Executive Summary

Today, Microsoft® offers Virtual Server 2005 R2, a software virtualization platform that runs most major x86 operating systems in a guest environment. Storage administrators deploy Virtual Server 2005 R2 to consolidate underutilized servers, support legacy operating systems, automate software test and development environments, and simplify disaster and recovery planning. In the future, Microsoft will offer Windows Server Virtualization (previously code named Viridian) as part of the Windows Server Longhorn release. This new hypervisor-based technology will provide a more scalable, secure, and highly available virtualization solution. Microsoft’s virtualization solutions combined with QLogic’s Host Bus Adapter (HBA) virtualization technologies further increase hardware utilization and enable organizations to rapidly configure and deploy virtual machines.

As Microsoft’s virtualization platform evolves and QLogic’s HBA technologies continue to advance, storage administrators must be able to effectively utilize the new virtualization technologies. Microsoft System Center™ Virtual Machine Manager (SCVMM), the management application for virtualized data centers, provides a unified and integrated tool for storage administrators. This paper describes QLogic’s HBA virtualization technologies and its strategic position to enable the technologies in SCVMM.

This information applies for the following operating systems:

- Microsoft Windows Server® “Longhorn”
- Windows Vista™
- Microsoft Windows Server 2003
- Microsoft Windows® XP

Key Findings

- N_Port ID Virtualization (NPIV) technology allows a single Fibre Channel (FC) HBA port to function as multiple virtual ports, increasing network scalability and flexibility.
- Virtual Fabric (VF) technology enables a single FC HBA port to participate in multiple virtual fabric domains to create secure and highly available networks.
- Together, NPIV and VF technologies allow storage administrators to create logical and secure ports from a single physical HBA port, simplifying the management of virtual storage network environments while increasing overall storage security.
- Storage administrators who deploy Microsoft System Center Virtual Machine Manager with QLogic® SANblade® 2400 Series 4Gb Fibre Channel HBAs will be able to create virtual machines and ports that are easier to deploy, manage, and support across a virtualized data center.
Introduction

A recent Forrester study indicated that 60% of companies with 500 or more employees already implement server virtualization. To address this market need, Microsoft has been very aggressive in establishing its market presence by releasing comprehensive server virtualization solutions and developing advanced server virtualization architectures to align with its Longhorn server release. During this same time, QLogic has been extending virtualization technologies to the HBA by offering NPIV and VF, HBA virtualization technologies used to create virtual HBA ports and isolated fabrics. Together, the combined technologies further simplify the management of an entire virtualized data center.

Server virtualization technology abstracts the Operating System (OS) from the underlying server hardware resources (processor, memory, I/O). By decoupling the OS from the physical hardware, a “host” operating system can run “guest” operating systems in a Virtual Machine (VM), allowing multiple operating systems and applications to share the resources of a single physical server. Microsoft Virtual Server 2005 R2 is a virtualization solution that creates multiple VMs as guests running on top of a Microsoft Server 2003 platform.

QLogic’s FC HBA virtualization technologies abstract the underlying physical port, creating multiple virtual ports that can be isolated into virtual fabrics. The HBA technologies can be utilized by native operating systems with mission critical applications or virtual machines with their own operating system installed.

In a standard cluster environment, two or more servers work seamlessly together to deliver higher levels of service and availability for supported applications. In a virtualized environment, server virtualization technologies abstract the underlying server hardware to allow multiple virtual machines to run on a single physical server. In both cases, a management application must be able to initiate “HBA virtualization commands” to the HBA hardware to create, delete, and manage virtual ports, while maintaining data isolation between applications and virtual machines, as shown below. Otherwise, virtual HBA ports cannot be created and presented properly to the operating system and related applications, regardless of the server configuration.
Creating Virtual Ports Using NPIV Technology

NPIV technology virtualizes the physical HBA port configured in a point-to-point Storage Area Network (SAN) topology. This HBA virtualization technology allows a single physical FC HBA port to function as multiple logical ports, each with its own identity. Now, each virtual machine can attach to its own virtual HBA port and distinct World Wide Port Name (WWPN).

Storage administrators who deploy VMs, using Microsoft Virtual Server 2005 R2 and System Center Virtual Machine Manager can create virtual machines that are easier to manage and maintain. With NPIV support, VMs are bound persistently to a specific virtual port. Now, during the migration of a VM to a new physical server, storage administrators no longer have to reconfigure their network settings (zoning, masking, binding) because they are maintained in the logical port configuration.

