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# 10 Strategies for Maximizing VMware Performance with Virtual I/O

Server virtualization increases server utilization, but also significantly adds to I/O complexity. Xsigo virtualized I/O unleashes complementary efficiencies and cost savings in the virtualized data center.

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## Introduction

Because VMware server virtualization increases server utilization, it also places new demands on server input/output (I/O). Increased network and storage traffic can cause bottlenecks that impact the user experience. A common response is to add more I/O resources to the server (more network and storage connections), but this results in greater management complexity, higher cost, and larger servers.

Virtual I/O eliminates bottlenecks, and reduces cost and complexity by consolidating the physical resources (cards and cables) to a single high speed link. Within the server, the storage and network connections (HBAs and NICs) are replaced by virtual resources (vHBAs and vNICs) that appear exactly as their physical counterparts.

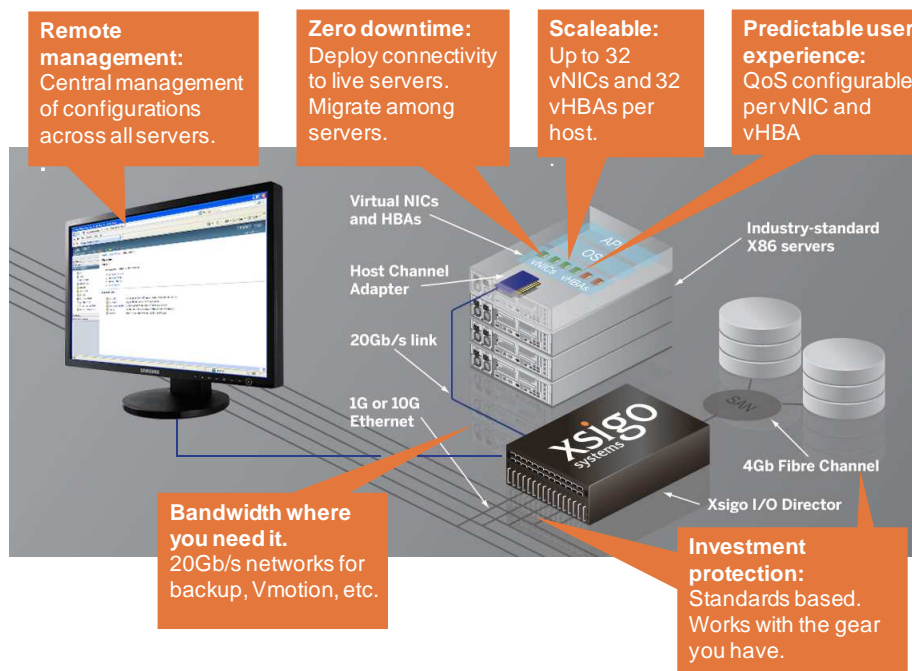
Virtual servers and virtual I/O are in fact analogous in several ways: While server virtualization divides processor resources among multiple applications, I/O virtualization divides I/O resources among multiple virtual connections. These virtual connections can be linked to virtual switches and virtual machines, just as you would with conventional NICs and HBAs.

The attributes of virtual I/O, including the ability to deploy virtual connections on the fly and to manage quality of service on a per-resource basis, provides management granularity and flexibility that deliver tangible benefits to VMware users.

The benefits of deploying virtualized I/O in a VMware environment include:

1. Predictable application performance
2. Lower server cost and less power
3. I/O resource mobility
4. Connectivity isolation
5. Lower latency
6. Faster backup
7. Relief from blade server connectivity limitations
8. Large-scale I/O across server farms
9. Centralized I/O management
10. Faster VMotion

This paper provides an overview of each of these virtual I/O characteristics so you can identify which best suit your virtual environment to help you meet your objectives and get the most from your VMware deployments.



## 1. Predictable Application Performance

It can be challenging to guarantee application performance and isolation when relying on shared resources. In production deployments, it's important to eliminate bottlenecks and guarantee throughput for critical applications.

With traditional I/O, IT managers resolve these issues by adding resources. Multiple connections to each server provide isolation and bandwidth, but they also drive up costs to the point that server I/O may be more expensive than the server itself.

