Principled Technologies®

TEST REPORT
FEBRUARY 2009

iSCSI 1Gb Software Initiator performance analysis

Executive summary

Software-based iSCSI initiators can provide effective low-cost iSCSI solutions for applications that are not CPU intensive, and they offer throughput results comparable to those of more expensive hardware-based iSCSI offloading technologies.

Dell Inc. (Dell) commissioned Principled Technologies (PT) to compare the CPU usage and throughput results of software-based iSCSI initiators (Software Initiator), TCP offload engines (TOE), and host bus adapters (HBA) in large and small block tests on the 1Gb Broadcom BCM5708C NetXtreme II GigE network card.

We used Iometer as the benchmarking tool. Iometer measures input/output (I/O) on single and clustered systems. We provide more information about our Iometer setup and configuration in the Test methodology section of this report.

We created nine custom Iometer access specifications: small block specifications measured Web file server, media streaming, SQL Server log, operating system (OS) paging, Web server, Exchange email, and OS drive performance on 4K, 8K and 64K block size I/Os; large block specifications measured video on demand and decision support system performance on 512K and 1MB I/Os.

KEY FINDINGS

- Based on our testing, Software Initiators provide effective low-cost iSCSI solutions for applications that are not CPU intensive, while HBA's offer the best iSCSI solution for CPU-intensive applications.
- Based on our testing, Software Initiators are effective and economic choices for large block workloads, while HBAs are effective choices for small block workloads.
- In 1Gb Broadcom testing with large block access specifications, the Software Initiator delivered MB-per-second results comparable to those of HBA while utilizing an acceptable level of CPU usage. (See Figure 1.)
- In 1Gb Broadcom testing with small block access specifications, the Software Initiator delivered IOPS results comparable to those of HBA while utilizing an acceptable level of CPU usage on only five of the ten access specifications. (See Figure 2.)
- Based on our testing, IOPS directly affects CPU utilization. (See Figure 2.)

We chose 8 percent as our threshold for acceptable CPU utilization based on an estimation of the CPU level that would significantly impact CPU-intensive applications. CPU usage below 8 percent indicates that a Software Initiator is an acceptable iSCSI solution, while CPU usage above that level indicates that an HBA would be the recommended iSCSI solution.

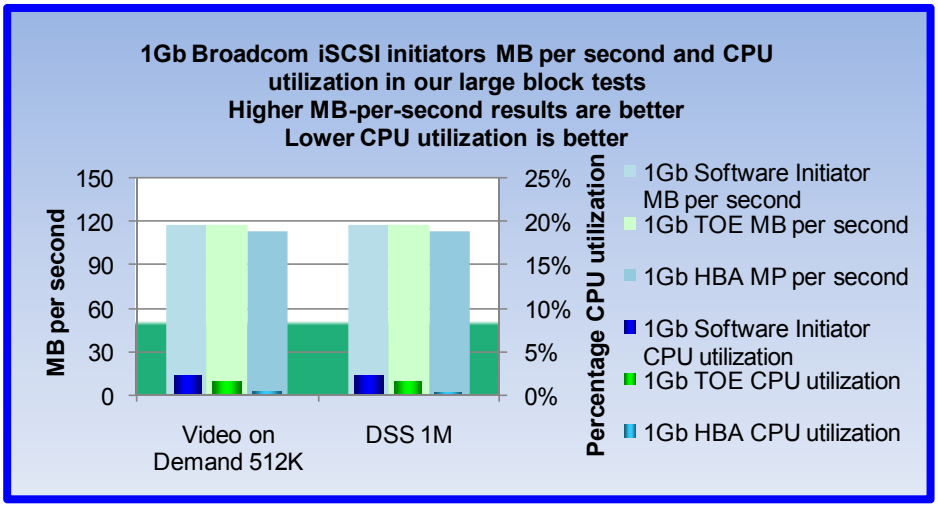

Figure 1: Average CPU utilization and MB-per-second results in our large block tests for the Broadcom NIC using a Software Initiator, TOE, and HBA. The solid green background represents 8 percent CPU usage.

Figure 1 displays large block test results: average CPU usage and MB-per-second output on the 1Gb Broadcom NIC. Each result is the average of the CPU utilization results that Iometer reported during individual large block tests.

