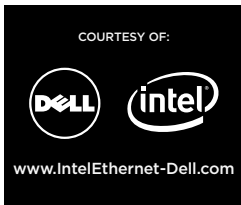




By Sunil Ahluwalia
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INTEL ETHERNET SERVER ADAPTERS MAXIMIZE THROUGHPUT PERFORMANCE FOR iSCSI CONNECTIVITY

Internet SCSI (iSCSI) connectivity is a compelling option for enterprises building virtualized IT environments. By selecting Intel® Ethernet server adapters with Dell™ PowerEdge™ servers and Dell EqualLogic™ PS Series storage area networks, organizations can achieve enterprise-class application performance while benefiting from the cost- and labor-saving advantages of iSCSI connectivity.



The trend toward virtualizing the data center has led to increased demand for networked storage, which can play an essential role in provisioning, backing up, and migrating virtual machines (VMs). Increasingly, enterprise IT groups are deploying storage area networks (SANs) with Internet SCSI (iSCSI) connectivity to take advantage of existing cost-effective, easy-to-manage Ethernet networks. Given advances in servers, storage systems, server adapters, and operating systems, enterprise-ready iSCSI is compelling for IT organizations because it uses Ethernet, which is a standardized, widely deployed, and well-understood technology. Using Intel Ethernet server adapters to connect 11th-generation Dell PowerEdge servers and Dell EqualLogic PS Series iSCSI SANs enables IT groups to achieve the requisite performance for running enterprise workloads in a virtualized environment—while realizing the significant cost- and labor-saving benefits of iSCSI connectivity.

ACHIEVING ENTERPRISE PERFORMANCE WITH iSCSI CONNECTIVITY

Powerful servers are critical for achieving enterprise performance in a virtualized environment that uses iSCSI connectivity. The 11th-generation Dell PowerEdge server family, equipped with the Intel

Xeon® processor 5500 series architecture, provides the processing performance, memory capacity, and I/O bandwidth needed to create a high-performance and scalable virtualized environment for business-critical applications. Beyond supplying the raw compute performance for hosting multiple VMs on each server, the Intel Xeon processors include Intel Virtualization Technology (Intel VT), which is designed to enhance host processing performance by providing hardware assistance for virtualization. In addition, advances in the memory architecture and support for Double Data Rate 3 (DDR3) memory help deliver significantly greater memory bandwidth compared with previous-generation Intel processors, enabling IT groups to host more applications on each physical server than in the past.

PowerEdge servers can also deliver the I/O bandwidth required to achieve outstanding performance in a virtualized environment. The Intel Xeon processor 5500 series architecture supports PCI Express (PCIe) 2.0 technology, which is designed to increase bandwidth for VM traffic by doubling the signaling bit rate of each I/O lane compared with previous-generation PCIe technology. This fast interface bus and the memory architecture enhancements of the latest Intel Xeon processors contribute to increased I/O scalability. The architecture enables

Intel Xeon processor 5500 series-based servers with four 10 Gigabit Ethernet (10GbE) ports to scale up to nearly 50 Gbps of bidirectional network throughput—scalability that can be put to good use for supporting high-bandwidth applications in virtualized environments.¹

Dell EqualLogic PS Series iSCSI SANs are well suited for virtualized environments running enterprise applications. With their redundant, hot-pluggable system architecture; RAID protection; and advanced monitoring capabilities, EqualLogic arrays deliver enterprise-class reliability and availability. To support a growing IT infrastructure, EqualLogic SANs can be scaled easily and seamlessly, without disrupting performance. Each EqualLogic array that administrators add helps increase not only storage capacity but also processing power, cache memory, and the number of available network connections. When administrators add arrays, the network load is spread across the new enclosures, enhancing throughput between servers and storage.

Moreover, EqualLogic SANs are designed for simplified management. They provide virtualized storage in which data volumes are provisioned automatically from a single scalable storage pool. To help maximize utilization of storage resources and streamline management, these SANs are designed to automatically load balance workloads from across all virtualized servers. As workloads change, storage resources are adjusted automatically, without requiring manual tuning. EqualLogic SANs also include a comprehensive suite of management tools, including advanced capabilities to support snapshots within a virtualized environment without additional software.

Using Intel Ethernet server adapters with native iSCSI initiators built into Microsoft® Windows®, Linux®, and VMware® ESX platforms can provide a simple, dependable, cost-effective way to connect

PowerEdge servers to EqualLogic SANs, TCP/IP stacks, and network stacks. These native initiators are broadly tested using multiple generations of operating systems, storage systems, and OS tools to help ensure reliability and ease of use. Standardizing on Intel Ethernet server adapters for iSCSI allows administrators to use a single initiator, TCP/IP stack, and set of management tools and IT policies. In addition, native OS initiators such as the Microsoft iSCSI Software Initiator have consistently delivered advanced features such as multipathing and IP Security (IPsec). Moreover, native OS initiators support the CRC-32 digest instruction set included in the Intel Xeon processor 5500 series, which is designed to avoid the transmission of data in a vulnerable state.