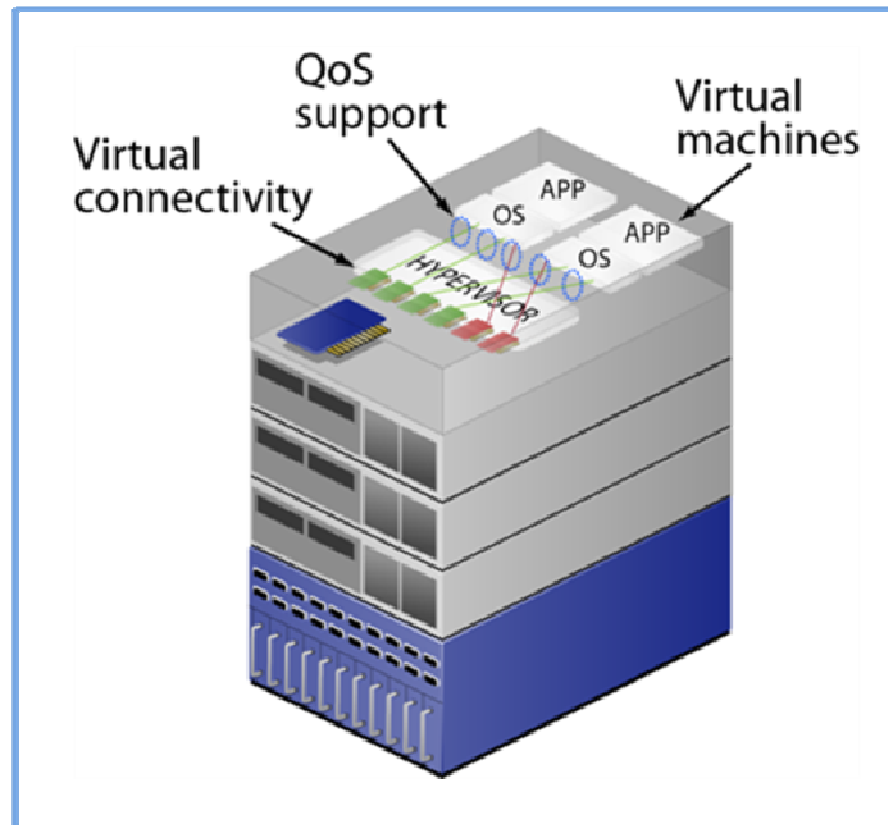
Virtual I/O provides a less costly, more easily managed alternative that delivers predictable application performance in three ways:

- Dynamically allocated bandwidth: 20Gb bandwidth to each server is dynamically shared among virtual machines. Conventional I/O may get only 1Gb bandwidth to an application. With virtual I/O, all bandwidth is available when needed.
- Resource isolation: Connectivity can be assigned to specific VMs for I/O isolation.
- Quality-of-service (QoS): Ensures that critical applications receive the bandwidth required.

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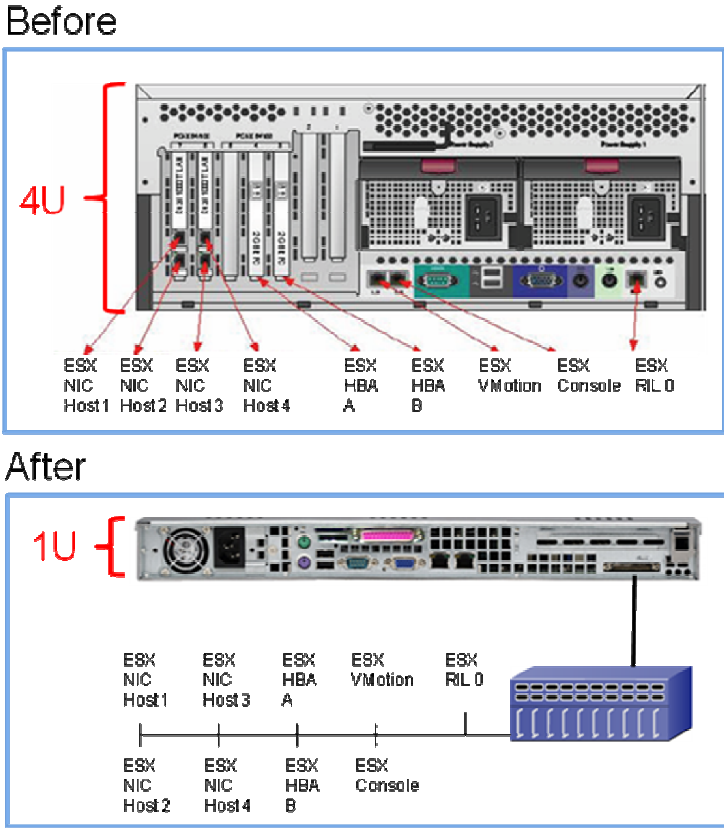
Xsigo QoS helps ensure predictable application performance by delivering guaranteed bandwidth, even when resource contention occurs. Throughput is hardware enforced, and controlled by the following user-defined settings:

