

# Simplify Cloud and Data Center Scale and Agility

## HIGHLIGHTS

- Delivers zero-touch scale-out via auto-forming fabrics based on Brocade VCS Fabric technology
- Simplifies management by enabling an entire multitenant Brocade VCS fabric to be managed as a single switch
- Enables efficiently load-balanced multipathing at Layers 1, 2, and 3, as well as multiple Layer 3 gateways
- Provides the industry's most open programmability and Software-Defined Networking (SDN) choices with plugins for OpenStack and VMware vRealize, support for Netconf and REST APIs, as well as OpenFlow 1.3 and DevOps integration for Puppet, Python, and Mistral
- Seamlessly unifies physical and virtual resources with Brocade VCS Gateway for NSX
- Reduces ongoing maintenance time and costs through automated service and resource upgrades
- Enables IP storage networking for improved performance, management, security, and span of control
- Automates infrastructure provisioning, validation, troubleshooting, and remediation workflows

## Brocade VCS Fabrics Enable an Open, Standards-based Approach to Data Center Design

Brocade® VCS® fabrics, delivered on Brocade VDX® switches, are designed to meet the needs of cloud environments and scale-out data center architectures. These open, highly automated, software-driven, and programmable solutions support a breadth of network virtualization options.

As an integral part of the Brocade open, standards-based approach to data center design (see Figure 1), VCS fabrics enable enterprise and cloud service provider organizations to achieve seamless scale and operational efficiency for Layer 2 deployments of up to 10,000 servers. With open automation and plug-and-play scalability, these fabrics provide the

foundation organizations need to evolve their data centers to a cloud model, at their own pace and without the steep cost and learning curves of proprietary, hardware-based, or open script-based solutions.

Brocade VCS fabrics deliver high levels of performance, utilization, availability, and simplicity. They are flatter than classic Ethernet architectures, eliminating the

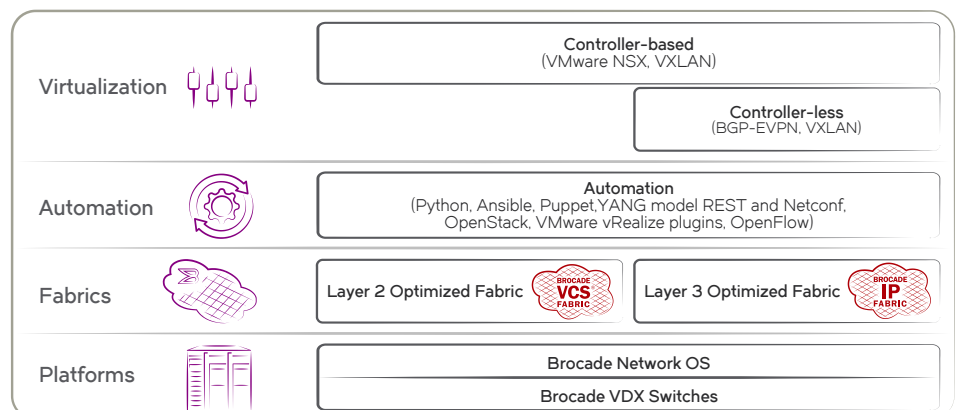
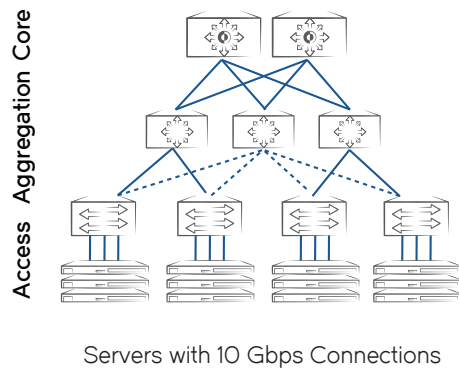
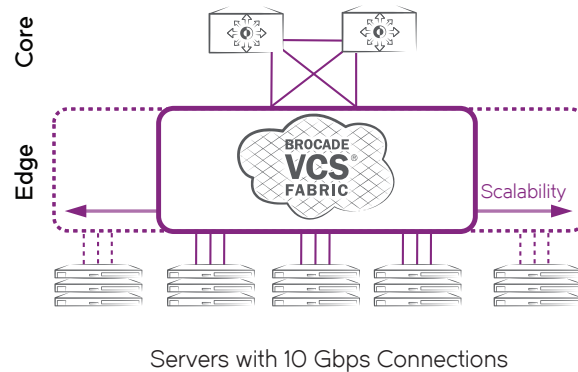


