

# Cisco Unified Fabric: Enable the Data Center Network

## What You Will Learn

Cisco® Unified Fabric is the networking foundation that enables the network of today and tomorrow and allows chief information officers (CIOs) and IT departments to achieve their goals.

## Challenges of Today's Data Centers

CIOs today are the primary interface between the business and the IT department. CIOs understand what the business needs are and how the IT department can service those needs, both in the short and the long term as a true partner rather than as a service bureau.

While challenged by budgets and the pressures of business needs, CIOs know that unceasing technological change due to burgeoning trends such as video, convergence, public/private cloud, and workload mobility have to be accounted for in data center design and practices. Operational silos and infrastructure not optimized for virtualized and cloud environments hamper the data center from becoming the engine of enablement for the business. Complexity from the human and technological sides of the equation hamper efficiency and impede progress in the data center. With all of this knowledge, the CIO want to bring the services that the business needs. But how?

IT department budgets are likely to remain at current levels or decline. In the traditional data center environment, IT staff focuses about 70 percent or more of its activity on maintenance tasks required to keep existing infrastructure operating properly. If that ratio can be reversed - to 70 percent of staff time spent on new projects that focus on the business and 30 percent spent on maintenance tasks - the needs of the business can be served without costly additional staffing. In addition, because IT staff will be able work on new projects rather than simply day-to-day maintenance, employee morale and job satisfaction is improved, which can reduce costly employee turnover.

IT is the strategic business enabler that must evolve as the business evolves. To do this, IT must be ahead of emerging trends, and to be a real partner to the business, the IT department needs to increase the speed at which projects are rolled out. To meet business goals, deployment times that range from 6 to 36 months are unacceptable. In the past, CIOs could increase staff to meet business needs, but today's budget constraints make that solution no longer feasible. The real solution is to shift the activity of the current IT staff from the current maintenance of ongoing operations to more business-oriented projects without endangering the current operations. The impact of IT on overall revenue is reduced with efficiencies enabled by evolving trends such as virtual desktop infrastructure (VDI).

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Evolution in the data center can help transform IT departments and break organizational silos and reduce technological complexity. Private and public and private cloud hybrids and other strategies can automate the data center and enable self-service for both IT and the business units. However, making the transition to any of these models is not a simple task, but a journey that requires multiple steps. Every data center has different requirements to serve the business. Most IT departments have started on server virtualization and consolidation projects, which constitute the first steps. 10 Gigabit Ethernet and the evolution of the data center network into a virtualization enabling environment are also part of it. The next step is to prepare the network for the journey to the cloud, whether private or a private and public hybrid environment.

### What Is Cisco Unified Fabric?

A key building block for general-purpose, virtualized and Cloud-based data centers, Cisco Unified Fabric provides the foundational connectivity and unifies storage, data networking and network services delivering architectural flexibility and consistent networking across physical, virtual and cloud environment. Cisco Unified Fabric enables CIOs to address the challenges of the data center in a comprehensive and complete manner. Cisco Unified Fabric creates a true multiprotocol environment on a single network that enables efficient communication between data center resources. Cisco Unified Fabric provides the architectural flexibility needed for companies to match their data centers to business needs and change as technology and the business changes. The functions of the data center are becoming more automated, shifting the focus from the maintenance of infrastructure to the servicing of business needs. CIOs need faster application response time not only in the headquarters office, but also for remote employees and often on a worldwide basis. They also need critical business applications deployed and upgraded quickly while providing consistency of experience for the end user and the IT administrator. Operating costs for the data center, including energy (both electrical costs and heating, ventilation, and air conditioning [HVAC] costs), need to be reduced, or at least not increase as energy prices increase. For IT to meet these CIO goals, it needs a strong and flexible foundation to run on, and Cisco Unified Fabric provides the architectural flexibility necessary. Cisco Unified Fabric provides the networking foundation for the Cisco Unified Data Center on which you can build the data center architecture, whether you run a traditional data center or are on the journey to full private cloud computing or hybrid private and public cloud computing.

Cisco Unified Fabric is built on three main pillars: convergence, scalability, and intelligence brings solutions when you need them, enabling optimized resources, faster application rollout, greater application performance, and lower operating costs. Cisco Unified Fabric can help you reduce costs, migrate to the next generation data center, and bring value to your business.