- Committed information rate (CIR) guarantees a minimum bandwidth.
- Peak information rate (PIR) limits the maximum amount of bandwidth the resource can consume. Maintaining the ability to use additional bandwidth set aside for less critical applications is a way to ensure that varying types of application VMs can coexist on a shared hardware platform.



## 2. Lower Server Cost and Less Power

With conventional I/O, the connectivity requirements for virtualization often drive deployment of costly 4U servers. 1U servers may cost a fraction as much, but are typically limited two I/O slots. By eliminating connectivity constraints, virtual I/O enables 1U servers to be more widely deployed. With just two adapter cards, as many as 32 fully redundant vNICs and vHBAs may be deployed to any server.



Fewer I/O cards means less power as well, saving as much as 40 watts per server. Edge switches and cables are also reduced, for a capital savings of 30% to 50% on server I/O costs alone. Power savings associated with the reduced number of PCI cards and networking switches range from 4 to 6 kilowatts for a 120 server installation.

### 3. I/O Resource Mobility

Virtual I/O eases the challenge of building fault-tolerant datacenter environments by enabling virtual I/O resources to be rapidly moved from one server to another. A server's I/O personality is defined by its connectivity, MAC addresses, and WWNs. With Xsigo, you can move all of those attributes from one server to another in a single operation, effectively moving the server personality. This enables the physical resource running a hypervisor to be quickly changed from one server to another in the event of a system failure or system upgrade.

The I/O mobility inherent in virtual I/O helps enable:

- Disaster recovery: The exact I/O resources at one site can quickly be created at another, thus accelerating switchover.
- Server replacement: When a server fails, its full connectivity profile (including WWNs and MAC addresses) can be instantly moved to another server.
- Isolation: To ensure physical isolation, a server may be configured only with the connectivity currently needed, and no more. When requirements change, the configuration can be changed without entering the data center. The IT manager is never forced to implement "big flat networks" or open storage.

### 4. Connectivity Isolation

All Xsigo I/O modules enable fine-grain Quality of Service (QoS) including Committed Information Rate (CIR) and Peak Information Rate (PIR) settings that are configurable for each virtual NIC and virtual HBA. The 10-Gigabit Ethernet module also allows QoS parameters, access controls and classifiers to be configured per flow based on the type of traffic.

Administrators can create many "physically" isolated networks due to the abundance of Ethernet adapters and HBAs. This allows you to isolate port groups or to create more isolated port groups. Isolating traffic and connectivity improves deterministic performance of virtual machines and eliminates potential denial of service risks that are prevalent in flat network architectures.

## 5. Lower Latency

Server-to-server communications benefit from the high-speed and low-latency switching of Xsigo's underlying fabric. By sending information from one vNIC to another, servers move traffic at nearly 10Gb per second with a latency of less than 30 microseconds using standard TCP/IP protocols. This performance enhancing feature for Ethernet-based applications requires no modifications to the applications themselves or to the TCP/IP stack.

InfiniBand protocols are supported as well. For high performance computing applications, the Xsigo I/O Director supports MPI with a latency of 3.5 microseconds for 0-byte messages, and a bandwidth of 846MB per second for 4KB messages.

Furthermore, with Xsigo you can deploy multiple vHBAs per hypervisor or per VM. By giving your applications multiple I/O queues you can overcome queue congestion often seen when many applications with different I/O behavior share the same queue. This allows the kernel to distribute I/O among multiple queues for better I/O distribution.

