



Enterprise and Intra-Data Center Interconnect Solution

Cisco's Intra-Data Center and Enterprise Data Center Interconnect (DCI) solution is optimized for high density with a small footprint; is deployed with a single operating system across the routing and optical layers; and is delivered with a unified management system that lets you do more with less.

IOS XR automation benefits

- Common data models for DCI network abstraction.
- Common streaming telemetry for transmitting DCI configurations.
- Common system behavior across Layers 1-3.
- Better coordination and fewer errors in Layers 1-3 network changes.

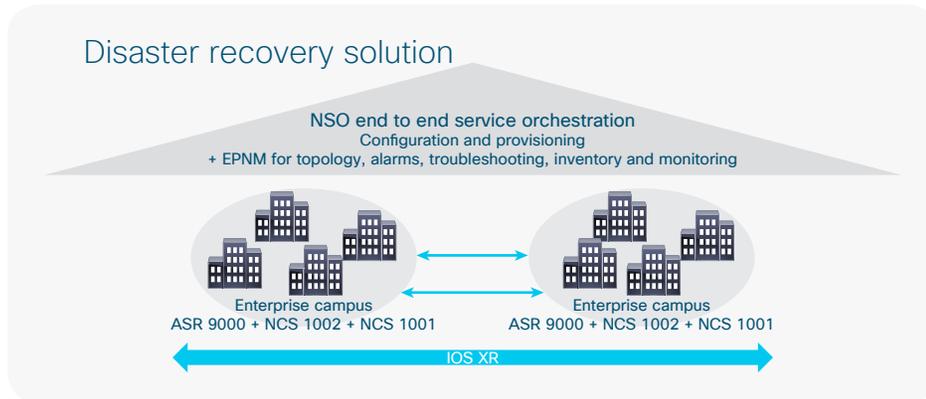
What if you could reduce your routing and optical footprint while adding more capacity to expand bandwidth while simultaneously reducing costs? What if you had more visibility into your network and more control over how you wanted it to run at both the optical and routing layer? With the Cisco Intra-Data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

Figure 1. Enterprise and Intra-Data Center DCI solution



The Intra Data Center solution connects several enterprise data centers and then brings their traffic via a high-speed optical link to the closest colocation or peering point. Once the enterprise data center is located in the colocation site, it can be managed by a single management system while configuration and provisioning can be automated when Cisco Network Services Orchestrator (NSO) orchestration is deployed.

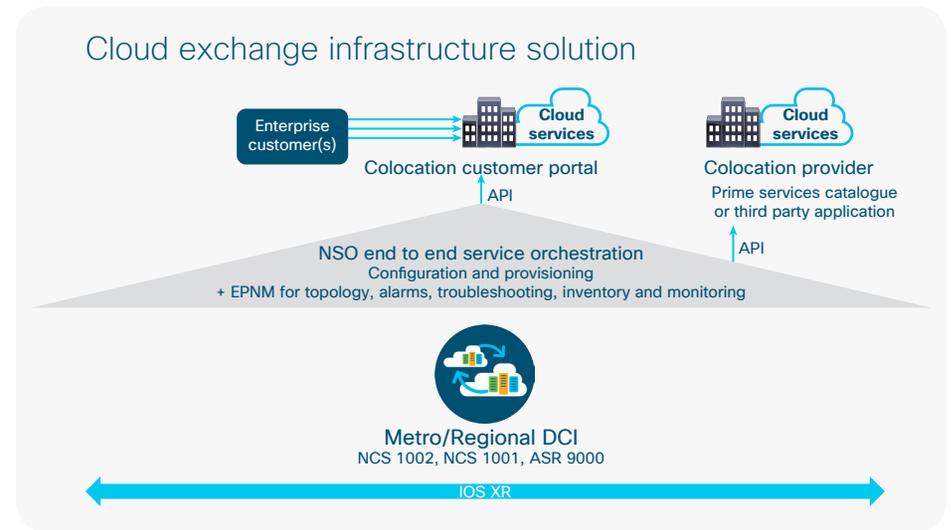
Figure 2. Enterprise disaster recovery solution



Large enterprises today deploy backup data centers to ensure the reliability of their most critical data for continuity and corporate compliance requirements.

Often multiple data centers are gathered and backhauled to the disaster recovery site where all data is replicated. The DCI must be robust enough to dynamically access all of the interconnected data centers, and in the case of a catastrophic event ensure that all the data is available and secure.

Figure 3. DCI for cloud infrastructure



Across the globe, enterprises are turning to cloud-based services to share the data center cost. Savvy colocation providers around the world are introducing valuable cloud exchange services to solve this growing need. Previously, enterprises had to cross the Internet on best effort links for their cloud services, but today colocation providers offer a direct connection and it is to multiple cloud providers within the colocation site.