#### Convergence

Convergence of the data center network is the melding of the storage network (SAN) with the general data network (LAN). Convergence is not an all or nothing exercise, despite fears to the contrary. Convergence, just like the private cloud data center, is a journey that has many steps. Companies need to keep using their current SAN infrastructure while extending it gradually, transparently, and non-disruptively into the Ethernet network. The traditionally separate LAN and SAN fabrics evolve into a converged, unified storage network through normal refresh cycles that replace old servers containing host bus adapters (HBAs) with new ones containing converged network adapters (CNAs), and storage devices undergo a similar refresh process. Customer investments are protected throughout their service and financial life; transitions are gradual and managed.

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One concern about the converged network is that Ethernet networks are not reliable enough to handle sensitive storage traffic: storage traffic needs to arrive with dependable regularity, and in order and without dropping any frames. However, with fully standardized IEEE Data Center Bridging (DCB), Cisco provides lossless, in-order reliability for data center environments in conjunction with Cisco's work with INCITS on Fibre Channel over Ethernet (FCoE). Cisco customers can deploy an Ethernet network for the data center that conforms to the needs of storage traffic, with a lossless, in-order, highly reliable network for the data center. The reliability features that are so necessary for storage traffic are also becoming increasingly necessary for general data center traffic, proving that these protocols and implementations are not merely storage specific, but a valuable part of the overall effort to increase the reliability of the data center environment as it evolves.

One of the main ways in which Cisco Unified Fabric brings about a converged network in the data center is through transparent integration. Transparency means that not only does a Cisco Unified Fabric bring the essential convergence, but it also integrates with the existing infrastructure, preserving the customer's investment in current SAN technology. Both the Cisco MDS 9000 Family and the Cisco Nexus<sup>®</sup> product family have features that facilitate network convergence. For instance, the Cisco MDS 9000 Family can provide full, bidirectional bridging for FCoE traffic to older Fibre Channel-only storage arrays and SANs. Similarly, servers attached through HBAs can access newer storage devices connected through FCoE ports. The Cisco Nexus 5548UP and 5596UP Switches have unified ports. These ports can support 10 Gigabit Ethernet (including FCoE) or Fibre Channel. With this flexibility, customers can deploy these Cisco Nexus models now connected to traditional systems with HBAs and convert to FCoE or other Ethernet- and IP-based storage protocols such as Small Computer System Interface over IP (iSCSI) or network-attached storage (NAS) as those servers are refreshed.

Because the Cisco Nexus Family and Cisco MDS 9000 Family run the same operating system, Cisco NX-OS Software, IT staff knowledge and scripts applies across all switching platforms in the converged network. For example, a new server with an HBA is zoned the same way on both a Cisco MDS 9000 Family and Cisco Nexus Family switch, and it would be zoned in the same way on both switch families if it had a CNA.

The transparent nature of convergence with Cisco Unified Fabric also extends to management. Cisco Data Center Network Manager (DCNM), Cisco's primary management tool, is optimized to work with both the Cisco MDS 9000 and Cisco Nexus Families. Cisco DCNM provides a secure management environment that can manage a fully converged network and also monitor and automate common network administration tasks. With Cisco DCNM, customers can manage storage and general data center networks as a single entity. By using a familiar tool to manage both networking and storage, Cisco eases the transition from separate storage and data networks to a converged environment.

Consolidation of the general data and storage network can save customers a lot of money. For example, customers can significantly decrease the number of physical cables and ports by moving to a converged 10 Gigabit Ethernet network because the number of cables required for reliability and application bandwidth is significantly reduced. A standard server requires at least four networking cables: two for the SAN and two for the LAN with current 1 Gigabit Ethernet and Fibre Channel technology. Often, more 1 Gigabit Ethernet ports are needed to meet bandwidth requirements and to provide additional connections for server management and for a private connection for server clusters. Two 10 Gigabit Ethernet converged ports can replace all these ports, providing a cable savings of at least 2:1. From a larger data center perspective, this cable reduction means fewer ports and the capability to decrease the number of switches and layers in the data center, correspondingly reducing the amount of network oversubscription. Reducing cabling saves both acquisition cost and the cost of running the cables, and it reduces cooling costs by improving airflow.

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Also, by eliminating or reducing the second network, customers end up with less equipment in the data center, saving on costly rack space, power, and cooling and making the overall data center much more efficient. However, the biggest cost savings is the capability for administrators to shift their time from maintenance of two separate networks and their associated cables and hardware to working on projects that directly benefit the business.

