

Implementing iSCSI in Storage Area Networks

The Advantages of a Software Initiator Solution

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- ADNET Systems, Inc. 
- NASA Goddard Space Flight Center 
- Task HECN – High End Computing Network
- Project Manager – J. Pat Gary

- Network Storage
- Implementation of Storage Area Network
- Implementation of iSCSI
- The iSCSI Test

- Direct Attached Storage (DAS)
- Network Attached Storage (NAS)
 - Advantages = multiple users; platform independence; expandability; fault tolerance
- Storage Area Network (SAN)
 - Advantage = prevents normal data backup over SAN from polluting regular network traffic

Implementation of SAN

	Fibre Channel	iSCSI
Advantages	<ul style="list-style-type: none">✓ Speed✓ Market Dominance✓ Data Only Traffic	<ul style="list-style-type: none">✓ Cost✓ Ethernet Ubiquities
Disadvantages	<ul style="list-style-type: none">✓ Cost✓ Additional Training	<ul style="list-style-type: none">✓ Speed✓ Mixed Network Traffic



Implementation of iSCSI

- iSCSI Initiator
- iSCSI Target
- iSCSI Gateway

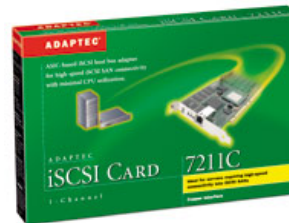
Implementation of iSCSI (Continued)

iSCSI Initiator Selections, e.g.

- Software Initiator
- Hardware Initiator



Microsoft



**Adaptec
7211C**

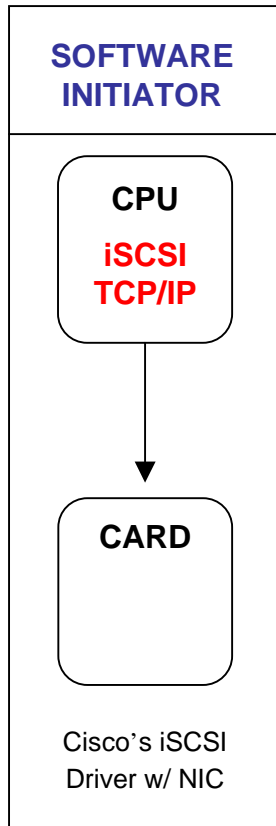


**Adaptec
TOE NAC
7711C**

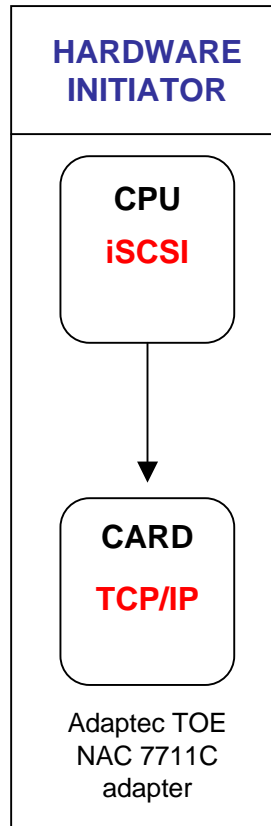
Implementation of iSCSI (Continued)

Off Load Scheme Selections

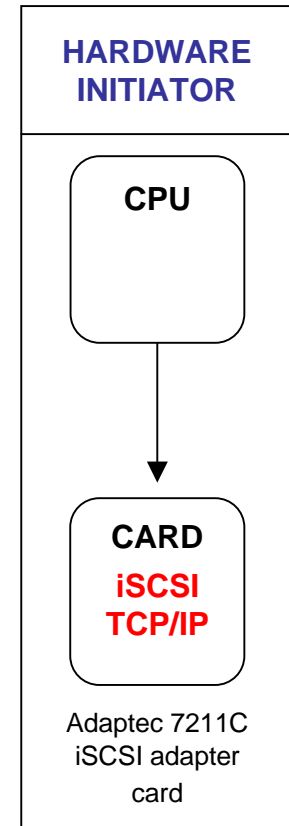
No Off-Load (Software Initiator)



TCP Off-load Engine (TOE)



iSCSI Host Bus Adapter (HBA)



- Goal
- Variables
- Configuration
- Results
- Analysis
- Conclusions

Compare performance of iSCSI data transfer using different offload methods

Do different operating systems affect the data transfer speed and efficiency?

Do different PC configurations affect the data transfer speed and efficiency?

