



DATA CENTER

An Introduction to Brocade VCS Fabric Technology

Brocade® VCS™ fabric technology, which provides advanced Ethernet fabric capabilities, enables you to transition gracefully to elastic, highly automated, cloud-optimized networks.

BROCADE

Not long ago, information was stored predominately in text form. Now, graphical data is combined with audio and video, and all of it needs to be stored, indexed, and archived. Consumer demand is also increasing, and current economic conditions make it challenging to balance budgets. End users demand fast and reliable access to information around the clock. Business leaders required that IT functions meet and exceed stringent service levels with minimum downtime. In turn, IT must be able to move at the speed of business to capitalize on new opportunities and respond to increasing global competition.

Brocade® VCS™ technology is designed to meet these challenges by enabling next-generation virtual data center and private cloud computing initiatives. VCS technology comprises three main technology pillars: Ethernet Fabric, Distributed Intelligence, and Logical Chassis. Dynamic Services extends the capabilities of the VCS architecture, providing the highest level of functionality and investment protection. This paper reviews key data center network challenges, including server virtualization, and how VCS technology addresses them.

INTRODUCTION

Industry discussions of server virtualization and cloud computing abound, for one simple reason: agility. Every year, CIOs are asked to support more—often much more, in terms of data and traffic—with less, and more quickly. In addition, a number of regulations have arisen in the last decade, forcing a stronger focus on data security and control. These business realities, along with improvements in WAN/LAN performance, have contributed to a retrenchment of IT operations and investments back into the data center.

But there are important differences in how the “new” data center must be architected, since server-to-server transactions will soon exceed data center–client exchanges. IT domains that had developed fairly independently in the client-server era have become much more interdependent, and the ability to coordinate resource allocation synchronously across servers, storage, and networks is increasingly necessary to guarantee application availability.

With regard to the data center network, Gartner has estimated that:

- “Data center network architects need to plan for at least a doubling in bandwidth from physical servers during the next two to four years” due to increasing VM density.¹
- Driven by more live virtual machine (VM) migrations, as well as growth in composite applications, “new traffic patterns will appear arbitrary and even chaotic, with fluctuations that can be 90 times higher than the traffic peaks experienced by most data centers today.”²

As a result, “by 2014, network planners should expect more than 80% of traffic in the data center network to be between servers.”³

In addition, the rise of cloud computing has created a newly pressing need for more infrastructure agility—meaning elasticity, architectural flexibility, manageability, and simplified coordination across IT domains—as a building block for service automation.

Recognizing these trends early on, Brocade brought its 15-year heritage in fabrics to bear on building new networks for Ethernet in the virtualized data center. Brocade released the first Ethernet fabric technology, Brocade VCS, in December 2010.

VCS: THE BROCADE APPROACH TO ETHERNET FABRICS

When Brocade set out to build an Ethernet fabric technology, we did so with several customer challenges in mind:

- Network barriers to expanding virtualization adoption and VM mobility
- Guaranteed application availability and performance in the face of network disruptions or bottlenecks
- The need to scale networks to support exponential growth of traffic with existing personnel
- Few options for adding many new switches or an entirely new architecture to support network or VM growth, due to power, space, or budget constraints

Accordingly, VCS is built upon three core design principles:

1. It must support non-stop networking in a modern, highly virtualized environment.
2. It should “just work,” with minimal human intervention.
3. It is evolutionary, interoperating with existing Ethernet networks.

NON-STOP NETWORKING

90% of Global 1000 companies rely on Brocade solutions to support their mission-critical applications. Resilience is a basic attribute of Brocade Fibre Channel networks, which are now a mature technology, and it is also a requirement in environments with heavy “east-west”, or server-to-server traffic. In developing VCS fabric technology, Brocade naturally carried over this core characteristic to its Ethernet fabric design.