## Scalability

A simple definition of scalability is the ability to grow as needs change, often described by the number of nodes that a given architecture can ultimately support. Cisco Unified Fabric brings thinking out-of-the-box perspective and offers multidimensional scalability, encompassing device performance, fabric and system scalability, and geographic span. The network has to be able to scale not only within the data center, but also to encompass all data centers to create a true unified network. Cisco Unified Fabric delivers true scalability: not just enabling increased growing port count as needed, but doing so without compromising on performance, manageability, or cost.

Scalability begins with 10 Gigabit Ethernet. 10 Gigabit Ethernet allows customers to consolidate their networks, which means fewer tiers to the network and fewer overall ports while providing exponentially more usable bandwidth for servers and storage. By moving to 10, 40, and 100 Gigabit Ethernet technologies, customers will be able to consolidate the number of ports and cables dedicated to servers as well as the overall number of switches under management in the data center. The reduction of devices reduces management overhead and comes with a concomitant reduction in rack space use, power, and cooling. In many cases, the consolidation of the network is in concert with or directly follows server consolidation through server virtualization.

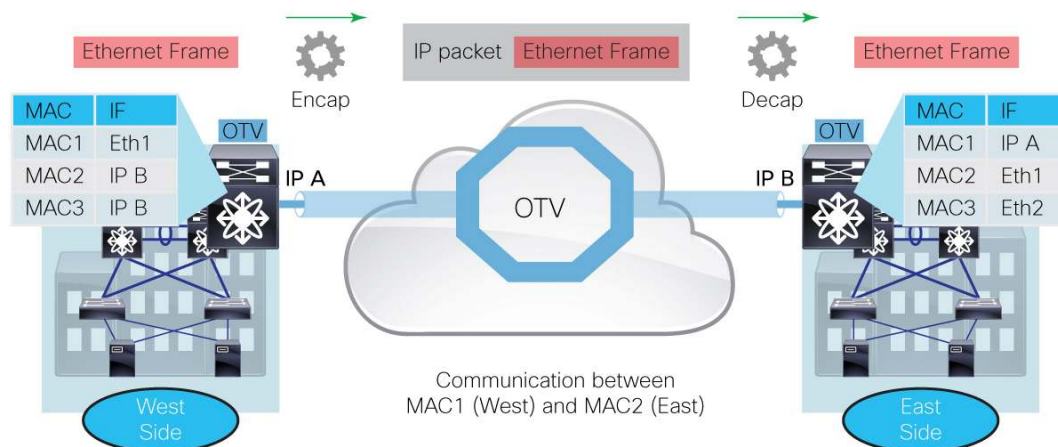
The capability to grow the network is a crucial aspect of scalability. Just as important is the capability to grow the network in a manner that causes little disruption of the data center and conforms to the needs of the particular business and data center environment. Cisco believes that each customer network has its unique characteristics and needs solutions that fit those characteristics, rather than subscribing to any single rigid architecture. Growth of the network depends on two factors: the capability to upgrade hardware and the capability to support new protocols as they arise. Cisco's well-known investment protection philosophy covers the first factor. Cisco consistently upgrades platforms, usually in place, preserving customers' investment in existing equipment and reducing disruption. The Cisco Nexus 7000 Series Switches reflect the kind of upgrades that support growth that customers can expect. With the new Fabric 2 cards and Fabric 2 I/O modules, the Cisco Nexus 7000 Series has doubled its capacity from its introductory switches. Similarly, Cisco MDS 9500 Series Multilayer Directors sold in 2002 can be field upgraded to support the newest FCoE and high-performance 8-Gbps modules. Cisco also designs its switches to support new protocols and networking capabilities as they are introduced. The Cisco Nexus and Cisco MDS 9000 Families both use Cisco NX-OS, a modern modular operating system that facilitates easy upgrades to the latest features and protocols as they become available.

Growth in the past has meant simply adding capacity. Growth today means taking into consideration virtualized servers, which may transport a great deal of east-west server-to-server traffic in addition to the more conventional north-south server-to-client traffic. Cisco FabricPath combines the simplicity of Layer 2 with the functions of Layer 3 without the problems of spanning tree. Cisco FabricPath allows multiple paths between endpoints, increasing redundancy and allowing much larger Layer 2 domains. The more complex network patterns that are created in virtualized and public or private cloud data centers require a flexible approach to work. With Cisco FabricPath, workloads can be easily moved from blade to blade, frame to frame, and rack to rack without the difficulty of blocked links. This capability increases workload reliability as well as resiliency. Cisco Nexus 2000 Series Fabric Extenders create a single infrastructure for both physical and virtual environments at the top of the rack and simplify networking by extending the line cards to the top of the rack.