Test Variables

High End PC

2 GHz Xeon with 100 MHz PCI



Low End PC

1.4 GHz Pentium IV with 33 MHz PCI



Cisco iSCSI Driver

Cisco iSCSI Driver

Cisco iSCSI Driver

Cisco iSCSI Driver

Adaptec 7211 iSCSI
adapter card

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Test Variables

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Test Variables



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Cisco iSCSI Driver

Cisco iSCSI Driver

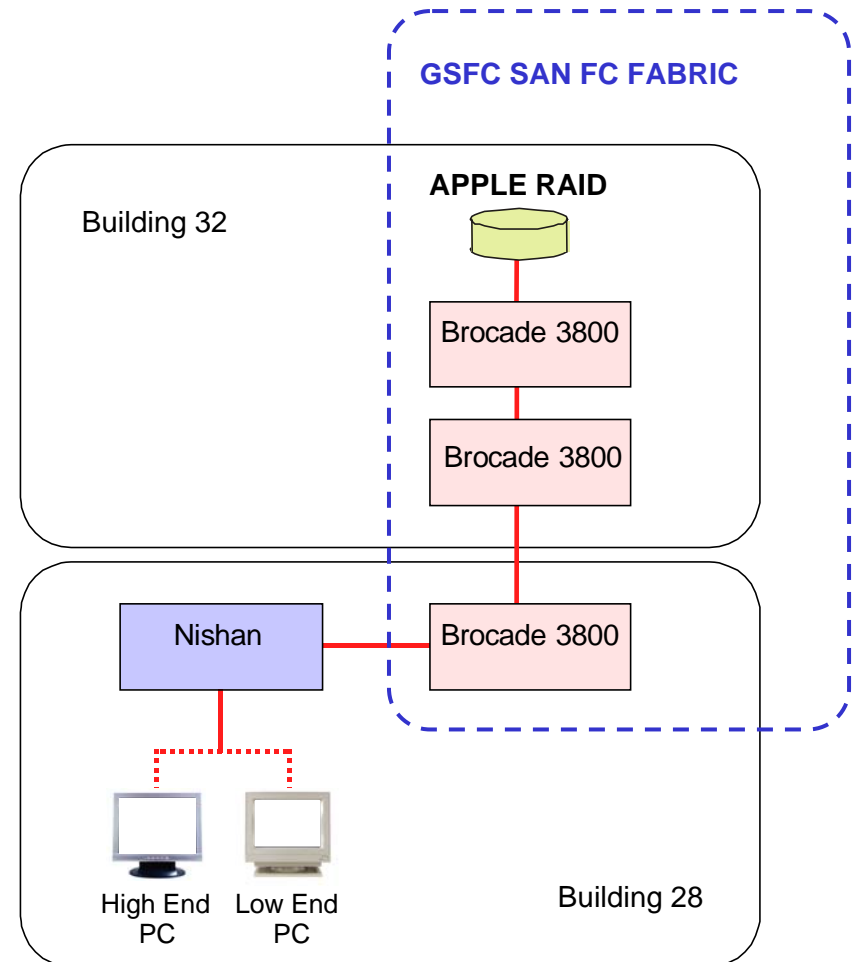
Adaptec 7211 iSCSI
adapter card

Adaptec 7211 iSCSI
adapter card

Adaptec TOE NAC 7711C

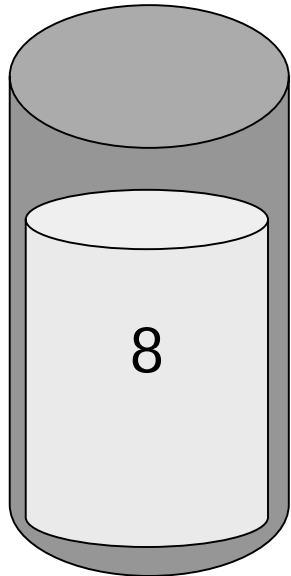
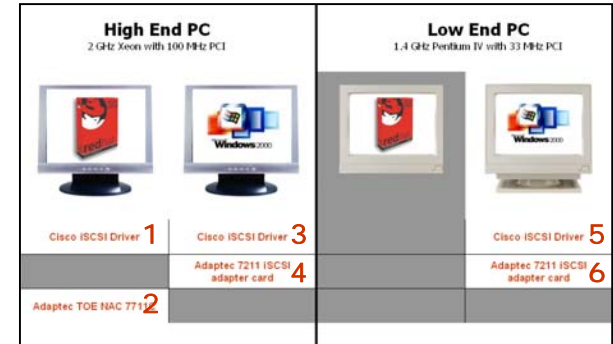
Test Configuration

- Target LUN0
 - 1 TB Apple Xserve Raid
- Fibre Channel Switch
 - Brocade 3800
- NASA GSFC SAN Fibre Channel Fabric
 - Brocade 3800
- iSCSI Gateway
 - Nishan 3000

