



Long Haul Data Center Interconnect Solution

Cisco's Long Haul Data Center solution is optimized for high density with a small footprint and is delivered with a unified management system that lets you do more with less.

Benefits of optical agility:

- Forms a cornerstone of programmable network architectures
- Contentionless add/drop line cards—the ability of an N-degree ROADM node to accommodate N wavelengths of the same frequency from a single add/drop device—combine non-blocking scale and touchless re-configurability in an easy-to-use form factor
- Colorless characteristic simplifies provisioning and allows dynamic restoration because the frequency of an ingress channel can be re-tuned by software without requiring its fiber to be relocated
- Omnidirectional ROADM ports are not associated with a specific ROADM degree so a wavelength re-route does not require a physical fiber move and it can be executed entirely by software
- With the Flex Spectrum feature, the amount of spectrum allocated to a wavelength can be flexibly provisioned to allow for multicarrier super channels or single wavelengths exceeding today's 50-GHz channel spacing

What if you could reduce your routing and optical footprint while adding more capacity to expand bandwidth while simultaneously reducing costs? What if you had more visibility into your network and more control over how you wanted it to run at both the optical and routing layer? With the Cisco Long Haul DCI solution, you can do all that and much more.

Overview

It seems there's no limit to the growth of network traffic. Per month, IP traffic is set to reach 278 exabytes and Internet traffic 235.7 exabytes by 2021. The average Internet user alone will generate 57.0 gigabytes of Internet traffic per month in 2021, up 139 percent from 23.9 gigabytes in 2016. By 2021, average broadband speeds will be a speedy 53 Mbps.¹

Within data centers, global IP traffic is expected to grow at a Compound Annual Growth Rate (CAGR) of 27 percent between 2015 and 2020. This growth will be driven by the increasing Machine-to-Machine (M2M) traffic as well as the demand for higher bandwidth for cloud services; increasing digitization; mobility; and the Internet of Things. Cloud traffic will nearly quadruple during the forecast period, representing 92 percent of data center traffic by 2020. Data center to data center IP traffic will grow at a CAGR of 31.9 percent during that time, to 1,381 exabytes annually.²

It's clear that this growth in network traffic will greatly impact all data centers globally. The challenge for large businesses and service providers will be to deploy infrastructure and solutions that maintain a high quality experience for employees and customers at the lowest possible cost. This will require a high degree of automation and intelligence; flexibility in resource sharing; solutions that promote greater density among existing transport resources and a long-term vision that embraces proaction instead of reaction.

Cisco Data Center Interconnect (DCI) solutions are designed to simplify, automate, and optimize different types of DCI solutions—from intra-data center campus, enterprise to data center, disaster recovery, Metro DCI and long haul data centers connecting globally.

Addressing growing demands, requirements and costs

The pressure is on in data centers. Manual turn-up of optical wavelengths and services and configuration of gear will soon be the past. Automation and orchestration are the newer, better ways of provisioning, deploying and managing DCI solutions. With an automated services environment, you go from weeks to hours for deployment and change requests. Service providers in particular can see a big reduction in operational costs so their teams can focus on more productive and helpful networking tools.

IP advances like Segment Routing can reduce your routing table size while also scaling the network. Newer optical advances like [Flexible Light Orchestration of Wavelengths](#) let you pack more capacity into an individual fiber and balance the tradeoffs between capacity and distance. And, do it with using the current mesh Reconfigurable Optical Add/Drop Multiplexer (ROADM) network you have in place today.

Data center footprint is also becoming a challenge as data centers are crammed with servers and networking equipment, contributing to growing power and cooling requirements. The ability to reduce the networking footprint can go a long way towards lowering costs and using local power and energy efficiently.

For DCI you need clear visibility into all of the packet flows, optical ports and DWDM trunks. Automation can help you correlate alarms to understand what actions are required. The Cisco automation environment along with real-time telemetry provide end-to-end visibility for more control and better management of services.

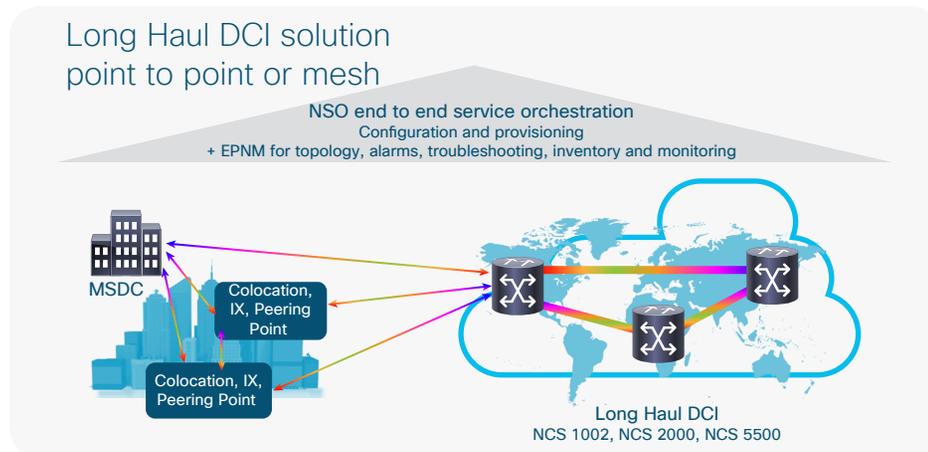
¹ Cisco Visual Networking Index (VNI) Forecast and Methodology 2016–2021.