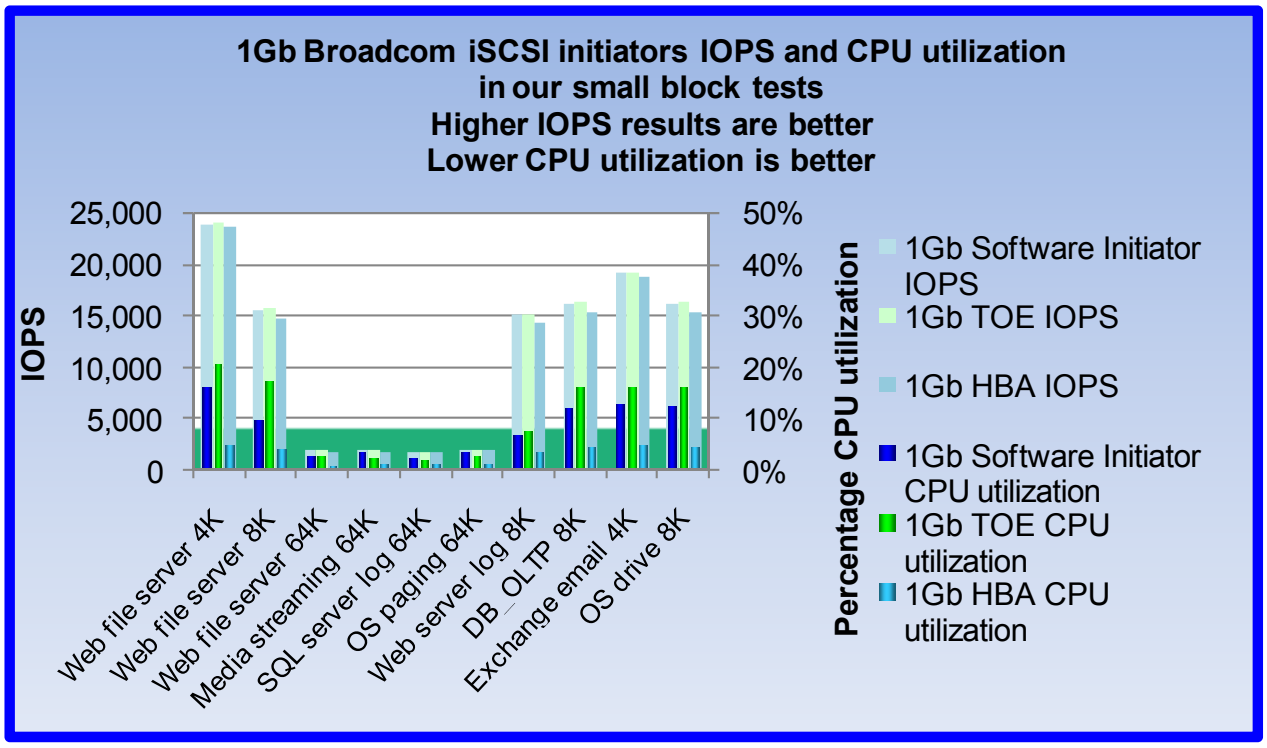

Figure 2: Average CPU utilization and IOPS results in our large block tests for the Broadcom NIC using a Software Initiator, TOE, and HBA. The solid green background represents 8 percent CPU usage.

Figure 2 shows our small block test results: average CPU usage and IOPS output on the 1Gb Broadcom NIC. Each result is the average of the CPU utilization results that Iometer reported during individual large block tests.

Test results

We report the results from both sets of our custom Iometer tests: MB-per-second and CPU utilization results from our large block tests, and IOPS and CPU utilization results from our small block tests. For both tests, higher IOPS and MB-per-second numbers are better and lower CPU utilization results are better, with 8 percent CPU usage being the threshold of acceptability. We ran the tests on the 1Gb Broadcom BCM5708C NIC. We also ran the tests on the 1Gb Intel PRO/1000 PT adapter with I/OAT enabled, and we report those results in Appendix B. We ran each test three times and report results from the run that produced the median of the three I/O-per-second results.

In our large block tests, Software Initiator CPU usage remained well under 8 percent for both access specifications: 2.18 percent for Video on Demand 512K and 2.20 percent for DSS 1M. Software Initiator MB-per-second results were higher than those for HBA: 118.29 for Video on Demand 512K and 118.28 for DSS 1M versus 113.42 and 113.41 respectively. These results indicate that, with large block access specifications, the Software Initiator delivers results comparable to those of HBA while utilizing an acceptable level of CPU usage. Based on our testing, Software Initiators are effective and economic choices for large block workloads. Figure 3 displays these results.

Iometer test name	MB-per-second results (higher is better)		
	1Gb Software Initiator MB per second	1Gb TOE MB per second	1Gb HBA MB per second
Video on Demand 512K	118.29	118.30	113.42
DSS 1M	118.28	118.29	113.41
	CPU utilization (lower is better)		
	1Gb Software Initiator CPU utilization	1Gb TOE CPU utilization	1Gb HBA CPU utilization
Video on Demand 512K	2.18%	1.52%	0.33%
DSS 1M	2.20%	1.46%	0.28%

Figure 3: MB-per-second and CPU utilization results for the 1Gb Broadcom NIC in our large block tests.

In our small block tests, Software Initiator CPU usage remained under 8 percent for the following five access specifications: Web file server 64K (2.72 percent), Media streaming 64K (3.41 percent), SQL server log 64K (2.28 percent), OS paging 64K (3.56 percent), and Web server log 8K (6.92 percent). For the remaining access specifications, Software Initiator CPU usage ranged from 9.67 percent to 16.03 percent. Software Initiator IOPS results were higher than those of HBA in every access specification. These results indicate that, with small block access specifications, the Software Initiator delivered IOPS results comparable to those of HBA. The Software Initiator CPU usage on 5 of the 10 access specifications, however, was higher than our 8 percent threshold. Based on our testing, HBAs are effective choices for small block workloads. The testing also shows that the IOPS of the workload directly affects CPU utilization. Figure 4 displays these results.