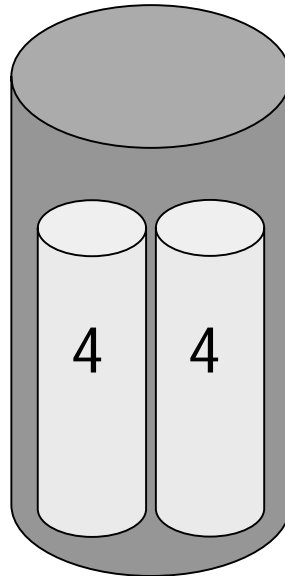


Test Configuration (Continued)

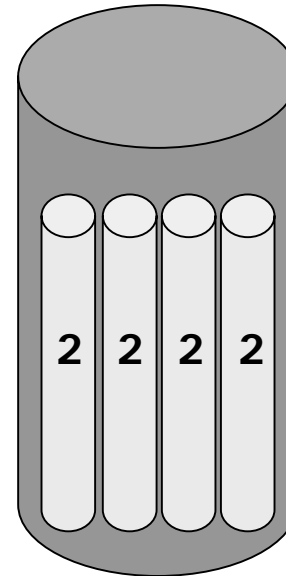
- **SPEED TEST — IOZONE**
 - File System Benchmark Tool
 - Versatile in Simulating Actual Apps
 - Write / Rewrite / Read / Re-read



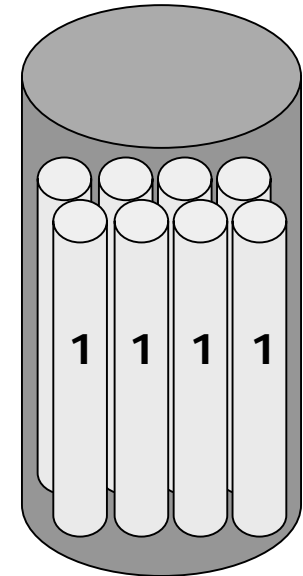
1 thread with a file size of 8 GB



2 thread with a file size of 4 GB



4 thread with a file size of 2 GB

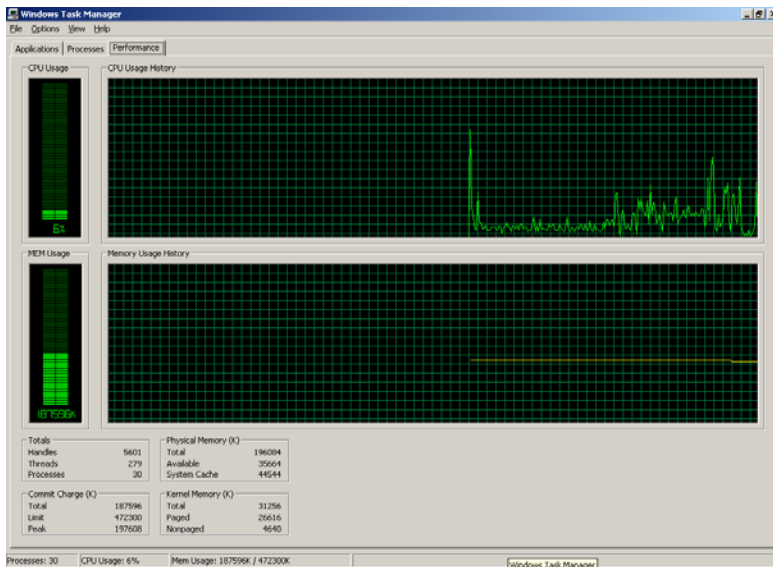


8 thread with a file size of 1 GB

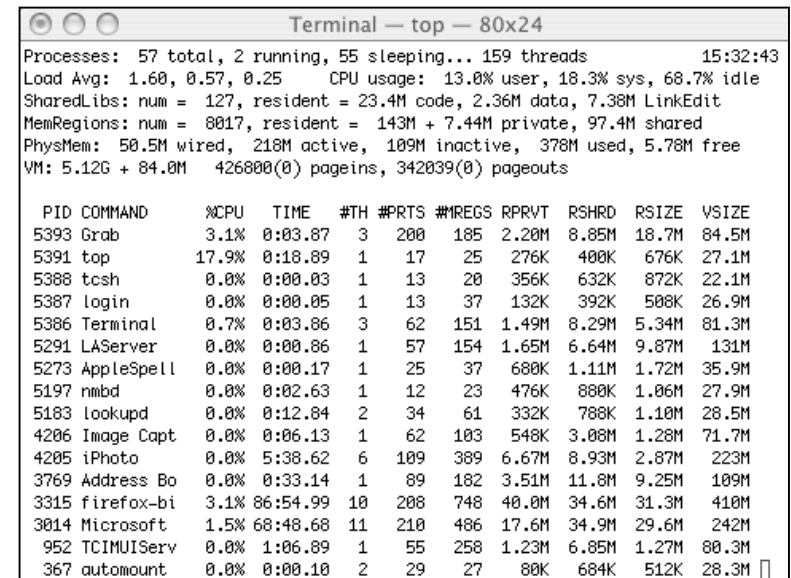
Test Configuration (Continued)

