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WHITE PAPER

Brocade VCS Fabrics: The Foundation for Software-Defined Networks

While Software-Defined Networking (SDN) offers significant new opportunities to centralize and implement network services more rapidly and fluidly, it also introduces new forms of complexity. Brocade VCS Fabric technology provides unique automation capabilities and unmatched resilience through innovations in every plane of the physical fabric, as well as integration and hardware support for leading SDN innovations and solutions.

Software-Defined Networking is the continuation of a network transformation started by Ethernet fabrics such as Brocade® VCS® Fabric technology. First delivered in 2010, and now seeing mainstream adoption, Brocade VCS Fabric technology took the first step toward abstracting the control plane by sharing intelligence across the nodes of a masterless—yet logically centralized—fabric.

Introduction

Software-Defined Networking (SDN) is a new architectural approach to networking that has quickly captured the imagination of the industry over the last two years. According to Infonetics , all major carriers are either evaluating SDN now or plan to do so within the next three years. Large enterprises, too, are examining SDN as a means of improving the manageability of rapidly growing data centers and improving IT service agility.

Just as fabrics simplify management and operations of the physical network, SDN does this on the logical level. Fabrics provide the best physical layer of a complete SDN architecture, ensuring reliability and simplicity in the foundation of the solution.

SDN Building Blocks

The term SDN is used to refer to a range of technologies. The original—and narrowest—definition of SDN is "the decoupling of the control plane from the data plane," with the centralization of control being implied. Protocols such as OpenFlow, and controllers that use these protocols, are the most common examples of this approach to SDN. Some in the industry also include overlay networks within the SDN umbrella, while others do not.

This picture remains incomplete, however, if the management plane of the network is not considered. Traditional network management tools are designed for discrete physical devices. New approaches recognize the network as a distributed system that serves as the connective tissue of another larger system, the cloud—or "on-demand"—data center. The focus here is to orchestrate and automate network policy and services as part of a holistic cloud service.

Brocade takes a broad view of SDN, one which assumes new approaches in all three network planes for the purpose of developing more flexible, manageable network systems.

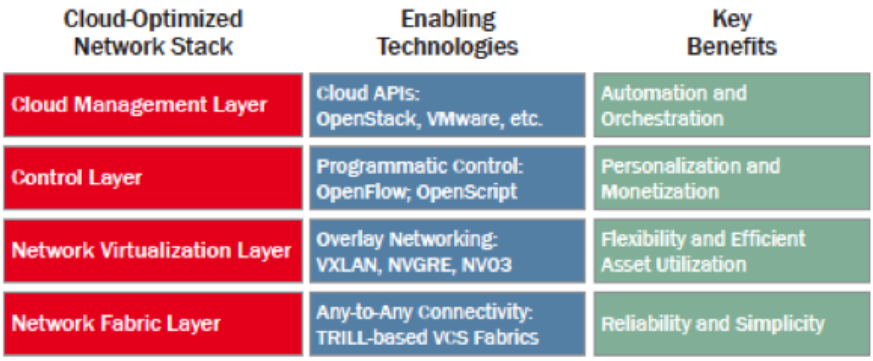

Figure 1: The components of the evolving data center network.

How are fabrics involved? Software-Defined Networks operate on top of and only somewhat independently of the physical network. An overlay network can be changed without considering the physical network; however, the performance, availability, and overall health of the physical network can unquestionably constrain the forwarding and prioritization options of the SDN. Therefore, optimizing the performance, reliability, and also manageability of the physical network is intrinsically part of building a functional software-defined network.

Resilient, Automated Fabrics Smooth SDN Adoption

While SDN offers significant new opportunities to centralize and implement network services more rapidly and fluidly, it also introduces new forms of complexity in the form of new processes and additional network layers to manage. In addition, SDN and fabrics address two separate but interdependent value propositions:

- Fabrics such as Brocade VCS fabrics provide the most efficient and reliable means of packet transport.
- SDNs focus on customized network policies and services for specific workloads or tenants.

This delineation allows network innovation to leap ahead with both fabrics and SDN along two parallel tracks: industrializing standard network operations at the transport level and developing an intelligent, systemic approach to network management and orchestration.

However, more layers of abstraction do not automatically simplify IT operations any more than existing virtualization and orchestration tools do. Infrastructure itself needs to become far simpler and yet possess sufficient local intelligence to share information automatically and laterally across devices, not just upwards to the management stack. These factors actually drive the need for more robust and sophisticated systems at the execution (forwarding) level. This is where intelligent fabrics such as Brocade VCS fabrics play a critical role.

