

Cisco Nexus Switches: Achieve Global Workload Mobility in a Virtualized Environment

Overview

Data centers are moving toward a new model in which IT enables business transformation instead of propelling business needs. This new flexibility and agility is achieved by adopting data center consolidation and virtualization solutions.

The proliferation of data center infrastructure (server, storage, and network) impedes business growth and increases total cost of ownership (TCO). Business growth is impeded by the inability of IT to respond quickly to the needs of the business. Increased infrastructure implies increased implementation times and maintenance requirements, leading to increased costs. TCO increases through inefficient utilization of resources, management complexity, high maintenance costs, and increased power and cooling costs.

Implementation of virtualization in the data center helps address these challenges by consolidating the hardware infrastructure and helping IT better manage all these resources from a single point of control. The consolidation of resources allows customers to scale their infrastructure efficiently as their businesses grow. However, server virtualization and consolidation have their own sets of challenges.

This document discusses the benefits of virtualization, the networking challenges posed by a virtualization deployment in the data center, and how the Cisco Nexus® Family of Switches delivers industry-leading innovations to provide a converged, scalable, and intelligent networking solution. This networking solution enables the customer to take the next step toward a data center model in which IT enables business transformation.

Data Center Challenges

Regardless of the industry in which they work and the size of their organization, IT managers share the constant challenge of meeting expanding business needs while controlling costs. As new applications proliferate, the ever-growing numbers of servers create challenges: increased management complexity and operating costs and less reliability and flexibility. Often, only about 30 to 40 percent of the server resources (processor, memory, and network) are utilized, with the remainder used to handle workload spikes. Moreover, environments have tended to become more heterogeneous, for instance requiring dedicated servers to support older operating systems, often resulting in low server utilization and overall inefficiency. Thus, data centers face these main challenges:

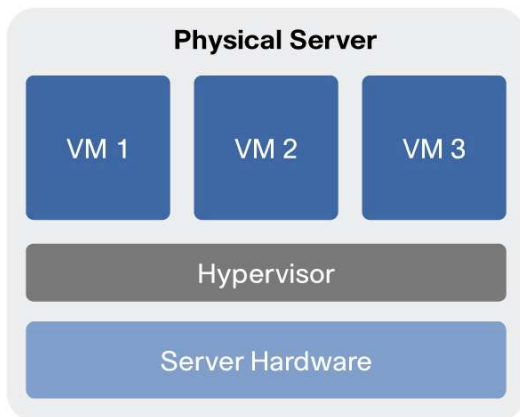
- Inability of IT to respond quickly to the needs of the business, impeding business growth
- Underutilized infrastructure resources (processor, memory, and network)
- Increased management complexity
- Infrastructure sprawl leading to increased costs for space, power, cooling, and management

What Is Virtualization?

Every physical server usually runs only one operating system with a few workloads and applications running on the system. In virtualization, the physical server is virtualized to create many virtual or logical servers called virtual machines. There is a thin layer of software installed on the server called the virtual machine monitor or hypervisor. The hypervisor abstracts all the hardware resources (processor, memory, and network) and allocates percentages of the resources to satisfy the requests of the virtual machine.

Each virtual machine has its own operating system and workloads and applications running on them. Each physical server can have many virtual machines and run any kind of application such as web servers and web applications and test and development environments (Figure 1).

Figure 1. Physical Server with Virtual Machines Managed by the Hypervisor



Virtualization offers these main benefits:

- Reduced server sprawl through consolidation of servers
- Efficient utilization of resources
- Single point of manageability

Virtual machine migration helps enable the customer to migrate workloads between servers for business continuity and disaster recovery and to balance workloads without having to take the server offline and reboot it completely. This capability facilitates faster server provisioning times.

Networking Challenges Resulting from Virtualization

Consolidation through virtualization has created servers with dense deployments of workloads. This has resulted in an increase in the number of virtual machines leading to many network-related problems:

- Increased demand for network bandwidth
- Proliferation of network hardware (adapters, cables, and switches) due to 1 Gigabit Ethernet connectivity that cannot handle the increasing bandwidth needs
- Limited number of server ports available to provide network and storage connectivity for the virtual machines and at the same time provide redundancy
- Performance degradation for applications due to the inability to meet the network bandwidth needs
- Inability of the network administrator to apply secure network policies to individual virtual machines
- Inability to migrate virtual machines across data centers for business continuity, resilience, or workload balancing

Cisco Nexus Switches: Networking Solution for Virtualization

Cisco Nexus Switches deliver industry-leading innovations that provide a converged, scalable, and intelligent data center that aids business transformation. Cisco Nexus Switches deliver virtual machine-aware solutions that help enable customers to gain the full benefits of a virtualized environment, beyond traditional connectivity.