In addition to testing the Broadcom NIC, we also tested a 1Gb Intel PRO/1000 PT Server Adapter with I/O Acceleration Technology (I/OAT) enabled. We present these results in Appendix B.

Iometer test name	IOPS results (higher is better)		
	1Gb Software Initiator IOPS	1Gb TOE IOPS	1Gb HBA IOPS
Web file server 4K	23,887.94	23,971.86	23,585.30
Web file server 8K	15,470.48	15,717.42	14,697.55
Web file server 64K	1,991.58	1,991.36	1,907.84
Media streaming 64K	1,918.63	1,926.68	1,830.98
SQL server log 64K	1,891.78	1,890.68	1,808.27
OS paging 64K	2,005.43	2,046.11	1,941.67
Web server log 8K	15,029.60	15,035.99	14,379.91
DB_OLTP 8K	16,131.24	16,282.42	15,277.90
Exchange email 4K	19,057.69	19,074.16	18,837.08
OS drive 8K	16,211.48	16,326.45	15,299.89
	CPU utilization (lower is better)		
	1Gb Software Initiator CPU utilization	1Gb TOE CPU utilization	1Gb HBA CPU utilization
Web file server 4K	16.03%	20.57%	4.89%
Web file server 8K	9.67%	17.12%	3.95%
Web file server 64K	2.72%	2.64%	0.92%
Media streaming 64K	3.41%	2.54%	1.04%
SQL server log 64K	2.28%	1.93%	1.07%
OS paging 64K	3.56%	2.64%	1.08%
Web server log 8K	6.92%	7.45%	3.66%
DB_OLTP 8K	12.14%	16.03%	4.27%
Exchange email 4K	13.00%	16.21%	4.77%
OS drive 8K	12.36%	16.05%	4.29%

Figure 4: IOPS and CPU utilization results for the 1Gb Broadcom NIC in our small block tests.

iSCSI overview

The Internet Small Computer Systems Interface (iSCSI) protocol is a technology that couples the SCSI standard and TCP/IP protocol to implement an enterprise-class storage area network (SAN). iSCSI allows systems to transfer large block data over the familiar Ethernet technologies that are present in almost every organization. IT staff can leverage existing equipment and knowledge of IP networks to implement high quality SANs, lowering costs and manageability requirements.

iSCSI initiators – their role and differences

An iSCSI implementation must have an initiator (the host) and a target (the drive array). The initiator packages the SCSI commands into packets and sends them over the IP network to the target. Broadly speaking, there are three approaches to the initiator: a pure software initiator with a standard network interface card (NIC), a specialized NIC with a TCP/IP offload engine (TOE), and a host bus adapter (HBA) that fully offloads the iSCSI and TCP/IP work. Offloading functionality and processing to the iSCSI interface card frees up server processing cycles. Figure 5 illustrates these three types of configurations.

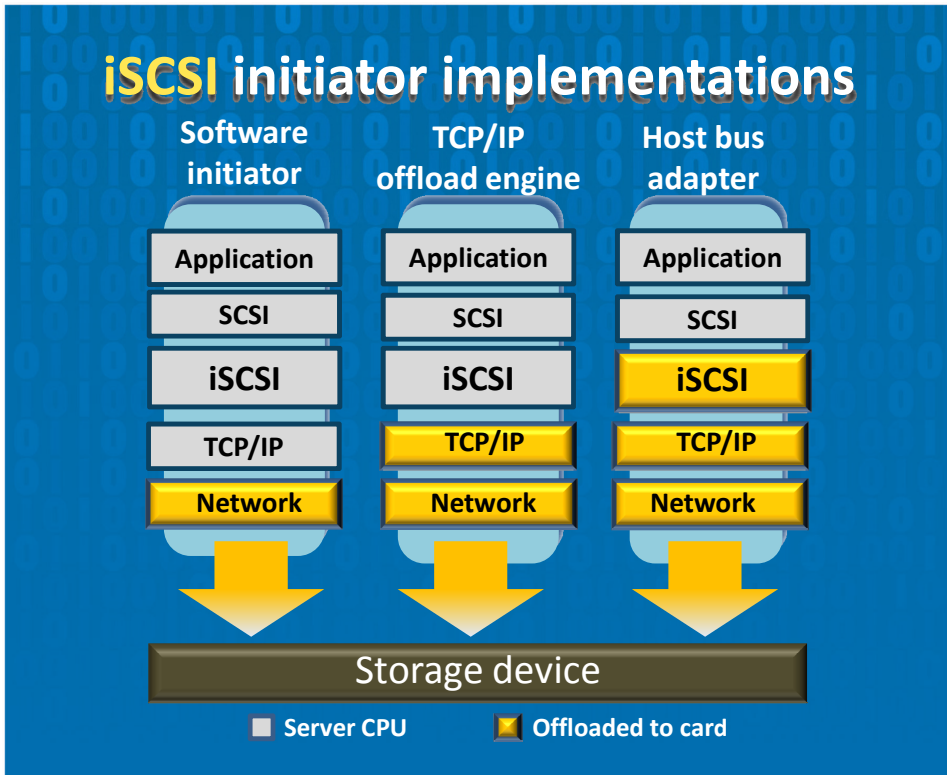

Figure 5: Three types of iSCSI initiator implementations.