² Cisco Cloud Global Index: Forecast and Methodology, 2015–2020.

Cisco Long Haul DCI solution overview

The Cisco Long Haul DCI solution is meant to interconnect data centers, massively scalable data centers (MSDCs), Internet Exchanges (IXs) and peering points stretching hundreds to thousands of kilometers. Two topologies can be deployed. A high-density optical mesh long haul DCI platform can be overlaid on your current optical network, creating express routes with high bandwidth. Or a point-to-point topology, with intermediate sites serving to amplify the signals.

Figure 1. Long Haul DCI: Point-to-point or mesh topology



In Figure 1, service providers, Over-The-Top (OTT) providers and colocation providers can connect multiple customers to large colocation sites across cities and countries. The colocation providers may sell space and power or be used as an Internet Exchange (IX) and peering point. An OTT provider may locate a large portion of their own data center in all of these colocation sites and interconnect their data centers at the optical and/or the routing layers. Some of the platforms used here are based on IOS XR and may use Cisco Evolved Programmable Network Manager (EPNM) for management, inventory and topology, while Cisco Network Services Orchestrator (NSO) is also offered for full end-to-end orchestration, configuration and provisioning of both the optical and routing layers.

The Cisco Long Haul DCI solution with a flexible mesh topology features an optical mesh topology that provides interconnectivity with high reliability and resiliency at a low cost point. The network architectures feature:

- **Cisco Network Convergence System (NCS) 5500 Series Routers** provide Layers 2-3 switching, and are interconnected at different data centers via an optical mesh topology. The NCS 5500 is low power, high density, offers flexible chassis options and runs IOS XR software that includes Segment Routing and enhanced scalability with options that include external Ternary Content-Addressable Memory (TCAM).
- **Cisco NCS 1002** has an optimized footprint at 2 RU and supports up to 2 Tbps of both client and 2 Tbps of trunk traffic. It can transport 100, 200 or 250 Gbps wavelengths on the same platform through software provisioning. The Cisco NCS 1002 features a software configurable modulation scheme per slice, allowing the operator to customize the spectral efficiency and reach characteristics of individual wavelengths. The system uses IOS XR and encompasses carrier-class software with a number of features such as Machine-to-Machine (M2M) APIs based on YANG data models; a streaming telemetry agent for real-time, granular device monitoring; and also an infrastructure for third-party applications. With increasing requirements for data privacy and data protection across the globe, encryption of any data that leaves the data center facility is becoming an important requirement for cloud operators. The NCS 1002 provides AES256-based MACSec encryption for 10GE, 40GE and 100GE clients. The solution supports smart licensing for flexible pay-as-grow models.
- **Cisco NCS 2000** series delivers agility, programmability, and massive scale across ultra-long-haul, metro, and enterprise optical networks. Using the Cisco NCS 2000 Series, you can deploy a simple yet intelligent DWDM network that scales with operational ease. The Cisco NCS 2000 Series delivers agility with a touchless, flex-spectrum ROADMs, and massive scale with 100 and 200 Gbps transponding and muxponding functionality.

The added resiliency of a meshed optical network using ROADMs alleviates the need to create diverse routes for failover, which can become very expensive.

The Cisco Long Haul DCI solution with point-to-point topology features single point-to-point high-speed optical connections from one data center to another. It has been a popular topology among cloud providers and Web-based companies due to its simplicity and because of the maximum capacity of a fiber that can be used between two links. The point-to-point architecture is also chosen by customers that don't need or want protection and restoration at the optical layer. The network architecture features:

- **Cisco NCS 1002** has an optimized footprint which at 2 RU supports up to 2 Tbps of both client and 2 Tbps of trunk traffic. It can transport 100, 200 or 250 Gbps wavelengths on the same platform through software provisioning. The Cisco NCS 1002 features a software configurable modulation scheme per slice, allowing the operator to customize the spectral efficiency and reach characteristics of individual wavelengths. The system uses IOS XR and encompasses carrier-class software with a number of features such as Machine-to-Machine (M2M) APIs based on YANG data models; streaming telemetry agent for real-time, granular device monitoring; and also an infrastructure for third-party applications. With increasing requirements for data privacy and data protection across the globe, encryption of any data that leaves the data center facility is becoming an important requirement for cloud operators. The NCS 1002 provides AES256-based MACSec encryption for 10GE, 40GE and 100GE clients. The solution supports smart licensing for flexible pay-as-grow models.
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With point-to-point interconnectivity, depending on the distance, the Cisco NCS 1002 can provide sufficient amplification. A protection and restoration module for the Cisco NCS 1002 is also optionally available, which is the NCS 1001 that can be used for higher loss spans or spans that extend slightly beyond 100kms.