Ethernet Fabrics

Compared to classic hierarchical Ethernet architectures, Ethernet fabrics provide higher levels of performance, utilization, availability, and simplicity. At a minimum, Ethernet fabrics have the following characteristics:

Flatter. Ethernet fabrics eliminate the need for Spanning Tree Protocol (STP), while still being completely interoperable with existing Ethernet networks.

Flexible. Ethernet fabrics can be architected in any topology to best meet the needs of a variety of workloads.

Resilient. Multiple “least cost” paths are used for high performance and high reliability.

Elastic. Ethernet fabrics easily scale up and down at need.

More advanced Ethernet fabrics borrow further from Fibre Channel fabric constructs:

- They are self-forming and function as a single logical entity, in which all switches automatically know about each other and all connected physical and logical devices.
- Management can thus be domain-based rather than device-based and defined by policy rather than by repetitive procedures.
- These features, along with virtualization-specific enhancements, make it easier to explicitly address the challenges of VM automation within the network, which facilitates better IT automation.

Learn more about Ethernet fabrics at www.brocade.com/ethernet-fabric.

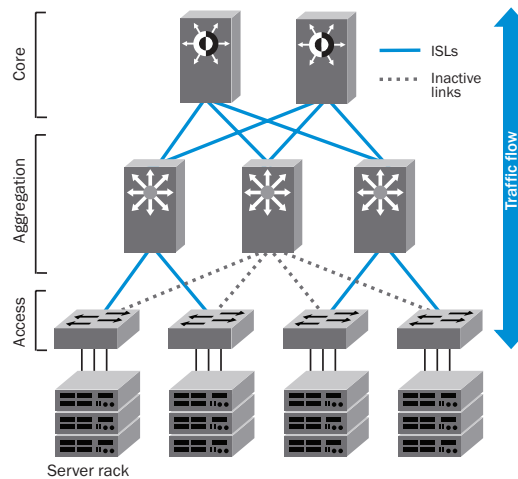
1 “Is Your Data Center Edge Network Ready for Virtualization?” (Munch, 4/21/11, ID G00210549).

2 “Your Data Center Network Is Heading for Traffic Chaos” (Munch, 4/27/11, ID G00210674).

3 Ibid.

In traditional Ethernet networks running STP, only 50% of the links are active; the rest (shown as dotted lines in Figure 1) act as backups in case the primary connection fails.

Figure 1.
Classic ethernet data center network.



In addition, it is considered a best practice to constrain the scalability of a traditional Ethernet network, because the larger the network, the longer the network takes to reconverge when a failure or other network change occurs. However, constraining the size of the network affects not just scale but flexibility, particularly in virtualized environments. VM mobility must occur within the bounds of a Layer 2 network; if the network remains small, the sphere of VM mobility also remains small.

TRILL

TRILL (Transparent Interconnect of Lots of Links) is a new standard for delivering Link Layer (Layer 2) multipathing and multi-hop routing. Unlike STP, with TRILL the shortest paths through the network are active, and traffic is automatically distributed across the equal-cost paths.

Brocade VCS technology does not use STP; rather, it is TRILL-based. Therefore, VCS fabrics allow for active-active connections originating from the server, and they enable much more rapid failover and convergence in the fabric. Links can be added or modified quickly and non-disruptively. This self-healing fabric approach doubles the utilization of the entire network while improving resilience. It also allows IT architects to confidently increase the size of their Ethernet networks, helping make VM mobility much more feasible.

Unlike other approaches to Ethernet fabric, which may require a central or “master” device, Brocade VCS fabrics are masterless and can be designed in full-mesh, partial mesh, leaf-spine, and various other topologies. With Brocade VCS, different end-to-end subscription ratios can be created or fine-tuned as application demands change over time, and the network can quickly and easily be reconfigured with minimal disruption to ongoing operations.

Brocade VCS provides auto-trunking in hardware and exceptionally efficient load balancing across trunk groups. Brocade ISL (Inter-Switch Link) trunks support packet-based (instead of less efficient flow-based) Equal-Cost Multipathing (ECMP), which provides 95% utilization of port bandwidth with automatic load balancing for better application response time and availability.