- **Pure software initiator with a standard NIC.** Every major operating system now contains an iSCSI software initiator. You can establish a connection to an iSCSI SAN with the built-in OS tools and a standard network card. This is an attractive low-cost solution, but you sacrifice some of the host CPU to handle iSCSI and TCP/IP processing overhead.
- **NICs with TOE.** A NIC with TOE has its own specialized circuitry and processing power that offloads some of the TCP/IP-related overhead from the host CPU, freeing up cycles for other applications. The host still incurs some processing overhead, as it packages SCSI commands and sends them to the NIC.
- **Full-offload HBAs.** A full-offload iSCSI HBA, with even greater on-board processing power than a NIC with TOE, controls both iSCSI packaging and TCP/IP overhead, relieving the server CPU of both of these activities. HBA provides the most effective iSCSI solution for CPU-intensive applications.

Test configuration

1GBase-T iSCSI

Storage

- Four Dell™ EqualLogic™ PS5000XV iSCSI arrays
- Four separate groups and storage pools, one per array
- Four 500GB logical unit numbers (LUNs), one per storage pool

Switch settings (Dell PowerConnect 6248)

- Jumbo frames enabled (on NIC and all ports on the switch)
- Flow control enabled
- IP routing enabled
- Spanning tree set to rapid spanning tree protocol (RSTP)
- Link layer discovery protocol (LLDP) disabled

Network connections

- Dell EqualLogic PS5000XV Array
  - Three 1Gb connections that we connected from each of the four active controllers to 12 front 1Gb switch ports
- Test Server
  - One 1Gb connection that we connected to one front 1Gb switch port

Iometer settings

- One worker per target (four total)
- 4GB dataset per target (8,388,608 sectors)
- Outstanding I/Os tuned for each access specification

Figure 6 displays the detailed settings for each application we used in our iSCSI initiator tests.

Test pattern	Payload size (KB)	Percentage read	Percentage write	Percentage random	Percentage sequential	Outstanding I/Os
Web file server 4K	4	95	5	75	25	64
Web file server 8K	8	95	5	75	25	28
Web file server 64K	64	95	5	75	25	20
DSS	1,024	100	0	100	0	4
Media streaming	64	98	2	0	100	1
SQL server log	64	0	100	0	100	1
OS paging	64	90	10	0	100	1
Web server log	8	0	100	0	100	12
DB-OLTP	8	70	30	100	0	28
Exchange email	4	67	33	100	0	52
OS drive	8	70	30	100	0	28
Video on demand	512	100	0	100	0	4

Figure 6: Detailed settings for each application we used in our iSCSI initiator tests.

Test methodology

Installing and configuring Iometer

1. Download the Iometer package from www.iometer.org.
2. Uncompress the files, and copy Iometer.exe, Dynamo.exe, and iometer.icf to c:\iometer.
3. Open Iometer.exe.

4. Verify that for Disk Targets, the # of Outstanding I/Os is set to the appropriate value.
5. Under Results Display, make sure that Iometer has selected Start of Test, and set the update frequency to ∞.
6. Under Test Setup, set the Run Time to 4 minutes and the Ramp Up Time to 60 seconds.
7. Exit Iometer.

Setting up the individual Iometer workloads

We set up Iometer using the test patterns shown in Figure 6. The test patterns defined the payload size, the percent read, percent write, percent random, percent sequential, and outstanding I/Os. In addition, we used the following settings for each test:

- Burstiness
  - Transfer Delay: 0ms
  - Burst Length: 1 I/O
- Align I/Os on: Sector Boundaries
- Reply Size: No Reply

1Gb NIC iSCSI

Setup

1. To run the Broadcom Advanced Control Suite, right-click the tray icon, and select Launch BACS.
2. Select the Broadcom NetXtreme II C-NIC iSCSI Adapter.
3. Select the Configurations tab.
4. Set the IPv4 DHCP to Disable.
5. Set the IP Address to `192.168.1.78`
6. Set the Subnet Mask to `255.255.255.0`
7. Click Apply.
8. Close the BACS.
9. Click Start→Control Panel.
10. Double-click Network and Sharing Center.
11. Click Manage network connections.
12. Right-click Broadcom BCM5708C NetXtreme II GigE, and select Properties.
13. Double-click Internet Protocol Version 4 (TCP/IPv4).
14. Select Use the following IP address.
15. Set the IP Address to `192.168.1.65`
16. Set the Subnet Mask to `255.255.255.0`
17. Click OK.
18. Click OK.
19. Right-click Intel PRO/1000 PT Server Adapter, and select Properties.
20. Double-click Internet Protocol Version 4 (TCP/IPv4).
21. Select Use the following IP address.
22. Set the IP Address to `192.168.1.66`
23. Set the Subnet Mask to `255.255.255.0`
24. Click OK.
25. Click OK.

