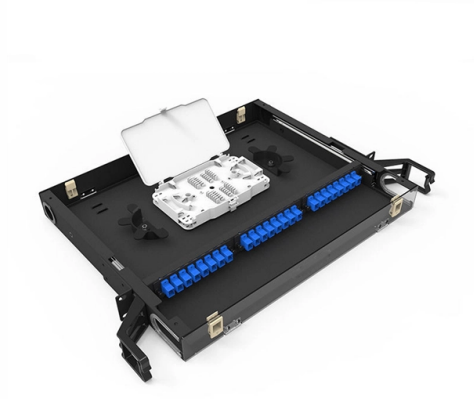


Data Center Construction and Optical Modules



Overview

The continuous construction of new data centers is fueling the growth of the high-speed optical transceiver market.

Key Takeaways

Optical modules, including coherent pluggable transceivers and high-speed optical transceivers, are essential for scalable, energy-efficient, and high-bandwidth data center networks. Overview of Optical Modules

Optical modules are critical components in data centers, converting electrical signals to optical signals and vice versa, enabling high-speed data transmission across servers, switches, and inter-data center links. They support bandwidths from 10 Gbps to 400 Gbps and beyond, with form factors such as SFP+, SFP28, QSFP+, QSFP28, QSFP-DD, and OSFP depending on speed and deployment requirements. Modules can be used in Top-of-Rack (TOR) switches, aggregation layers, and core routers, ensuring low latency and high reliability.

Coherent Pluggable Modules



Modern data centers increasingly adopt coherent pluggable modules for interconnects between data centers. These modules simplify architecture by replacing stand-alone optical transponders, reducing space, power, and cooling requirements by over 80% . Coherent optics improve signal integrity over distances from 40 km to over 1,000 km, making them ideal for Data Center Interconnects (DCI) . They also enhance network visibility and automation, enabling better IP network management and performance predictability .

High-Speed Transceivers and Trends

The demand for AI, 5G, and cloud computing drives the adoption of high-speed transceivers. Currently, 400-Gbps ZR/ZR+ transceivers are widely used, with a market shift toward 800-Gbps and 1.6 Tbps modules expected by 2029 . These transceivers often use InP-based EML technology, which is complex to manufacture but critical for high-speed, low-latency data center applications . Integration of optics with chips in compact form factors improves energy efficiency and scalability .

Considerations for Data Center Construction

When selecting optical modules for a data center, consider:

- Transmission speed and reach: Choose modules that match intra-rack, inter-rack, or inter-data center distances.
- Form factor and compatibility: Ensure modules are compatible with existing switches and routers.
- Power efficiency: Low-power modules reduce operational costs and cooling requirements.
- Future-proofing: Opt for multi-vendor compatible modules that support modular growth and AI-driven network fabrics .
- Network architecture: Coherent optics and DWDM solutions can maximize fiber utilization and simplify traffic engineering .

Leading Solutions

Vendors like Cisco and Lumentum provide a range of optical modules, including tunable lasers, coherent transponders, and high-density line cards, enabling flexible, scalable, and cost-effective data center interconnects . These solutions support dynamic network scaling, high bandwidth, and low-latency connectivity, essential for hyperscale and enterprise data centers. In summary, optical modules are strategic enablers in modern data center construction, providing high-speed, energy-efficient, and scalable connectivity while supporting future growth in AI, cloud, and 5G applications. Proper selection and deployment of these modules are critical for optimizing performance, cost, and operational efficiency.

Article Content

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