Big Data Center Interconnection Solution Design

Overview

Explore the advanced Spine-Leaf architecture and EVPN-VXLAN technology in data center networks, providing high-bandwidth, low-latency, and scalable solutions.

Key Takeaways

A robust Big Data Center Interconnection solution integrates high-speed, low-latency network architecture with flexible, simulation-driven power system planning to ensure scalability, reliability, and operational efficiency. Network Architecture for DCISpine-Leaf Architecture: Modern data centers adopt a Spine-Leaf network design, which decouples core and access layers, reduces multi-layer convergence, and allows horizontal scaling by adding uplinks without disrupting bandwidth. Each interconnection link typically supports 100G or higher, with internal POD (Point of Delivery) capacity reaching 24Tb to support high-performance computing clusters and storage systems.

Overlay Networks and Virtualization: Technologies like EVPN-VXLAN enable flexible, elastic network deployments, allowing dynamic allocation of resources and network virtualization. This supports production and office network separation, firewall protection, and high-speed inter-POD communication up to 1. 6Tb/s.

DC

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I Physical Infrastructure: High-capacity fiber-optic links, carrier-neutral connectivity, and advanced cabling solutions like MMC connectors and Flow Ribbon Cables maximize fiber density, reduce conduit space, and accelerate installation, critical for hyperscale AI-driven data centers. Security and Automation: DCI solutions incorporate encryption, secure tunneling, SDN, and programmable network architectures to maintain data security, simplify management, and adapt to evolving business requirements.

Power System Interconnection

Large Load Considerations: Data centers are now hundreds of megawatts in size, often connecting at transmission-level voltages. Their dynamic load profiles, especially for AI training clusters, can fluctuate tens of megawatts within seconds, resembling variable generation rather than traditional industrial loads. Flexible Energy Solutions: To manage grid constraints and interconnection delays, strategies include islanded operation, behind-the-meter generation and storage, and front-of-the-meter integration with batteries or flexible thermal units.

Hybrid energy systems and grid-forming technologies help maintain stability and reliability under rapid load cycling.

Simulation-

First Planning: Using digital twins, load flow, and contingency modeling, operators can validate ride-through, protection, and power quality before physical connection. Hardware-in-the-loop testing ensures controllers and equipment settings are optimized, reducing risk and avoiding costly late-stage changes. Early Engagement: Interconnection planning should start well before project queues, including site selection, energy procurement, and risk management, to prevent delays and ensure high availability for AI workloads.

Integrated Design Approach

Align Network and Power Planning: Ensure network bandwidth and latency requirements match power availability and redundancy strategies. Scalable Architecture: Use Spine-Leaf and overlay networks for horizontal scaling, while designing power systems to accommodate future load growth. Redundancy and Reliability: Implement multi-path network links, carrier-neutral connectivity, and hybrid energy systems to maintain uptime.

Simulation and Validation: Employ high-fidelity simulations for both network and power systems to anticipate bottlenecks, voltage/frequency disturbances, and operational risks. Security and Automation: Integrate SDN, encryption, and programmable controls to manage both network and energy resources efficiently. By combining high-speed, virtualized network interconnects with flexible, simulation-driven power integration, a Big Data Center Interconnection solution can support hyperscale AI workloads, ensure operational resilience, and provide scalable infrastructure for future growth.

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Article Content

Accelerating Data Center Interconnection with Advanced Network ...

Explore the advanced Spine-Leaf architecture and EVPN-VXLAN technology in data center networks, providing high-bandwidth, low-latency, and scalable solutions. Discover the benefits

Data Center Interconnect Solution Overview

The term DCI (Data Center Interconnect) is relevant in all scenarios where different levels of connectivity are required between two or more data center locations in order to provide flexibility for deploying

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Planning for Data Center Grid Interconnection | GE Vernova

Learn how developers manage data interconnection, grid access delays, and data center power issues with flexible power strategies and modeling insights.

Data Center Interconnect Design Guide for Virtualized Workload

The following sections will clarify what are the specific storage requirements for ESX hosts in order to enable workload mobility between data center locations, and will discuss a couple of

Data Center Interconnect Reference Design Guide

So how does a network architect interconnect data centers that are resilient and scalable? This document tries to clarify data center interconnect (DCI) and offer applied solutions to networking

Large load data centers: Interconnection with the power system

While older industrial loads were large but steady and predictable, modern large loads have characteristics that create new and complex challenges for the power system.

DCI Architecture Design: Overcoming Core Challenges in Modern

The rapid growth of cloud services and data-driven applications demands high-performance Data Center Interconnect (DCI) solutions. However, building robust DCI architecture

Scaling large data center interconnects: Challenges and solutions ...

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This paper discusses, from Google''s perspective, emerging challenges and possible technical solutions for scaling intra-datacenter and intra-campus interconnection network bandwidth.

Ultimate Guide to Data Center Interconnect (DCI): Enhancing

Discover the ins and outs of Data Center Interconnect (DCI) technology linking multiple data centers for enhanced connectivity and performance.

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3. Summary□NADDOD Accelerate Data Center Interconnection Considering the current trends in business transformation and the increasing demand for big data, most data center network

AZ-305: Designing Microsoft Azure Infrastructure Solutions

The "cheapest solution that satisfies the security and technical requirements" is frequently the correct architectural response.

Interconnection 101: A Complete Guide [What Is, Types ...

Additionally, the cost of establishing and maintaining interconnections can be a challenge for organizations. What is an example of interconnection? An example of interconnection is the direct

Designing Efficient Data Centers and Interconnection Networks

Data centers are the backbone of our online world. They house critical computing and storage resources, ensuring that applications, data, and content are always accessible. A well

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