1Gb Broadcom BCM5708C Software Initiator with TOE disabled

1. Connect the network cable to the Broadcom BCM5708C network port.
2. Restart the computer.
3. Click Start→Administrative Tools→iSCSI Initiator.
4. Select the Targets tab.
    a. Select the first target, and click Log on.
    b. Click Advanced.
    c. Set the Local Adapter to Microsoft iSCSI Initiator.

d. Set the Source IP to `192.168.1.65`
e. Set the Target Portal to `192.168.1.251 / 3260`
f. Click OK.
g. Click OK.
h. Click OK.
i. Repeat steps a through h two more times, for a total of three times.
j. Select the second target, and click Log on.
k. Click Advanced.
l. Set the Local Adapter to Microsoft iSCSI Initiator.
m. Set the Source IP to `192.168.1.65`
n. Set the Target Portal to `192.168.1.251 / 3260`
o. Click OK.
p. Click OK.
q. Click OK.
r. Repeat steps j through q two more times, for a total of three times.
s. Select the third target, and click Log on.
t. Click Advanced.
u. Set the Local Adapter to Microsoft iSCSI Initiator.
v. Set the Source IP to `192.168.1.65`
w. Set the Target Portal to `192.168.1.251 / 3260`
x. Click OK.
y. Click OK.
z. Click OK.
aa. Repeat steps s through z two more times, for a total of three times.
bb. Select the fourth target, and click Log on.
cc. Click Advanced.
dd. Set the Local adapter to Microsoft iSCSI Initiator.
ee. Set the Source IP to `192.168.1.65`
ff. Set the Target Portal to `192.168.1.251 / 3260`
gg. Click OK.
hh. Click OK.
ii. Click OK.

5. To open a command prompt window, click the shortcut on the desktop.
6. Type `netsh int tcp set global chimney=disabled` into the command prompt, and press Enter.
7. To confirm that the system is not offloading any connections, type `netstat -nt | findstr /i offloaded` into the command prompt, and press Enter. If it lists connections, then the system is not offloading any connections.
8. Open a command prompt.
9. Type `cd c:\Iometer` and press Enter.
10. Type `Test1.bat`
11. Wait 5 minutes.
12. Press Enter.
13. Copy the result files from the server.
14. Repeat steps 8 through 13 two more times, for a total of three runs.

1Gb Broadcom BCM5708C Software Initiator with TOE enabled

1. Connect the network cable to the Broadcom BCM5708C network port.
2. To open a command prompt window, click the shortcut on the desktop.
3. Type `netsh int tcp set global chimney=enabled` into the command prompt, and press Enter.
4. Restart the computer.
5. Click Start→Administrative Tools→iSCSI Initiator.
6. Select the Targets tab.
    a. Select the first target, and click Log on.
    b. Click Advanced.

c. Set the Local Adapter to Microsoft iSCSI Initiator.
d. Set the Source IP to `192.168.1.65`
e. Set the Target Portal to `192.168.1.251 / 3260`
f. Click OK.
g. Click OK.
h. Click OK.
i. Repeat steps a through h two more times, for a total of three times.
j. Select the second target, and click Log on.
k. Click Advanced.
l. Set the Local Adapter to Microsoft iSCSI Initiator.
m. Set the Source IP to `192.168.1.65`
n. Set the Target Portal to `192.168.1.251 / 3260`
o. Click OK.
p. Click OK.
q. Click OK.
r. Repeat steps j through q two more times, for a total of three times.
s. Select the third target, and click Log on.
t. Click Advanced.
u. Set the Local Adapter to Microsoft iSCSI Initiator.
v. Set the Source IP to `192.168.1.65`
w. Set the Target Portal to `192.168.1.251 / 3260`
x. Click OK.
y. Click OK.
z. Click OK.
aa. Repeat steps s through z two more times, for a total of three times.
bb. Select the fourth target, and click Log on.
cc. Click Advanced.
dd. Set the Local Adapter to Microsoft iSCSI Initiator.
ee. Set the Source IP to `192.168.1.65`
ff. Set the Target Portal to `192.168.1.251 / 3260`
gg. Click OK.
hh. Click OK.
ii. Click OK.

7. To confirm that the system is offloading connections, type `netstat -nt | findstr /i offloaded` into the command prompt, and press Enter. It must list at least four connections to confirm that the system has enabled TCP/IP offload, and that TCP/IP offload is working properly.
8. Open a command prompt.
9. Type `cd c:\Iometer` and press Enter.
10. Type `Test1.bat`
11. Wait 5 minutes.
12. Press Enter.
13. Copy the result files from the server.
14. Repeat steps 8 through 13 two more times, for a total of three runs.