Finally, each Brocade VCS-enabled switch has a full, fabric-wide view of Layer 2 address tables, as well as quality of service (QoS), security, and VLAN-related information. Brocade VM-Aware Network Automation also provides secure connectivity and full visibility to virtualized resources with dynamic learning and activation of port profiles. This helps ensure consistency across all fabric elements and minimizes downtime due to human errors.

SIMPLE AND AUTOMATED—“IT JUST WORKS”

Traditionally, network management has been very labor-intensive, and it accounts for a very high percentage of overall data center network TCO (total cost of ownership). Administrators must possess extensive knowledge of a wide range of commands and protocols. Each device must be configured individually, and, in many networks, switches in different tiers run different operating systems. In a classic three-tier architecture, increasing network scale has a multiplicative effect on the number of switches that must be purchased and deployed, and on the level of effort required to do so.

This mode of operation was manageable while traffic growth and virtualization adoption both remained at low to moderate levels. However, all industry data point to a rapid explosion in the data that is generated, exchanged, and stored, while most observers believe staff growth will remain relatively flat. According to IDC:

Over the next decade, the number of servers (virtual and physical) worldwide will grow by a factor of 10, the amount of information managed by enterprise datacenters will grow by a factor of 50...Meanwhile, the number of IT professionals in the world will grow by less than a factor of 1.5.

(“Extracting Value from Chaos,” June 2011)

The need to automate IT operations in general, and networking in particular, is abundantly clear. This does not mean simply relying on broad IT orchestration and management tools to help manage existing devices at a higher level than before. This masks rather than reduces complexity and may even complicate troubleshooting. Instead, the complexity of every element of data center infrastructure must be reduced and ease of alignment between IT domains improved, so that the higher-level IT management stack can provide better visibility and control of data center operations as a whole.

Network Automation

Brocade VCS fabrics are self-forming and self-aggregating, making them very elastic and enabling real-time scaling. The fabric is automatically aware of all devices (servers, switches, and appliances) within its domain. Users can add and remove switches from a VCS fabric without any manual configuration, and physical and virtual servers can be located upon connection without the fabric requiring manual reconfiguration (see Figure 2). Trunks are also created dynamically without user intervention. (It is worth noting that not all current Ethernet fabric offerings behave this way: some competing approaches still require varying degrees of manual, device-based configuration and management.)

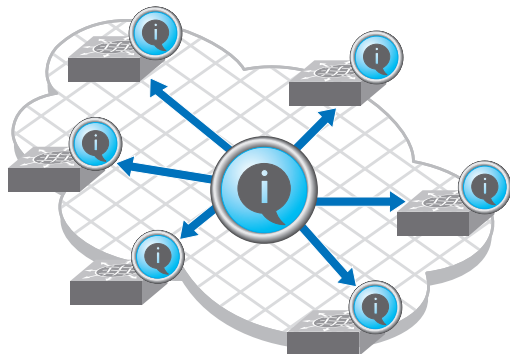


Figure 2. Brocade VCS fabrics are self-aware and share information about all connected devices.

Moreover, a Brocade VCS fabric is designed to be managed as a single “logical chassis,” so that each new switch will inherit the configuration of the fabric, and the new ports become available immediately. The fabric then appears to the rest of the network as a single Layer 2 switch. This significantly reduces complexity for the management layer, which in turn improves reliability and reduces troubleshooting.

Zero-Touch Virtualization Support

Today, most IT organizations say approximately 30% of their workloads are virtualized. Most would like to get beyond 50% virtualized in the near future. However, one of the major barriers to greater virtualization adoption to date has been the difficulty of consistently aligning network connectivity and services with virtual machines, another factor in the relatively slow adoption of VM mobility.

