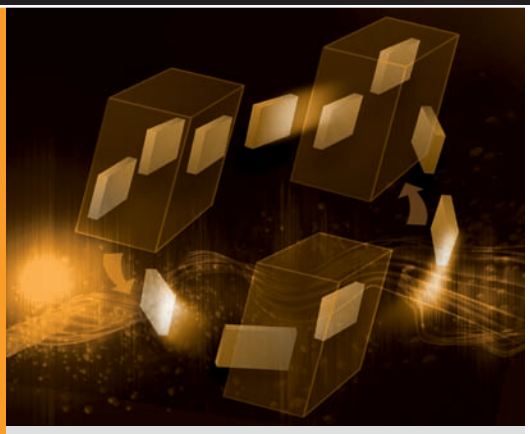

STRATEGIES TO OPTIMIZE VIRTUAL MACHINE CONNECTIVITY WITH XSIGO VIRTUAL I/O

By Scott Hanson

Server virtualization places demands on I/O infrastructures that can limit overall performance and efficiency. By using virtual connectivity and a high-speed converged interconnect to remove traditional barriers, Xsigo® virtual I/O can help increase virtual machine performance and flexibility, reduce power and cooling requirements, and simplify management.

Increased resource utilization is the primary objective of enterprise consolidation initiatives—and typically the greatest single benefit of server virtualization. But IT managers are now finding that deploying virtualization with a traditional server I/O architecture introduces its own problems that can prevent consolidation projects from reaching their full potential.

There are several reasons why server virtualization places greater demands on connectivity than traditional non-virtualized environments. The increased hardware utilization, storage traffic, and network traffic increases the risk of I/O bottlenecks. Application mobility requires that each server be able to access storage and network resources across the environment, increasing the number of connections per server. And connectivity for virtual machine (VM) migration and management networks further increases connectivity demands.

Faced with these challenges, IT staff commonly try to enhance connectivity by adding network and storage ports to the servers. But this approach has its limitations. The increased connectivity can increase management complexity, costs, and server space requirements—and even then, performance and efficiency may be suboptimal. In some cases, connectivity may be limited by the space constraints of the servers themselves. Failure to address these issues, meanwhile, can lead to unpredictable performance due to traffic congestion and an inflexible infrastructure that may not be able to accommodate the needs of particular applications.

Xsigo virtual I/O is designed to overcome these challenges to server connectivity, complementing Dell™ PowerEdge™ rack-optimized or blade servers by enabling fast, easily managed connectivity to Gigabit Ethernet and 10 Gigabit Ethernet networks and to storage systems such as Dell EqualLogic™ PS Series Internet SCSI (iSCSI) storage area network (SAN) arrays and Dell/EMC arrays. By transitioning to a next-generation virtual I/O approach in virtualized environments, organizations can greatly simplify the infrastructure while providing the necessary I/O capacity to maximize efficiency and VM performance.

APPLYING VIRTUALIZATION TECHNOLOGY TO SERVER I/O

As fundamental a change as server virtualization itself, virtual I/O can be thought of as two technologies: I/O resource virtualization and converged connectivity. Together, they can deliver dramatic management and performance advantages in virtualized environments.

I/O resource virtualization is somewhat analogous to server virtualization. Just as server virtualization allows one processor to function as multiple virtual processors, virtual I/O allows one physical adapter card to appear as multiple virtual network interface cards (vNICs) and virtual host bus adapters (vHBAs).

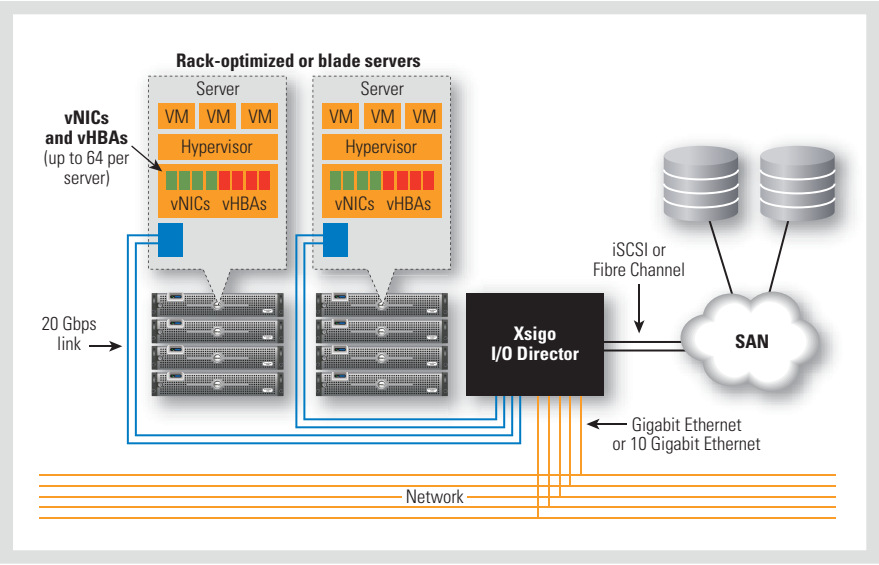

Figure 1. *The Xsigo I/O Director connects servers to conventional LAN and SAN resources through up to 64 vNICs and vHBAs without downtime*