Cisco has also been working with industry partners on virtual extensible LANs (VXLAN), which enable Layer 2 networking over Layer 3 and so allow Layer 2 domains to be isolated from one another while allowing them to be extended across Layer 3 boundaries, creating the capability to move workloads from data center to data center without assigning new IP addresses.

The cross-data center space is where the benefits of Cisco Unified Fabric are particularly apparent. For example, the Cisco Overlay Transport Virtualization (OTV) feature can extend your Ethernet network between data centers without creating static tunnels that require the configuration of each data connection (Figure 1). OTV encapsulates standard LAN traffic and moves it through the IP infrastructure in between data centers. OTV prevents common events such as unknown unicast packets or spanning-tree events from crossing the OTV link, providing connectivity with operational isolation. OTV supports multi-homing and virtual PortChannel (vPC) technology, making it well-suited for next-generation networks. In addition, OTV is simple to deploy and maintain, especially when compared to traditional methods such as Multiprotocol Label Switching (MPLS). As part of the Cisco Unified Fabric, OTV allows customers to scale their data centers beyond the walls, linking together geographically distant data centers with relative ease, enabling the fast movement of workloads between data centers. For connecting storage networks across data centers, the Cisco MDS 9000 I/O Accelerator (IOA) feature reduces the effect of distance-induced latency, enabling reduced backup and replication windows and making optimal use of expensive long-haul bandwidth.

**Figure 1.** OTV



### Intelligence

Cisco Unified Fabric intelligence is what makes everything come together. True efficiency and usability come from intelligence in the network. The intelligence in the Cisco Nexus and Cisco MDS Families come from their common operating system, Cisco NX-OS. Cisco NX-OS provides the OS consistency and common feature set that are necessary to a truly integrated switching solution. Cisco NX-OS allows intelligent services to be delivered directly to the network in a consistent and even manner, regardless of whether the application is a standard physical server or a virtual server workload.

The intelligence in Cisco Unified Fabric is implemented with policy-based network services. By using policy, data center managers can achieve several advantages. After a policy is set, it can be applied the same way to any workload. This feature is particularly advantageous in a virtualized environment, where workloads tend to proliferate, particularly in the application development area.

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Security is one area in which policy-based network services can enable operations. With consistent policy, every workload can have the proper security settings for its security class. Network-based policy services are enabled by the Cisco Nexus 1000V or its hardware counterpart, the Cisco Nexus 1010. The Nexus 1000V is a soft switch designed to be integrated with VMware vCloud Director. The 1000V comprises two components, a soft switch embedded into the machine hypervisor and the Virtual Supervisor Module, which enables and manages per VM policies.

Security audits are much simpler to perform, and overall security of the data center environment is significantly increased. Security of stored data can be protected using Cisco Storage Media Encryption (SME) for the Cisco MDS 9000 Family so that organizations no longer have to worry about data loss if backup tapes are lost or failing disk drives are replaced. Cisco Data Mobility Manager improves application availability by allowing applications to continue to run while data is migrated from one storage array to another.

Cisco Unified Fabric contains a complete portfolio of security and Layer 4 through 7 application-networking services that are completely virtualization aware. These services run as virtual workloads to provide the scalable, cloud-ready services that your critical applications demand.

Cisco provides consistency from the physical network to the cloud, with consistent policies for virtual and standard workloads and consistent of policy management across physical and virtual appliances, such as the Cisco ASA 1000V Cloud Firewall (virtual) and the Cisco ASA Adaptive Security Appliances (physical). Other products, such as the Cisco Virtual Security Gateway (VSG) virtual firewall, provides logical isolation of virtual machines in trust zones on the basis of traditional firewall policies as well as virtual machine attributes that correspond to the application type, tenant, etc. As a virtual firewall node, Cisco VSG scales easily and allows security policies to migrate easily with application mobility. Cisco offers a number of other virtualized appliances, The Cisco ASA 1000V Cloud Firewall provides tenant-edge security services in multi-tenant environments and is operationally consistent with the physical Cisco ASA security appliances and blades for a transparent transition from a physical to a cloud environment. Cisco Virtual Wide Area Application Services (vWAAS) provides WAN optimization for improved performance of virtual data center applications to client desktops, and the virtual Cisco Network Analysis Module (NAM) provides deep insight into application and network performance problems, allowing administrators to efficiently identify bottlenecks and optimize resources. For storage backup and replication traffic, the Cisco MDS 9000 IOA feature improves reliability, performance, and bandwidth utilization for business continuance and disaster recovery solutions.

