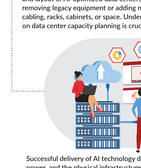
Transforming Data Center Infrastructure to Meet AI Optimization

Global survey reveals **90%** of IT leaders believe that unifying the data lifecycle on a single platform is critical for analytics and AI.

Artificial intelligence (AI) growth challenges data center build-out projects due to the need for more data center space, a tight labor market, and ongoing materials shortages. The unique architecture, infrastructure requirements, and layout of AI-optimized data centers require a transition that could involve removing legacy equipment or adding new equipment requiring additional cabling, racks, cabinets, or space. Understanding and preparing for AI's impact on data center capacity planning is crucial.



Successful delivery of AI technology depends on algorithms, computational power, and the physical infrastructure. Optical fibers play a pivotal role as the backbone for information transmission, especially within data centers hosting AI technology. For those designing, deploying, or certifying/validating AI data center network equipment and managing it, you must consider the following:

How Can AI Help with Data Analysis?

AI Data Center Network Requirements

Powerful GPU server clusters require extensive connections and significantly more electricity than front-end servers. They are linked to the main network for routing, so data centers need to prepare for AI.

SPEED

Rapid AI advancements necessitate quick adaptation by data center operators, achieved using pre-terminated, plug-and-play assemblies to address labor shortages.

SIMPLICITY

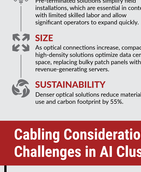
Pre-terminated solutions simplify field installations, which are essential in contexts with limited skilled labor and allow significant operators to expand quickly.

SIZE

AI optical connections increase, compact, high-density solutions optimize data center space, replacing bulky patch panels with revenue-generating servers.

SUSTAINABILITY

Denser optical solutions reduce material use and carbon footprint by 35%.



Cabling Considerations and Challenges in AI Clusters

INCREASED CONNECTIVITY NEEDS

- High-speed links (100G – 800G)
- Thousands of 400G-800G ports in a single cluster
- 96 fibers per server
- 36 servers per rack= 3,456 fibers per rack

CHALLENGES OF INTER-RACK CABLING

- Power and heat restraints of GPU servers – fewer servers per rack, more inter-rack cabling
- Cable management, space utilization, reliability

NETWORK EQUIPMENT

Choosing the right network equipment is crucial for data center performance and reliability. High-speed switches, advanced cabling, and software-defined networking (SDN) are essential for optimal operations:

High-Speed Switches
25G, 40G, or 100G capacities handle increasing data volumes and support bandwidth-heavy applications.

Fiber Optics
Fiber optics offer high-speed, low-latency transmission, crucial for modern data centers.

SDN Flexibility
SDN allows centralized network management and adaptability, improving response to business changes.

Investing in high-bandwidth switches, fiber optic cabling, and SDN technologies equips data centers with the necessary infrastructure to support high-performance networking demands.

Fiber Optic Deployment is Key to AI-Driven Data Centers

To fully utilize AI capabilities, technicians must ensure their network infrastructure can support the demanding computational requirements. This is where fiber optic deployments play a crucial role. Fiber optics benefit AI-driven hyper-scale data centers in the following ways.

Extensive Bandwidth and Speed

Optical fiber excels in data transmission, supporting up to 400Gbps, surpassing the 10G limit of the best copper cables, making it ideal for AI data centers requiring high bandwidth.

Long-Distance Integrity

Fiber optic cables maintain signal quality over long distances, ensuring reliable connectivity for geographically dispersed AI data centers.

Low Latency

Fiber optic cables transmit data at near-light speeds, significantly reducing latency compared to copper cables, which enhances data processing efficiency and speed.

Reliability and Scalability

Optical fibers are more stable and less prone to signal loss than copper, supporting extensive and scalable AI data center operations with technologies like wavelength division multiplexing.

Heavy AI Workload Support

Optical fibers provide the necessary capacity and low-latency environment for intensive AI tasks, facilitating swift decision-making and advanced AI functionalities.

Cooling Challenges and Considerations

A typical enterprise data center is not running at 10kW in a cabinet. It's probably running at four or five, with professionals seeing more and more instances where 50 kW, 75 kW, even 100 kW in one cabinet.

AIR COOLING IS LIMITED TO 5kW-20kW APPLICATIONS

COOLING MAKES UP OVER 30% OF THE TOTAL POWER USED IN MANY DATA CENTERS

PROS		CONS
• Integrates with existing server hardware • Simpler to deploy	In-Row Cooling	• Footprint • Cabinet flexibility
• Increased cooling capacity - up to 75kw	Rear-Door Exchangers	• Increased rack-depth • Server maintenance challenges
• Cooling Efficiency – up to 100kw	Liquid Immersion	• Requires special servers • Unable to use fiber connections • Server maintenance challenges
• Low footprint • Integration at Manufacturer	Cold Plate	• Cost • Not all components cooled

Security Considerations

Security is crucial for protecting sensitive data and preventing unauthorized network access. Strong security measures are vital for a high-performance data center connectivity infrastructure.

FIREWALLS AND INTRUSION DETECTION SYSTEMS (IDS)

Monitor and filter incoming and outgoing network traffic, detecting and mitigating potential security threats.

ACCESS CONTROLS

Ensure only authorized users can access sensitive data and network resources, reducing the risk of data breaches and insider threats.

REGULAR SECURITY AUDITS

Identify vulnerabilities and weaknesses in the network infrastructure, allowing organizations to address them proactively.

By prioritizing security considerations and implementing these robust measures, organizations can safeguard their data center connectivity infrastructure against cyber threats and ensure the integrity and confidentiality of their data.

Constructing a high-performance data center connectivity infrastructure requires an investment in high-bandwidth equipment to meet the evolving demands of today's digital-first world and prioritizes scalability and resilience.

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