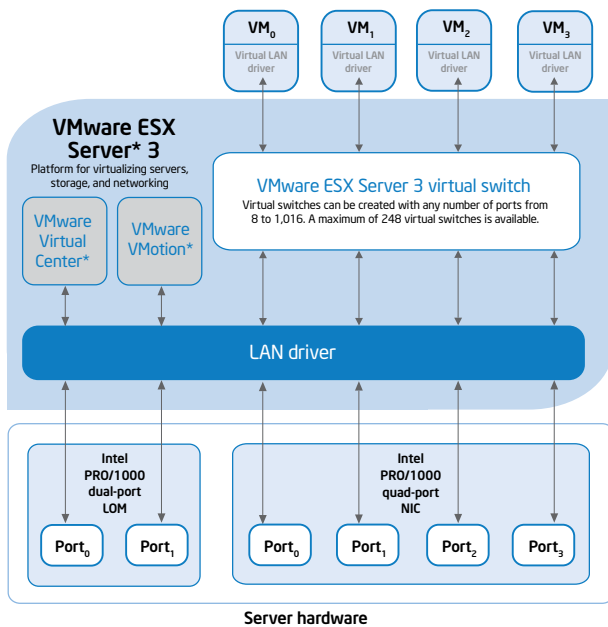(intel®)
Leap ahead™

Using Intel® Multi-Port Server Adapters to Optimize Virtual Infrastructures

By Robert Hays and Eric Pan

Using virtualization to consolidate physical servers, storage, and networks; improve resource utilization; and streamline business continuity processes is an increasingly popular strategy undertaken by organizations struggling to contain IT costs. To optimize the benefits of virtualization, multi-port server adapters can be an essential hardware component that helps ensure availability, reliability, and performance within a virtual infrastructure.

In an era where the continuing challenge is to do more with less, IT departments are casting a critical eye on server sprawl and improving business continuity. Responding to company growth and rapidly changing business needs, many organizations add substantial numbers of new servers—which can increase hardware costs, systems management complexity, administrative overhead and site costs. Compounding this problem is underutilization of server resources. Improving server utilization from the typical 10 to 15 percent up to 80 or 85 percent[1] can have dramatic effects on total cost of ownership—helping to reduce both equipment and administrative costs.

The requirement to lower total cost of ownership for IT assets is driving organizations to reduce the number of physical servers, switches, and storage devices by implementing virtual infrastructures. This approach can help reduce IT costs while increasing flexibility and responsiveness, streamlining business continuity, and optimizing performance and reliability of IT infrastructures. The flexibility to pool resources enables distributed services to optimize and manage IT environments so they can respond immediately to changing business needs and cost-effectively scale the IT capacity of the enterprise.

Recommended LAN Configuration for VMware ESX Server* 3

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[1] In multiple-workload tests, a virtualization platform comprising Dell PowerEdge* 2850 servers configured with single-core and dual-core Intel® Xeon® processors DP, Intel® PRO/1000 Multi Port Server Adapters, and VMware ESX Server* software achieved 85 percent CPU utilization. For more information, see "VMware ESX Server Performance on Dual-Core Dell PowerEdge 2850 Servers" by Todd Muirhead and Dave Jaffe, Ph.D., in *Dell Power Solutions*, May 2006, www.dell.com/downloads/global/power/ps2q06-20060236-Muirhead.pdf.