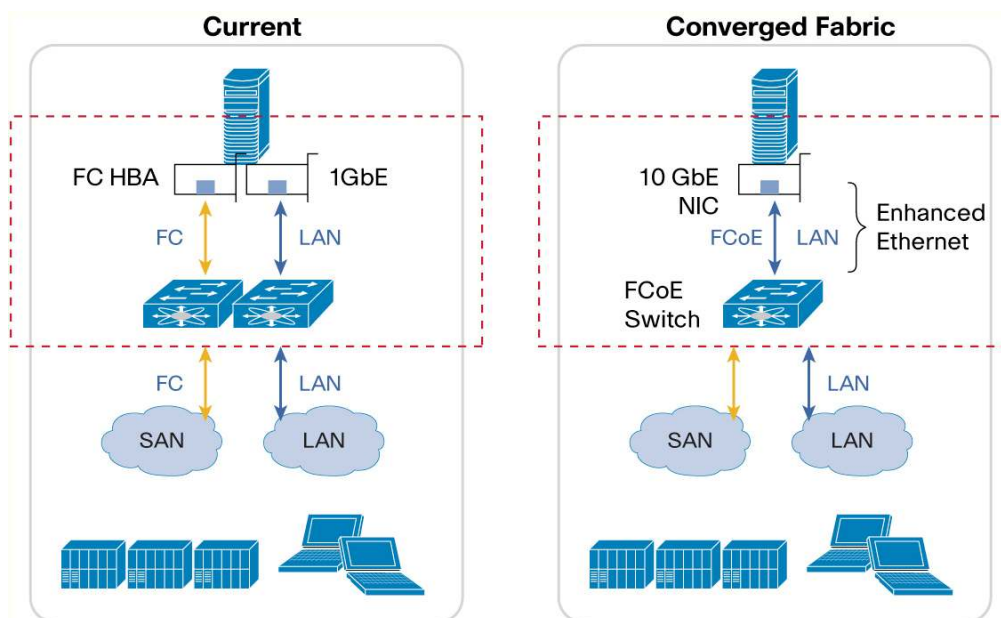
Convergence: Lower TCO with Network Consolidation

Virtualization improves performance and bandwidth and allows more virtual machines to be added to the physical server. This addition of virtual machines requires additional connectivity. Redundancy is needed for both network and storage resources, and different management tools are needed to manage the different protocols. This complexity limits the scalability of virtual machines on the server because it can affect performance. Solutions such as 10 Gigabit Ethernet and converged network fabric were designed to address this challenge.

10 Gigabit Ethernet resolves the problem of a limited number of server ports for I/O connectivity. Instead of using multiple ports with 1 Gigabit Ethernet bandwidth for virtual machines, connectivity, and redundancy, the ports are consolidated into a 10 Gigabit Ethernet solution. With this consolidation, more server ports are available to scale and handle more virtual machines per server, thereby further reducing TCO for the overall infrastructure. 10 Gigabit Ethernet also requires fewer network hardware resources, reducing the total number of server I/O adapters, clearing the cable mesh, and decreasing overall power and cooling consumption.

The standards body such as INCITS, IETF developed standards such as Data Center Bridging (DCB) and Fibre Channel over Ethernet (FCoE). FCoE allows the consolidation of the LAN and SAN onto Ethernet. DCB is a collection of IEEE 802.1 standard enhancements that allows the LAN to drop packets when congestion occurs while still meeting the SAN requirement of no loss of frames (Figure 2).

Figure 2. Current Network Infrastructure with Separate LAN and SAN Fabric Compared to a Converged Fabric Using FCoE



Cisco understands the need for a 10 Gigabit Ethernet solution for the data center and provides 10 Gigabit Ethernet connectivity with Cisco Nexus Switches along with FCoE capabilities to support converged network adapters. Cisco Nexus Switches also provide a solution that enables the customer to scale to 40 and 100 Gigabit Ethernet connectivity.

Scalability: Scale the Data Center as the Business Grows

Data centers need to be able to scale to meet the needs of business growth. However, traditional environments often cannot scale sufficiently, which has resulted in two trends:

- Smaller servers are consolidated into larger servers: Servers offer technologies such as hyperthreading and multi-core processor servers to help in scaling. These features help customers consolidate servers and provide more room for growth.

- Use of server virtualization technologies: Multiple virtual machines are created on a single physical server, thereby consolidating servers to scale effectively and efficiently during business growth.

Cisco Nexus Switches can scale, and also provide additional network infrastructure scalability benefits. Cisco Nexus Switches can scale from 1 Gigabit Ethernet to 10 Gigabit Ethernet to 40 and 100 Gigabit Ethernet connectivity. With Cisco® FabricPath technology, customers can build resilient, scalable, and simplified Layer 2 switching fabrics that can span the entire data center, providing virtualization deployment flexibility.

