

Article Overview

Co-packaged optics (CPO) integrates optical engines directly with switch or compute chips, drastically reducing power consumption and increasing bandwidth density.

What is Co-Packaged Optics?

Co-packaged optics (CPO) is a networking architecture that places the optical engine--responsible for converting electrical signals into light--directly onto the switch chip's package, rather than in a removable front-panel transceiver . In traditional switches, the optical transceivers are connected via long copper traces, which introduce signal loss, require digital signal processing (DSP) for correction, and consume significant power. By moving the optical engine millimeters from the ASIC, CPO eliminates long electrical paths, reduces the need for DSP, and allows only fiber to exit the switch .

Key Benefits

- o **Power Efficiency:** CPO reduces interconnect power consumption by up to 70-80% compared to traditional pluggable optics, dropping energy use from around 15 pJ/bit to near 5 pJ/bit .
- o **Bandwidth Density:** Integrating optics close to the ASIC allows higher channel density, supporting massive switches (e.g., 51.2T or 102.4T) without being limited by front-panel space .
- o **Low Latency:** Shorter electrical paths reduce signal degradation and latency, which is critical for AI and high-performance computing workloads .
- o **Thermal Management:** Less power consumption translates to lower heat generation, reducing cooling requirements and supporting green data center initiatives .

Applications

CPO is particularly valuable in AI superclusters, high-performance computing (HPC), and large-scale data centers, where massive data transfer between GPUs or processing nodes is required . It addresses the power-performance wall faced by traditional pluggable optics and enables scaling of generative AI models and other data-intensive workloads.

Comparison with Other Optical Architectures

- o **Pluggable Optics:** Traditional modules connected via front-panel interfaces; higher power consumption and longer electrical paths.
- o **Near-Packaged Optics (NPO):** Optics placed close to the ASIC on the mainboard; offers some power savings but less integration than CPO .

Introduction to Co-packaged Optics Concepts

o Extra-Dense Pluggable Optics (XPO): High-throughput front-panel modules; maintains serviceability but requires advanced cooling and DSP support . CPO represents a fundamental shift in switch design, requiring new manufacturing, cooling, and maintenance approaches, but it provides unmatched efficiency and scalability for next-generation data centers .

Co-packaged optics (CPO) is a disruptive approach to increasing the interconnecting bandwidth density and energy efficiency by

Co-Packaged Optics (CPO) is an advanced integration of optics and silicon on a single packaged substrate addressing interconnect

As co-packaged optics (CPO) becomes a pivotal solution for high-end data centers, the choice of packaging

IDTechEx Research Article: The rise of co-packaged optics is transforming modern data centers and high

The rise of co-packaged optics is transforming modern data centers and high-performance networks by addressing

The definition, key innovations, major advantages of co-packaged optics, and how they will develop in the future are discussed in this

Co-Packaged Optics - List of Examples As datacenters strive to meet escalating demands for efficiency and bandwidth, particularly

Co-packaged optics (CPO) has evolved as a solution to meet the growing demand for data. Compared to typical

In the 5G era, the demand for high-bandwidth computing, transmission, and storage has led to the development of

Co-packaged optics (CPO) technology offers a promising solution by integrating photonic integrated circuits (PICs)

Co-packaged optics (CPO) represents a transformative approach in optical networking, where optical and electronic

Co-Packaged Optics (CPO) is emerging as a critical technological path for optical interconnects in AI data centers.

Introduction to Co-packaged Optics Concepts

Co-packaged optics (CPO) are heterogeneous integration packaging methods to integrate the optical engine (OE) which consists of

Co-Packaged Optics (CPO) technology is designed to enable more extensive scale and faster integration by placing

Co-Packaged Optics (CPO) is a paradigm shift in building switch systems that involves packaging Optical engines on

Conventional pluggable optics cannot catch up with the fast-growing bandwidth density and energy efficiency

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