STANDARDS LEADERSHIP

Brocade works with industry-leading organizations to facilitate the development of standards, technologies, products, and services designed to simplify data center infrastructure management and implementation. Brocade has a long history as a major contributor to the evolution of industry standards, ranging from Fibre Channel communication technology to Ethernet fabric to SDN.

Brocade representatives currently hold leadership roles in the following groups:

Open Daylight Project, Technical Steering Committee Chair

Open Networking Foundation, Forwarding Abstractions Working Group (FAWG) Chair

OpenStack Initiative, Fibre Channel SAN Extensions

IETF, TRILL Working Group

IETF, NV03 Working Group

TRILL

TRILL 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.

Physical Networks That "Just Work"

At a time when administrators adopting SDN need to be focused on learning new skills, standard processes may need to be retooled, and yet more layers of networks and management must be overseen, it becomes critically important to reduce the operational overhead of the physical network.

Brocade VCS fabrics provide a highly resilient and efficient TRILL forwarding plane. In addition, Brocade VCS fabric links form automatically. Also, the fabrics are self-healing, automatically redirecting traffic in the event of a link or node failure. The active-active nature of VCS links and Layer 3 gateways, with per-packet load-balancing, helps keep the VCS fabric running optimally without administrator involvement, while maximizing the number of low-latency links available for SDN flows. At the forwarding level alone, VCS fabrics greatly simplify the practical adoption of SDN.

Extending the Data Plane

Many SDN use cases include the implementation of overlay networks using a variety of proposed protocols such as VXLAN, NVGRE, STT, and NV03. In a fully virtualized environment, the overlays typically terminate in the hypervisor at the endpoint host, so they remain entirely abstracted from the physical network. This makes it easy for administrators to set up, move, or tear down virtual networks as needed, in conjunction with the creation and changes to associated virtual machines.

Management of these "virtual networks" resides alongside that of the corresponding virtual machines within the hypervisor management tool. However, this effectively creates a closed system with limited awareness of the physical network the traffic traverses. It may also exclude the use of third-party monitoring and security tools that use packet scanning techniques, and management of in-line services may be fragmented.

Fortunately, operators of the physical network can regain visibility of overlays running on top of VCS fabrics. The ASICs in the Brocade VDX® 8770 Switch can read frame formats deep into the packet header, where the encapsulation header is stored, which restores network visibility and control of tunneled traffic. Line-rate services can be applied consistently, regardless of tunneling protocol type.

In cases of physical to virtual or virtual to physical translation, such as transporting traffic of non-virtualized workloads via overlays, the overlay may be terminated on a physical network device instead of a hypervisor, typically at the edge of the data center network. The Brocade VDX 6740 Switch supports this use case with VXLAN termination capabilities.

In all cases, VCS fabrics reduce the complexity of managing overlays with mechanisms that help ensure service consistency and shared health awareness between physical and virtual networks. At the same time, forwarding decisions can be made flexibly according to current tenant needs, as opposed to traditional physical constraints.

Scaling SDN Deployments with the Distributed VCS Control Plane

Brocade VCS fabrics have a distributed control plane in which configuration, health, and state information about each node is automatically shared with all other nodes. This automatic exchange means nodes can be added or removed non-disruptively, allowing the fabric to scale elastically as required without service interruption. Furthermore, the fabric is automatically aware of all physical and virtual devices (servers, network devices, storage arrays, and appliances) attached to or within its domain. At the same time, the fabric—though masterless—is logically centralized for management purposes.

This architecture is crucially important for scaling an SDN environment. SDN controller domains are not yet large, and mechanisms for controller federation are nascent. Being able to deploy customized policies to several logical domains, as opposed to separate connections with each individual node, significantly expands the reach of a single controller. Similarly, organizations using orchestration tools such as such as OpenStack benefit from a smaller integration burden and fewer calls between the fabric and the orchestration framework.

Simplified Management Throughout the Network

The cloud data center is a system of systems. A change or error in any part of the system can cause a cascade of failures. Logically centralized management enables policy consistency throughout the stack. Automating routine processes further reduces the chance of errors.

A Brocade VCS fabric is designed to be managed as a single "logical chassis." This significantly reduces the traditional configuration and management burden, as global changes need only be defined once and are then propagated automatically to all the nodes, allowing the network to scale out with ease. From the perspective of the rest of the network, including higher-level SDN elements, the fabric appears as a single logical switch, and the internal policy distribution behavior is invisible. Fabric- and node-level APIs give SDN operators an efficient means to deliver customized policies, defined for specific tenants or distributed workloads, across all affected nodes.

VCS Logical Chassis

To learn more about VCS Logical Chassis, read An Overview of Brocade VCS Logical Chassis White Paper.