1Gb Broadcom BCM5708C iSCSI HBA (iSOE)

1. Connect the network cable to the Broadcom BCM5708C network port.
2. Restart the computer.
3. Click Start→Administrative Tools→iSCSI Initiator.
4. Select the Targets tab.
    a. Select the first target, and click Log on.
    b. Click Advanced.
    c. Set the Local Adapter to Broadcom NetXtreme II C-NIC iSCSI Adapter on PCI bus 3, device 0, function 0.
    d. Set the Source IP to `192.168.1.78`

e. Set the Target Portal to `192.168.1.251 / 3260`
f. Click OK.
g. Click OK.
h. Click OK.
i. Repeat steps a through h two more times, for a total of three times.
j. Select the second target, and click Log on.
k. Click Advanced.
l. Set the Local Adapter to Broadcom NetXtreme II C-NIC iSCSI Adapter on PCI bus 3, device 0, function 0.
m. Set the Source IP to `192.168.1.78`
n. Set the Target Portal to `192.168.1.251 / 3260`
o. Click OK.
p. Click OK.
q. Click OK.
r. Repeat steps j through q two more times, for a total of three times.
s. Select the third target, and click Log on.
t. Click Advanced.
u. Set the Local Adapter to Broadcom NetXtreme II C-NIC iSCSI Adapter on PCI bus 3, device 0, function 0.
v. Set the Source IP to `192.168.1.78`
w. Set the Target Portal to `192.168.1.251 / 3260`
x. Click OK.
y. Click OK.
z. Click OK.
aa. Repeat steps s through z two more times, for a total of three times.
bb. Select the fourth target, and click Log on.
cc. Click Advanced.
dd. Set the Local Adapter to Broadcom NetXtreme II C-NIC iSCSI Adapter on PCI bus 3, device 0, function 0.
ee. Set the Source IP to `192.168.1.78`
ff. Set the Target Portal to `192.168.1.251 / 3260`
gg. Click OK.
hh. Click OK.
ii. Click OK.

5. Open a command prompt.
6. Type `cd c:\Iometer` and press Enter.
7. Type `Test1.bat`
8. Wait 5 minutes.
9. Press Enter.
10. Copy the result files from the server.
11. Repeat steps 5 through 10 two more times, for a total of three runs.

Intel PRO/1000 PT Server Adapter with I/O Acceleration Technology (I/OAT) enabled

1. Connect the network cable to the Intel PRO/1000 network port.
2. Restart the computer.
3. Press F2 to enter the system BIOS.
4. Select Integrated Devices.
5. Set I/OAT DMA Engine to Enabled.
6. Press Escape.
7. Press Escape.
8. Select Save Changes and Exit.
9. Press Enter.
10. Click Start→Administrative Tools→iSCSI Initiator.
11. Select the Targets Tab.

a. Select the first target, and click Log on.
b. Click Advanced.
c. Set the Local Adapter to Microsoft iSCSI Initiator.
d. Set the Source IP to `192.168.1.66`
e. Set the Target Portal to `192.168.1.251 / 3260`
f. Click OK.
g. Click OK.
h. Click OK.
i. Repeat steps a through h two more times, for a total of three times.
j. Select the second target, and click Log on.
k. Click Advanced.
l. Set the Local Adapter to Microsoft iSCSI Initiator.
m. Set the Source IP to `192.168.1.66`
n. Set the Target Portal to `192.168.1.251 / 3260`
o. Click OK.
p. Click OK.
q. Click OK.
r. Repeat steps j through q two more times, for a total of three times.
s. Select the third target, and click Log on.
t. Click Advanced.
u. Set the Local Adapter to Microsoft iSCSI Initiator.
v. Set the Source IP to `192.168.1.66`
w. Set the Target Portal to `192.168.1.251 / 3260`
x. Click OK.
y. Click OK.
z. Click OK.
aa. Repeat steps s through z two more times, for a total of three times.
bb. Select the fourth target, and click Log on.
cc. Click Advanced.
dd. Set the Local Adapter to Microsoft iSCSI Initiator.
ee. Set the Source IP to `192.168.1.66`
ff. Set the Target Portal to `192.168.1.251 / 3260`
gg. Click OK.
hh. Click OK.
ii. Click OK.

12. To open a command prompt window, click the shortcut on the desktop.
13. Type `netsh int tcp set global chimney=disabled` into the command prompt, and press Enter.
14. To confirm that the system is not offloading any connections, type `netstat -nt | findstr /i offloaded` into the command prompt, and press Enter. If it lists no connections, then the system is not offloading any connections.
15. Open a command prompt.
16. Type `cd c:\Iometer` and press Enter.
17. Type `Test1.bat`
18. Wait 5 minutes.
19. Press Enter.
20. Copy the result files from the server.
21. Repeat steps 15 through 20 two more times, for a total of three runs.

Appendix A –Test server information

Figure 7 provides detailed information for the test servers.