- EFFICIENCY TEST — CPU Usage

Windows—Task Manager



Linux—TOP



Test Results

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2 GHz Xeon with 100 MHz PCI



Low End PC

1.4 GHz Pentium IV with 33 MHz PCI



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Cisco iSCSI Driver

Cisco iSCSI Driver

Adaptec 7211 iSCSI adapter card

Adaptec 7211 iSCSI adapter card

Adaptec TOE NAC 7711C

Test Results (Continued)

1

High End PC

2 GHz Xeon with 100 MHz PCI



Cisco iSCSI Driver

Adaptec TOE NAC 7711C



Cisco iSCSI Driver

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Low End PC

1.4 GHz Pentium IV with 33 MHz PCI



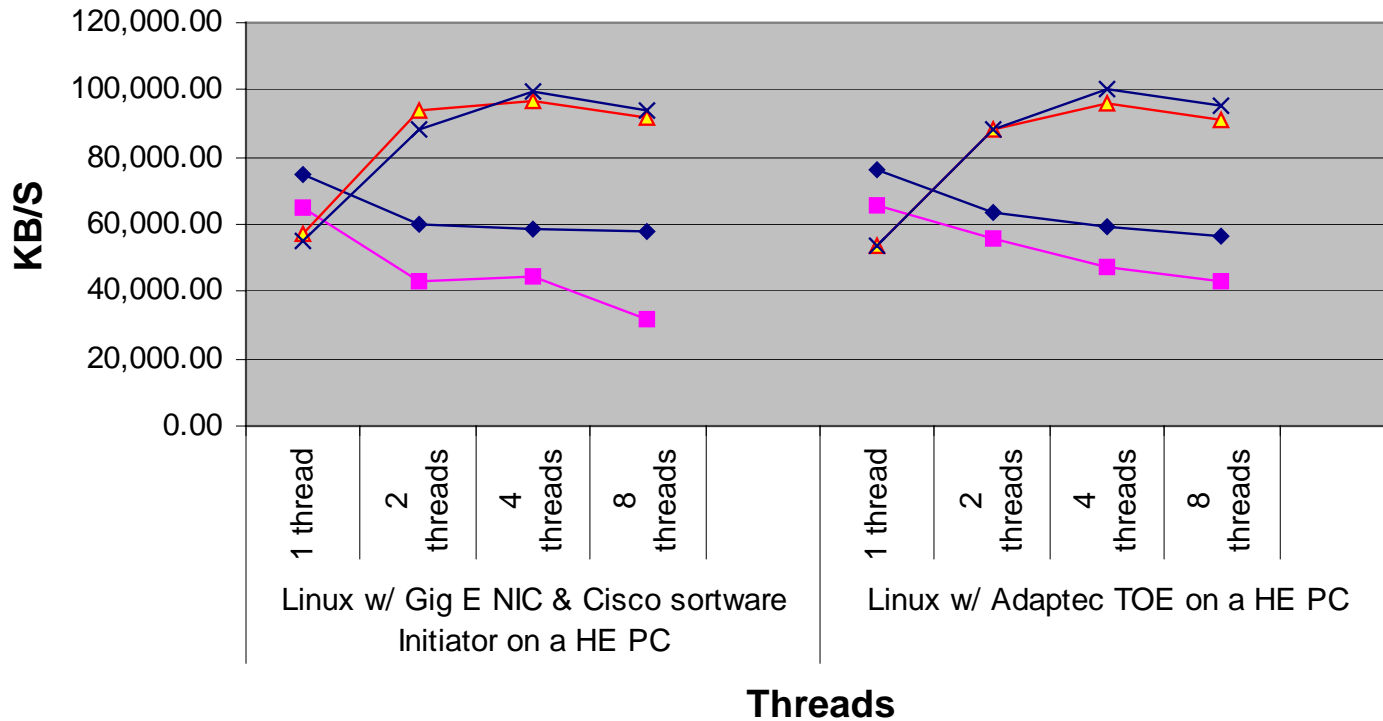
Cisco iSCSI Driver

Adaptec 7211 iSCSI adapter card

Test Results (Continued)