Case Study
Intel® PRO Multi-Port Adapters
Design and Manufacturing

**Virtual Computing
Delivers Cost Savings**

Virtualization Helps Woodward Governor Company Consolidate Servers and Improve IT Responsiveness

Challenges	Solutions	Benefits
▪ Increase IT efficiency while controlling costs ▪ Serve end users better by improving performance, reliability, and IT responsiveness ▪ Scale quickly and flexibly to meet business demands	▪ Dell PowerEdge* 2850 servers (single-core and dual-core Intel® Xeon® processors) ▪ Intel® PRO/1000 Dual Port Network Adapters ▪ Intel® PRO 1000MT Quad Port Network Adapters ▪ VMware ESX Server* virtualization software ▪ VMware VirtualCenter* management software ▪ VMware VMotion* technology	▪ Reduced the number of new physical server deployments by 50 percent using virtual servers ▪ Kept IT costs to a minimum every year for the past three years ▪ Accelerated provisioning and simplified resource allocation using Intel® multi-port adapters and VMware–based virtual servers compared to a deployment comprising all physical servers ▪ Enhanced network reliability and optimized performance for high-bandwidth applications using Intel multi-port adapters and VMware virtualization software
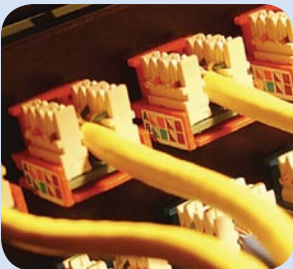
As one of the world's largest independent designers, manufacturers, and service providers of energy control systems for industrial and aircraft engines, Woodward Governor Company is adept at helping customers gain efficiency and high performance. Unfortunately, a few years ago the IT department at Woodward found it difficult to do the same for its internal customers.

As business needs grew and changed, the IT organization, which supports roughly 3,500 global end users, began searching for a way to optimize computing resources and current investments while providing the bandwidth and reliability needed for business-critical applications. When Woodward discovered that server virtualization could help meet these challenges, the company began consolidating servers and never looked back.

Since implementing VMware virtualization software, Woodward has reduced the need for separate physical servers and reigned in server sprawl. Of nearly 100 potential server replacement or deployment

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Providing the foundation: Virtualization software

VMware Infrastructure* 3 is a feature-rich suite designed to deliver a production-ready virtual infrastructure that empowers a responsive data center. This product suite offers tremendous benefits to IT environments and enhances efficiency, increases availability, and provides dynamic workload management. At the core of VMware Infrastructure 3 is VMware ESX Server* 3—a platform for virtualizing servers, storage, and networking.

VMware ESX Server 3 software runs on industry-standard Intel® Xeon® processor–based platforms, providing the virtualization layer that allows multiple virtual machines (VMs) to coexist in isolation from one another on a single physical server as well as virtualizing storage and networking. ESX Server 3 software typically enables organizations to run from one to eight VMs per processor on two-processor and four-processor systems such as the Dell PowerEdge* 1950 server, Dell PowerEdge 2950 server, and Dell PowerEdge 6850 server as well as the Dell PowerEdge 1955 blade server.

opportunities, 60 percent have been on virtual machines. New workloads are first evaluated as potential virtualization candidates before any hardware is purchased, and as existing servers age and are replaced, the IT department continues to pursue consolidation opportunities to help improve IT efficiency and system performance.

Virtual environment

To enable virtualization, Woodward is running VMware ESX Server 2.5 and VMware VirtualCenter 1.3 on 10 Dell PowerEdge 2850 servers, all configured with a 2 Gbps Fibre Channel connection to a Dell/EMC CX300 SAN (see figure at right). Each server has two Gigabit Ethernet connections plus an Intel PRO/1000 quad-port server adapter. One port on the quad-port adapter is dedicated for a connection to an iSCSI-based network, while the other three ports are connected to the data center LAN switches. Some of the adapter ports are dedicated to a specific virtual machine (VM) that may have high bandwidth needs while other adapter ports are bonded together to provide a dual-gigabyte trunk for VMs.

Woodward has more than 80 VMs spread across 10 Dell PowerEdge 2850 servers. Some of the virtualized servers were running outdated operating system versions on aging hardware that was becoming unreliable and a challenge to support. The legacy servers were moved into Woodward's virtual environment, where they are now running in VMs on leading-edge hardware that would not necessarily be supported by the legacy operating systems.