Figure 1: Brocade enables an open, standards-based approach to data center design.

## Classic Hierarchical Ethernet Architecture



## Ethernet Fabric Architecture



**Figure 2:** Compared to classic Ethernet architectures, Ethernet fabrics allow all paths to be active and provide greater scalability—while reducing management complexity.

need for Spanning Tree Protocol (STP), yet are completely interoperable with existing Ethernet networks (see Figure 2). VCS fabrics can be architected in any topology to best meet the needs of a variety of workloads. In addition, they are resilient, offering multiple “least cost” paths for high performance and reliability, and easily scale up and down as needed. VCS fabrics also are self-forming and function as a single logical entity in which all switches automatically know about each other as well as all connected physical and logical devices. This allows management to span the entire domain, rather than being limited to each individual device. These features, along with virtualization-specific capabilities, make it easier for organizations to explicitly address the challenges of VM automation and evolve their networks to take full advantage of cloud, mobile, and social networking advancements.

### Unmatched Simplicity and Automation

Brocade VCS fabrics, in conjunction with Brocade VDX switches, streamline

configuration and management, maximize efficiency, and create a more automated and reliable network, especially in highly virtualized environments. These fabrics deliver unmatched automation, efficiency, and resilience compared to traditional architectures and competitive fabric offerings.

### Fast, Easy Deployment and Configuration

Brocade VCS Fabric technology streamlines network operations and deployment with embedded features that enable centralized, automated configuration and management. These features include:

- **Self-forming fabric** to simplify configuration. As additional switches are added, they inherit the configuration of the fabric, allowing the network to scale out with ease. Configuration and device information is shared among all Brocade VDX switches, allowing fabric nodes to be added or removed, and physical or virtual servers to be relocated—without the fabric requiring manual reconfiguration.

- **Centralized management** to enhance availability and reliability. Brocade VCS Logical Chassis enables organizations to manage an entire VCS fabric as a single switch, upgrade software across the fabric with one command, and centralize monitoring and troubleshooting. This single point of management eliminates the need to manually configure and manage each switch, thereby simplifying management, lowering operational costs, and reducing configuration errors. Organizations can push software upgrades across the fabric with a single command, accelerating deployment. VCS Logical Chassis also provides a single view of the fabric for easy monitoring and troubleshooting, minimizing the time to repair network issues. Fabric-level REST and Netconf APIs and support for common industry automation tools, such as OpenStack and VMware vRealize plugins, allow for higher-level management frameworks to provide efficient orchestration of VCS fabrics within a cloud context. For more information about VCS Logical Chassis, read [An Overview of Brocade VCS Logical Chassis](#).

- **Automated provisioning** to enable simple, rapid deployment. Provided natively in Brocade VDX switches through VCS Fabric technology, installation, software download, and configuration tasks are possible without user intervention.

Brocade VDX switches are preconfigured so that newly deployed switches require only power and a network connection to become part of the fabric. RBridge-ID, VCS-ID, and other VCS fabric parameters are automatically assigned. In addition, Inter-Switch Links (ISLs) automatically form between all new and existing switches in the fabric.

