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The Role of Optical Modules in AI Chips



Overview

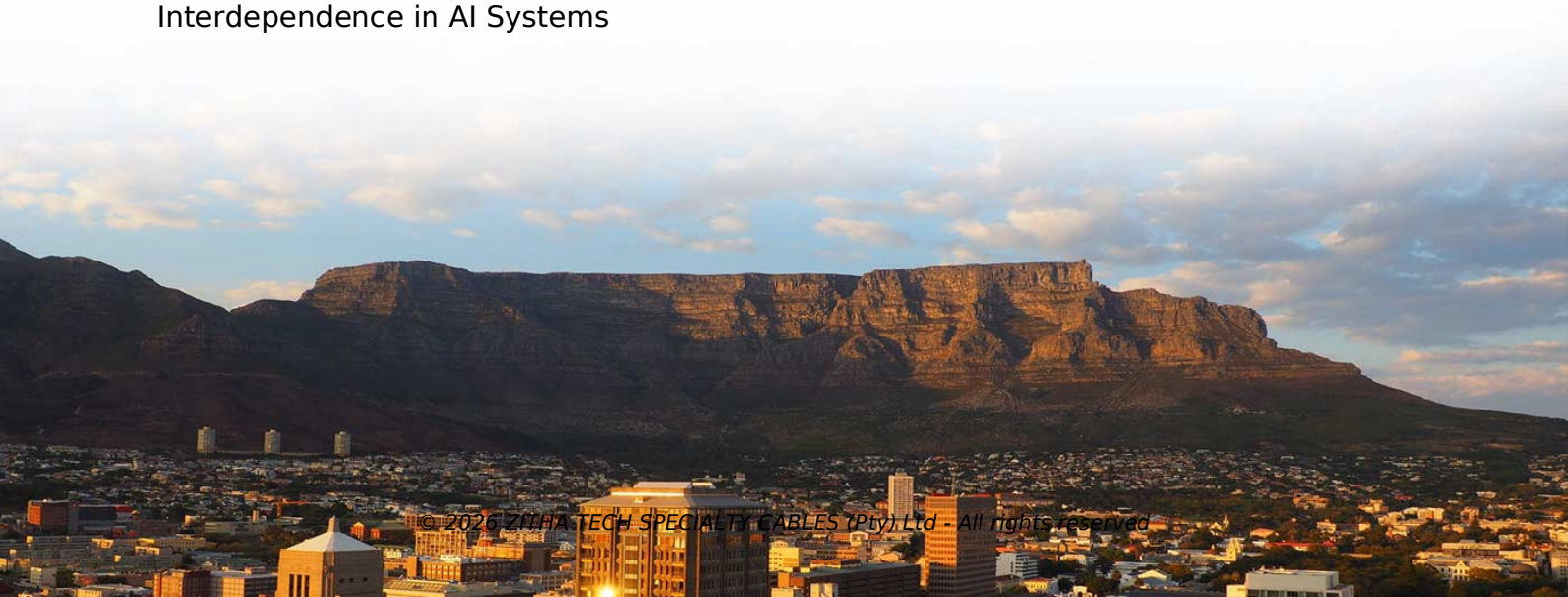
Key point: The growth of Chinese optical module companies came from playing the “plumber” role in AI data centers.

Key Takeaways

AI chips and optical modules form a tightly coupled system where AI chips handle computation while optical modules enable high-speed data transmission, together driving modern AI infrastructure.Functional Roles

AI chips are specialized processors designed for artificial intelligence workloads, responsible for large-scale parallel computation, neural network training, and inference tasks. They act as the “computing brain” of AI systems, determining how fast computations can be performed . Optical modules, on the other hand, are devices that convert electrical signals into optical signals and vice versa, enabling high-speed, low-latency communication between AI chips across servers and data centers. They serve as the “high-speed highway” for data, ensuring that massive datasets can be transmitted efficiently without bottlenecks .

Interdependence in AI Systems



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AI chips and optical modules are not substitutes but complementary components. As AI models grow in size and complexity, the demand for inter-chip communication increases dramatically. Optical modules provide the bandwidth and low-latency links necessary for thousands of GPUs or AI chips to communicate during both training and inference . A typical AI data center architecture illustrates this relationship: GPU/AI chip → NVLink/PCIe → Switch ASIC → Optical module (400G/800G) → Optical fiber network → Other server GPUs . Without optical modules, AI chips would be limited by bandwidth, distance, and power constraints, making large-scale AI training inefficient or impossible .

Technological Synergy

Optical modules integrate optical chips as their core functional units, which handle signal generation, modulation, and reception. This “chip + module” synergy ensures that AI systems can scale efficiently while maintaining high performance and energy efficiency . Together, AI chips and optical modules form a dual-engine system of compute and communication, where AI chips determine computational speed and optical modules determine data transfer speed. This combination is foundational for modern AI clusters, hyperscale cloud computing, and large-model training .

Industry and Market Impact

The explosive growth of AI has driven unprecedented demand for optical modules. Global shipments of high-speed optical transceivers (800G and above) are projected to reach tens of millions of units, with hyperscale cloud providers investing heavily to expand AI infrastructure . Leading manufacturers, particularly in China, are producing high-capacity modules (up to 12.8T) to support AI clusters with hundreds of thousands of GPUs .

Summary

In essence, AI chips and optical modules are mutually dependent: AI chips perform the computation, while optical modules ensure that data moves quickly and reliably between them. This relationship is critical for scaling AI systems, improving efficiency, and enabling the next generation of large-scale AI models .

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New light-based chip boosts power efficiency of AI tasks 100 fold

Using light dramatically cuts the power needed to perform these tasks, with efficiency 10 or even 100 times that of

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While DSPs are the principal device inside these modules, they are complemented by transimpedance amplifiers and

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The more accelerators an AI system uses, the more data needs to move between them. That is helping drive

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Emerging Optical Interconnects for AI Systems

1. Introduction Large-scale AI systems are the foundation of modern online services. As the world is recovering from COVID-19, there

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All AI Data Center Interconnects Will Be Optical Within 5 Years

I spent several days at OFC (Optical Fiber Communications Conference) 2026 in LA. The crowds were huge and the

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AI networks require an infrastructure that can handle continuous high utilization and harsh thermal conditions – and

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High-quality optical modules play a crucial role in this process, providing stable high-bandwidth and low-latency links

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