## 6. Faster Backup

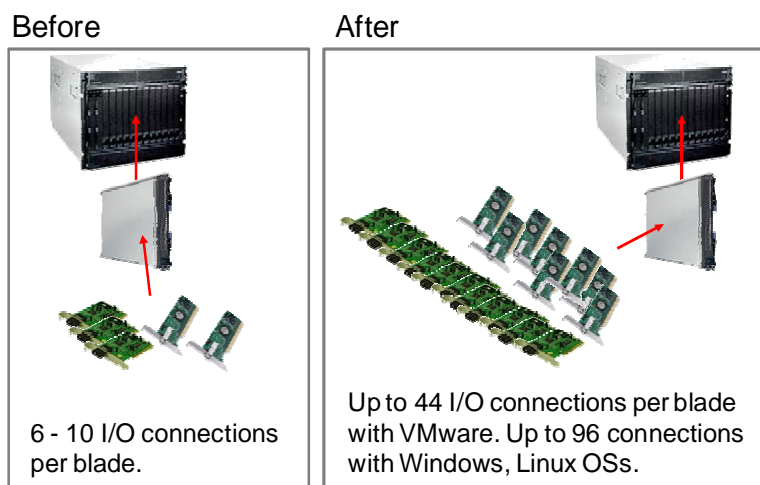
For hosts connected to the Xsigo chassis you accelerate the backup process by configuring a low latency, high bandwidth dedicated backup network. This has several advantages compared with creating a dedicated physical network. First, the virtual network needs to exist only when it is needed, so the resource is not lying idle outside the backup window. Second, instead of giving every backup client access to your backup network or backup SAN, you can simply move a secure vNIC or vHBA from client to client as the backup window requires.

## 7. Relief from Blade Server Connectivity Limitations

Blade servers have limited I/O expansion capabilities. In most cases, a fully populated server blade can only provide four Ethernet NICs and two Fibre Channel HBAs. Because shared connectivity may result in conflicts and bottlenecks, this limits your ability to run multiple virtual machines per host. Most blade systems are available with HCAs that are proven compatible with virtual I/O.

Virtual I/O resolves the blade server I/O bottleneck by replacing the traditional I/O resources with high-speed links and virtual resources. With more bandwidth and better isolation, blades can run more virtual machines. Other benefits include:

- 802.3ad supported across up to ten 1Gb ports allows for better link aggregation than other blade I/O solutions.
- I/O resource can be shared between blades and servers, not just between the blades in the blade enclosure.
- With up to 32 NICs and 12 HBAs per hypervisor, you can better support VMware best practices of dedicated connectivity for critical VMs and management functions.



## 8. Large-scale I/O across Server Farms

Xsigo virtual I/O allows connectivity to be added based on need. This allows a virtualized datacenter to be configured and re-configured on demand for a true utility computing model. Typical installations may include hundreds of servers connected to each pair of I/O Directors. Up to 16 I/O Directors may be clustered, enabling configurations of over 1,000 servers.

## 9. Centralized I/O Management

The Xsigo graphical user interface is a browser based interface that provides centralized management of all I/O connections, system-wide, from a single screen. Interface wizards guide the user through the process of creating server I/O profiles, individual virtual resources or templates. XMS also provides reporting views which enable an administrator to see all of the servers, virtual NICs or virtual HBAs that are currently configured. Traffic monitoring tools also enable administrators to better understand how their resources are being used.

In addition to running as a stand-alone system, the Xsigo Management System has been integrated with the VMware Infrastructure Client. This integration enables complete management of virtual machines and virtual I/O from a single application.

## 10. Faster VMotion

Xsigo virtual I/O is built in a high-speed, low-latency switched fabric. Within that fabric it is simple to configure an isolated VMotion network that is both extremely fast and separate from production traffic. Traffic flows only between virtual NICs and does not appear on the LAN.

- Improves VMotion performance and reliability by creating an instant on high-speed network for VMotion traffic
- Improves security by isolating VMotion traffic from the rest of the datacenter
- Reduces the burden on the LAN by keeping all of the VMotion traffic within the Xsigo chassis
- Reduces the need for expensive and dedicated high-speed networking ports and server NICs
- Keep swap file local and still attain high speed VMotion

## Product Overview: The Xsigo I/O Director

The Xsigo I/O Director is an enterprise-class, hardware-based solution that provides LAN and SAN connectivity for up to hundreds of servers. Under software control, any server may be configured with access to any LAN or SAN. Because the vNICs and vHBAs can be configured on-the-fly without a server reboot, the server's network connectivity is truly flexible and reconfigurable.





## About Xsigo

Xsigo is the leader in data center I/O virtualization, a solution that dramatically reduces operational expense by changing the way that servers are connected to networks and storage.

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