For longer distances, the NCS 2000 is usually deployed with multiple degrees and ROADM capability. This is an efficient use of long haul fibers.

Key features and technologies

- **Flex Spectrum:** This feature supports a new flexible control plane for the NCS optical platforms and provides more capacity and spectral efficiency per fiber. Targeted for use in both point-to-point and mesh topologies, Flex Spectrum allows for a higher modulation to boost capacity by up to 30 to

50 percent. By using the flexible control plane, providers can adjust their bandwidth automatically to take advantage of the physical tradeoffs that exist.

- **Cisco Evolved Programmable Network Manager:** Cisco EPN Manager provides simplified, converged, end-to-end lifecycle management for carrier-grade networks of all sizes. It helps you increase operational scale and efficiency through integrated and automated device operations, network provisioning, and network assurance. You can proactively assure service performance and minimize future service disruption through real-time fault management. Service agility is increased through integrated lifecycle management and standards-based Northbound Interfaces (NBIs) to third-party Operations Support Systems (OSSs). With EPN Manager, you can perform service provisioning, monitoring, and change and compliance management to accelerate device and services deployment and to rapidly resolve problems that can affect the end-user experience.
- **Cisco WAN Automation Engine (WAE):** WAE is a powerful and flexible optimization platform that automates the engineering and operations of multivendor physical and virtual WAN infrastructures. You can use WAE to deploy new services, including global load balancing, bandwidth on demand, and premium/latency based network routing. It can help you optimize traffic load-balance over core MPLS and segment routing links. It can also minimize service down-time through worst case failure analysis and reduce both OPEX and CAPEX costs through efficient asset utilization.
- **Cisco Network Services Orchestrator (NSO):** Cisco NSO lets you deliver services faster and more easily to your customers through network automation. It can drastically reduce the time to on-board new services in the network using model-driven orchestration. NSO can help you accelerate revenue-generating services with automated, self-service, on-demand provisioning that reduces activation times from months to minutes. You can increase business agility with the capability to create, reconfigure, and repurpose services in real time. Simplify your network operations by automating the end-to-end service lifecycle and reducing manual configuration steps by up to 70 percent, according to Cisco estimates. NSO can help you differentiate the services you offer with automated advanced device features, bundled network services, and real-time assurance. Dramatically reduce downtime with exceptional control over network changes and the capability to reconfigure devices and services during live production.

Cisco Services

Cisco Services has decades of professional services experience helping enterprise businesses, content providers, service providers and others plan, build, and manage network migration projects.

Cisco DCI solutions can be slightly different from customer to customer. We have the flexibility to understand and help you achieve your specific goals. Cisco Services uniquely deliver innovative solutions, unmatched expertise, and smart service capabilities using a collaborative partner approach. [Learn more.](#)

Financing to help you achieve your objectives

Cisco Capital can help you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce CapEx and accelerate your growth. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. Cisco Capital is available in more than 100 countries. [Learn more.](#)

Diverse DCI solutions

Metro DCI

- Metropolitan and regional links
- Distance: 10s to 100s of km
- Cisco DCI supporting both mesh and point-to-point topologies

Enterprise Intra DCI

- Within a campus of data centers
- Distance: Within 10s to 100s of km
- Cisco DCI with a point-to-point optical topology

Long Haul DCI

- National and global long distance links
- Distance: 100s to 1000s of km
- Cisco DCI supporting both mesh and point-to-point long haul topologies

Enterprise

- Enterprise connection to colocation center, Internet Exchange and peering point, and disaster recovery
- Distance: 10s to 100s of km
- Cisco DCI supporting both point-to-point routing and optical topologies

Why Cisco?

As a global networking innovator, Cisco understands the needs of network operators and businesses that need to harness the latest cost benefits and features of the network to survive and thrive. Our DCI solutions span the broadest range of platforms, technologies and topology options designed to provide you with the right solution to address your specific needs.

Our customers are pursuing DCI solutions to enhance workload mobility and to provide business continuity and disaster recovery. New, more efficient, more automated and lower cost ways of interconnecting data centers are here. Trust Cisco to be at the forefront of their development and look to us as a valuable partner within the data center and beyond.

Next steps

Learn more about Cisco solutions for Long Haul DCI. Contact your Cisco account representative today.

[Cisco NCS 5500](#)

[Cisco NCS 2000](#)

[Cisco NCS 1002](#)