Without virtual HBA ports, storage administrators must use the physical WWPN of the HBA to define fabric zones, mask storage Logical Unit Numbers (LUN), and configure VMs. In addition, storage administrators typically define one zone where all disks are exposed to every server to support the migration of VMs to new servers. This design creates security concerns for disks with sensitive information and requires the reconfiguration of the network if more than one zone is defined. Virtual HBA ports allow storage administrators to bind VMs to storage and define multiple zones using the virtual port parameters, creating an more manageable and more secure virtualized environment, as shown below.
Benefits of NPIV technology:

- **Lower Total Cost of Ownership (TCO)** – With server consolidation through virtualization, HBA expenditures are minimized by leveraging available virtual HBA ports.
- **Guaranteed Quality of Service (QoS)** – Each VM is allocated its own logical HBA port, creating multiple I/O paths for prioritization.
- **Higher Availability** – Multiple logical ports create redundant paths to VMs and their data.
- **Increased Security** – Each VM and its associated storage are completely isolated from other VMs.
- **Simplified Management** – Eliminates the need to reconfigure fabric zoning and LUN masking parameters after a VM Migration.

Creating Isolated Networks Using VF Technology

QLogic was the first-to-market with HBA support for Virtual Storage Area Networks (VSANs), now a T11 standard used to deploy virtual fabrics. VF technology provides the ability to create completely isolated network islands, each with its own set of fabric services (name server, zone server, login server) and management policies, as shown in the diagram below. An FC switch supporting VF technology appends a special VSAN tag to each FC frame, essentially dividing its ports into groups that function like separate physical switches. Without VF technology at the HBA level, frame level data isolation cannot be provided to each virtual machine. In this instance, all VMs connected to a physical HBA port must share a single fabric and its services in the domain.

Benefits of VF technology:

- **Extended Virtualization** – VMs running on physical servers are assigned to their own virtual SAN, each with their own QoS, security, and management policies.
- **Lower Total Cost of Ownership** – Instead of purchasing dedicated HBA and switch ports for each VF, a single physical HBA port can participate in multiple domains.
- **Increased Security** – Application based security and isolation based on VF IDs and WWPNs.
- **Guaranteed QoS** – Incoming and outgoing I/Os are prioritized by the HBA based on VF ID.
- **Enhanced Traffic Management** – FC frames are routed end-to-end, depending on VF membership.

Once NPIV is configured on a Windows server platform, a management application can specify the virtual fabric membership for each virtual port. QLogic is the first FC HBA vendor to extend VF capabilities to the HBA level, thereby tagging each FC frame and creating completely isolated virtual fabrics at the HBA level, as shown in the diagram below. Without VF technology, a single FC HBA port could only participate in one virtual fabric domain. With VF enabled, a single FC HBA port can now participate in multiple virtual fabric domains, eliminating the need to purchase multiple HBAs in an environment with multiple VFs.
Managing VMs, Ports, and Fabrics in Windows

Using Microsoft's Virtual Server 2005 R2, storage administrators can easily create multiple VMs (each with its own operating system) on a single physical server. The VM parameters and requirements (processor utilization, memory capacity, I/O connection) can be specified during the VM creation process. Once the VMs are created and started, they can be moved from one physical server to another with little or no disruption in service using standard migration functions. This migration function is useful in high availability scenarios where physical server resources may fail, and the VMs automatically failover to another server. Also, storage administrators may need to take a physical server offline for maintenance. This can be accomplished by migrating all VMs to another physical server until the maintenance task is completed on the original server.

Together, NPIV and VF technologies allow storage administrators to create logical and secure ports from a single physical HBA port, simplifying the management virtual storage network environments. Virtual ports are first created with their own WWPN through NPIV and are then secured into their specific virtual fabric through VF technology.

HBA Virtualization with System Center Virtual Machine Manager

Microsoft's System Center Virtual Machine Manager is a new management application that facilitates the management of VMs in large virtualized data center environments. Besides the other hardware devices in a virtualized network, SCVMM can also manage all available virtual ports from a single application, simplifying the management complexity, as shown in the following diagram.

QLogic partnered with Microsoft to define a standards-based approach to support NPIV and VF within the Windows OS architecture and management application interface. Microsoft System Center Virtual Machine Manager initiates system calls to the HBA to migrate virtual ports. Storage administrators can create virtual HBA ports within multiple zones and assign them to VMs for migrations, without having to reconfigure any zoning or LUN masking settings. Storage administrators who deploy Microsoft’s SCVMM along with QLogic’s SANblade 2400 family of 4Gb FC HBAs can now create virtual machines and ports that are easier to manage, maintain, and support across the virtualized data center. The solution will be available to customers during the second half of 2007.

Summary and Conclusion

QLogic is the first HBA vendor to market HBA support for both NPIV and VFs, offering a hardware platform to support both HBA virtualization technologies. QLogic is continuing its leadership position in the virtualization market by partnering with Microsoft and enabling NPIV in System Center Virtual Machine Manager. QLogic HBA virtualization technologies allow storage administrators to use management applications such as Microsoft's SCVMM to easily support virtual machines, ports, and fabrics, thereby creating a scalable virtualized data center that is more secure and easier to manage.
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