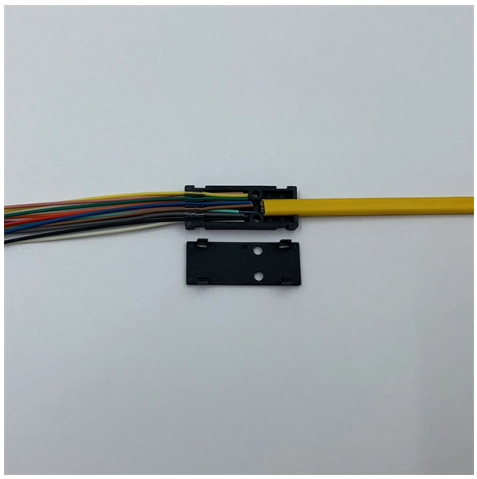
High-speed and low-speed optical modules



Overview

Explore the evolution of optical modules in speed and form factors from 400G to 1.6T, stressing key enhancement technologies, and paths to achieving high-speed optical modules.

Key Takeaways

High-speed optical modules are designed for large-scale, high-performance data transmission, while low-speed optical modules are suited for short-distance or internal communications with lower data rates. Key Differences1. Transmission Rate High-speed optical modules support very high data rates, often ranging from 400G to 3.

2T, making them ideal for interconnecting data centers, supercomputing clusters, and high-performance computing environments. Low-speed optical modules typically operate at 10G, 25G, or 100G, suitable for short-distance communication within a data center or access layer networks. 2.

Application ScenariosHigh-speed modules: Used in scenarios requiring massive data processing and long-distance transmission, such as cloud computing, AI clusters, and backbone networks. Low-speed modules: Applied in short-distance communications, internal data center links, and mass deployment scenarios where cost efficiency is critical. 3.

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Design and Cost High-speed modules involve complex designs, often incorporating Digital Signal Processing (DSP) or Linear Pluggable Optics (LPO) to manage signal integrity, latency, and bandwidth. They consume more power (e.g., 16–40W for 800G–3. 2T modules) and require advanced thermal management, including liquid cooling in dense deployments.

Low-speed modules are simpler, consume less power (1–8W), and are more cost-effective due to mature technology and widespread market competition. 4. Technology and Performance High-speed modules leverage advanced technologies such as multi-channel designs, DSP, LPO, and silicon photonics to achieve high bandwidth and low latency.

They also require careful thermal management to prevent performance degradation. Low-speed modules rely on established optical transceiver designs with minimal signal processing, making them easier to deploy and maintain. 5.

Power and Thermal Considerations High-speed modules generate significant heat due to higher power consumption, necessitating precision cooling solutions like liquid cooling and high thermal conductivity materials. Low-speed modules generate minimal heat, allowing standard air cooling to suffice.

Summary

In essence, high-speed optical modules are optimized for performance, long-distance transmission, and high-density data environments, but come with higher costs, power consumption, and thermal management requirements. Low-speed optical modules are optimized for cost-efficiency, short-distance communication, and simpler deployment, making them suitable for internal data center links and access networks.

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