The use of policy also enables faster deployment of applications. In the past, deploying an application required considerable effort to configure the overall physical infrastructure. With Cisco Unified Fabric, policy can be set with standard availability, security, and performance characteristics while maintaining the capability to tune those features to the needs of a specialized application if necessary. In that case, policies for that application can be built using the standard policies, with the policies retained, making reinstallation or expansion of even a specialized application easy. In addition, with policies, if the performance characteristics of the network change, rolling the change to every workload is as simple as changing the policy and applying it. With consistent policies, application uptime is significantly increased. The potential for human error is essentially eliminated.

Management of the network is the core of the network's intelligence. With Cisco DCNM, Cisco Nexus and Cisco MDS 9000 Family products, including the virtual Cisco Nexus 1000V Switch for server virtualized environments, can be managed from a single pane. Cisco DCNM can be used to set policy and to automatically provision that policy in converged LAN and SAN environments. Cisco DCNM also proactively monitors performance and can perform path analytics for both physical and virtual machine environments.

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The features provided by Cisco NX-OS can all be deployed with Cisco DCNM, and it provides multiple dashboards for ease of use. These dashboards include operational features and can also include network topological views. Cisco DCNM allows customers to analyze the network from end to end, including virtualized elements, and record historical performance and capacity trends. Cisco DCNM has been updated to include FCoE, handling provisioning and monitoring of FCoE deployments, including paths containing a mix of Fibre Channel and FCoE.

Cisco DCNM has extensive reporting features that allow you to build custom reports specific to your environment or use reports from preconfigured templates. Cisco DCNM can build these reports across specific fabrics or across the entire infrastructure. These reports can be sent by email or exported for further processing by another application, all on a user-defined schedule. Cisco DCNM also provides automated discovery of the network, keeping track of all physical and logical network device information. Cisco DCNM discovery data can be used for audit verification for asset tracking or imported into change-management software.

### Cisco Unified Fabric For Your Business

While Cisco Unified Fabric can bring quite a bit of cost savings to your data center, and that is a business benefit, the true benefits are in the long-term results. Cisco Unified Fabric changes the focus of data center personnel from mainly on the maintenance of infrastructure to the deployment of new applications and processes that directly benefit the business. At Cisco, we use our own technologies and philosophies in our internal IT department and data centers. With Cisco Unified Fabric, Cisco IT was able to shift data center administrator focus from 70 percent maintenance work and 30 percent new projects for the business to 40 percent maintenance work and 60 percent new projects for the business. This shift in operational focus means that new applications, upgrades, and other business-urgent projects are now installed and running in days rather than weeks or months. The business side of Cisco directly benefits from the new speed and responsiveness of Cisco IT. CIOs are always looking for the cost savings that goes with greater automation and consolidation, but the real benefit is the increased productivity of the IT department as it relates to the rest of the business. The business side of the organization will notice the increased service and understand that IT is a vital part of the business, not simply an expense center to be managed. CIOs can accomplish the goal of making IT truly an equal with the rest of the business by concentrating on operation excellence, and that excellence can be enabled with Cisco Unified Fabric.

### Technology and Trends Enabled by Cisco Unified Fabric

Cisco Unified Fabric supports numerous IT trends, including server virtualization, network consolidation, private cloud, and data center consolidation. In many cases, the unified fabric functions as the basis for the trend, providing the bandwidth, automation, and intelligence required to implement the trend in the organization. These trends require a network that is not merely good enough, but one that is data center class and ready for more change in the future as technology and trends continue to evolve.

#### Server Virtualization

The Cisco Unified Data Center Server supports virtualization with Cisco's fabric extender technology and the Cisco Nexus 1000v. The Cisco Nexus 1000v provides a soft switch at the hypervisor and management control on a per-VM basis with services profiles. Cisco Data Center Virtual Machine Fabric Extender (VM-FEX) creates a single infrastructure containing both physical and virtual switching at the top of the rack. Cisco Adapter FEX creates many virtual network interface cards (vNICs) from a single adapter, extending control and visibility from the rest of the network to the server level.