Optionally, for DevOps-centric organizations, Brocade VDX switches can be provisioned using Brocade Workflow Composer™ and the Brocade Data Center Fabrics Automation Suite. This event-driven, workflow-centric automation platform and powerful automation suite provide turnkey automation to automatically provision Brocade VDX switches in the fabric.

- **Zero-touch scale-out** enabled through automatic configuration of VCS fabric parameters, self-forming trunks, and logical chassis. Data center administrators can add, move, and remove Brocade VDX switches without having to add or delete network configurations. This helps organizations contain costs while increasing reliability and speed when provisioning clouds and data centers.
- **A reliable foundation for software-defined networks** built on Brocade technologies. Brocade VCS Fabric technology supports SDN protocols including VXLAN/NVGRE. VCS Logical Chassis technology and northbound APIs with fabric- and node-level orchestration capabilities provide

operationally scalable management and integration with data center orchestration frameworks such as OpenStack and VMware vRealize.

## Maximum Efficiency and Resiliency

Brocade VCS Fabric technology creates a more efficient and resilient network with a flat-meshed Layer 2 topology that delivers the high performance and high reliability required by data centers. Self-healing capabilities in VCS fabrics, including traffic redirection in the case of a link failure, help prevent traffic flow disruption or data loss. These flexible networks help organizations rapidly adapt to changing business conditions and traffic patterns.

## Optimized East-West Traffic

Traditional data centers are architected with a rigid, three-tier tree topology that is optimized for north-south, or client-server, traffic flows—but can compromise performance, increase latency, and create bottlenecks. With the increased prevalence of virtualization and distributed applications, data center network traffic is now predominantly east-west, or server-server. The Brocade VCS fabric is optimized to address these traffic patterns by moving traffic through any of the active paths, and to avoid the multiple hops required in other tiered topologies.

## Multitenant Cloud Data Centers

Distributed virtualized workloads must be quickly and securely deployed in a scalable manner on a per-tenant basis. Traditional VLANs can be used for this purpose up to a point, but limitations on VLAN ID scale and the complexity of configuring large numbers of VLANs restrict their usefulness in larger data centers. The Brocade VCS Virtual Fabric feature addresses the scalability restrictions of traditional VLANs used for multitenant segmentation. It provides

native secure multitenant support for both physical and virtual application deployments within and across VCS fabrics. Managed centrally through Brocade VCS Logical Chassis, the VCS Virtual Fabric feature simplifies and accelerates application deployment, and ensures policy consistency for each tenant regardless of how application components are distributed across the data center. VXLAN and VRF-Lite are other options for network segmentation within a VCS fabric. To learn more, read [Multitenancy Options in Brocade VCS Fabrics](#).

## Virtual Fabric Extension

Virtual fabric extension creates a Layer 2 connection between VCS fabrics interconnected over a Layer 3 cloud, allowing VLANs to span multiple VCS fabrics. This is achieved through VXLAN encapsulation of Layer 2 frames, which are tunneled across VCS fabrics over a Layer 3 cloud.

Virtual fabric extension does not require a controller or multicast to be running in Layer 3 clouds interconnecting VCS fabrics. With virtual fabric extension, organizations can extend Layer 2 traffic across multiple virtual fabrics within a data center, or across multiple data centers, while maintaining multitenancy. Moreover, they can avoid installing costly dedicated WAN links or an MPLS/GRE underlay, as virtual fabric extension requires only simple Layer 3 IP connectivity across sites.

## Multiple Load-Balanced Paths at Layers 1–3

Brocade VCS Fabric technology enables highly elastic domains with extremely efficient load balancing in Layers 1–3. Innovative Brocade ISL Trunking load balances traffic across all the links in a trunk for improved performance at Layer 1. In Layer 2, Equal Cost Multi-Path (ECMP) routing uses all available network

bandwidth, allowing all links to be fully active and utilized. In the event of a failure, traffic is automatically routed to the closest path, providing higher resilience and greater application uptime. In Layer 3, the fabric automatically load balances all flows among a number of Layer 3 instances that collectively act as a single Layer 3 gateway. Multilayer multipathing helps improve network utilization, reduce latency, and increase overall network performance. Read the white paper [Setting a New Standard for Network Efficiency with VCS Fabric Multilayer Multipathing Capabilities](#) to learn more.