High End PC Running Red Hat 9 Performance Comparison

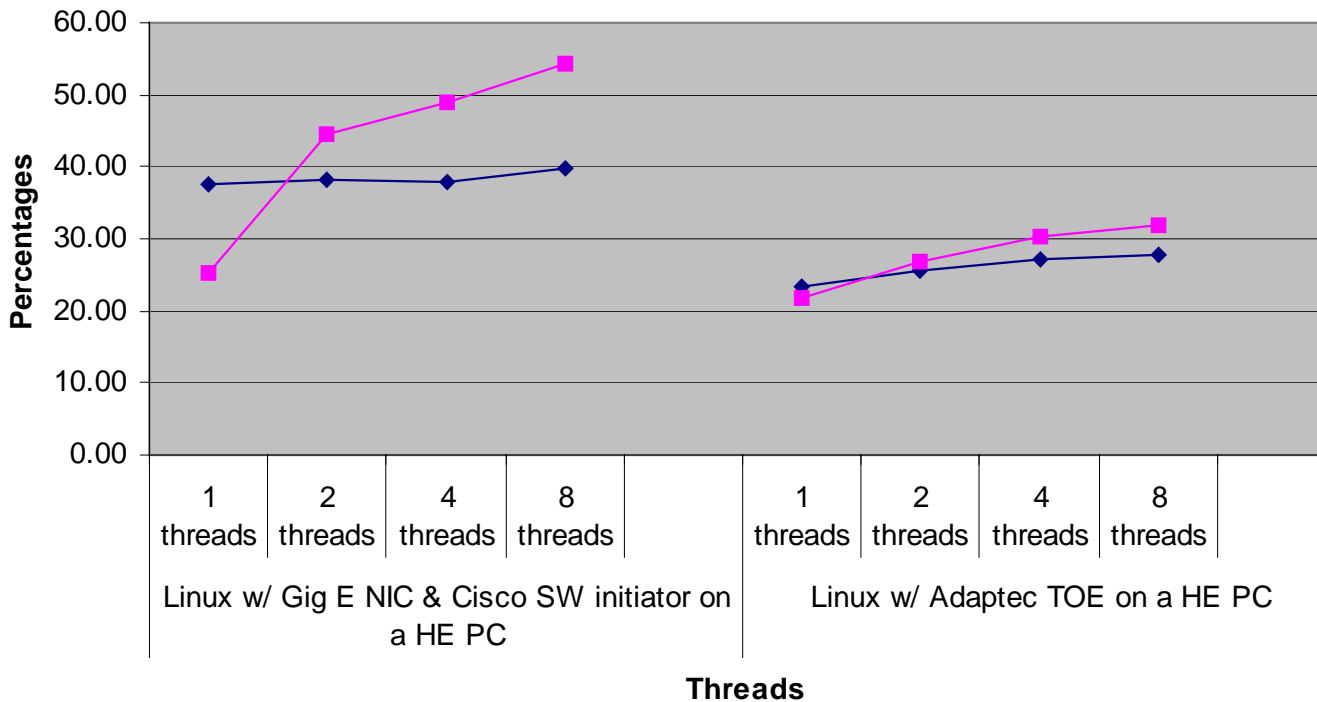


◆ Initial write ■ Rewrite ▲ Read × Re-read

Test Results (Continued)



High End PC Running Red Hat 9 CPU Usage Comparison



—◆— Linux overall write

—■— Linux overall read

Test Results (Continued)

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Test Results (Continued)