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For every vNIC created, a corresponding virtual Ethernet (vEth) port on the switch is created, eliminating the need for a separate virtual machine switching infrastructure. Every virtual machine has a dedicated virtual port on the host switch rather than on a local virtual machine software switch. This approach moves the switching from the CPU of the server to the specialized application-specific integrated circuits (ASICs) in the switch itself while maintaining the flexibility of a local soft-switch architecture. The vEth and vNICs are treated just like normal physical ports, allowing the use of port profiles and all the familiar network management tools on them.

This approach simplifies the infrastructure and improves application performance. Both physical and virtual network traffic can be monitored, managed, and provisioned as a whole, without a self-contained local server hypervisor switch. CNAs that support Cisco Adapter FEX can also create virtual HBAs (vHBAs) for FCoE deployments and network consolidation. Cisco has its own cards enabled for Cisco Adapter FEX for the Cisco Unified Computing System™ (Cisco UCS™) and is working with third-party vendors such as Broadcom, QLogic, Emulex, and Intel to support Cisco Adapter FEX.

Cisco Data Center VM-FEX and Adapter FEX communicate with the upstream parent switch, a Cisco Nexus 5000 Series Switch, using a prestandard implementation of the IEEE 802.1BR standard. Cisco Data Center VM-FEX has two primary modes: regular and high performance. In regular mode, traffic traverses the server hypervisor as usual. In high-performance mode, traffic bypasses the server hypervisor and goes directly to the switching source. I/O performance in this state is very near bare-metal I/O performance. Cisco Data Center VM-FEX has more than 3000 production customers and more than 3 million ports deployed. Cisco Data Center VM-FEX and Adapter FEX together with a Cisco Nexus 5500 platform switch upstream bring networking visibility all the way to each individual virtual machine on the server. These technologies combine to empower the networking administrator to create port profiles, apply switching features (quality of service [QoS], access control lists [ACLs], etc.) and get exposure to the traffic generated by each individual virtual machine. Virtual machine mobility then becomes a simple process for the network administrator since these port profiles also move with the virtual machine within the same switch domain.

With the end-to-end visibility and enablement that Cisco Data Center VM-FEX and Adapter FEX provide, workloads can much more easily be moved from machine to machine or rack to rack. Automation can be achieved with Cisco DCNM and server hypervisor management tools using service profiles to automatically create the network environment needed for a given workload. Networking and server workload become a single process rather than separate segments that need to be managed in a linear way.

### Inter-Data Center Communication

As companies accelerate their journey to private cloud architecture, they want to be able to move workloads between data centers with the same ease that they move workloads from server to server or rack to rack. Inter-data center communication offers numerous benefits. It aids disaster recovery, helping restore data center functions after a system failure; although server virtualization makes it much easier to reinstall operating systems and applications in a different data center, the networking infrastructure is not so easy to re-create, and inter-data center communication helps address this challenge. Inter-data center communication also enables organizations to move applications across the world for a follow-the-sun approach or burst capacity to other corporate data centers in response to usage spikes. Cisco helps provide these capabilities with the OTV feature, discussed earlier, and Cisco Locator/ID Separation Protocol (LISP).



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LISP provides a new way to route and to address IP. The current IP routing infrastructure uses a single number to identify a device's location and identity. LISP separates the device identity from the device location. In simple terms, by separating location and identity, LISP meets routing scalability challenges because a central location holds all the location information, eliminating the need for every router to know the entire routing table. It simplifies multihoming and eliminates the need to renumber IP addresses. By eliminating the need to renumber IP addresses, LISP allows customers to move entire workloads even onto foreign IP subnets and still have connectivity. LISP is also an enabler for the transition from IPv4 to IPv6. It allows customers to incrementally deploy IPv6 or run IPv4 over an IPv6 infrastructure. In this way, LISP decreases complexity created by older methodologies and enables easier operations. Cisco is working with the IETF LISP Working Group to continue the development of LISP and to create a standard for it.

Of course, moving a workload to a remote data center does no good unless the data that the workload needs is also there. The SAN extension and IOA features of the Cisco MDS 9000 Family can interconnect unified storage networks at multiple sites, providing Fibre Channel traffic with data compression (typically 4:1 or better), encryption for data in flight, and protocol acceleration to reduce latency and increase throughput and bandwidth utilization.

