

# Data Center Interconnect with Cisco Coherent Pluggable Optics

Gain a Simpler and More Energy Efficient Way to Scale Your  
Data Center Interconnect





## The need for scalable, simple, and sustainable high-bandwidth connections between data centers

AI workloads, cloud-native applications, and other distributed data types continue to increase in size. This puts mounting pressure on data centers to meet rising bandwidth demand, improve scalability, and simplify operations.

To overcome these challenges and achieve business objectives, network operations professionals say interconnecting distributed workloads is their top priority, according to the [2023 Cisco Global Networking Trends Report](#).<sup>1</sup> The key requirements to overcome these challenges include:

- Delivering high-bandwidth connections to cloud providers and colocation sites for mission-critical applications<sup>2</sup>
- Ensuring consistent AI experiences with low-latency connections between data centers<sup>3</sup>
- Fulfilling security, resiliency, and data privacy regulations with secure and protected paths for critical data<sup>4</sup>
- Optimizing data center footprint and energy consumption to reduce operating costs<sup>5</sup>

Traditionally, delivering 400 Gbps between geographically distributed data centers required investing in dedicated optical transport networks or leasing high-capacity circuits from service providers. Both options add cost and complexity to data centers. There are now more innovative options.

<sup>1</sup> [Cisco 2023 Global Networking Trends Report](#).

<sup>2</sup> The global hybrid cloud market is expected to grow at a compound annual growth rate (CAGR) of 22.12% over the 2024–2029 period (Mordor Intelligence, [Hybrid Cloud Market Size and Share Analysis – Growth Trends and Forecasts \(2024–2029\)](#)).

<sup>3</sup> 79% of enterprise networks must reduce latency and/or improve throughput to fully support AI workloads ([Cisco AI Readiness Index, November 2023](#)).

<sup>4</sup> Cloud and endpoint security risks are top challenges to providing secure access from distributed locations ([Cisco 2023 Global Networking Trends Report](#)).

<sup>5</sup> Power demand from data centers is expected to see a six-fold increase over the coming decade (John Pettigrew, CEO of National Grid, March 2024).

## Benefits

Cisco Routed Optical Networking offers a simplified architecture that can help reduce costs and simplify operations, while improving scalability and sustainability for data center interconnect:

- Lowers equipment costs by replacing stand-alone optical networking devices with a pluggable coherent optical module that can be deployed in routers and switches
- Improves network performance and enables predictability and control of traditional transport through increased visibility in the IP networking layer
- Eliminates the complex traffic engineering required to overcome impairments in optical fiber infrastructure with a more robust, coherent optics technology for delivering high speeds
- Reduces over 80% of energy use by lowering power, cooling, and footprint for delivering high-bandwidth transport.
- Simplifies operations of the network with automation and assurance capabilities

## Overview

To expand high-bandwidth connections between data centers, there is now a solution built to offer increased scalability, simplicity, and energy efficiency. [Cisco Routed Optical Networking](#) is designed to offer a simplified architecture to scale Data Center Interconnect (DCI) and create opportunities to reduce operating costs and lower energy consumption. The solution simplifies transport between data centers by replacing stand-alone optical transponders with the Cisco® portfolio of standardized coherent pluggable modules, which can be deployed directly in a data center switch or router.

This can reduce the cost and complexity of extending 400G signals between data centers located from 40 km to over 1,000 km apart. In addition, the smaller footprint and lower power consumption means that data centers can save over 80% on space, power, and cooling requirements for their DCIs.<sup>6</sup> Operations can be simplified further by making transport streaming telemetry data visible and actionable for IP network automation, management, and assurance systems.

<sup>6</sup> [ACG Whitepaper: The economic benefits of Routed Optical Networks for DCI, Metro, and long-haul applications.](#)

## How it works

Cisco Routed Optical Networking for DCI connects switches and/or routers in data centers over dark fiber by plugging industry-standard 400G coherent pluggable optics into QSFP-DD ports.

