

## DATA CENTER

# Virtual Fibre Channel for Hyper-V

Virtual Fibre Channel for Hyper-V, a new technology available in Microsoft Windows Server 2012, allows direct access to Fibre Channel (FC) shared storage by multiple guest virtual machine (VM) partitions. Combined with the Brocade cloud-optimized Fibre Channel Storage Area Network (SAN) infrastructure, this new capability simplifies connectivity between Fibre Channel SAN storage and Hyper-V applications and offers unprecedented levels of availability, scalability, and operational efficiency for virtualized workloads and cloud architectures.



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Gold Virtualization

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## INTRODUCTION

To gain the full benefits of server virtualization and cloud architectures, virtualized workloads need to connect easily and reliably to existing SANs. For many enterprise organizations, Hyper-V deployments were limited in scale and scope because they lacked the ability to directly connect VMs to Fibre Channel SAN storage from inside a VM.

Hyper-V in Windows Server 2012 now provides virtual Fibre Channel Host Bus Adapter (HBA) ports within the guest operating system that runs the virtual machine, connecting virtual machines directly to Fibre Channel SAN Logical Unit Numbers (LUNs). Virtual Fibre Channel for Hyper-V provides several important advantages for Hyper-V environments:

- Simplifies storage connectivity for virtualized workloads to ultra-reliable, high-performance Fibre Channel SAN storage
- Enables new solutions that require shared storage, such as failover clustering, live migration, and multipath I/O
- Leverages and protects existing investments in Fibre Channel storage
- Enables advanced FC SAN storage functionality for VMs
  - Facilitates migration of FC workloads into the cloud
  - Enables improved monitoring and troubleshooting, with visibility from the VM to the FC SAN storage
  - Enables centralized management of Ethernet and FC-based virtualized workloads

Combining Virtual Fibre Channel for Hyper-V and the Brocade® Fibre Channel SAN infrastructure greatly simplifies connectivity between Fibre Channel SAN storage and virtualized applications, enabling enterprise IT and hosting providers to achieve new levels of availability, reliability, and scalability for cloud-based services.

## TECHNOLOGY OVERVIEW

Virtual Fibre Channel for Hyper-V (also referred to as Synthetic Fibre Channel) provides VM guest operating systems with direct access to a Fibre Channel SAN by using a standard World Wide Name (WWN) associated with a virtual machine. With this new capability, Hyper-V users can now use Fibre Channel SANs to virtualize workloads that require direct access to SAN LUNs. Fibre Channel SANs also allow you to deploy new solutions, such as running the Failover Clustering feature inside the guest operating system of a virtual machine connected to shared Fibre Channel storage.

Mid-range and high-end storage arrays are capable of advanced storage functionality that helps offload certain management tasks from the hosts to the FC SAN. Virtual Fibre Channel presents an alternate hardware-based I/O path to the Windows software virtual hard disk stack, allowing the use of advanced functionality offered by FC SAN storage directly from Hyper-V virtual machines. For example, you can use Hyper-V to offload storage functionality—like taking a snapshot of a LUN—on the FC SAN hardware by using a hardware-based Volume Shadow Copy Service (VSS) provider from within a Hyper-V virtual machine.

Virtual Fibre Channel for Hyper-V guests use the existing N\_Port ID Virtualization (NPIV) T11 standard to map multiple virtual N\_Port IDs to a single physical Fibre Channel N\_Port. A new NPIV port is created on the host each time you start a virtual machine that is configured with a virtual HBA. When the virtual machine stops running on the host, the NPIV port is removed.

### Technology Requirements

Brocade SAN environments using Virtual Fibre Channel for Hyper-V require the following:

- One or more installations of Windows Server 2012 with the Hyper-V role installed. Hyper-V requires a computer with processor support for hardware virtualization.
- A computer with one or more Fibre Channel HBAs with HBA driver support for Virtual Fibre Channel. While the solution works with any HBA that supports Virtual Fibre Channel, updated Brocade HBA drivers are included in-box with Windows Server 2012 to simplify deployment. The HBA ports to be used with virtual Fibre Channel should be set up in a Fibre Channel topology that supports NPIV.
- A Brocade NPIV-enabled SAN
- Virtual machines configured to use a virtual Fibre Channel adapter, which must use Windows Server 2008, Windows Server 2008 R2, or Windows Server 2012 as the guest operating system
- Storage accessed through virtual Fibre Channel support devices that present LUNs. Virtual Fibre Channel LUNs cannot be used as boot media.

