1 6T Active Optical Device for Edge Computing

Article Overview

1.6T active optical devices enable ultra-high-speed, low-latency interconnects for AI, HPC, and edge computing, supporting 200-224G per lane PAM4 transmission with integrated DSPs and optical engines.

Overview

1.6T optical devices are designed to meet the bandwidth and latency demands of next-generation AI and edge computing networks. They achieve 1.6 terabits per second by using 8 lanes at 200-224G per lane with PAM4 modulation, which increases transmission efficiency compared to traditional NRZ signaling (2-level) and allows higher data throughput in compact form factors . These devices are critical for high-density AI clusters, hyperscale data centers, and edge computing nodes, where low latency and high bandwidth are essential.

Key Components and Technologies

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Digital Signal Processors (DSPs): Modern 1.6T DSPs, such as Credo's Robin DSP, provide equalization, signal compensation, and PAM4 signal enhancement, ensuring high signal integrity across optical links while maintaining low power consumption . They support active optical cables (AOCs), linear receive optics (LRO), and fully retimed transceivers.

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Optical Engines: POET's Teralight 1.6T optical engines integrate transmit and receive functions on a single system-on-chip, including EML lasers, photodiodes, TIAs, optical multiplexers, and high-speed drivers. This integration reduces cost, simplifies module design, and improves reliability .

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Form Factors: OSFP-XD is currently the mainstream form factor for 1.6T modules due to its superior heat dissipation and ability to accommodate complex DSPs and optical engines, while QSFP-DD is limited to short-reach scenarios . DR and FR solutions support mid- to long-reach single-mode links, with EML and silicon photonics (SiPh) technologies competing for efficiency and integration advantages.

Performance Metrics

o Lane Rate: 200-224G per lane PAM4
o Latency: Sub-7ns for PCIe retimers and low-latency optical links
o Power Efficiency: Linear pluggable optics (LPO) and LRO modules consume 4-16W depending on reach and integration

o Integration: Co-packaged optics (CPO) and near-packaged optics reduce signal loss and improve energy efficiency

Applications in Edge Computing

o AI and HPC Clusters: 1.6T modules support high-bandwidth, low-latency interconnects for distributed AI training and inference, enabling large-scale GPU/CPU clusters to communicate efficiently .

o Edge Data Centers: Compact, low-power 1.6T transceivers allow high-density deployment in edge nodes, supporting real-time analytics and AI inference close to data sources.

o Cloud-Scale Networks: These devices facilitate lossless RDMA networks and high-speed chip-to-chip communication, critical for hyperscale cloud infrastructure .

Market Trends

o Rapid Growth: Global demand for 1.6T optical modules is projected to reach 3-5 million units in 2025, with market value exceeding $1 billion, driven by AI and HPC workloads .

o Supply Chain Maturity: Increasing availability of integrated DSPs, optical engines, and co-packaged optics is accelerating adoption in both hyperscale and edge computing environments.

o Future Expansion: Technologies like POET's Blazar light source and integrated optical interposers aim to scale beyond 1.6T toward 3.2T pluggable modules, further enhancing bandwidth and reducing cost per bit .

Conclusion

1.6T active optical devices combine high-speed DSPs, integrated optical engines, and advanced modulation techniques to deliver ultra-high bandwidth, low latency, and energy-efficient interconnects. They are essential for AI-driven edge computing, hyperscale data centers, and next-generation cloud networks, enabling scalable, high-performance infrastructure while addressing power, thermal, and integration challenges. These devices represent a critical step in the evolution from 400G/800G to multi-terabit optical interconnects.

Explore the evolution of 1.6T optical transceivers, including their working principles, key technologies, module types,

3.2T and 1.6T OpenLight"s PASIC platform enables the design and manufacture of breakthrough, 3.2Tbps and 1.6Tbps, fully

The 800G optical module supports high-speed backhaul between 5G base stations through fronthaul and midhaul networks, and at

This article explains how this new 1.6T rate emerged, what the technical principles and key features of 1.6T optical

This article analyzes leading 1.6T optical module vendors, key technology developments, and future deployment

Discover the power of 1.6 T optical transceiver modules for data centers, featuring 400G, 800G, and OSFP designs.

We propose a photonic edge computing scheme based on a directly modulated laser array (DML) , aiming to

In AI and HPC environments, where massive east-west traffic dominates, 1.6T transceivers are becoming a key

Explore the differences between 1.6T OSFP and OSFP-XD optical transceivers, including bandwidth scalability,

With the rapid growth of cloud computing, artificial intelligence (AI), 5G, and the Internet of

Learn the key differences between 1.6T transceiver models, including InfiniBand vs Ethernet protocols, DR4 vs FR4

This paper describes the technical route of optical communication from 400G to 800G to 1.6T optical modules and

The complete optical system-on-chip consists of a 1.6T transmit optical engine and a 1.6T receive optical engine, each approximately

5G-Advanced and Edge Computing Infrastructure The 800G optical module supports high

Co-packaged optics (CPO) combines photonic devices with high-performance electronics via advanced packaging to

The 1.6T light engine is a highly integrated device featuring 200G electrical and optical interfaces. It consumes less