If a colocation provider offers a customer portal, with the Cisco NCS 1000 and Cisco ASR 9000 platforms and Cisco NSO simple provisioning of the network elements can be done via an API, keeping the colocation portal and network topology in place. If no portal exists, Cisco offers a colocation provider the Cisco Prime Services Catalogue or a third party application to help create a portal for that provider, making for an easy transition to provisioning through the Cisco NSO API.

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 proactive measures 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. Cisco provides the only DCI solution with a single operating system across both the IP and optical components of the network with the ASR 9000 Series and the NCS 1000 Series. This common operating system—IOS XR—offers several compelling benefits for the combined solution.

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

Data center footprint is also becoming challenging 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 the energy more 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 Enterprise and Intra-Data Center DCI solution overview

The Cisco Intra-Data Center and Enterprise DCI solution is meant to interconnect traffic between local data centers and to facilitate various enterprise interconnect requirements. These include connecting gear in enterprise buildings throughout a campus and connecting enterprise data centers to colocation sites for routing to ISPs, national or international carriers and content providers.

The Cisco Intra-Data Center and Enterprise DCI solution features secure, 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 ASR 9000 Series Routers** provide Layers 2-3 switching and routing, and are interconnected at different data centers via an optical mesh topology. The ASR 9000 is low power, supports high density 100GE interfaces, offers flexible chassis options and runs highly resilient IOS XR software that includes Segment Routing and enhanced scalability. IOS XR enables such features 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.
- **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 also 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.

- **Cisco NCS 1001** is a Dense Wavelength-Division Multiplexing (DWDM) line system that is mechanically optimized for data center environments. It is performance optimized for maximum capacity and provides complete automation of installation and configuration with real-time and fine-grained monitoring. The Cisco NCS 1001 is a 1RU system that is capable of supporting up to three pluggable modules. The modules can be amplifiers or protection switch modules.

Key features and technologies

Cisco DCI solutions run on a single operating system – Cisco IOS XR – for routing, aggregation and optical transport. The software is packed with features representing over 15 years of global development and deployment. Cisco IOS XR is modular so that major features are available as independent packages. Industry-standard RPMs align update and upgrade procedures with those used in the data center.

- **Zero touch provisioning and iPXE:** Say goodbye to manual processes – device onboarding is now automated. Boot and day-zero provisioning are fast and bring devices online in minutes instead of hours. The iPXE feature supported in Cisco IOS XR software allows an administrator to boot from TFTP, HTTP or FTP.
- **YANG data models for automated provisioning:** Cisco IOS XR cloud-scale features include integration with structured, data model-driven, high-performance APIs so you can move beyond the Command Line Interface (CLI), if you wish. A comprehensive set of YANG-based configuration and operational data models let you control the rich feature set of the OS. There is support for native, OpenConfig and IETF models. The YANG modeling language is optimized for network devices with many tools and utilities. Encoding is decoupled from the model so you can deploy with data encoded in JSON, XML or Google Protocol Buffers (GPB) format. Transport is also decoupled from the choice of encoding for further flexibility. Use NETCONF, RESTCONF or Google RPC (gRPC). The Yang Development Kit (YDK) is provided, letting developers auto-generate model-driven APIs from any Yang model for Python and C++.

- **Model-driven telemetry for real-time, detailed visibility:** End-to-end visibility into network infrastructure is a required feature of cloud-scale networking. Until now, visibility has been limited to sections of network topologies. And it hasn't been available to administrators in real time. But with the demands of a quickly digitizing world, you need to see what is going on in all facets of your network all the time. Visibility must be continual and automated to support the scale and agility required today and increasing in the future.

Cisco model-driven telemetry, available with Cisco IOS XR Software, is a new and improved approach to network monitoring. Data is streamed and captured continuously from devices with efficient, incremental updates. Model-driven telemetry is fully configurable using telemetry YANG models. You can precisely specify what data to stream, to where, and with what encoding and transport using just the models. With model-driven telemetry, you simply specify the YANG model that contains the data you want.

Model-driven telemetry opens up your entire operational space for fine-grained control. The increased visibility provided by the streaming telemetry push model enables the highly efficient techniques of segment routing for near real-time network optimization.

Additional technologies that can be used with this solution include:

- **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: 10km to 100s of km
- Cisco DCI supporting both mesh and point-to-point topologies

Enterprise Intra DCI

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

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 Enterprise and Intra-Data Center DCI. Contact your Cisco account representative today.

[Cisco ASR 9000](#)

[Cisco NCS 1001](#)

[Cisco NCS 1002](#)