### Use Cases

Virtual Fibre Channel for Hyper-V allows the direct connection to Fibre Channel LUNs from within a virtual machine, allowing the use of existing Fibre Channel investments for Hyper-V virtualized workloads. Virtual Fibre Channel for Hyper-V also enables the use of any advanced storage functionality directly from the VMs. In addition, Virtual Fibre Channel enables many new related capabilities, including distributed workload clustering, live migration, Multipath I/O (MPIO), and virtual SANs, which are briefly discussed later in this document.

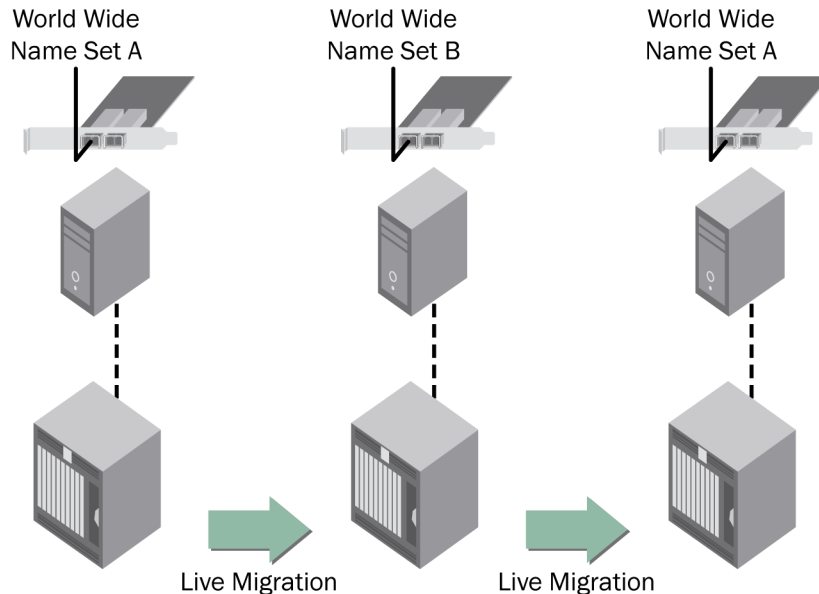
### Distributed Workload Clustering

Clustering applications such as Microsoft Exchange or SQL Server that are running on multiple VMs allows workloads to be distributed between VMs. Clustering high availability applications in this way allows workload balancing for increased utilization and efficiency, as well as performing routine maintenance of individual VMs without disturbing the workload. In the event of an application failure, the application can be migrated to another VM without any disruption.

The new Virtual Fibre Channel feature allows VM clustering across a Fibre Channel SAN, allowing clustered Microsoft Exchange, SQL Server and other key applications to leverage a highly available, highly resilient, and highly scalable FC SAN infrastructure.

## Live Migration

Virtual Fibre Channel enables live migration of VMs without any reconfiguration of the SAN. To support live migration of virtual machines across Hyper-V hosts while maintaining Fibre Channel connectivity, two WWNs are configured for each virtual Fibre Channel adapter, as shown in Figure 1: Set A and Set B. Hyper-V automatically alternates between the Set A and Set B WWN addresses during a live migration. This ensures that all LUNs are available on the destination host before the migration and that no downtime occurs during the migration.



**Figure 1.** Alternating WWN addresses during a live migration.

## MPIO Functionality

Hyper-V in Windows Server 2012 can use the MPIO functionality to ensure continuous connectivity to Fibre Channel storage from within a virtual machine. You can use MPIO functionality with Fibre Channel in the following ways:

- Use MPIO for host access. Install multiple Fibre Channel ports on the host, and use MPIO to provide highly available connectivity to the LUNs that are accessible by the host.
- Virtualize workloads that use MPIO. Configure multiple virtual Fibre Channel adapters inside a virtual machine, and use a separate copy of MPIO within the guest operating system of the virtual machine to connect to the LUNs that the virtual machine can access. This configuration can coexist with a host MPIO setup.
- Use different Device-Specific Modules (DSMs) for the host or each virtual machine. This approach allows live migration of the virtual machine configuration, including the configuration of DSM and connectivity between hosts, and compatibility with existing server configurations and DSMs.