### Data Center Interconnect

Brocade Metro VCS technology provides an innovative solution to interconnect data centers and their traffic flows over distance, guaranteeing supported traffic characteristics. Metro VCS technology configured for regular Ethernet traffic supports 10 GbE ISLs up to 80 km, 40 GbE ISLs up to 40 km, and 100 GbE ISLs up to 40 km. To configure Metro VCS technology for lossless traffic applications (DCB/FCoE), refer to the

*Brocade Metro VCS Pre-deployment Guide* for details.

### Optimized for Virtualization

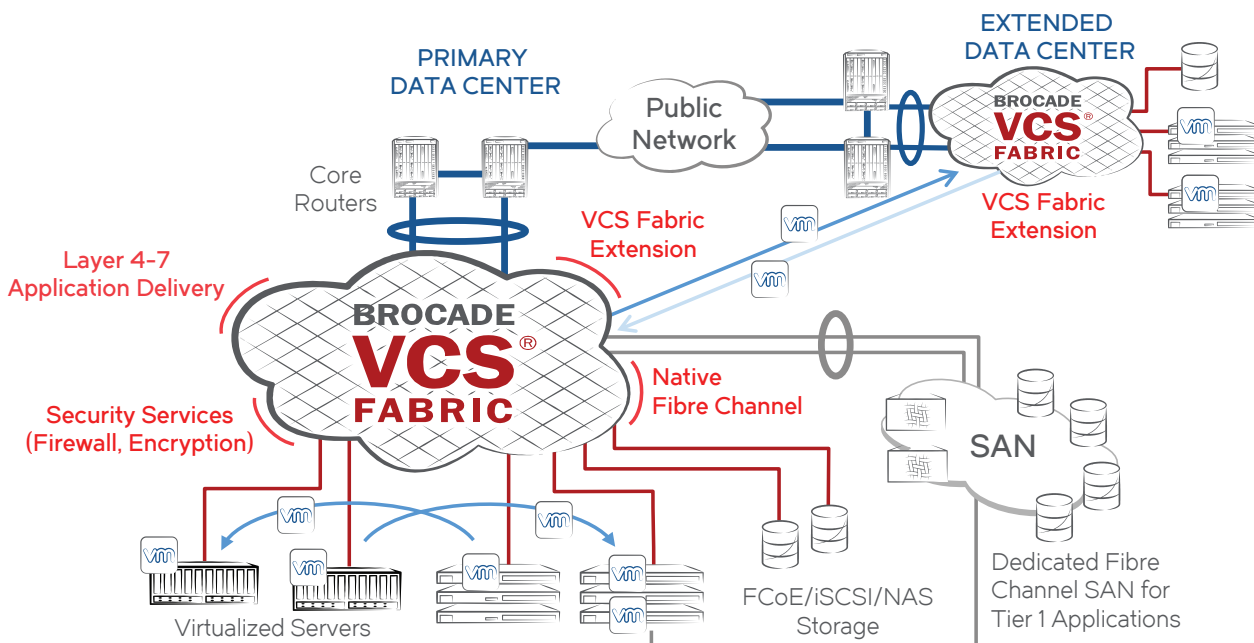
Brocade VCS Fabric technology offers unique features to support virtualized server and storage environments, and enable the transition to cloud computing (see Figure 3):

- **Brocade VCS Fabric Gateway for VMware NSX:** The Brocade VCS Fabric Gateway for VMware NSX enables the entire VCS fabric to function as a VXLAN gateway and eliminates the need for specific network placement. The NSX Controller sees the VCS fabric as a single logical gateway, thereby simplifying management and providing resiliency. Administrators can leverage existing infrastructure while gaining the benefits of VXLAN to support multitenancy and large-scale deployments of distributed applications.