Servers	Dell™ PowerEdge™ 2950
General	
Number of processor packages	2
Number of cores per processor package	4
Number of hardware threads per core	8
System power management policy	Balanced
CPU	
Vendor	Intel
Name	Xeon E5405
Stepping	C0
Socket type	LGA771
Core frequency (GHz)	2.00
Front-side bus frequency (MHz)	1,333
L1 cache	32 KB + 32 KB (per core)
L2 cache	12 MB (2 x 6 MB)
Platform	
Vendor and model number	Dell 0M332H
Motherboard chipset	Intel 5000X
BIOS name and version	Dell 2.5.0 (09/12/2008)
BIOS settings	Default
Memory module(s)	
Vendor and model number	Samsung M395T5750EZ4-CE66
Type	PC2-5300 FB-DDR2
Speed (MHz)	667
Speed in the system currently running @ (MHz)	667
Timing/latency (tCL-tRCD-iRP-tRASmin)	5-5-5-15
Size (GB)	16,384
Number of RAM modules	8
Chip organization	Double-sided
Channel	Dual
Hard disk	
Vendor and model number	Western Digital WD800AAJS
Number of disks in system	1
Size (GB)	80
Buffer size (MB)	8
RPM	7,200
Type	SATA 3.0 Gb/s
Controller	Intel 6321ESB
Controller driver	Microsoft 6.0.6001.18000 (06/21/2006)
Operating system	
Name	Windows Server 2008 Enterprise x64
Build number	6001
Service Pack	1
Microsoft Windows update date	12/09/08
File system	NTFS
Kernel	ACPI x64-based PC
Language	English
Microsoft DirectX version	10

Servers	Dell™ PowerEdge™ 2950
Graphics	
Vendor and model number	ATI ES1000
Chipset	ATI ES1000
BIOS version	BK-ATI VER.008.005.028.000
Type	Integrated
Memory size (MB)	16
Resolution	1,280 x 1,024
Driver	ATI 8.240.50.3000 (01/21/2008)
Network card/subsystem	
First network card/subsystem	
Network card	Broadcom BCM5708C NetXtreme II GigE
Type	Integrated
Network driver	Broadcom 4.6.14.0 (10/16/2008)
iSCSI driver	Broadcom 4.6.15.0 (10/20/2008)
Second network card/subsystem	
Network card	Intel PRO/1000 PT Server Adapter
Type	Discrete
Network driver	Intel 9.12.30.0 (09/26/2008)
Optical drive	
Vendor and model number	Teac CD-224E-N
Type	CD-ROM
Interface	EIDE
Dual/single layer	Single
USB ports	
Number of ports	4
Type of ports (USB 1.1, USB 2.0)	2.0

Figure 7: Detailed system configuration for the test server.

Appendix B – Intel 1Gb Server Adapter test results

In addition to testing the Broadcom NIC, we also tested a 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled. We invoked I/OAT network accelerations by setting the I/OAT DMA engine BIOS setting to enabled. Our goal in running these tests was to show the CPU usage, MB-per-second results, and IOPS results for the 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled.

Figures 8 through 11 present our large and small block test results for the 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled. We ran each test three times and report the run that produced the median of the three results. We set 8 percent as our threshold for acceptable CPU utilization.

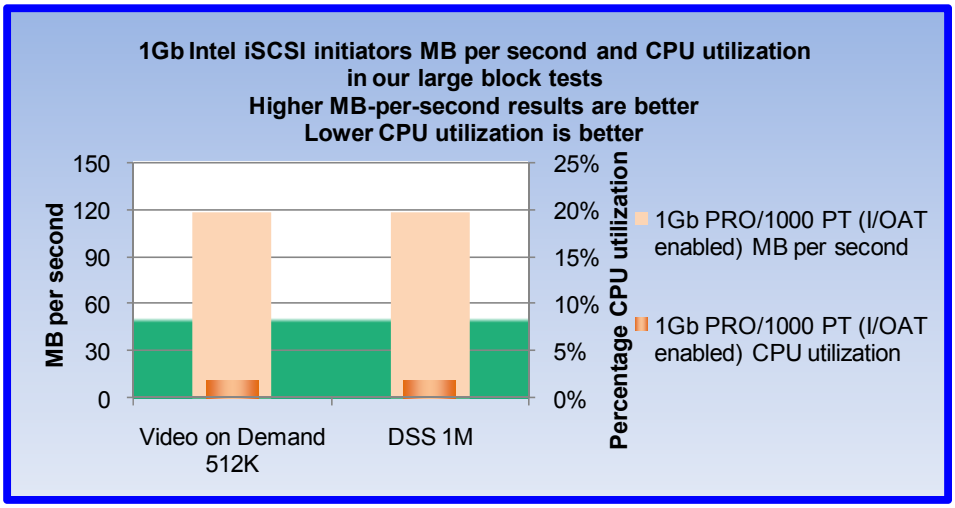

Figure 8: IOPS and CPU results for the Intel 1Gb AT Server Adapter with I/OAT enabled in our large block tests. The solid green background represents 8 percent CPU usage.