Intelligence: Virtualization-Aware Networking That Promotes Automated Workload Mobility

The deployment of virtualization has brought new challenges, including how to migrate virtual machines across data centers, and how to provide secure network policies to the virtual machine based on the administrator's role. Cisco Nexus Switches deliver leading innovations such as Cisco Nexus 1000V Series Switches, Cisco Virtual Security Gateway (VSG), and Cisco Overlay Transport Virtualization (OTV) technology to help enable secure, policy-based virtual machine migration across data centers. Cisco Nexus switches provide flexibility and agility for service deployments, with security during business continuance, disaster recovery, and load balancing.

Cisco Nexus 1000V Series Switches

Cisco Nexus 1000V Series technology makes the network infrastructure virtual machine aware. It provides tools with the same levels of visibility, security, and troubleshooting for virtual machines as customers are accustomed to having in physical devices.

Cisco Nexus 1000V technology provides advanced hypervisor switching solutions with secure, network services in a multi-tenant environment. It allows the customer to define network security and quality-of-service (QoS) policies in the form of port profiles for each virtual machine. These profiles follow the virtual machines during migration within and across data centers.

Cisco vPath architecture provides secure data flow without degrading performance. The network policies defined by the network administrator in the Cisco Nexus 1000V Series Switch are applied to the first set of data packets destined for a specific virtual machine. After the initial deployment of these policies, the data packets for that specific virtual machine automatically acquire the network policy, and the policy does not need to be applied again, thereby improving performance. In addition, Cisco VSG can deploy secure policies across multiple physical servers in a multi-tenant environment. Cisco Nexus 1000V Series Switches along with their services enable secure workload balancing across physical servers, business continuity, Disaster Recovery, and the capability to scale as the business grows.

Cisco Overlay Transport Virtualization Technology (OTV)

A critical network design requirement for a server virtualization deployment is having all servers in the same Layer 2 network. Meeting this requirement in distributed data centers means extending VLANs over the Layer 3 network, but current solutions introduce operational and resiliency challenges when Layer 2 VLANs are extended over the WAN.

To address these challenges, Cisco developed a new data center interconnect (DCI) solution for the Cisco Nexus Switches, Cisco OTV technology. OTV provides customers with an innovative and simple means of extending Layer 2 networks over Layer 3 networks for both inter- and intra-data center applications without the operational complexities of existing interconnect solutions. OTV is an important technology for efficient migration of virtual machines across distributed data centers to support application availability and flexible workload mobility.

Cisco NX-OS Software: The Foundation Operating System for Cisco Nexus Switches

Cisco NX-OS Software is a proven, purpose-built single operating system available across the data center for Cisco Nexus switches, Cisco MDS 9000 Family storage switches, and Cisco UCS 6100 Series Fabric Interconnects in the Cisco Unified Computing System™. The modular architecture of Cisco NX-OS provides the industry's highest levels of resiliency, efficiency, virtualization services, and extensibility. These features help enable customers to easily and rapidly incorporate innovations and new technologies in a virtualized environment.

Cisco Nexus Switches: A Component of Cisco Data Center Business Advantage

The Cisco Data Center Business Advantage (DCBA) architectural framework allows customers to deploy data center consolidation and virtualization to enable infrastructure automation and secure private cloud deployment. Cisco's networking capabilities align with the three pillars in the architectural framework: Unified Fabric, Unified Network Services, and Unified Computing.

The Unified Fabric pillar provides a simplified, integrated physical network for all I/O in the data center. Cisco Nexus Switches in Unified Fabric form the basic data center switching fabric. As part of the overall architectural framework, Cisco Nexus Switches closely interact with the other networking solutions in the Unified Network Services and Unified Computing pillars.

Customers can deploy a networking solution with Cisco Nexus Switches, and not just with hardware. The networking solution can help customers meet their networking challenges and successfully transform their businesses.

Conclusion

Virtualization addresses many challenges: for instance, it reduces server sprawl and management complexity and provides a flexible solution to enable efficient scalability to meet growing business needs. However, these benefits have resulted in many networking challenges such as network proliferation, increased demand for network bandwidth, and difficulty in providing secure network policies to the virtual machines.

10 Gigabit Ethernet addresses network bandwidth challenges and network hardware proliferation and also improves performance. Cisco Nexus Switches go further, by providing convergence, scalable and intelligent solutions to help customers transform their business.

For More Information

- Cisco Nexus Switches: <http://www.cisco.com/go/nexus>
- FCoE: <http://www.cisco.com/go/fcoe>
- Cisco OTV: <http://www.cisco.com/go/otv>
- Cisco FabricPath: <http://www.cisco.com/go/fabricpath>
- Cisco Nexus 1000V Series Switches: <http://www.cisco.com/go/nexus1000v>
- Cisco VSG: <http://www.cisco.com/go/vsg>



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