The Brocade VCS Fabric Gateway for VMware NSX offers the benefits of agility with self-service provisioning, flexible network architecture, scale-out modularity with the VCS fabric,

multitenancy, and a unified solution for physical and virtual assets that can be managed centrally with the VMware NSX Controller.

- **Zero-touch VM discovery with vCenter:** Brocade VM-Aware Network Automation eliminates the manual configuration of port profiles when a VM is added to the fabric or moved, providing an additional level of automation. The VCS fabric directly communicates with VMware vCenter, automatically downloading all port profile information and the associated MAC address, and distributes the VM-specific information to all switches within the fabric. When the VM moves, no additional configuration is required.
- **Hypervisor-agnostic VM migration:** During a VM migration, the destination network switch ports must be configured to ensure that the VM traffic experiences consistent policies and configurations. With the Brocade Automatic Migration of Port Profiles (AMPP) feature, the VM policies and networking policies follow the VM within the VCS fabric. As a VM



**Figure 3:** Brocade VCS Fabric technology simplifies the network architecture, enables unified storage connectivity, improves VM mobility, and allows the seamless insertion of services.

migrates, the destination port in the fabric learns of the MAC address move and automatically activates the port profile configuration within a single fabric or across separate fabrics. AMPP can be used with various hypervisors.

### Supports Storage Environments with Advanced Flexibility

Brocade VCS Fabric technology offers advanced storage support for multiple storage connectivity options, including FCoE, Fibre Channel (Brocade VDX 6740 only), iSCSI, and NAS storage. Data Center Bridging (DCB), which enables the reliable exchange of storage traffic over the LAN network, eliminates packet loss when network congestion occurs and allocates bandwidth as needed to keep the network running efficiently. Moreover, Network-Attached Storage (NAS) Auto QoS intelligence prioritizes delay-sensitive IP storage traffic within the VCS fabric to help ensure consistent performance while decreasing latency.

### Open Interfaces Enable Automation and Agility

Organizations eager to capitalize on the benefits of virtual environments, namely increased automation, need networks that can be easily and quickly deployed. This requires network tools and infrastructure that are open and able to change rapidly with their businesses. Brocade supports an assortment of programmatic solutions and DevOps tools that allow a customized approach to provisioning, validating, and troubleshooting the network. These solutions offer a new level of simplicity, agility, and rapid, automatic deployment, enabling data centers to evolve to meet new technology requirements.

### Turnkey and Customizable Lifecycle Automation

Organizations that aim to automate the entire network lifecycle but lack sufficient engineering resources can leverage Brocade Workflow Composer, a server-based, DevOps-inspired

network automation platform powered by StackStorm. The Brocade Workflow Composer platform automates the entire infrastructure lifecycle—from provisioning and validation to troubleshooting and remediation. It also integrates across IT domains for end-to-end event-driven workflow automation. For more information, see the [Brocade Workflow Composer At-A-Glance](#).

Designed to run with the Brocade Workflow Composer platform, Brocade Workflow Composer Automation Suites are ideal for IT organizations that seek to embrace automation yet possess limited automation training or time. The suites provide out-of-the-box network lifecycle automation for commonly performed tasks, and are packaged to address major use cases.