## Virtual SAN Support

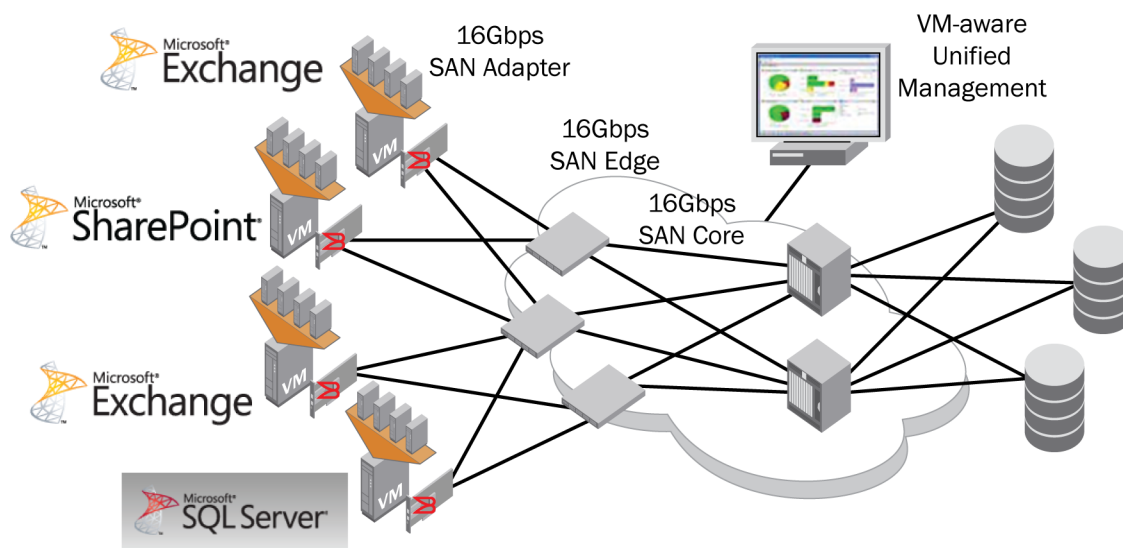
Hyper-V enables IT administrators to define virtual FC SANs on the host to accommodate scenarios where a single Hyper-V host is connected to different SANs through multiple Fibre Channel ports. A virtual SAN defines a named group of physical Fibre Channel ports that are connected to the same physical SAN.

For example, consider a scenario in which a Hyper-V host is connected to two FC SANs—a production SAN and a test SAN. The host is connected to each SAN through two physical Fibre Channel ports. In this example, two virtual SANs are configured—one named “Production SAN,” which has two physical Fibre Channel ports connected to the production SAN, and one named “Test SAN,” which has two physical Fibre Channel ports connected to the test SAN. IT administrators can use the same technique to name two separate paths to a single storage target.

Microsoft Windows Server 2012 enables the configuration of up to four virtual Fibre Channel adapters on a virtual machine, and it associates each adapter with a virtual SAN. Each virtual Fibre Channel adapter connects with one WWN address (or two WWN addresses, to support live migration), and each WWN address can be set automatically or manually.

## THE BROCADE ADVANTAGE

As the industry leader in cloud-optimized Fibre Channel storage fabrics and a strategic Microsoft technology partner, Brocade delivers unprecedented capabilities for Hyper-V Fibre Channel environments. With an in-box Windows Server 2012 adapter driver that supports the new Virtual Fibre Channel for Hyper-V feature, virtualized FC workloads can be deployed quickly and easily. Brocade also offers an NPIV-enabled SAN with unmatched availability, performance, and scalability, meeting the needs of demanding I/O-intensive virtualized workloads. With new levels of management visibility from the VM to the LUN, Brocade also enables improved monitoring, Quality of Service (QoS), and troubleshooting capabilities, ensuring maximum uptime and operational efficiency for Hyper-V environments (as shown in Figure 2).



**Figure 2.** Brocade offers a robust, NPIV-enabled SAN infrastructure for optimized Hyper-V environments.

### Highest Levels of Availability

Brocade Fibre Channel technology continues to be the solution of choice for highly virtualized enterprise and cloud environments. With almost 99.9999 percent availability, Brocade Fibre Channel SANs deliver the reliability and resiliency required to support virtualized mission-critical workloads and increasing virtual machine densities.

Brocade support for the Virtual Fibre Channel for Hyper-V feature means that customers can now leverage their highly available, highly resilient Brocade Fibre Channel SAN to support VM clustering and live migration, ensuring non-stop application availability. In addition, Multipath I/O (MPIO) functionality can be used to ensure continuous connectivity to Fibre Channel SAN storage from within a virtual machine, further increasing availability.