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2



Cisco iSCSI Driver

Adaptec TOE NAC 7711C



Cisco iSCSI Driver

Adaptec 7211 iSCSI
adapter card

Low End PC

1.4 GHz Pentium IV with 33 MHz PCI



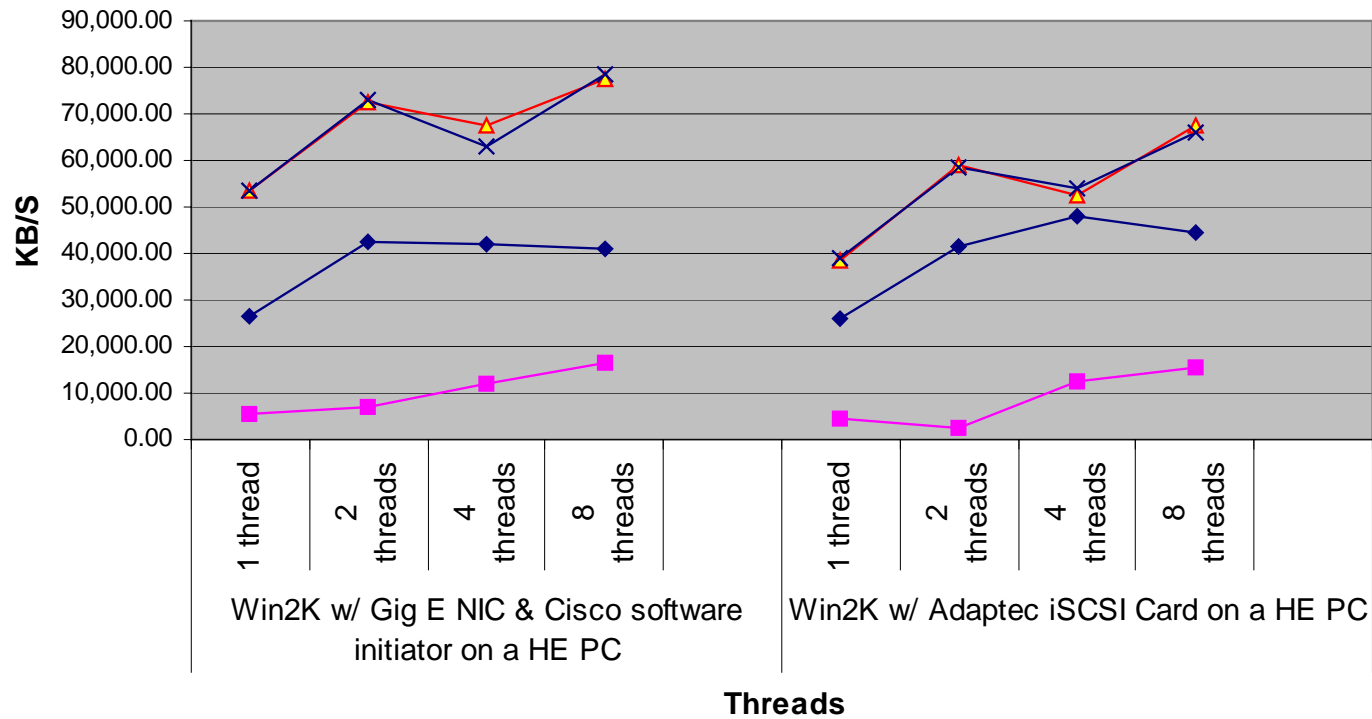
Cisco iSCSI Driver

Adaptec 7211 iSCSI
adapter card

Test Results (Continued)