# Brocade Workflow Composer Architecture

Powered by StackStorm

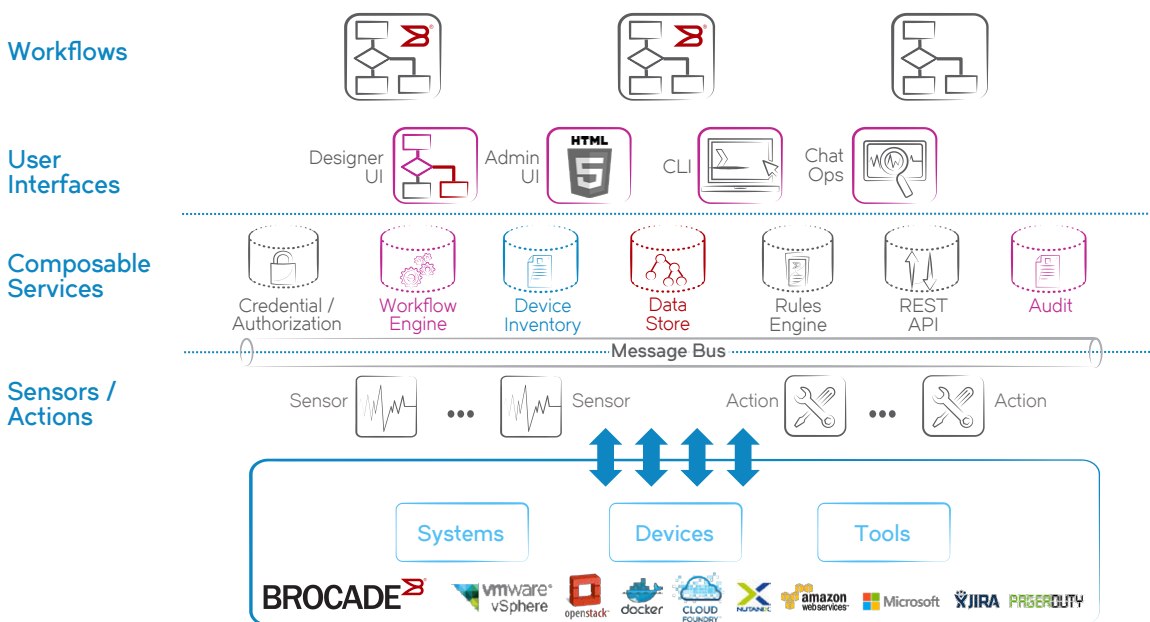


Figure 4: The Brocade Workflow Composer architecture brings workflow-centric, cross-domain network automation to IT operations.

The automation suites include:

- **Network Essentials:** Basic building blocks to help organizations with limited resources get up and running quickly, including workflows that automate steps common to most networks.
- **Data Center Fabrics:** A collection of workflows specific to provisioning, troubleshooting, and remediating data center fabrics, including Brocade IP fabric deployments.
- **Internet Exchange Points:** Workflows to automate steps specifically associated with Layer 2 Internet exchange connectivity, such as tenant provisioning and maintenance.

Each automation suite includes documentation and a collection of turnkey yet customizable workflows, services, sensors, actions, and rules. Organizations can use Brocade Automation Suites as-is or as starter kits for building or customizing workflows specific to their data center requirements to reduce time-to-value. For more information, see the [Brocade Workflow Composer Automation Suites At-A-Glance](#).

Additionally, Brocade VDX switches and VCS fabrics offer programmability and interoperability options through a PyNOS Library and YANG model-based REST and Netconf APIs. Cloud orchestration and control through OpenStack and

OpenDaylight-based SDN controller support enable full network integration with compute and storage resource provisioning and management.

## About Brocade

Brocade networking solutions help organizations achieve their critical business initiatives as they transition to a world where applications and information reside anywhere. Today, Brocade is extending its proven data center expertise across the entire network with open, virtual, and efficient solutions built for consolidation, virtualization, and cloud computing. Learn more at [www.brocade.com](http://www.brocade.com).