These vNICs and vHBAs function just as conventional NICs and HBAs would: they are designed to be compatible with existing operating systems, hypervisors, and applications, and appear to LANs and SANs as conventional cards.

Converged connectivity replaces the numerous I/O cables of a typical server with a single cable that provides shared transport for all network and storage connections. That cable (or two cables for redundancy) connects to the external Xsigo I/O Director™ device, which then provides connections to the conventional data center Ethernet and Fibre Channel switches (see Figure 1). Up to 64 virtual connections can be deployed to each server, which means that each server can be attached to 64 distinct Ethernet and Fibre Channel networks.

INCREASING VM FLEXIBILITY

Virtual I/O helps address the demands of server virtualization in several ways, but one key attribute is that virtual I/O is *dynamic*: new connections can be deployed on demand without server downtime. VM mobility, for example, often presents a management challenge because different applications require access to different network and storage resources: one application may require iSCSI over 10 Gigabit Ethernet for storage connectivity, while another needs Fibre Channel. But configuring every server with both these resources can quickly become expensive.

Virtual I/O offers a simplified, powerful, cost-effective solution for VM mobility. Because vNICs and vHBAs are software elements, they can be deployed to different servers as needed—any server can potentially connect to any network or storage asset, in real time, without regard for the physical configuration of that device. This approach helps eliminate operational boundaries that could otherwise limit flexibility and VM density.

Blade systems in particular can benefit from this capability. Because virtual I/O helps reduce the dependency on mezzanine cards, blade servers can be dynamically configured with the specific I/O required for a given workload. This in turn helps increase the utility of the blades by enabling them to support a wider range of applications and more VMs per blade than they could otherwise.

ENHANCING VM PERFORMANCE

Traditional I/O can introduce performance bottlenecks when heavily trafficked connections become overloaded. IT staff could add I/O resources to help alleviate this problem, but this approach comes at the cost of additional equipment and increased complexity.

Virtual I/O actually addresses this type of bottleneck in the opposite way: it *reduces* the number of physical resources. Xsigo virtual I/O uses a single 20 Gbps connection that is dynamically allocated in real time across multiple virtual connections to both storage and network resources. Because this 20 Gbps capacity typically exceeds the I/O capacity of the server itself, the link is not a limiting factor. In I/O-intensive applications, this approach can help increase both VM performance and the potential number of VMs per server.

Server-to-server data transfer can also benefit from virtual I/O. For example, when an application server accesses data from a database server, the data transfer occurs entirely within the virtual I/O environment over the 20 Gbps link, without utilizing external networks—helping both increase application performance and decrease network congestion.

ACCELERATING AND SIMPLIFYING VM MIGRATION

The high-speed Xsigo server-to-server communication link helps accelerate VM migration as well. Moving a VM from one server to another requires transferring the application's state information—which could be gigabytes of data. Best practices recommend using a dedicated interconnect for this type of transfer, typically by implementing VM migration over a separate Gigabit Ethernet network. Virtual I/O enables administrators to configure a dedicated network that has access to the full 20 Gbps bandwidth when required, which can help significantly accelerate the migration process.

Virtual I/O can also help simplify VM migration by minimizing hardware constraints. Migration usually requires identical I/O on the source and destination servers, a restriction that can limit flexibility. Virtual I/O enables connectivity to be configured on the fly, allowing VM migration to proceed without regard for the physical I/O resources.

MAINTAINING QUALITY OF SERVICE

Within a virtualized server, the virtual switch provides a useful tool for sharing I/O among multiple VMs—but can also result in unpredictable performance because of resource contention at the physical I/O level. Virtual I/O can help eliminate resource contention without the need to add I/O cards and cables.