Other examples of enterprise applications running in VMs on Dell PowerEdge 2850 servers with single- and dual-core Intel Xeon processors include database servers, software update servers and systems management servers.
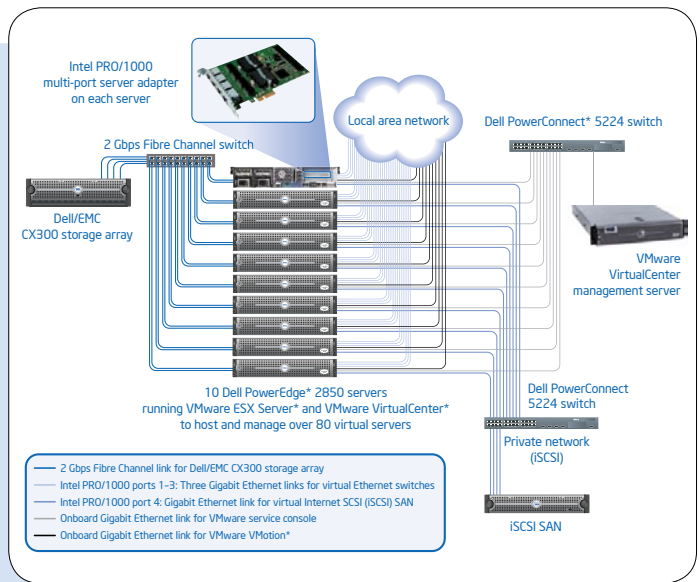
Role of Intel multi-port adapters

When the company began implementing server virtualization, it deployed both Intel PRO dual- and quad-port adapters extensively to support the new virtual computing infrastructure. Woodward purchases Intel PRO adapters specifically because Intel offers full support for VMware software and demonstrates consistently high throughput.

Intel PRO multi-port network adapters are now a key component in Woodward's toolkit. Moving from dual-port to quad-port NICs has provided Woodward with enhanced server virtualization capabilities, enabling improved bandwidth as well as increased flexibility and scalability.

For example, Intel PRO network adapters enable the IT department to optimize network reliability and performance for high-bandwidth applications, and to rapidly deploy new applications and services. As a result, the IT department can easily allocate server resources to support variable workloads. Having multiple ports available allows Woodward's IT staff to leverage features

such as network segmentation, adapter teaming for high throughput, load balancing, and fault tolerance.

Using Intel PRO multi-port Gigabit Ethernet network adapters and VMware virtualization software running on Dell PowerEdge servers, Woodward's IT department has been able to maximize resource utilization and minimize IT costs every year for the past three years—which indicates a very real return on investment.

Additional components of the VMware Infrastructure 3 suite feature distributed services designed to increase high availability and minimize downtime and system recovery times.

Enabling technology:
Multi-port server adapters

To achieve the benefits of server virtualization, administrators must ensure that the

appropriate number and type of network connections are available on physical servers. Best practices for VMware ESX Server 3 recommend a minimum of three, and typically four or more, network ports—which can be a challenge if physical servers are constrained by an insufficient number of PCI slots. With VMware ESX Server 3, two network ports, which are provided as standard LAN on

Motherboard (LOM) connections, are dedicated for VMware VirtualCenter* management software and VMotion* technology (see figure on first page). Additional network ports, via add-in server adapters, are required to support guest operating system application networking and/or networked storage data. In choosing the right server adapter for virtualized servers, IT administrators

Understanding the Benefits of PCI Express*
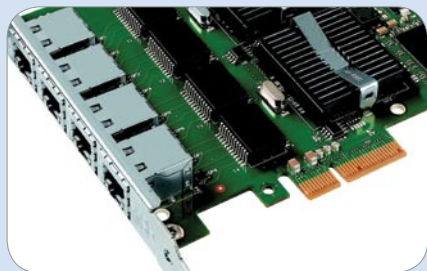
PCI Express[3] is designed to provide faster Ethernet network performance for desktop and server slots than that of PCI and PCI Extended (PCI-X). PCI Express derives a performance advantage from serial bus architecture that supports dedicated, bidirectional I/O at 2.5 GHz, compared to the 133 MHz parallel bus supported by PCI-X.

