Data Center Optical Modules



Overview

Learn how and where to implement Cisco Optics solutions to gain the reach you need for connecting data centers across your metro areas and beyond.

Key Takeaways

Data centers use optical modules to enable high-speed, reliable, and scalable data transmission between servers, switches, and storage systems.

What Optical Modules Are

Optical modules, also known as optical transceivers, are compact, hot-pluggable devices that convert electrical signals from network equipment into optical signals for transmission over fiber optic cables, and vice versa. They consist of a transmitter, a receiver, and supporting electronics that facilitate this conversion, allowing data to travel long distances with minimal loss and latency.

Why Data Centers Use Optical Modules

Data centers rely on optical modules for several key reasons: High-Speed Connectivity: Optical modules support speeds ranging from 10G to 400G and beyond, enabling fast data transfer between servers, switches, and storage devices. Extended Reach: Unlike copper cables, optical modules can transmit data over longer distances without significant signal degradation, which is essential for cross-rack and inter-pod connections. Energy Efficiency: Modern optical modules are designed to deliver high data rates per watt, reducing power consumption and heat generation in large-scale data centers.

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Scalability and Flexibility: Small form factors like QSFP-DD, OSFP, and SFP+ allow data centers to host multiple ports in a single rack unit, supporting modular growth and easy upgrades. Reliability: Optical modules maintain signal integrity and low latency, which is critical for AI workloads, cloud computing, and real-time applications.

Types of Optical Modules

Optical modules come in various types to meet different networking needs: SFP/SFP+ (1G–10G): Common for short-distance connections and top-of-rack switches. SFP28 (25G): Supports higher-speed server connectivity. QSFP+/QSFP28 (40G–100G): Used for aggregation and core layers.

QSFP-DD/OSFP (200G–400G): Designed for high-density, high-bandwidth applications, including AI and cloud workloads.

DWDM and Bi

Di Modules: Enable long-distance and wavelength-division multiplexing for specialized applications.

Emerging Developments

Companies like Kyocera are developing pluggable optoelectronic modules supporting PCIe 6. 0, which convert electrical signals from CPUs and GPUs into optical signals, enhancing high-speed communication and power efficiency in data centers. Similarly, NVIDIA Mellanox modules address bandwidth challenges in leaf-spine architectures, supporting 25Gbps per lane over multimode fiber for cross-aisle connections.

Conclusion

Optical modules are essential for modern data centers, providing high-speed, reliable, and energy-efficient connectivity. They enable scalable network architectures, support AI and cloud workloads, and allow for flexible upgrades without overhauling the entire infrastructure. By selecting the appropriate module type and form factor, data centers can optimize performance, reduce latency, and maintain robust network operations.

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Top Optical Transceiver Modules for Data Center Applications

Explore the best optical transceiver modules for modern data centers, including SFP+, QSFP28, QSFP-DD, and OSFP. Learn how to select the right module for speed, distance, and

All AI Data Center Interconnects Will Be Optical Within

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Applications of Optical Module PCBs in AI Data Centers

Optical modules serve as core components in high-speed optical communication links within AI data centers. Inside an optical module, the PCB serves as the electrical platform for

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