High End PC Running Windows 2000 Pro Performance Comparison



◆ Initial write

■ Rewrite

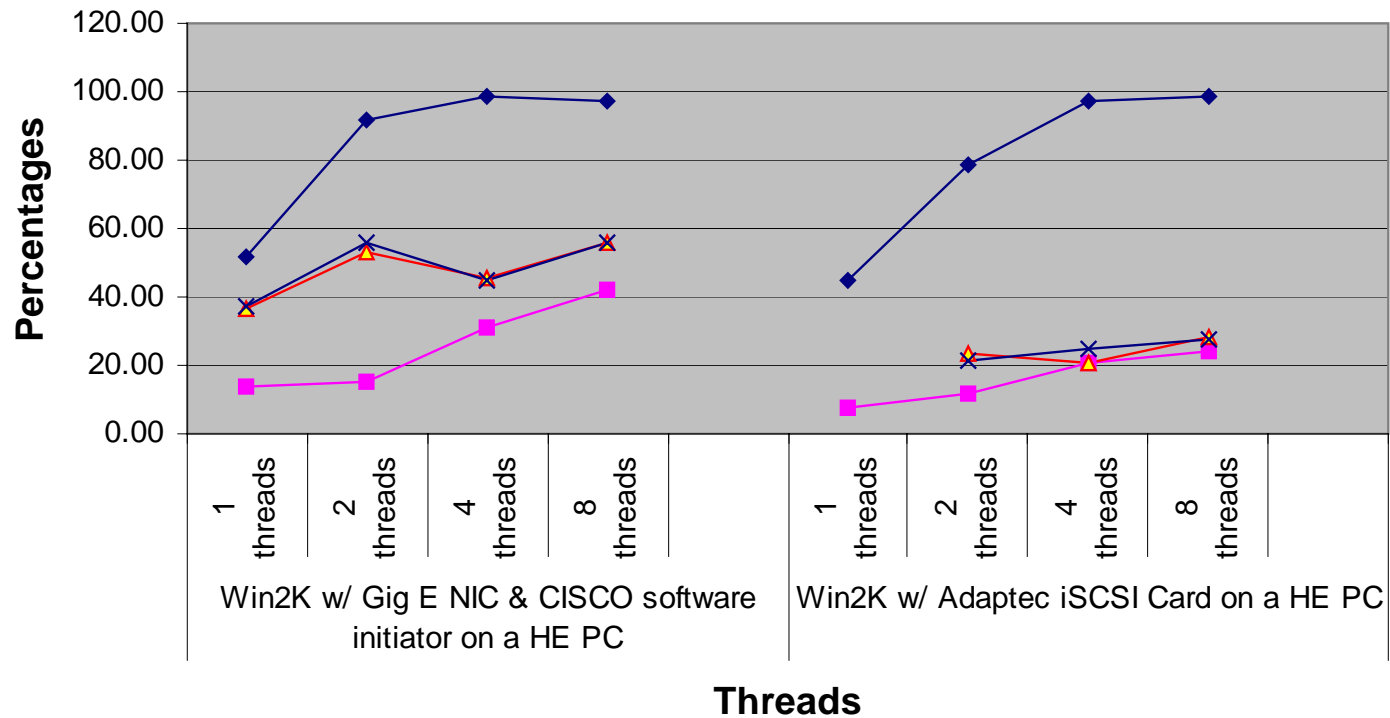
▲ Read

× Re-read

Test Results (Continued)



High End PC Running Windows 2000 Pro CPU Usage Comparison



◆ Initial write ■ Rewrite ▲ Read × Re-read

Test Results (Continued)

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2 GHz Xeon with 100 MHz PCI



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Cisco iSCSI Driver

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Test Results (Continued)



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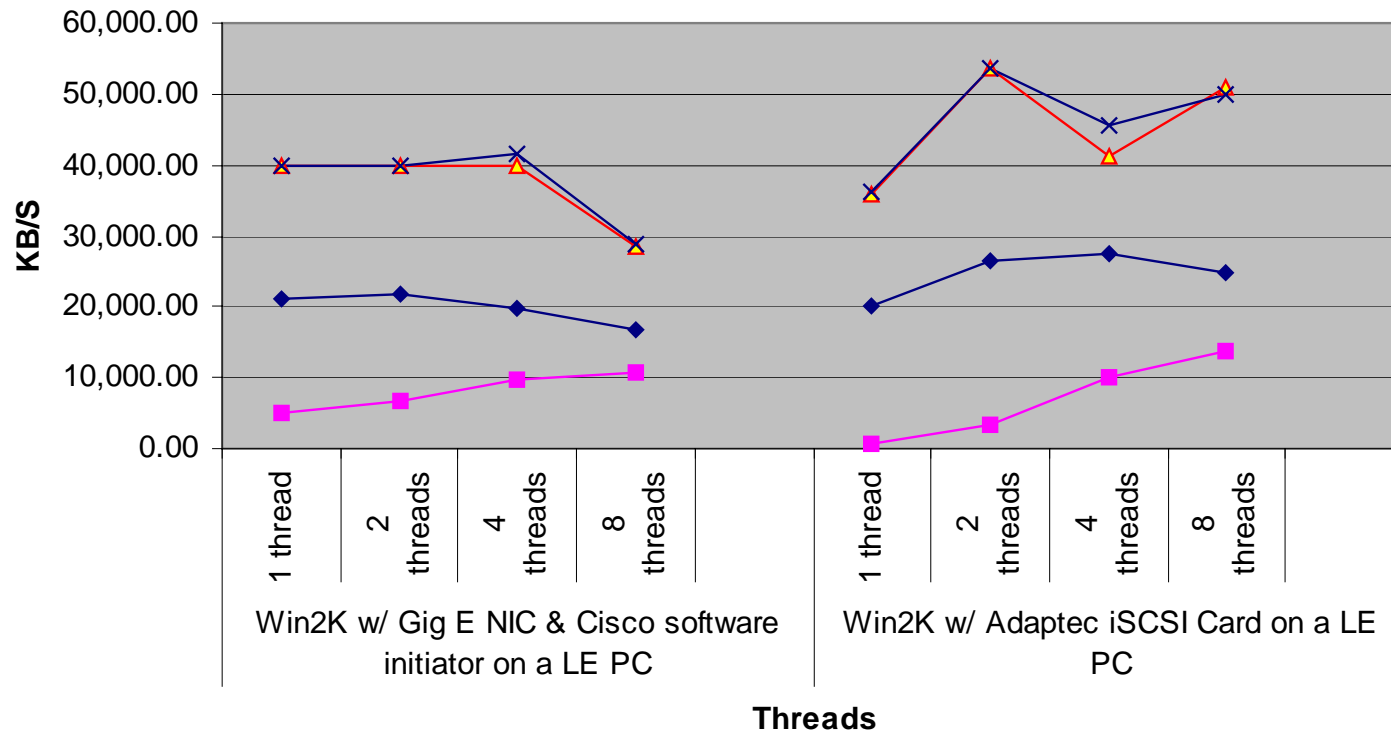
Adaptec 7211 iSCSI
adapter card

