

## Introduction

The costs and inefficiencies of maintaining increasingly large IT infrastructures have led to major infrastructure consolidation initiatives. Virtualization allows IT departments to maximize existing resources by sharing a physical device among several logical functions, rather than devoting the entire device to a single function and underutilizing the capacity of that physical device.

## The Varying Degrees of Virtualization

There are many degrees to which a device is virtualized, defined by the level of fault containment and management separation provided. The main elements that characterize the degree to which a network device is virtualized include:

- **Control plane:** The capability to create multiple independent instances of the control plane elements enables the creation of multiple logical topologies and fault domains.
- **Data (or forwarding) plane:** Forwarding tables and other databases can be partitioned to provide data segregation.
- **Management plane:** Well-delineated management environments can be provided independently for each virtual device.
- **Software partitioning:** Modular software processes can be grouped in partitions that are dedicated to specific virtual devices, thus creating well-defined fault domains.
- **Hardware components:** Hardware components can be partitioned and dedicated to specific virtual devices, allowing predictable allocation of hardware resources to different virtual devices.

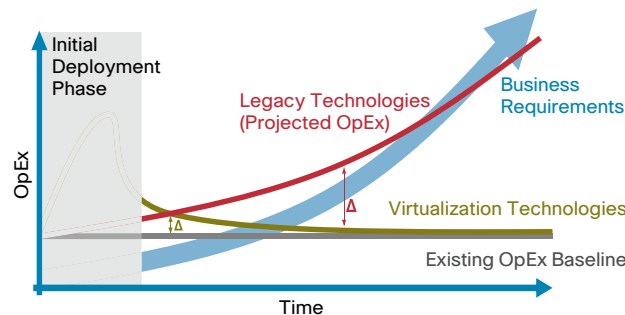
The Cisco Nexus™ 7000 Series supports all these degrees of virtualization through virtual device contexts (VDCs). VDCs combine groups of dedicated software processes with dedicated hardware to provide virtualized control and data planes within an independent management context.

## Demand for Virtualization

The capacity and power of computing, storage, and networking infrastructure resources have increased significantly in recent years. At the same time, the demand for these resources continues to grow. These two factors have led to proliferation of distributed infrastructure resources while creating a surplus of underutilized infrastructure capacity distributed throughout the network.

As demand continues to increase, the number of underutilized systems continues to grow, resulting in extremely large, complex, and costly infrastructure and high capital expenditures (CapEx) and operating expenses (OpEx). Additionally, costs associated with power, cooling, and space increase as infrastructure grows.

Figure 1. Insertion of Appropriate Virtualization Technologies Reducing OpEx over Time



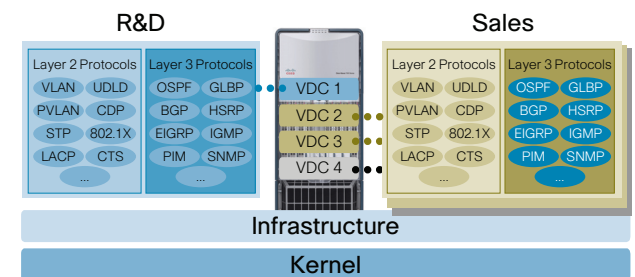
The capability to consolidate multiple functions onto fewer devices leads to a simplified architecture, which provides operating efficiencies by reducing the number of tasks to be processed, as well as the number of

elements to be maintained without sacrificing efficiency, utilization, and scalability. For virtualization of the network infrastructure, VDCs help consolidate multiple networks onto a single physical infrastructure while maintaining operational independence between the consolidated networks, improving device utilization.

## Virtual Device Contexts

Cisco Nexus 7000 Series switches can be segmented into virtual devices based on business need (Figure 2). VDCs deliver true segmentation of network traffic, context-level fault isolation, and management through the creation of independent hardware and software partitions.

Figure 2. Virtual Device Contexts



A consolidated infrastructure increases flexibility and simplifies operations. VDCs improve CapEx and OpEx by optimizing power consumption, space requirements, device utilization, maintenance operations, and, ultimately, service speed.