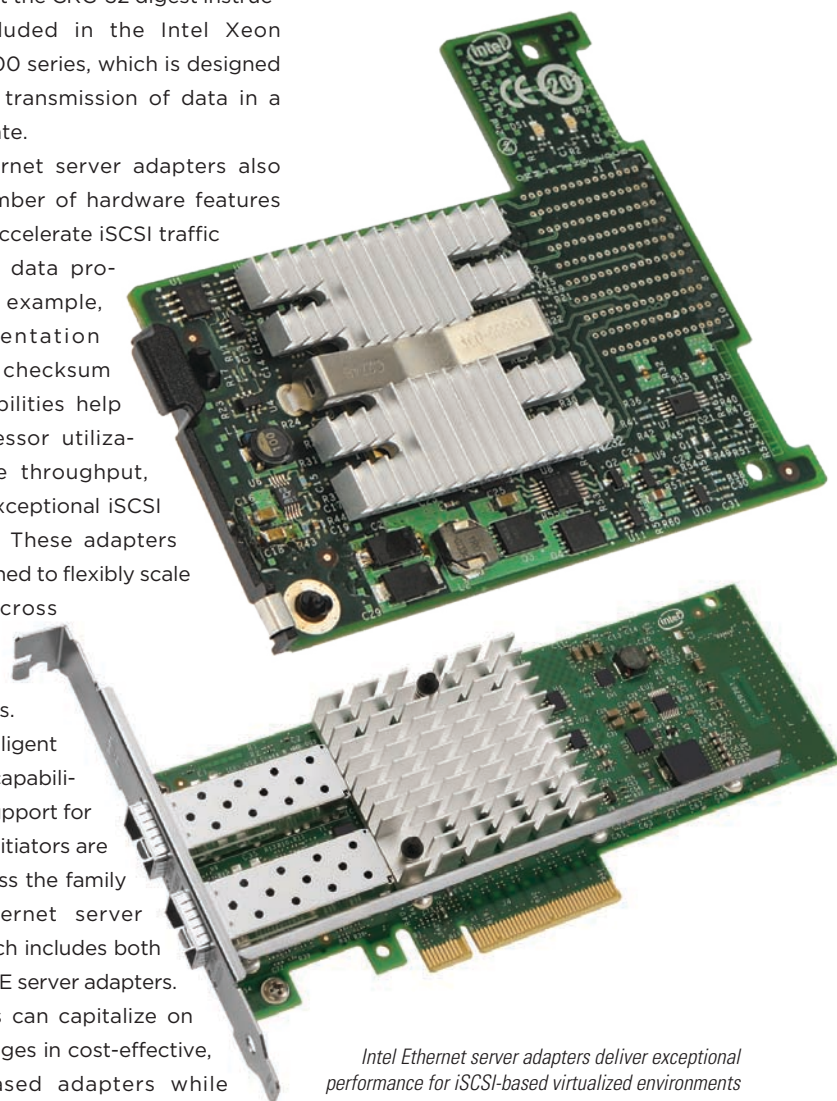
Intel Ethernet server adapters also include a number of hardware features designed to accelerate iSCSI traffic and enhance data processing. For example, TCP segmentation offload and checksum offload capabilities help reduce processor utilization, increase throughput, and deliver exceptional iSCSI performance. These adapters are also designed to flexibly scale workloads across multi-core processor-based systems.

These intelligent acceleration capabilities and the support for native iSCSI initiators are available across the family of Intel Ethernet server adapters, which includes both GbE and 10GbE server adapters. Organizations can capitalize on these advantages in cost-effective, standards-based adapters while

tailoring network connectivity to their specific needs.

OPTIMIZING iSCSI PERFORMANCE FOR VIRTUALIZED ENVIRONMENTS

Intel Ethernet server adapters also enhance performance in virtualized environments using iSCSI connectivity. Intel Virtual Machine Device Queues (Intel VMDq), a component of Intel Virtualization Technology for Connectivity (Intel VT-c) that is supported in Microsoft and VMware hypervisors, helps accelerate I/O performance by removing processing burdens from the hypervisor. In traditional



Intel Ethernet server adapters deliver exceptional performance for iSCSI-based virtualized environments

¹Based on Intel testing performed in March 2009 using the bandwidth-intensive IxChariot network benchmark on an Intel preproduction system configured with two quad-core Intel Xeon X5570 processors at 2.93 GHz, 12 GB of DDR3 RAM at 1,066 MHz, an Intel 82599 10GbE controller, and an unmodified stock installation of Microsoft Windows Server 2008. Network throughput was measured on 64 KB I/O transfers between the test system and multiple network targets.