#### Disaster Recovery and Business Continuity

The goals of disaster recovery and business continuity are to help ensure that the most business-critical processes handled by IT can be restored with little downtime. The amount of downtime that is tolerable for a given organization varies greatly, but for most organizations more than a few hours of downtime adversely affects business. For some organizations, any downtime is an adverse business condition. Nevertheless, even disaster recovery and business continuity plans have to fit within the budget and can be costly especially when a dual-hot data center strategy is used.

One of the most compelling reasons to deploy Cisco Unified Fabric is the capability to quickly recover in the event of a disaster. With the profiles enabled by Cisco DCNM and Cisco UCS Manager, bringing up critical processes at an alternate hot-site location is much easier. Cisco Unified Fabric can provide the bandwidth needed for cross-data center replication through WAN acceleration in combination with OTV. Data can be quickly replicated between data centers, with one designated as a hot spare. Cisco Unified Fabric, coupled with server virtualization technologies that abstract the workload from the physical server hardware, makes helping ensure disaster recovery and business continuity much easier.

Cisco NX-OS supports in-service software upgrade (ISSU). The overall modular software architecture of Cisco NX-OS supports plug-in-based services and features. This framework makes it possible to perform complete image upgrades without affecting the data-forwarding plane. This transparent upgrade capability enables nonstop forwarding (NSF) during a software upgrade, including upgrades between full image versions (for example, from Release 4.0 to Release 4.1).

ISSU is initiated manually either through the command-line interface (CLI) by an administrator, or (in future releases) through the management interface of the Cisco DCNM software platform. The upgrade process consists of several phased stages designed to reduce the impact on the overall system, with no impact on data traffic forwarding.

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## Private Cloud

Server virtualization and the consolidation of data center equipment that has accompanied it have created leaner, more efficient data centers. For customers who have completed consolidation, network updates, and server virtualization, the stage is set for private cloud. Private cloud gives customers a service portal that is serviced by an orchestrator. The service portal allows IT and even non-IT personnel, depending on how the portal is configured, to request and automatically deploy IT resources. For example, through the service portal a developer can request a Microsoft Windows server on the development infrastructure. The orchestration layer then automatically creates the workload and installs Microsoft Windows on it, allocating server, network, and storage resources. This new workload can also be decommissioned on a timed basis to prevent the creation of orphaned resources. This kind of automation can be used to create access for new employees and expand resources for existing applications; a service portal and orchestrator can handle anything that can be automated. However, for a service portal and orchestrator to be able to function with little intervention, they need to be on a network infrastructure that facilitates that automation. Cisco Unified Fabric provides the network fabric layer that enables the private cloud.

Cisco Unified Fabric enables the private cloud with advanced automation and hooks designed to facilitate private cloud implementation in Cisco NX-OS. Cisco NX-OS supports not only Cisco cloud automation tools such as Cisco Intelligent Automation for Cloud (IAC) and Cisco Process Orchestrator, but also a wide range of third-party automation and orchestration software. Technologies such as Cisco FEX Technology and the advanced features built into the Cisco Nexus and Cisco MDS 9000 Families are enabled by Cisco NX-OS for Cisco cloud orchestrators and service portals as well as for third-party cloud orchestrators and service portals.

## Virtual Desktop Infrastructure

Cisco Virtualization Experience Infrastructure (VXI) relies on Cisco Unified Fabric as one of its foundational elements. Cisco VXI is Cisco's agile data center infrastructure for virtual desktop deployment. Virtual desktops are becoming more common at enterprises not just for the normal maintenance, technical support, and security benefits, but also as a means to project enterprise applications onto personal devices such as tablets and smartphones (through bring-your-own-device [BYOD] initiatives), enabling employees to be productive in the field regardless of the device they are using. However, a virtual desktop deployment is only as successful as the data center infrastructure on which it runs. As part of the overall Cisco VXI solution, Cisco Unified Fabric enables the use of port profiles and service profiles to help ensure performance and security across the virtual desktop infrastructure. It also offers scalability, with the capability to easily add capacity based on need, which is crucial to VDI. Cisco Unified Fabric also can easily handle any number of storage connections for VDI, including iSCSI, Fibre Channel, FCoE, and standard NAS shares.