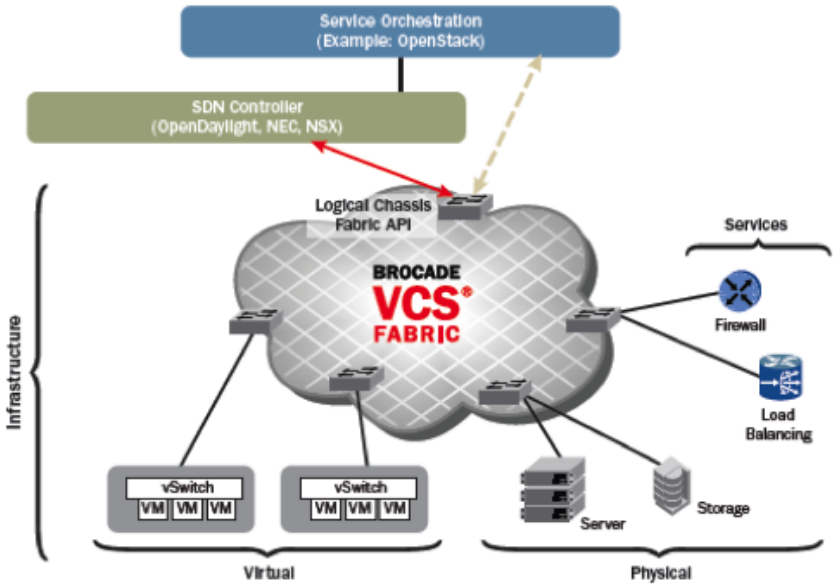

Figure 2: Brocade VCS Logical Chassis simplifies and scales SDN deployments.

Automation within the fabric further simplifies interactions with adjacent resources. Brocade VM-aware network automation provides secure connectivity and full visibility to virtualized resources with dynamic learning and activation of port profiles. AMPP, implemented in a hypervisor-agnostic manner, enables seamless VM migration, since the VCS fabric is aware of port profiles and automatically tracks them as they move. Paired with the visibility and control of overlay tunnels provided by VCS Fabric technology, an end-to-end virtualized environment in which physical resources are naturally synchronized with virtual requirements finally becomes simple to operate.

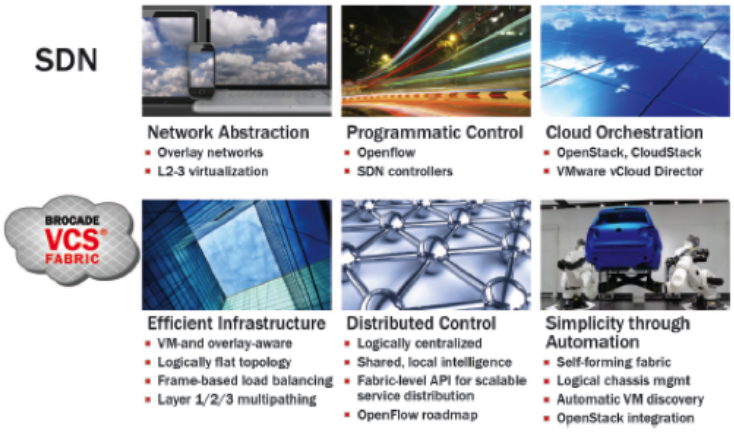

Figure 3: Brocade VCS fabrics support SDN throughout every aspect of the network system.

Summary

Cloud computing is moving toward mainstream adoption as it promises many benefits, including greater economies of scale and greater flexibility to adopt new application workloads. In this context, consistency of policy and performance is critical, regardless of where a workload component resides or moves to. This means ensuring that compute, network, and storage services are synchronized throughout the life of the workload.

SDN provides a variety of methods for centralizing and orchestrating policy and service definition for the network. At the same time, there is a deeply symbiotic relationship between software-defined networks and the physical network infrastructure that their traffic traverses. The architecture of the physical network infrastructure significantly affects latency, resilience, and overall performance. Improving automation, manageability, and resilience in the underlying physical network will, in fact, improve the performance and operational feasibility of SDNs.

Brocade VCS Fabric technology, the leading Ethernet fabric, provides unique automation capabilities and unmatched resilience through innovations in every plane of the physical fabric, as well as integration and hardware support for leading SDN innovations and solutions.

Glossary

The following is a list of acronyms used in this document and their definitions.

Term	Definition
AMPP	Automatic Migration of Port Profiles
API	Application Programming Interface
ASIC	Application-Specific Integrated Circuit
NVGRE	Network Virtualization Using Generic Routing Encapsulation
SAN	Storage Area Network
SDN	Software-Defined Networking
STP	Spanning Tree Protocol
STT	Stateless Transport Tunneling
TRILL	Transparent Interconnection of Lots of Links
VM	Virtual Machine
VXLAN	Virtual Extensive Local-Area Network

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