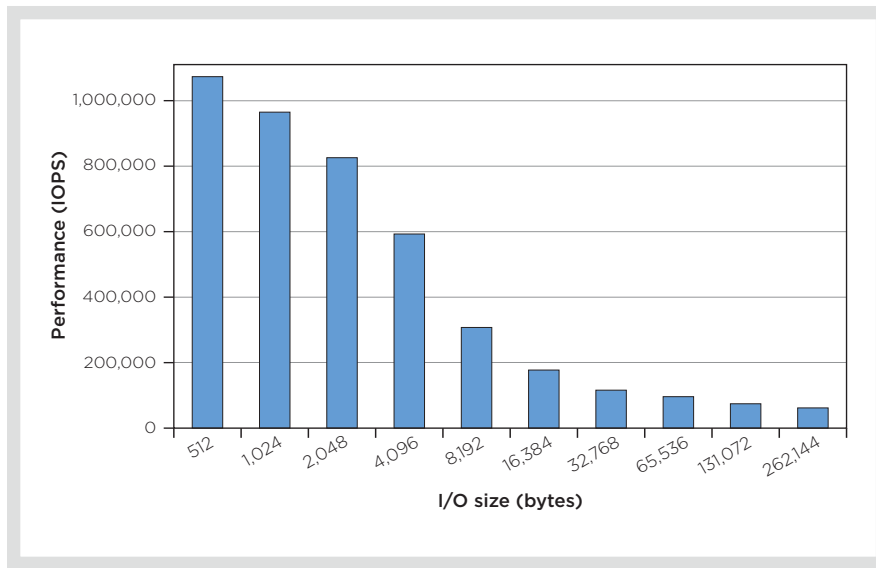


Figure 1. Average iSCSI read/write performance using an Intel 10GbE controller and the native Microsoft Windows Server 2008 R2 initiator

virtualized environments, I/O resources are shared among multiple VMs, and the hypervisor is responsible for sorting and routing packets from shared I/O to destination VMs—tasks that consume processor cycles and can diminish overall network I/O performance. With VMDq, the Ethernet controller sorts packets and then groups packets going to the same destination VM into the same queue. By removing processing burdens from the hypervisor, VMDq helps accelerate I/O traffic.


DELIVERING MEASURABLE RESULTS

By incorporating native iSCSI initiator support, intelligent acceleration capabilities, and virtualization optimizations, Intel Ethernet server adapters help organizations achieve high levels of iSCSI performance. In Intel testing, servers with the Intel Xeon processor 5500 series architecture and 10GbE server adapters achieved up to 1 million bidirectional, transmit-and-receive I/Os per second

(IOPS) at block sizes of 512 bytes, without proprietary iSCSI offloads (see Figure 1).² This level of performance, attained using the native iSCSI initiator in the Microsoft Windows Server® 2008 R2 OS, is approximately twice that achieved using previous-generation solutions.³ Although a number of factors can affect total IOPS in real-world implementations, the test results demonstrate the effectiveness of Intel Ethernet server adapters in helping deliver exceptional performance in environments using iSCSI connectivity. In a virtualized environment, this I/O throughput helps ensure strong performance for multiple applications running on each physical server.

MEETING THE NEED FOR COST-EFFECTIVE iSCSI PERFORMANCE

iSCSI has become a viable connectivity option for enterprise infrastructures deploying virtualized environments. Implementing iSCSI connectivity in a virtualized environment enables organizations to realize the benefits of virtualization

in an efficient, cost-effective way. Intel Ethernet server adapters, available on a comprehensive range of Dell PowerEdge servers, provide a cost-effective, easy-to-manage solution that helps organizations achieve enterprise-class performance in virtualized environments with iSCSI connectivity. 

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² Based on Intel testing performed in December 2009 using version 2006.07.27 of the Iometer benchmark on a virtualized server configured with two quad-core Intel Xeon W5580 processors at 3.2 GHz, 24 GB of DDR3 RAM, an Intel 82598 10GbE controller, and Microsoft Windows Server 2008 R2. The server hosted 10 VMs allocated with 2 GB of RAM each, and connected through a Cisco Nexus 5020 switch to an iSCSI software storage target at 10 Gbps. The Iometer benchmark was configured with 10 managers (1 per VM), 50 workers (5 per manager), and 50 LUNs (1 per worker), with 90 outstanding I/Os, I/O sizes ranging from 512 bytes to 1 MB, and a maximum transmission unit (MTU) of 1,500 bytes.

³ Based on Intel testing performed in December 2009 using version 2004.07.30 of the Iometer benchmark on a server configured with two quad-core Intel Xeon X5365 processors at 3.0 GHz, 8 GB of RAM at 667 MHz, an Intel 82598 10GbE controller, and Microsoft Windows Server 2008. The server connected through a Cisco Catalyst 6509 switch to an iSCSI software storage target at 10 Gbps. The Iometer benchmark was configured with 1 manager, 12 workers, and 12 LUNs (1 per worker), with 4 outstanding I/Os, I/O sizes ranging from 512 bytes to 512 KB, and a maximum transmission unit (MTU) of 1,500 bytes.