Brocade also offers proactive monitoring and advanced diagnostics capabilities that extend to Hyper-V hosts to identify potential problems before they have an operational impact. For example, Brocade Diagnostic Port (D-Port) capabilities non-intrusively test and verify transceiver and cable health to ensure link-level integrity from the SAN core to the server edge. Not only does this accelerate fabric deployment, it identifies and isolates optics and cable problems faster, reducing downtime.

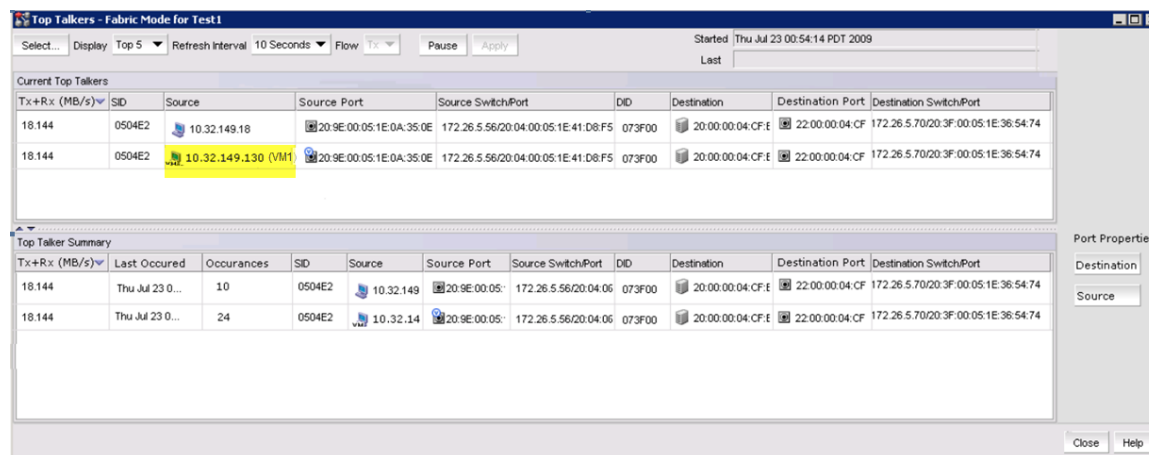
### Unmatched Performance and Scalability

Brocade leads the industry in transitioning Fibre Channel to 16 gigabits per second (Gbps), setting a new benchmark for performance and scalability to effectively handle the peaks and valleys created by dynamic applications and virtualized workloads. With a non-blocking SAN architecture and ultra-low latency, Brocade ensures maximum throughput with full-duplex, line-rate 16 Gbps FC across the storage fabric.

Brocade also leads the industry in I/O performance through integrated adapter and switch technology. Delivering over one million IOPS per dual-port adapter, the award-winning Brocade 1860 Fabric Adapter extends the

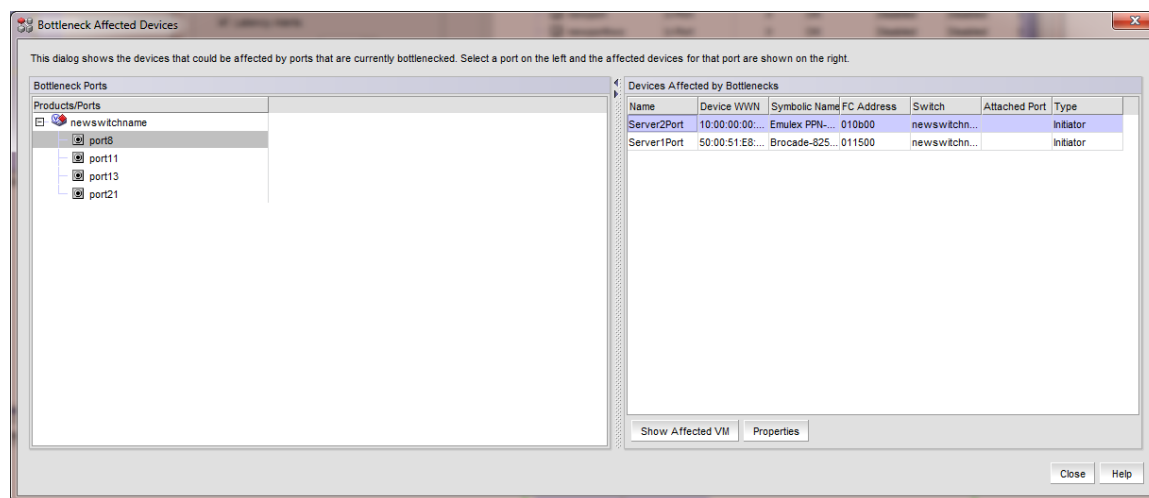
intelligence and advanced fabric services of Brocade FC fabrics into Hyper-V hosts. With support for N\_Port Trunking, users can have a 32 Gbps FC pipe that can be shared by multiple NPIV Virtual Fibre Channel ports, and they can still use MPIO on top of Virtual Fibre Channel ports for high availability. Together with frame level load balancing and VM-aware QoS, the Brocade 1860 delivers unmatched levels of performance and fault tolerance for demanding Hyper-V mission-critical workloads. The Brocade 1860 also offloads tasks from Hyper-V onto the adapter, to reduce CPU overhead and enable line-rate performance.