Clearly, the network has an important role to play here. 71% of IT organizations are running virtualization technologies from at least two different vendors, according to ESG. Brocade VCS technology is hypervisor-agnostic, providing basic VM alignment capabilities that match the reality of most data centers. Brocade Automatic Migration of Port Profiles (AMPP) and VM-Aware Network Automation features enable customers to fully align virtual server and network infrastructure resources and realize the full benefits of server virtualization.

Brocade VM-Aware Network Automation provides secure connectivity and full visibility to virtualized resources with dynamic learning and activation of port profiles. In VMware environments, the Brocade VCS fabric communicates directly with VMware vCenter™ to eliminate manual configuration of port profiles. Brocade VCS fabric also supports VM mobility across VCS fabrics within a data center, while providing protection against VM MAC spoofing. Additional VMware vCenter integration with Brocade Network Advisor provides another layer of intelligence to network administrators.

True “plug-and-play” fabric capabilities that automatically align physical and virtual resources are critical for cloud deployments, where services that rely on virtualized infrastructure may be turned on or off in real time. Only Brocade VCS Ethernet fabrics deliver this capability today.

EVOLUTIONARY

The hierarchical three-tier Ethernet network shown in Figure 1 above was designed for “north-south” traffic between physical servers running monolithic applications and clients. However, such a design is also inflexible and difficult and expensive to scale. In environments with significant “east-west” traffic within server clusters, it also imposes significant latency burdens.

The Brocade VCS architecture is based on a traditional Top-of-Rack (ToR) access-layer design for several reasons:

- Increasing VM density means increasing I/O at the access point. By eliminating STP within the access layer, Brocade VCS immediately doubles the available links and bandwidth to the servers, without multiplying the capital and facilities costs of twice as many switches.
- Brocade VCS flattens the network by collapsing the access and aggregation layers, since there is no need for additional aggregation switches to manage subscription ratios and provide server-to-server communication. Eliminating the aggregation tier can immediately reduce TCO by 15–20%, taking into account capital costs, reduced management overhead, and power, cooling, and space needs.
- Core switches are the most expensive part of a data center network. By implementing Ethernet fabrics at the access layer rather than in the core, Brocade VCS offers a low cost of adoption while preserving existing core investments.
- The Brocade Ports on Demand (PoD) feature enables pay-as-you-grow scaling, without disrupting upstream network architecture.

Brocade VCS technology also supports storage (for example, iSCSI, NAS, and FCoE) over a unified fabric, so you can converge when and how you want.

In short, compared to core-based Ethernet fabric designs, Brocade VCS offers a cost-effective approach for transitioning gradually to end-to-end data center fabrics, future-proofing your network and providing a strong foundation for cloud adoption.

SUMMARY

Brocade VCS fabric technology allows IT organizations to create efficient data center networks that “just work.” Ethernet fabric architectures built on Brocade VCS technology share information across nodes, greatly simplifying management and reducing operational overhead. Brocade VCS technology offers unmatched VM awareness and automation versus traditional architectures and competitive fabric solutions—and supports storage over a unified fabric when you are ready for it.

Only Brocade VCS technology, backed by a heritage of proven fabric innovations, delivers IT agility and assures reliability, with a cost-effective point of entry to allow you to transition gracefully to elastic, highly automated, mission-critical networks in virtualized data centers.

Brocade VCS technology is embedded in the Brocade VDX Data Center Switch portfolio. Brocade VDX Data Center Switches are available today to enable IT organizations to build Ethernet fabrics to support cloud-optimized networking and greater enterprise agility.

To learn more about Brocade VCS technology, please refer to Brocade Virtual Cluster Switching Technical Architecture⁴.

THE BROCADE VDX FAMILY OF DATA CENTER SWITCHES

As IT organizations look for better ways to build clouds and virtualized data centers, they are turning to high-performance networking solutions that increase flexibility through leading-edge technologies. Brocade[®] VDX[™] Data Center Switches are specifically designed to improve network utilization, maximize application availability, increase scalability, and dramatically simplify network architecture in virtualized data centers. Brocade VDX Data Center Switches with Brocade VCS fabric technology enable organizations to build data center Ethernet fabrics—revolutionizing the design of Layer 2 networks and providing an intelligent foundation for cloud computing.

