrates optical components directly with electronic ASICs, offering higher bandwidth, lower power consumption, and reduced latency compared to traditional optical modules.Overview of CPO

Co-Packaged Optics (CPO) is an advanced optical interconnect architecture where optical components—such as photonic integrated circuits (PICs), lasers, and modulators—are integrated directly alongside switching ASICs or processors within the same package . This integration significantly shortens the electrical I/O distance, reducing power consumption, improving signal integrity, and enabling higher bandwidth density. Unlike traditional pluggable optical modules, which are detachable and rely on discrete transceivers, CPO shifts optical connectivity to a chip-level solution, making it ideal for next-generation AI and high-performance computing (HPC) data centers .

Comparison with Other Optical Architectures
• Linear Pluggable Optics (LPO): Uses a purely analog "linear direct-drive" optical link, removing DSPs and CDRs to reduce power consumption and latency. LPO retains a pluggable form factor, making it easier to service and maintain .

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• Near Package Optics (NPO): Places the optical engine close to the xPU (GPU, NPU, or switch) on the same PCB, reducing channel loss and improving bandwidth without exposing optics to high thermal stress .

• CPO: Integrates optics directly with the ASIC, eliminating discrete transceivers, reducing latency, and enabling higher lane counts such as 400 Gbps and beyond . CPO is particularly suited for hyperscale data centers and AI clusters where ultra-high bandwidth and energy efficiency are critical.

Advantages of CPO

• High Bandwidth and Low Latency: By co-packaging optics with ASICs, CPO reduces electrical path length, enabling faster data transfer and lower latency .

• Power Efficiency: Eliminates discrete transceivers, cutting power consumption per bit and reducing cooling requirements .

• Cost Reduction: Reduces bill-of-materials costs by up to 30% and lowers operational expenses in large-scale deployments .

• Scalability: Supports high lane counts and dense interconnects, essential for AI-driven HPC and hyperscale data centers .

Market Trends

The CPO market is rapidly growing, with a projected increase from USD 1.55 billion in 2026 to USD 4.12 billion by 2034, reflecting a CAGR of 11.2% . Key drivers include hyperscale data center expansion, 5G/6G network rollout, and increasing demand for high-bandwidth, energy-efficient solutions. North America currently dominates the market, while Asia-Pacific is expected to be the fastest-growing region . Major players investing in CPO include Intel, Broadcom, Cisco, and Acacia Communications .

Applications

CPO is primarily deployed in:

• Hyperscale Data Centers: For cloud-native workloads requiring high-speed interconnects.

• AI and HPC Clusters: To handle massive data exchange between GPUs, switches, and memory systems.

• Telecom and Metro Networks: Supporting 400 Gbps and higher optical links.

• Edge Data Centers: Where compact, energy-efficient solutions are critical .

Conclusion

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CPO represents a fundamental shift in optical interconnect technology, moving from module-level pluggable solutions to integrated chip-level optics. It offers higher bandwidth, lower latency, and improved energy efficiency, making it a key enabler for AI, HPC, and next-generation data center architectures. While LPO and NPO provide intermediate solutions with pluggable or near-package designs, CPO delivers the most integrated and scalable approach for future ultra-large-scale computing platforms .

Article Content

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A typical CPO assembly combines an electrical chip, an optical engine, a silicon interposer and a fiber interface:

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Co-Packaged Optics (CPO) Solutions Co-Packaged Optics (CPO) Solutions Today, data centers use a

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This article was originally published in Chip Scale Review – Nov/Dec 2024 In this article we focus on the optical interfacing

Co-packaged optics are inching closer to

AOC: transceivers with integrated fibers DAC: copper cables datacenter Interconnect Each new generation of optical modules are

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Collaborative efforts focus on expanding module density, standardizing interfaces, and ensuring compatibility with emerging 5G and

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