To ensure overall SAN optimized performance as the Hyper-V infrastructure grows and evolves, Brocade offers unique capabilities, such as Top Talkers and Bottleneck Detection. Top Talkers identifies which data flows are consuming the most bandwidth and correlates the top flows to the associated Hyper-V VM, identifying which hosts may be causing issues. Figure 3 illustrates a VM Top Talker and associated Hyper-V host name through Brocade Network Advisor.



**Figure 3.** Brocade Network Advisor identifies a VM Top Talker flow along with the source Hyper-V host name.

Bottleneck Detection identifies hot spots in the fabric—caused by a slow draining device, for instance—and identifies which Hyper-V VMs are affected by the bottleneck. By selecting the Virtual Fibre Channel port and clicking on the Properties button, a dialog (shown in Figure 4) is launched that shows the Hyper-V VMs affected by the bottleneck.



**Figure 4.** Brocade Network Advisor identifies Hyper-V hosts that are impacted by bottlenecks.



Reported through Brocade Network Advisor, Top Talkers and Bottleneck Detection give server administrators critical information about the performance of Hyper-V hosts, SAN, and storage resources, to keep Hyper-V application performance optimized.

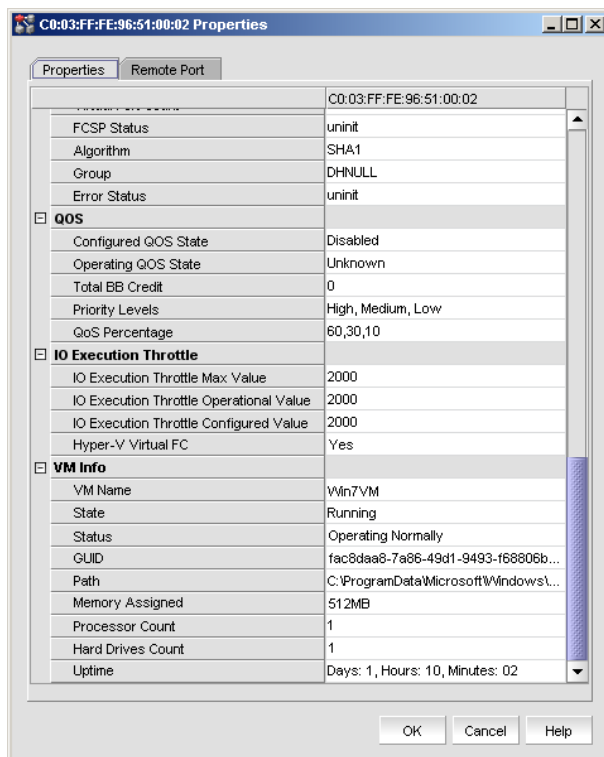
## Operational Efficiency

Virtualization and cloud-based architectures allow organizations to consolidate, simplify, and automate their IT resources to increase business agility while reducing capital and operational expenditures. Brocade offers unique technologies and capabilities that help IT achieve these objectives in Hyper-V Fibre Channel environments.