Because vNICs and vHBAs can be deployed on demand, administrators can easily provision critical VMs with dedicated storage and network connectivity. Quality-of-service (QoS) controls help ensure that critical applications receive the bandwidth required from each connection. Administrators can define QoS controls per virtual resource (on both storage and network connections), and can control both the committed information rate (the minimum allowed bandwidth) and peak information rate (the maximum allowed bandwidth). These controls help ensure that critical applications can coexist on a shared hardware platform without resource contention.

INCREASING ENERGY EFFICIENCY

Virtualized servers tend to be more I/O intensive than traditional non-virtualized servers, and those I/O resources can require a surprising amount of power. In a typical environment with 120 servers, Xsigo virtual I/O can require 70 percent fewer I/O cards, cables, and switch ports than a traditional I/O infrastructure—helping to reduce power consumption by up to 30 percent and significantly lowering related power and cooling costs in the data center.[1]

CENTRALIZING I/O MANAGEMENT

Virtual sprawl typically refers to an overabundance of VMs, but it could just as easily apply to connectivity. Managing the physical connections, virtual switches, and data center switches is becoming increasingly challenging. But because using virtual I/O means that those virtualized resources exist in software, they can be monitored and managed from a software utility.

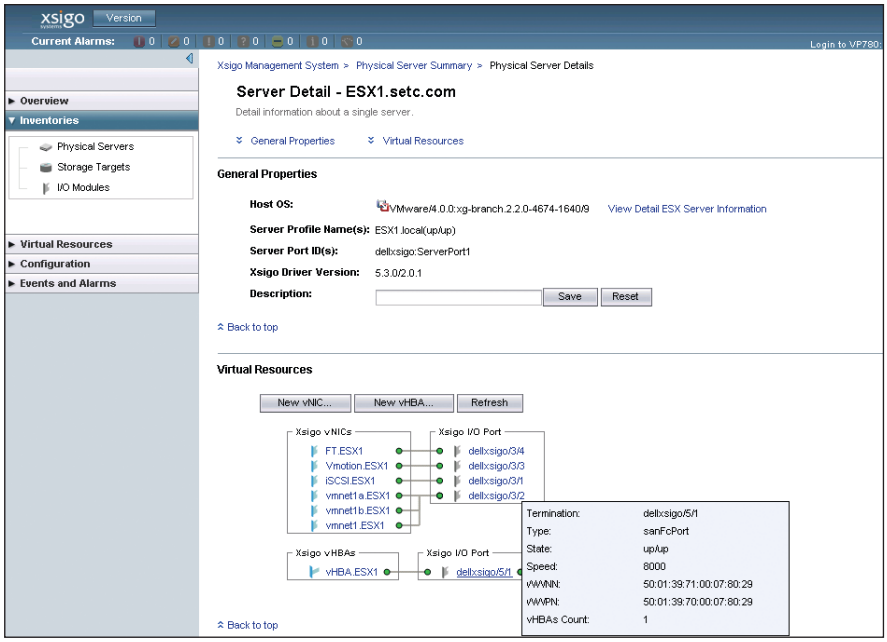

Figure 2. *The Xsigo Management System provides reporting and monitoring tools to help manage virtual connectivity*

The Xsigo Management System (XMS) provides reporting views that enable administrators to see the currently configured servers, vNICs, and vHBAs from a single management console (see Figure 2). Traffic monitoring tools in the XMS help administrators understand how their resources are being used. And in addition to running as a stand-alone system, the XMS has also been integrated with the VMware® Infrastructure Client to enable comprehensive management of VMs and virtual I/O from a single application.

OPTIMIZING CONNECTIVITY IN VIRTUALIZED ENVIRONMENTS

The dynamic data center enabled by virtualization technology can offer major advantages, but also introduces multiple performance and management challenges. Virtual I/O is designed to meet those challenges—helping increase VM flexibility and performance, reduce power and cooling requirements, and simplify management through an approach that matches the technological elegance of server virtualization itself.

Scott Hanson is a senior engineering consultant on the Dell Enterprise Technology Center team. Scott has a B.S. in Computer Science from the University of North Texas and holds Microsoft® Certified Systems Engineer + Internet (MCSE+I) and Red Hat Certified Engineer® (RHCE®) certifications.

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[1] Comparison based on 120 servers each configured with four Ethernet ports and two Fibre Channel ports. Typical server connectivity for this configuration includes 120 quad-port Ethernet cards, 120 dual-port HBAs, 10 Ethernet switches, and 6 Fibre Channel switches, and draws approximately 4,200 W; Xsigo connectivity includes 120 dual-port host channel adapters (HCAs), 2 Xsigo I/O Director devices, and 6 Xsigo expansion switches, and draws approximately 2,912 W. Savings will vary based on configuration, usage, and manufacturing variability.