Designed for PCI Express, the latest family of Intel® PRO Ethernet multi-port server adapters enables organizations to realize maximum benefit from server virtualization and consolidation by taking advantage of the higher bandwidth and scalability of PCI Express.

Dell PowerEdge* servers can support multiple PCI Express slots to accommodate multiple Gigabit Ethernet adapters for network performance–enhancing techniques such as network segmentation and network adapter teaming. In high-density, low-profile rack servers, slots can be fully utilized by selecting dual- or quad-port Gigabit Ethernet adapters.

Intel PRO 1000 Network Server Adapters that support PCI Express include the following:

- Intel PRO/1000 PT (U3867) or PF (GF668) Server Adapters for PCI Express* slots: High-performance, self-configuring 10/100/1,000 Mbps connection

- Intel PRO/1000 PT Dual Port Server Adapter (X3959): 2 Gbps copper server connections in a single PCI Express slot

- Intel PRO/1000 PT Quad Port Server Adapter (EXPI9404PT, EXPI9404PTBLK): 4 Gbps copper server connections in a single PCI Express slot

- Intel PRO/1000 PF Dual Port Server Adapter (EXPI9402PF): 2 Gbps fiber server connections

should consider factors such as the number of guest operating systems, application network bandwidth requirements, cable type, PCI slot availability, and redundancy/failover protection requirements.

Multi-port server adapters such as Intel® PRO/1000 PCI-X and PCI Express* Dual and Quad Port Server Adapters provide up to four ports in a single network card. These adapters, available for both copper and fiber networks, conserve valuable PCI slots in servers while helping to eliminate network bottlenecks in connection-dense virtual computing environments.

Reliability is critical in a consolidated infrastructure

On a server running multiple VMs, a port failure may result in a costly business interruption. Intel PRO multi-port Gigabit Ethernet[2] adapters are designed to prevent network downtime. Intel® Advanced Network Services (ANS) software allows administrators to maximize uptime with redundant, teamed connections. Intel multi-port adapters can be configured to automatically switch to a secondary link when a server's primary link fails, and features such as switch fault tolerance and test switch configuration help administrators verify compatibility and enhance uptime.

Realizing the benefits of virtual infrastructures

Virtual infrastructures empower organizations to create resource pools from servers, storage and networks so that IT resources can be matched and scaled to specific enterprise requirements—significantly enhancing IT efficiency and responsiveness. In this way, a virtual infrastructure consisting of VMware Infrastructure 3 software, Intel Xeon processor–based Dell PowerEdge servers, and Intel PRO multi-port server adapters can help IT managers simplify operations, improve resource utilization, and scale cost-effectively.

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[2] This term does not connote an actual operating speed of 1 Gbps. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.
[3] For more information about PCI Express*, see the white paper "PCI Express Ethernet Networking" by Intel Corporation, September 2005, www.intel.com/network/connectivity/products/whitepapers/mesh_pcie_whitepaper.pdf.

For More Information

Henderson, Bill, and Tracy D. Edwards. "Using Intel Multi-Port Server Adapters to Enable Virtual Infrastructure in the Data Center." *Dell Power Solutions*, May 2005. www.dell.com/downloads/global/power/ps2q05-20050131-Intel.pdf.

Intel Network Solutions:
www.intel.com/network/connectivity/index.htm

Virtualization solutions from Intel and VMware:
www.intel.com/network/connectivity/solutions/virtualization.htm

Gigabit solutions from Intel and Dell:
www.intel.com/go/dellgig10

VMware virtual infrastructure software:
www.vmware.com/dell

Dell and VMware:
www.vmware.com/virtuallyspeaking
www.dell.com/vmware