The solution is enabled by several key innovations:

- Application-Specific Integrated Circuit (ASIC) designs, such as [Cisco Silicon One](#), which provide significant improvement in switching/routing port density, throughput, and power efficiency
- Silicon photonics, low-power Digital Signal Processor (DSP) ASICs, and advanced optoelectronic packaging designs implemented in Cisco coherent pluggable optics to enable the functionality of a chassis-based Dense Wavelength-Division Multiplexing (DWDM) transponder to be implemented in a pluggable form-factor

- Industry standards and open, multi-source agreement specifications that create a robust foundation for the **Cisco portfolio of coherent optical interfaces**, which can overcome optical impairments on existing fiber spans and interoperate across open line systems
- Network and software automation that simplify provisioning, operations, performance management, and assurance of 400G interconnects, optical networks, and IP and service layers

### Point-to-point deployment model

The simplest deployment model is **point-to-point**, which connects two locations directly from switch ports in the data center, transporting a single 400G wavelength. Typically, this deployment model spans up to 40 km reaches without the need for amplification and can be extended to longer reaches with amplification (Figure 1).

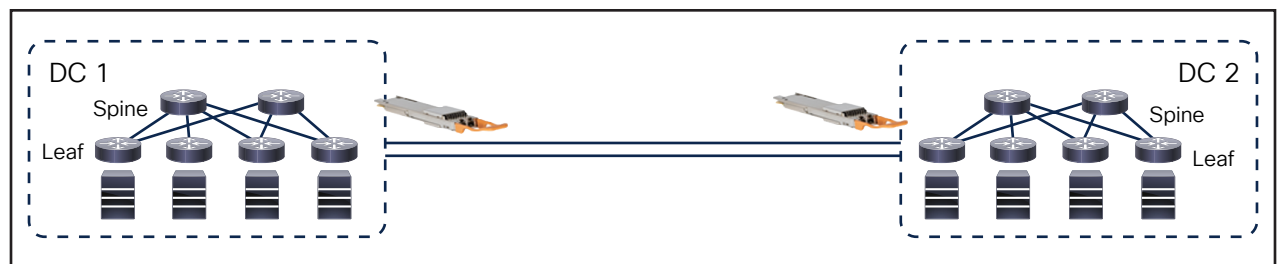


Figure 1. DCI transport from data center switches

### Point-to-point solution components

Cisco coherent pluggable optics:

- [Cisco 400G QSFP-DD ZR](#)
  - Reaches up to 120 km at 400G with amplified links
- [Cisco 400G QSFP-DD ZR+](#)
  - Reaches up to 1,000 km at 400G with amplified links
  - High-performance Forward Error Correction (FEC) for longer transmission distances

- [Cisco 400G QSFP-DD ZR+ High Tx Power](#)

- Reaches up to 1,200 km at 400G; compatible with any type of DWDM infrastructure
- Integrated optical amplifier offers higher transmission power and longer reach

Cisco data center switch platforms:<sup>7</sup>

- Cisco Nexus® 9000 Series Switches
- Cisco Nexus 9300 Series Switches
- Cisco Nexus 9400 Series Switches
- Cisco Nexus 9500 Series Switches
- Cisco Nexus 9800 Series Switches

Cisco data center network management, automation, and assurance platform:

- [Cisco Nexus Dashboard](#)
  - Cisco Nexus Dashboard is a single platform to configure, operate, and analyze data center network infrastructure and extend the management of Cisco Nexus-based networks for DCI connections. The dashboard enables automating the provisioning of DCI connections and creates opportunities for more energy-efficient data centers by factoring energy consumption, emissions, and costs

<sup>7</sup> Check the [Cisco Optics-to-Device Compatibility Matrix](#) for compatibility.

## Router-enhanced deployment model

A second type of deployment model enhances 400G transport with more scalable network and traffic route control functionality implemented through Cisco routing platforms. This deployment model is ideal for delivering carrier-class performance across multi-site connections with traffic prioritization and load balancing.

- Capacity can be expanded by adding multiple wavelengths over an Optical Line System (OLS). The simplified optical line system is offered through Cisco QSFP-DD OLS, which provides optical amplification and multiplexing/demultiplexing in a standardized QSFP-DD form factor. Cisco coherent pluggable optics are interoperable across Cisco and third-party open line systems (See Figure 2).

