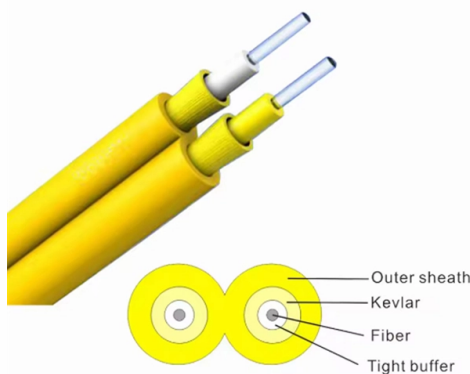


Future Development of Ethernet Optical Modules



Overview

EthernetRoadmap 2025-Side1-Final-RGBThe ever-increasing demand for power efficiency in data centers is driving the transition to new interconnect solutions.

Key Takeaways

Ethernet optical modules are rapidly evolving toward 1. 6T and 3. 2T speeds, driven by AI workloads, hyperscale data centers, and the need for higher bandwidth, lower latency, and energy-efficient interconnects.

Evolution of Speeds and Form Factors

Ethernet optical modules are following a "speed-doubling" roadmap, with each generation arriving roughly every two to three years. The market has moved from 400G modules, widely deployed in QSFP-DD form factors, to 800G modules, primarily in OSFP form factors for AI and HPC clusters. Early commercial deployment of 1.

6T modules began around 2025–2026, with emerging form factors like OSFP-XD and OSFP-HS designed to handle higher SerDes rates, advanced DSP complexity, and thermal challenges. Looking ahead, 3. 2T modules are expected to follow, enabling even greater bandwidth density without proportionally increasing power consumption or footprint.

Technological Drivers

The surge in AI workloads, including training trillion-parameter models and real-time inference, is creating unprecedented demand for low-latency, high-bandwidth interconnects. Optical modules are critical for east-west traffic in AI clusters, where GPUs constantly synchronize and exchange massive datasets. Co-packaged optics (CPO) and hybrid assemblies integrating copper and fiber are emerging to optimize power efficiency, port density, and operational flexibility.

InP-based EML lasers remain a key technology for high-speed transceivers, though supply constraints and complex manufacturing processes pose challenges.

Market Trends and Forecasts

The Ethernet optical module market is expected to grow significantly from 2026 to 2031, with high-speed modules (400G, 800G, 1.6T, and 3.2T) capturing increasing market share across cloud, enterprise, and telecom segments.

AI-driven data centers are accelerating adoption of 800G and 1.6T modules, while traditional telecom and enterprise networks may adopt these technologies more gradually due to cost sensitivity. The market is also seeing a shift toward retimed transceivers, LPO/LR, and CPO/NPO modules, sorted by reach and form factor, to meet diverse deployment needs.

Challenges and Considerations

Key challenges for future Ethernet optical modules include: Thermal management: Higher speeds increase power density, requiring advanced cooling and module design. Manufacturing complexity: High-speed InP-based EML production has historically low yields, affecting supply and cost. Standards and interoperability: 1.6T and beyond require new standards, with organizations like the Ethernet Alliance and OIF actively developing specifications.

Energy efficiency: Optimizing power per bit is critical for hyperscale deployments to control TCO and cooling requirements.

Outlook

The future of Ethernet optical modules is characterized by continuous speed upgrades, integration of co-packaged and hybrid optics, and a focus on AI-optimized data center interconnects. By 2030, 1.6T and 3.2T

modules are expected to become mainstream in hyperscale and HPC environments, while innovations in form factors, DSP, and photonics will continue to improve bandwidth density, energy efficiency, and reliability. This evolution ensures that network throughput keeps pace with rapidly scaling compute performance, particularly in AI and cloud infrastructures.

Article Content

EthernetRoadmap 2025-Side1-Final-RGB

The ever-increasing demand for power efficiency in data centers is driving the transition to new interconnect solutions, such as Co-Packaged Optics (CPO), On-Board Optics (OBO), and

Mapping the Future: The Ethernet Alliance and its 2026 Ethernet

The roadmap highlights key speeds, interfaces, and optical technologies shaping Ethernet's future, demystifying complex technologies while ensuring industry alignment. Complimentary copies of the

2026 Ethernet Roadmap

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The Development Path of Optical Modules highlights major shifts in form factor, speed, and integration shaping next-gen 100G to 800G networks.

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This article provides a strategic and technology-focused roadmap for the evolution of optical modules from 400G to 800G, 1.6T, and ultimately 3.2T, helping data center operators make

High-speed Ethernet Optics

This report analyzes the impact of growing data traffic and the changing architecture of data centers on the market forecast for Ethernet optical transceivers with a focus on the high-speed modules used in

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HTFuture offers industry-leading fiber optic products and WDM system solutions with global recognition for excellence and innovation.

How Industry Collaboration Fosters NVIDIA Co-Packaged Optics

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