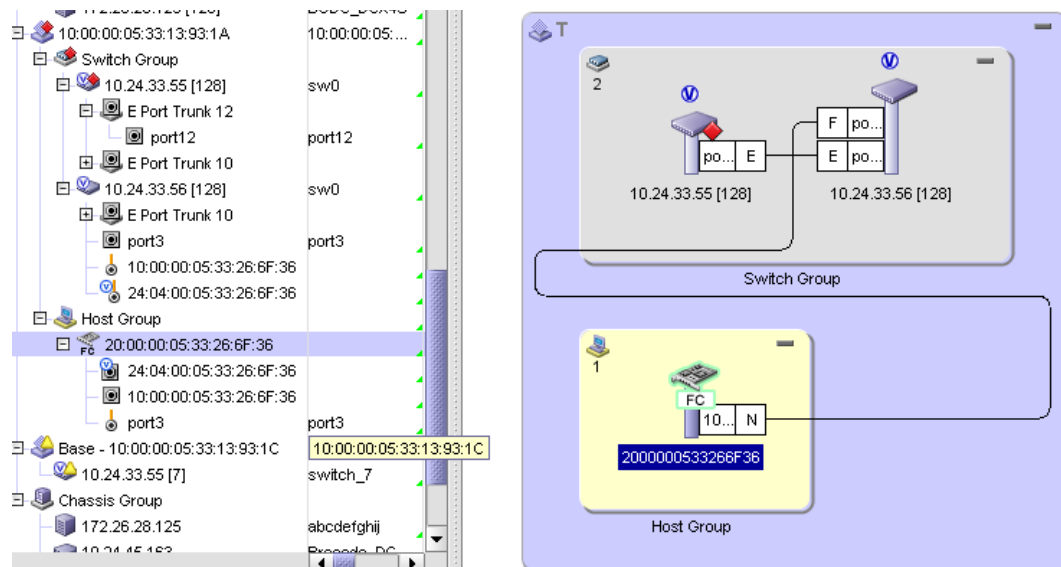
The industry-leading throughput performance, scalability, and port density of the Brocade FC SAN switch platforms enable maximum consolidation, reducing VM infrastructure complexity. The Brocade 1860 and its Brocade AnyIO™ technology also facilitates consolidation, allowing organizations to consolidate multiple Network Interface Cards (NICs) and HBAs while maintaining isolation, QoS, and bandwidth allocations for different Hyper-V workloads. The Brocade 1860 also allows organizations to leverage highly optimized virtual server platforms to maximize VM and application density.

In addition, the NPIV deployment in Virtual Fibre Channel for Hyper-V allows increased visibility into the storage fabric from the VM. Rather than simply displaying the WWN, Brocade Network Advisor provides the detailed information available about a specific VM, including VM Name, VM Status, VM Memory Assigned, VM CPU Usage, and other VM properties (shown in Figure 5), accelerating fault isolation and troubleshooting in VM environments. Device tree/topology visualization of the NPIV support in Brocade Network Advisor is shown in Figure 6.

When using a Brocade HBA in conjunction with Virtual Fibre Channel, users can also monitor the LUN-level profile that is associated to the VMs.



**Figure 5.** The properties dialog provides detailed information about a specific VM.



**Figure 6.** The device tree/topology visualization available through Brocade Network Advisor.

In addition, Brocade Network Advisor consolidates SAN switch and adapter management under a single pane-of-glass, providing health and performance statistics in simple, at-a-glance views. Brocade Network Advisor also seamlessly integrates with Microsoft System Center Operations Manager (SCOM) for centralized control of Hyper-V environments. This single consolidated view means that server administrators need less training and fewer tools, increasing productivity.

## CONCLUSION

The new Virtual Fibre Channel for Hyper-V feature, combined with the Brocade industry-leading SAN infrastructure, provides an important new shared storage option for virtualized workloads, offering enterprise-class availability, scalability, and reliability for Hyper-V environments. For existing Brocade Fibre Channel customers, Virtual Fibre Channel for Hyper-V provides investment protection, enabling customers to leverage existing FC SAN infrastructure for virtualized high-availability applications such as Microsoft Exchange and SQL Server. In addition, Virtual Fibre Channel for Hyper-V leverages the Brocade storage fabric to enable the use of advanced functionality—such as VM clustering, live migration of VMs, and multipath connectivity—to deliver new levels of availability, efficiency, and management simplicity for virtualized workloads.

Brocade NPIV-enabled cloud-optimized SAN switch, adapter, and management platforms provide a unified solution that offers unprecedented capabilities for Hyper-V Fibre Channel environments. With new levels of management visibility, from the Hyper-V VM to the LUN, Brocade provides valuable insight that simplifies the management of highly virtualized data centers and cloud-based architectures.

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