Figure 8 shows our large block test results: average CPU usage and MB-per-second output during large block tests on the 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled. Each result is the average of the CPU utilization results that Iometer reported during individual large block tests. Higher MB-per-second and lower CPU utilization results are better.

In our large block tests, CPU usage for the 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled remained well under 8 percent for both access specifications: 1.88 percent for Video on Demand 512K and 1.85 percent for DSS 1M. MB-per-second results were identical: 118.28 for both Video on Demand 512K and DSS 1M. Figure 9 displays these results.

Iometer test name	MB-per-second results (higher is better)
	1Gb PRO/1000 PT (I/OAT enabled) MB per second
Video on Demand 512K	118.28
DSS 1M	118.28
	CPU utilization (lower is better)
	1Gb PRO/1000 PT (I/OAT enabled) CPU utilization
Video on Demand 512K	1.88%
DSS 1M	1.85%

Figure 9: MB-per-second and CPU utilization results for the 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled in our large block tests.

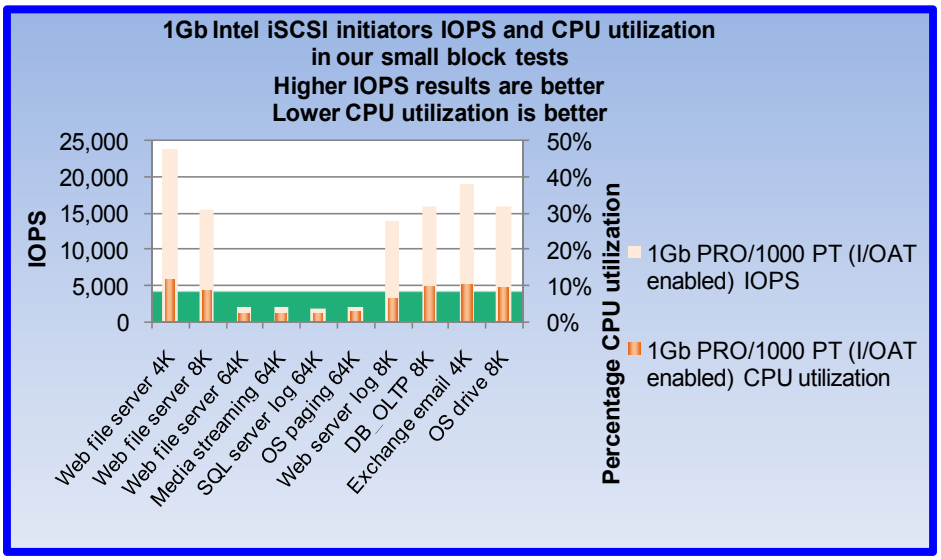

Figure 10: IOPS and CPU results for the 1Gb Intel PRO/1000 PT Server Adapter with I/OAT enabled and disabled in our small block tests. The solid green background represents 8 percent CPU usage.

Figure 10 shows our small block test results: average CPU usage and IOPS output during small block tests on the 1Gb Intel PRO/1000 AT Server Adapter with I/OAT enabled. Each result is the average of the CPU utilization results that Iometer reported during individual small block tests.

In our small block tests, CPU usage for the 1Gb Intel PRO/1000 AT Server Adapter with I/OAT enabled remained under 8 percent for the following five access specifications: Web file server 64K (2.28 percent), Media streaming 64K (2.57 percent), SQL server log 64K (2.50 percent), OS paging 64K (2.90 percent), and Web server log 8K (6.17 percent). For the remaining access specifications, CPU usage for the 1Gb Intel PRO/1000 AT Server Adapter with I/OAT enabled ranged from 8.73 percent to 11.55 percent. Figure 11 displays these results.

Iometer test name	IOPS results (higher is better)
	1Gb PRO/1000 PT (I/OAT enabled) IOPS
Web file server 4K	23,990.55
Web file server 8K	15,519.95
Web file server 64K	1,991.68
Media streaming 64K	1,900.07
SQL server log 64K	1,740.92
OS paging 64K	1,959.65
Web server log 8K	13,910.46
DB_OLTP 8K	16,002.29
Exchange email 4K	19,053.80
OS drive 8K	16,033.91
	CPU utilization (lower is better)
	1Gb PRO/1000 PT (I/OAT enabled) CPU utilization
Web file server 4K	11.55%
Web file server 8K	8.73%
Web file server 64K	2.28%
Media streaming 64K	2.57%
SQL server log 64K	2.50%
OS paging 64K	2.90%
Web server log 8K	6.17%

	CPU utilization (lower is better)
DB_OLTP 8K	9.99%
Exchange email 4K	10.09%
OS drive 8K	9.19%

Figure 11: IOPS and CPU utilization results for our small block tests on the 1Gb Intel PRO/1000 PT Server Adapter.

About Principled Technologies

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.
When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help you assess how it will fare against its competition, its performance, whether it's ready to go to market, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

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