## Brocade Network OS Capabilities

### Layer 2 switching

---

- Service Node Load Balancing BFD/ARP Optimizations
- Conversational MAC Learning
- Virtual Link Aggregation Group (vLAG) spanning
- Layer 2 Access Control Lists (ACLs)
- Supports 2K ingress and egress ACLs
- Edge Loop Detection (ELD)
- Address Resolution Protocol (ARP) RFC 826
- Private VLANs
- Maintenance Mode/Graceful Traffic Diversion
- Distributed VXLAN Gateway
- Diagnostic Ports
- IP MAPS support
- High availability/In-Service Software Upgrade—hardware-enabled
- IGMP snooping support for multicast flooding
- IGMPv1/v2 Snooping
- IGMPv3
- MAC Learning and Aging
- Link Aggregation Control Protocol (LACP) IEEE 802.3ad/802.1AX
- Virtual Local Area Networks (VLANs)
- VLAN Encapsulation 802.1Q
- Per-VLAN Spanning Tree (PVST+/PVRST+)
- Rapid Spanning Tree Protocol (RSTP) 802.1w
- Multiple Spanning Tree Protocol (MSTP) 802.1s
- STP PortFast, BPDU Guard, BPDU Filter
- STP Root Guard
- Pause Frames 802.3x
- Static MAC Configuration
- Uni-Directional Link Detection (UDLD)
- Uplink switch for Brocade VDX switches, Brocade VCS fabrics, and the Brocade VCS Virtual Fabric feature
- Transparent LAN Services
- L2 Traceroute for VXLAN

### Layer 3 switching

---

- Border Gateway Protocol (BGP4+)
- DHCP Helper
- Layer 3 ACLs
- Multicast: PIM-SM, IGMPv2
- OSPF v2/v3
- Static routes
- IPv4/v6 ACL
- Policy-Based Routing (PBR)
- Bidirectional Forwarding Detection (BFD)
- 32-Way ECMP
- VRF-Lite
- VRF-aware OSPF, BGP, VRRP, static routes
- VRRP v2 and v3
- uRPF for IPv4 and IPv6
- IPv4/IPv6 dual stack
- IPv6 ACL packet filtering
- BGP Additional-Path
- BGP-Allow AS
- BGP Generalized TTL Security Mechanism (GTSM)
- BGP Peer Auto Shutdown
- Multicast Refactoring
- IPv6 routing
- OSPF Type-3 LSA Filter
- Wire-speed routing for IPv4 and IPv6 using any routing protocol
- Multi-VRF
- VRRP-E
- Fabric Virtual Gateway

## Brocade Network OS Capabilities *(continued)*

### Automation and programmability

---

- OpenFlow 1.3
  - REST API with YANG data model
  - Puppet
  - Python libraries (PyNOS)
  - VMware vRealize plugins
  - DHCP automatic fabric provisioning
  - Netconf API
- 

### Multitenancy and virtualization

---

- TRILL FGL-based VCS Virtual Fabric feature
  - Virtual fabric extension
  - VM-Aware Network Automation (for VMware vCenter)
  - BFD for virtual fabric extension
  - Brocade VCS Fabric Gateway for VMware NSX (VMware-certified HW VTEP)
  - Automatic Migration of Port Profiles (AMPP)
  - Option to block VLAN creation when importing port profiles from vCenter
- 

### DCB

---

- Priority-based Flow Control (PFC) 802.1Qbb
  - Enhanced Transmission Selection (ETS) 802.1Qaz
  - Manual configuration of lossless queues for protocols other than FCoE and iSCSI
  - Data Center Bridging Exchange (DCBX)
  - DCBX Application Type-Length-Value (TLV) for FCoE and iSCSI
- 

### IP storage

---

- Inter-Switch Link (ISL)
  - Deep on-chip packet buffer
  - Auto QoS for NAS
  - VCS fabric auto-forming / auto-healing
- 

### Fibre Channel/FCoE

---

- Multi-hop Fibre Channel over Ethernet (FCoE); requires Brocade VCS Fabric technology
  - FC-BB5 compliant Fibre Channel Forwarder (FCF)
  - Native FCoE forwarding
  - FCoE to Fibre Channel Bridging
  - FCoE on Brocade VDX 6740 and Brocade VDX 6740T
  - FCoE on QSFP+ port
  - Multi-hop Access Gateway Support
  - End-to-end FCoE (initiator to target)
  - FCoE Initialization Protocol (FIP) v1 support for FCoE device login and initialization
  - Name Server-based zoning
  - Supports connectivity to FIP Snooping Bridge (FSB) device
  - FCoE traffic over standard LAG
  - Interface Binding
  - Dual Personality Ports
  - Logical SANs
- 

