

Supercomputers and Optical Modules



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...

Article Content

Jul 23, 2026

Designing a Module for High-Speed Optical Communication

This article explores MPS optical module solutions to meet the design requirements of high-speed optical communication as well as

May 01, 2026

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

Sep 13, 2025

Optical Module MCUs Become Critical as AI Data Centers Drive

MCU chips for optical modules emerge as a critical semiconductor segment as AI data center buildout drives

Apr 03, 2026

Low power and high density optical interconnects for future ...

Increasing performance in supercomputers requires a concomitant increase in intrasystem interconnect bandwidth. We review the

Jul 30, 2025

Optical interconnection networks for high-performance systems

Then we discuss the electrical and optical models used for optical links and present an example of designing the silicon photonic link

Jul 15, 2026

Optical interconnects for extreme scale computing systems

Optical systems have been discussed so far in this paper for transmission exclusively, i.e. for carrying data from one

Apr 09, 2026

Lightmatter®

Lightmatter has joined the NVIDIA NVLink Fusion ecosystem, bringing our photonic interconnects to the AI infrastructure powering

Jul 10, 2026

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

Feb 10, 2026

The Supercomputer Supernet testbed: a WDM-based supercomputer ...

The novel scheme interconnects asynchronous wormhole routing switches used in parallel supercomputers via multi-channel WDM

Nov 27, 2025

The Evolution of Optical Modules: 400G → 800G → 1.6T – A Strategic ...

Discover the evolution from 400G to 800G and 1.6T optical modules. Learn key technologies, CPO vs pluggable, and

May 19, 2026

Networking chips and modules for AI data centers: Infiniband, Ultra ...

In September, Marvell, Lumentum, and Coherent demonstrated optical links for data centers as far apart as 300 miles.

Jun 13, 2026

Optical interconnects for extreme scale computing systems

In this paper, we review the on-going efforts that will enable the eventual emergence of next generation optical

Feb 04, 2026

HotChips2023Final

Up to 8 superpod systems in a single cluster! Each Superpod has enough fiber to encircle the state of Rhode Island!

Jan 24, 2026

(PDF) Optical Interconnects in Future Servers

Optical interconnects are common in today's petascale supercomputers, and will become pervasive at the exascale

Apr 02, 2026

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

Nov 09, 2025

Lightmatter®

Rethinking the limits of AI, Lightmatter merges photonics and computing to build a future where speed, efficiency, and intelligence

Feb 19, 2026

Optical Interconnect Opportunities in Supercomputers and High End

Optical interconnect for supercomputers and other high-end compute systems will likely grow at >200% CAGR (deployed Gb/s),

Aug 08, 2025

Quantum computing

Linear optical quantum computing — photonic model using photons and linear optical elements. Neutral

Oct 02, 2025

Building quantum supercomputers: Scientists connect two quantum ...

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

Jul 10, 2026

Paving the way to quantum supercomputers | ScienceDaily

Paving the way to quantum supercomputers Date: February 5, 2025 Source: University of Oxford Summary: In a

Nov 07, 2025

Optical Interconnects in Exascale Supercomputers

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

Dec 08, 2025

Optical interconnection networks for high-performance systems

Large-scale high-performance computing (HPC) systems in the form of supercomputers and warehouse-scale data centers permeate

Jan 29, 2026

LRO, LPO, and Silicon Photonics: Reducing Power Consumption in Optical ...

Silicon photonics reduces power consumption in both LRO and LPO modules by integrating optical components

Sep 07, 2025

GlobalFoundries accelerates adoption of co-packaged optics for

SCALE CPO solution is the industry's first OCI MSA capable platform and built with GF's proven silicon photonics

Dec 17, 2025

Optical interconnects for extreme scale computing systems

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

Jul 11, 2026

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

Contact Us

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