Whether organizations want to enhance their classic hierarchical network architectures, deploy flatter scale-out fabrics for virtualized data centers, the Brocade VDX family delivers the innovative technology to enhance and simplify their networks. For classic Ethernet architectures, Brocade VCS technology enables IT managers to preserve existing network designs and cabling and to gain active-active server connections without employing STP. For scale-out fabric architectures, Brocade VCS technology allows organizations to flatten the network design, provide VM mobility without network reconfiguration, and manage the entire fabric more efficiently.

Brocade VDX Data Center Switches provide a flexible choice for building an Ethernet fabric using two switches initially and scaling to add additional switches as demand increases. IT managers can mix and match 1-G and 10-G fixed switches in the fabric using the Brocade VDX 6710 Data Center Switch⁵ for cost-effective 1-Gigabit Ethernet (GbE) connectivity, and the Brocade VDX 6720 Data Center Switch⁶ and the Brocade VDX 6730 Data Center Switch⁷ for high-bandwidth 10-GbE connectivity. The portfolio of Brocade VDX Switches provides Ethernet storage connectivity for FCoE, iSCSI, and NAS storage solutions within a single product family. IT organizations can protect their Fibre Channel investment by connecting Fibre Channel SANs to Ethernet fabrics with the new Brocade VDX 6730 Switch.

⁴ www.brocade.com/downloads/documents/technical_briefs/vcs-technical-architecture-tb.pdf

⁵ www.brocade.com/vdx6710

⁶ www.brocade.com/vdx6720

⁷ www.brocade.com/vdx6730

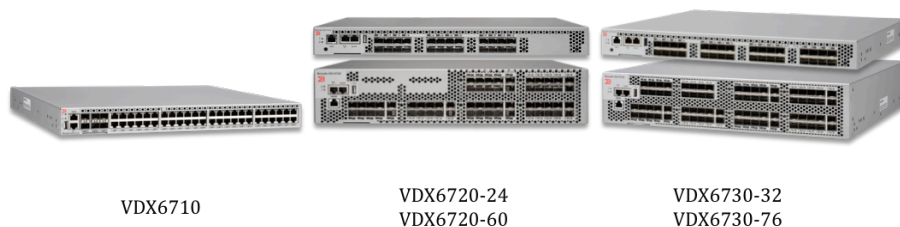


Figure 3.
Brocade VDX Data Center
Switches

BROCADE VCS TECHNOLOGY AND BROCADE NETWORK ADVISOR

Brocade Network Advisor extends core VCS capabilities by providing a simple yet powerful tool for defining and implementing policy and services within VCS fabric domains. Brocade Network Advisor allows organizations to maximize their VCS technology investments by:

- Managing a Brocade VCS fabric as a single virtual switch while allowing drill-down into the cluster for planning and troubleshooting
- Providing extensive visibility at both the VCS cluster level and individual node level, and even monitoring the health of multiple component types with Brocade Fabric Watch
- Simplifying port profile management by enabling network managers to create, read, inventory, delete, associate, and disassociate profiles to VMs
- Offering better visibility of port profiles and VMware port groups through tight integration with VMware vCenter

Learn more about Brocade Network Advisor here:

www.brocade.com/products/all/management-software/product-details/network-advisor/

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

© 2011 Brocade Communications Systems, Inc. All Rights Reserved. 08/11 GA-WP-1491-03

Brocade, the B-wing symbol, BigIron, DCFM, DCX, Fabric OS, FastIron, IronView, NetIron, SAN Health, ServerIron, Turbolron, and Wingspan are registered trademarks, and Brocade Assurance, Brocade NET Health, Brocade One, Extraordinary Networks, MyBrocade, VCS, and VDX are trademarks of Brocade Communications Systems, Inc., in the United States and/or in other countries. Other brands, products, or service names mentioned are or may be trademarks or service marks of their respective owners.

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