### High availability

---

- ISSU L2 and L3
  - BFD
  - OSPF3-NSR
  - BGP4-GR
- 

### Quality of Service (QoS)

---

- ACL-based QoS
  - Eight priority levels for QoS
  - Class of Service (CoS) IEEE 802.1p
  - DSCP Trust
  - DSCP to Traffic Class Mutation
  - DSCP to CoS Mutation
  - DSCP to DSCP Mutation
  - Random Early Discard
  - Per-port QoS configuration
  - ACL-based Rate Limit
  - Dual-rate, three-color token bucket
  - ACL-based remarking of CoS/DSCP/Precedence
  - ACL-based sFlow
  - Scheduling: Strict Priority (SP), Deficit Weighted Round-Robin (DWRR), Hybrid Scheduling (Hybrid)
  - Queue-based Shaping
  - Flow-based QoS
-

## Brocade Network OS Capabilities *(continued)*

### Management and monitoring

---

- Logical chassis management
  - IPv4/IPv6 management
  - Industry-standard Command Line Interface (CLI)
  - Netconf API
  - REST API with YANG data model
  - Brocade VDX Plugins for OpenStack Neutron
  - Link Layer Discovery Protocol (LLDP) IEEE 802.1AB
  - MIB II RFC 1213 MIB
  - Switch Beacons
  - Management VRF
  - Switched Port Analyzer (SPAN)
  - Telnet
  - SNMP v1, v2C, v3
  - sFlow RFC 3176
  - Out-of-band management
  - Remote SPAN (RSPAN)
  - RMON-1, RMON-2
  - NTP
  - Management Access Control Lists (ACLs)
  - Role-Based Access Control (RBAC)
  - Range CLI support
  - UDLD
  - Python
  - Puppet
  - Mistral
  - Distributed Configuration Management
  - MAPS switch health monitoring
- 

### Security

---

- Port-based Network Access Control 802.1X
  - RADIUS (AAA)
  - TACACS+
  - Secure Shell (SSHv2)
  - BPDU Drop
  - Lightweight Directory Access Protocol (LDAP)
  - Secure Copy Protocol
  - Port Security
- 

#### Corporate Headquarters

San Jose, CA USA  
T: +1-408-333-8000  
info@brocade.com

#### European Headquarters

Geneva, Switzerland  
T: +41-22-799-56-40  
emea-info@brocade.com

#### Asia Pacific Headquarters

Singapore  
T: +65-6538-4700  
apac-info@brocade.com



© 2017 Brocade Communications Systems, Inc. All Rights Reserved. 06/17 GA-AG-5936-02

Brocade, the B-wing symbol, and MyBrocade are registered trademarks of Brocade Communications Systems, Inc., in the United States and in other countries. Other brands, product names, or service names mentioned of Brocade Communications Systems, Inc. are listed at [www.brocade.com/en/legal/brocade-Legal-intellectual-property/brocade-legal-trademarks.html](http://www.brocade.com/en/legal/brocade-Legal-intellectual-property/brocade-legal-trademarks.html). Other marks may belong to third parties.

Notice: This document is for informational purposes only and does not set forth any warranty, expressed or implied, concerning any equipment, equipment feature, or service offered or to be offered by Brocade. Brocade reserves the right to make changes to this document at any time, without notice, and assumes no responsibility for its use. This informational document describes features that may not be currently available. Contact a Brocade sales office for information on feature and product availability. Export of technical data contained in this document may require an export license from the United States government.

**BROCADE** 