Cisco Nexus 7000 Series Switches support the Cisco NX-OS operating system, a new class of operating system designed for data centers. Based on Cisco IOS® Software, Cisco® MDS 9000 SAN-OS Software, and important acquisitions, Cisco NX-OS introduces support for VDCs, allowing a switch to be virtualized at the device level. Each configured VDC presents itself as a unique device to connected users within the framework of that

physical switch. The VDC runs as a separate logical entity within the switch, maintaining its own unique set of running software processes, having its own configuration, and being managed by a separate administrator.

## Characteristics of Cisco Nexus 7000 Series Virtualized Network Devices

- Fault containment is the capability to prevent a problem on one virtual device from affecting other virtual devices running on the same physical device
- Independent management contexts per virtual device are needed to streamline operation and management of the various virtual environments. The hierarchy of management users restricts certain operators to specific management contexts or subsets of those management contexts.
- Flexible separation and distribution of software components is necessary across virtual devices. Within an OS, software components generally include processes or instances of processes. Cisco NX-OS provides modular software processes, and this modularity is instrumental in enabling the separation and distribution of software components required by VDCs.
- Flexible separation of hardware resources is needed to be able to allocate hardware resources to specific virtual devices. The degree to which faults can be contained is highly dependent on the capability to separate and allocate hardware resources to different virtual devices. Resources such as ports can be dedicated to a VDC; after a port is assigned to a VDC, the port is not available to other VDCs.
- Scalability is required for a hardware platform to support virtualization. The amount of traffic that must be managed by the physical device increases significantly when multiple logical devices are deployed. The distributed architecture of Cisco Nexus 7000 Series Switches, in conjunction with VDC hardware

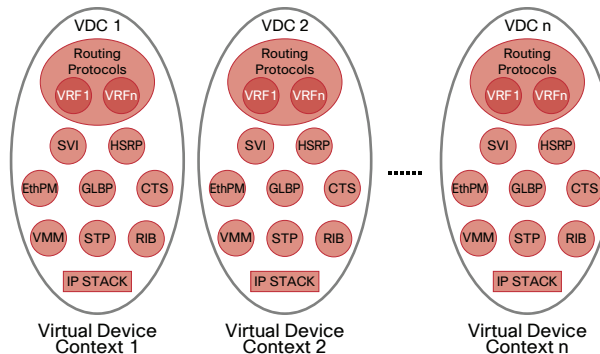
allocation, enables outstanding intelligent scaling of the platform, maximizing utilization of available resources.

## Operating Characteristics of the VDC

Is a subset of the physical ports on the switch

- Uses a unique configuration file representing that device to define its capabilities
- Is administered separately from other VDCs
- Can be used to isolate traffic flows of VDCs enabled on the same physical infrastructure
- Supports process independence and fault isolation between VDCs on the same switch (Figure 3)

Figure 3. VDC Fault Isolation



## Possible Use Cases for VDCs

- Offer a secure network partition for the traffic of multiple departments, enabling departments to administer and maintain their own configurations independently
- Facilitate the collapsing of multiple tiers within a data center for total cost reduction in both capital and operational expenses, with greater asset utilization
- Test new configuration or connectivity options on isolated VDCs on the production network, which can dramatically improve the time to deploy services

- Enable utility computing with different customers connected to isolated domains with different SLAs
- Provide a device context for network administrator and operator training purposes to lower training overhead

## Why Data Center Customers Invest in VDCs

Customers investing in data centers can gain a significant advantage with the deployment of VDCs in Cisco NX-OS.

VDCs enhance virtualization by enabling data center customers to partition physical switch resources by creating multiple logical switch contexts. Additionally, new functions are being introduced such as reuse of IDs (VLAN, Virtual Route Forwarding [VRF], etc.) across different VDCs to enable true autonomous operation and scaling of infrastructure.

Numerous operational enhancements such as fault and administration isolation increase the availability of the system and provide isolation that can be used to offer new and innovative network services to data center customers.

VDCs provide traffic isolation and extend the physical resources of the switch beyond the base limits. This extensive list of benefits offers data center customers the next generation in virtualization support to extend the use of the Cisco Nexus 7000 Series Switches beyond their physical limits.

## For More Information

- Cisco Nexus 7000 Series: <http://www.cisco.com/go/nexus7000>
- Cisco NX-OS: <http://www.cisco.com/go/nxos>
- Cisco Data Center Network Manager (DCNM): <http://www.cisco.com/go/dcnm>