

Optical modules used in supercomputers



Article Overview

Optical modules are critical components in modern supercomputers, enabling high-speed, low-latency, and energy-efficient interconnects between processors and racks.

Role of Optical Modules

Optical modules in supercomputers serve as high-bandwidth interconnects that transmit data using light rather than electrical signals. This approach overcomes the limitations of traditional copper-based connections, which face resistance, heat generation, and bandwidth bottlenecks as computational power scales. By using photons, optical modules allow nearly lossless data transmission at the speed of light, reducing latency and energy consumption while supporting massive parallel processing workloads in AI, scientific simulations, and data-intensive applications .

Implementation in Leading Supercomputers

- Google TPU v7: Each TPU chip uses 1.5 optical modules for intra-rack communication and an additional 2.6 modules for inter-rack links, forming a 3D torus network within racks and a multi-layer data center network for cross-rack traffic. This ensures sufficient bandwidth for large-scale AI model training while balancing cost and performance .
- Google TPU v4: Optical circuit switches (OCSes) dynamically reconfigure interconnect topologies, improving scalability, utilization, and energy efficiency. Optical components account for less than 5% of system cost and 3% of power, yet significantly enhance performance for large language models.
- NVIDIA Rubin Platform: Uses co-packaged optics and Spectrum-X Ethernet Photoni...

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Today's petascale supercomputers make substantial use of optical interconnects. For the exascale, optics will

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Submersible Optical Transceiver For Super Computing

The FireFly transceiver is a mid-board optical module which is less than 25% of the size of a

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Building quantum supercomputers: Scientists connect two quantum ...

Scientists have connected two quantum computers, paving the way for distributed quantum computing, quantum

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The Rise of Co-Packaged Optics: A Deep Dive into CPO Optical Modules

A CPO optical module integrates optical and electronic components to boost data center speed, efficiency, and

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Optical module

An optical module is a typically hot-pluggable optical transceiver used in high-bandwidth data communications applications. Optical

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Optical interconnection networks for high-performance systems

The Consortium for OnBoard Optics (COBO), led by Microsoft, is defining the standard for optical modules that can be mounted or

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The Application of Optical Modules in High-Performance Computing

Optical modules deliver high bandwidth, low latency, and scalable connectivity for high-performance computing,

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Optical Computing: What It Is, And Why It Matters

The idea of optical computing—the use of photons instead of electrons to perform

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Optics for high-performance servers and supercomputers

We report the optical interconnect for POWER7-IH systems, which provides high-BW, low-latency connectivity for 100,000s of high

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Cisco Optics | Transform Your Network

Get the highest quality, performance-leading optical transceivers for any network architecture. Find the transceiver model to fit your

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Optical interconnects for extreme scale computing systems

J.A. Kash, Leveraging optical interconnects in future supercomputers and servers, 2008 16th IEEE Symposium on

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Everything You Need to Know About Optical Modules

Optical modules are electronic devices used in communication systems to transmit optical signals. These modules

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Nvidia outlines plans for using light for communication

Earlier this year, Nvidia outlined that its next-generation rack-scale AI platforms will use

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The physics of optical computing

Optical computing has the potential to be faster and more energy-efficient than conventional digital-electronic

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The Evolution of Optical Modules: Powering the Future

Enter optical modules, which leverage the power of light to transmit data efficiently over long

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Understanding Optical Modules: Working Principles, Structures, and ...

Explore the working principles, structures, and performance metrics of optical modules, essential components of

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Optical Interconnects for Green Computers and Data Centers

In this chapter, state-of-the-art optical interconnect technologies for supercomputers and data centers (DCs) are presented with

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800G Optical Modules Explained: Standards, Types & Use Cases

Discover everything about 800G optical modules—standards, packaging, types & applications. Learn how they power

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Optical module

Optical modules typically have an electrical interface on the side that connects to the inside of the system and an optical interface on

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Seng Tiong Ho Photonics in Supercomputers: Pushing

The transition to photonic supercomputers represents a paradigm shift in computing

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Optical computing

Optical computing or photonic computing uses light waves produced by lasers or incoherent sources for data processing, data

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Optical interconnect opportunities in supercomputers and high end ...

Optical interconnect opportunities in supercomputers and high end computing
Abstract: A collection of slides from the author's

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Google's TPU v7: How 1.5 & 2.6 Optical Modules per Chi | BestHub

The article explains how Google's TPU v7 supercomputer uses a simple yet powerful networking scheme—1.5 optical

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Programmable Fabrics with Optical Switches in AI Supercomputers

Abstract: We explore the integration of Optical Circuit Switches (OCSs) in AI/HPC clusters' fabrics, to enhance resiliency in case of

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Optical Interconnect Technology Analysis: LPO, NPO, CPO

Exploring optical interconnects for AI data centers: LPO for low-power, short-distance links, NPO for high-density,

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Optical interconnects for extreme scale computing systems

Most optical links in today's supercomputers are based on multi-mode optical fibers and Vertical Cavity Surface

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Optical module design resources | TI

Integrated circuits and reference designs help you create a smaller and faster optical module design used in high-bandwidth data

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