Cisco has partnered with several companies in the VDI space, including Citrix, Microsoft, and VMware. On the storage side, Cisco has an extensive partnerships with EMC and NetApp to facilitate the implementation of virtual desktops. Cisco's tested and validated designs with Cisco Unified Fabric at their core create stable, secure, and scalable virtual desktop infrastructure.

## Bandwidth Expansion

Growth in the data center, particularly the increase in overall use of bandwidth, has been a challenge for as long as there have been data center networks. With the continued exponential growth of data, and with ever more devices accessing the network in the data center (virtual machines) and in the access layer (tablets, smartphones, and laptops), data growth is unlikely to abate. Both customers and employees now expect to have the world at their fingertips, and slow response times are unacceptable to people who have become accustomed to nearly

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universal, ubiquitous access. To maintain customer and employee satisfaction, the expansion of bandwidth must continue. Cisco Unified Fabric helps assure customers that new technologies and switch capacity improvements will be available well before they need them. Customers can also be assured that Cisco's upgrades are developed with the goal of preserving customer investment as much as possible. The Cisco Unified Fabric architecture is designed to be easily upgraded and expanded, scaling to fit customer needs.

Recently there has been much discussion about tiering in the data center. In traditional data center designs, a three-tier strategy yielded the most benefits for the customer, and many customers adopted this design. In today's modern, fully virtualized or private cloud data center, three-tier designs may not be the most efficient. Cisco has always prided itself on providing the solution that best fits the customer. For some customers, that will mean a single-tier design; for other customers, it will mean a two- or three-tier design. Cisco can accommodate any of these design choices and will advise the customer on what is best for the customer's unique environment. Whatever design best fits a customer's business needs is the one that Cisco recommends for the customer. One size does not fit all, and Cisco's wide range of products and services helps ensure that customers get what they need, not a solution prescribed because that is the way a particular vendor does things.

#### Data Center Consolidation

Advancements in not only network density but also server density, with blade servers such as Cisco UCS products, have accelerated consolidation in the data center. Virtualization and ongoing efforts to standardize on fewer pieces of software have also reduced the overall data footprint. It is now possible, and likely desirable, both to consolidate within the data center and to reduce the total number of data centers. Many large organizations will have more data center space than they need after consolidation. The benefits of closing data centers include not only the reduction in facilities costs, but also the simplification of the company's overall IT strategy and disaster recovery plans.

Cisco Unified Fabric can help facilitate the consolidation of data centers by improving the interconnection between existing data centers and through Cisco Services. Cisco Services can help you plan for the network changes needed to help ensure that mission-critical data and processes are not lost in the transition. Cisco's expertise with unified fabric technologies and Cisco's long experience with routers can smooth the path to data center consolidation. Technologies such as LISP and OTV can create the necessary stable links to enable data center consolidation as well as help ensure a solid connection between the data centers retained.

#### Why Cisco?

All the reasons discussed in this document make Cisco an easy choice for your data center. There are many other reasons as well. Cisco has been in the data center for the company's entire existence, often leading the way in many changes in the data center environment over the past 20 years. We have expanded our portfolio to include not just networking equipment but also video, communications, security, and servers, and the innovative Cisco UCS line of blade and rack-mount servers are designed for the virtualized data center environment.

Cisco has one of the biggest research and development budgets in the industry, and we use our industry experience to craft solutions that fit our customer's business models. Cisco strives to be the data center toolbox, able to create a solution to any customer problem from our extensive product portfolios and those of our close industry partners.

In addition to technology partners, Cisco has reseller partners who add exponentially to our collective expertise. Some of the biggest resellers in the world sell and service Cisco equipment with expert staff fully trained through

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our rigorous certification programs. If you are considering upgrading your existing data center or building a new data center, contact Cisco and let Cisco put its product and service experience to work for you.

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## Conclusion

Cisco Unified Fabric reduces complexity in the data center while enabling virtualization and public/private cloud and emerging trends. As a key building block for general-purpose, virtualized and Cloud-based data centers, Cisco Unified Fabric provides the foundational connectivity and unifies storage, data networking and network services delivering architectural flexibility and consistent networking across physical, virtual and cloud environment. Only Cisco has the diversity of tools and years of experience in the data center required to deliver a solution that can decrease deployment times and increase reliability.

## For More Information

<http://www.cisco.com/go/unifiedfabric>.

<http://www.cisco.com/go/datacenter>.




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