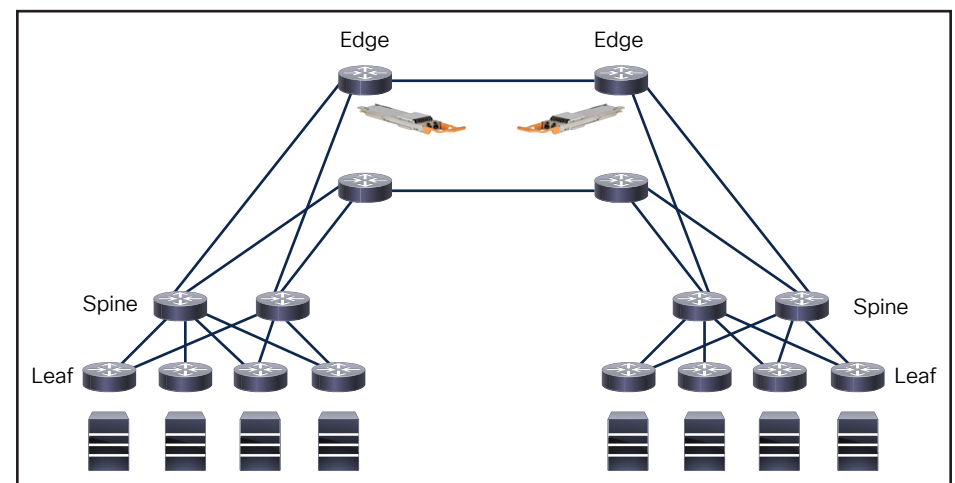


Figure 2. DCI transport from edge routers

## Router-enhanced solution components

Cisco coherent pluggable optics:

- [Cisco 400G QSFP-DD ER1](#)
  - Transmits at a single wavelength of 400G up to 45 km
- [Cisco 400G QSFP-DD ZR](#)
  - Reaches up to 120 km with amplified links
- [Cisco 400G QSFP-DD ZR+](#)
  - Reaches up to 1,000 km at 400G with amplified links
  - High-performance FEC for longer transmission distances
- [Cisco 400G QSFP-DD ZR+ High Tx Power](#)
  - Reaches up to 1,200 km at 400G; compatible with any type of DWDM infrastructure
  - Integrated optical amplifier offers higher transmission power and longer reach
- [Cisco QSFP-DD OLS](#)
  - Pluggable OLSs offer an integrated optical amplifier and multichannel line system; supports 4, 8, 16, or 32 channel systems directly from a QSFP-DD port

Cisco routing platforms:<sup>8</sup>

- Cisco 8000 Series Routers
- Cisco Network Convergence System 540 Series Routers
- Cisco ASR 9000 Series Aggregation Services Routers
- Cisco Network Convergence System 5500 and 5700 Series

Cisco network management, automation, and assurance platforms:

- [Cisco Crosswork Network Automation](#)
  - Simplifies and modernizes network planning, design, implementation, and operations. It offers multi-vendor and multi-domain network automation to help execute service lifecycle management and operations with speed, precision, and accuracy
- [Cisco Provider Connectivity Assurance](#)
  - Provides service assurance for DCI performance with real-time monitoring and automated closed-loop control for proactive assurance

<sup>8</sup> Check the [Cisco Optics-to-Device Compatibility Matrix](#) for compatibility.

## Learn more

- [Discover](#) Cisco coherent pluggable optics that can transform your high-capacity data center interconnect
- [Save now](#) on Cisco 400G coherent pluggable optics
- [Learn more](#) about new architectures enabled by Cisco Routed Optical Networking

## Use cases

Government (Local, State, Federal)	<ul style="list-style-type: none"> <li>• Public safety systems</li> <li>• Secure data transport</li> <li>• Middle mile connectivity</li> </ul>
Finance	<ul style="list-style-type: none"> <li>• High-speed and low-latency financial transactions</li> <li>• AI/ML applications</li> <li>• Disaster recovery</li> </ul>
Utilities	<ul style="list-style-type: none"> <li>• Disaster recovery requirements for critical infrastructure</li> <li>• High-bandwidth connectivity between locations/substations</li> </ul>
Healthcare	<ul style="list-style-type: none"> <li>• High-bandwidth connectivity for medical imaging</li> <li>• AI/ML applications</li> </ul>
Education	<ul style="list-style-type: none"> <li>• High-bandwidth connectivity for advanced research networks</li> <li>• Connectivity between major campus locations and research centers</li> </ul>
Transportation	<ul style="list-style-type: none"> <li>• High-bandwidth connectivity between locations</li> <li>• Connectivity along transport right-of-way</li> </ul>

## The Cisco Advantage

Cisco offers a vertically integrated solution from the optical interconnects to data center switching and routing platforms to software, automation, and assurance that can deliver the simplification needed to transform a DCI.