Adaptec TOE NAC 7711C

Test Results (Continued)



Low End PC Running Windows 2000 Pro Performance Comparison

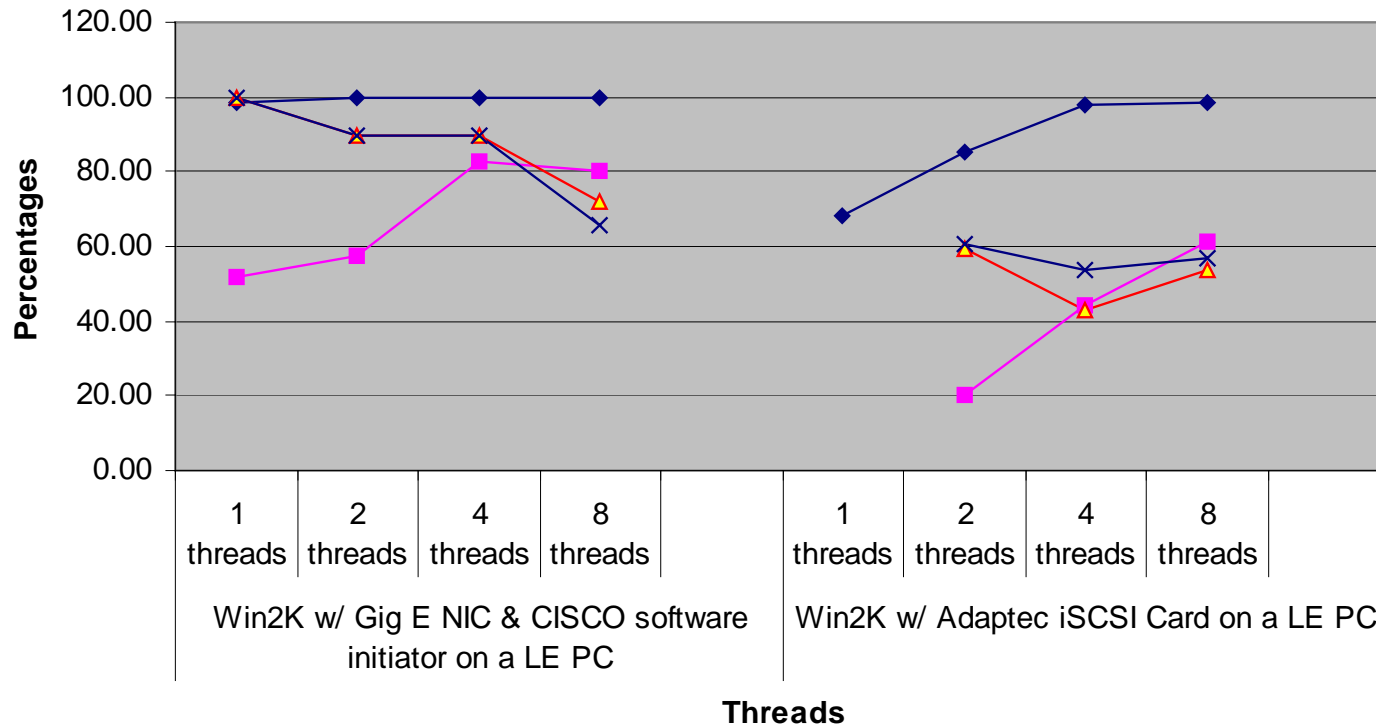


◆ Initial write
 ■ Rewrite
 ▲ Read
 × Re-read

Test Results (Continued)



Low End PC Running Windows 2000 Pro CPU Usage Comparison



◆ Initial write

■ Rewrite

▲ Read

× Re-read

- Performance & CPU Usage Comparison
- Windows vs. Linux Environment
- High End vs. Low End PC

Analysis (Continued)



High End PC Running Red Hat 9

	Performance		CPU Usage	
	Cisco iSCSI Driver	Adaptec TOE NAC 7711C	Cisco iSCSI Driver	Adaptec TOE NAC 7711C
Overall Write	100%	110%	100%	68%
Overall Read	100%	98%	100%	67%

Analysis (Continued)



High End PC Running Windows 2000 Pro

	Performance		CPU Usage	
	Cisco iSCSI Driver	Adaptec 7211 iSCSI	Cisco iSCSI Driver	Adaptec 7211 iSCSI
Overall Write	100%	103%	100%	79%
Overall Read	100%	80%	100%	47%

Analysis (Continued)

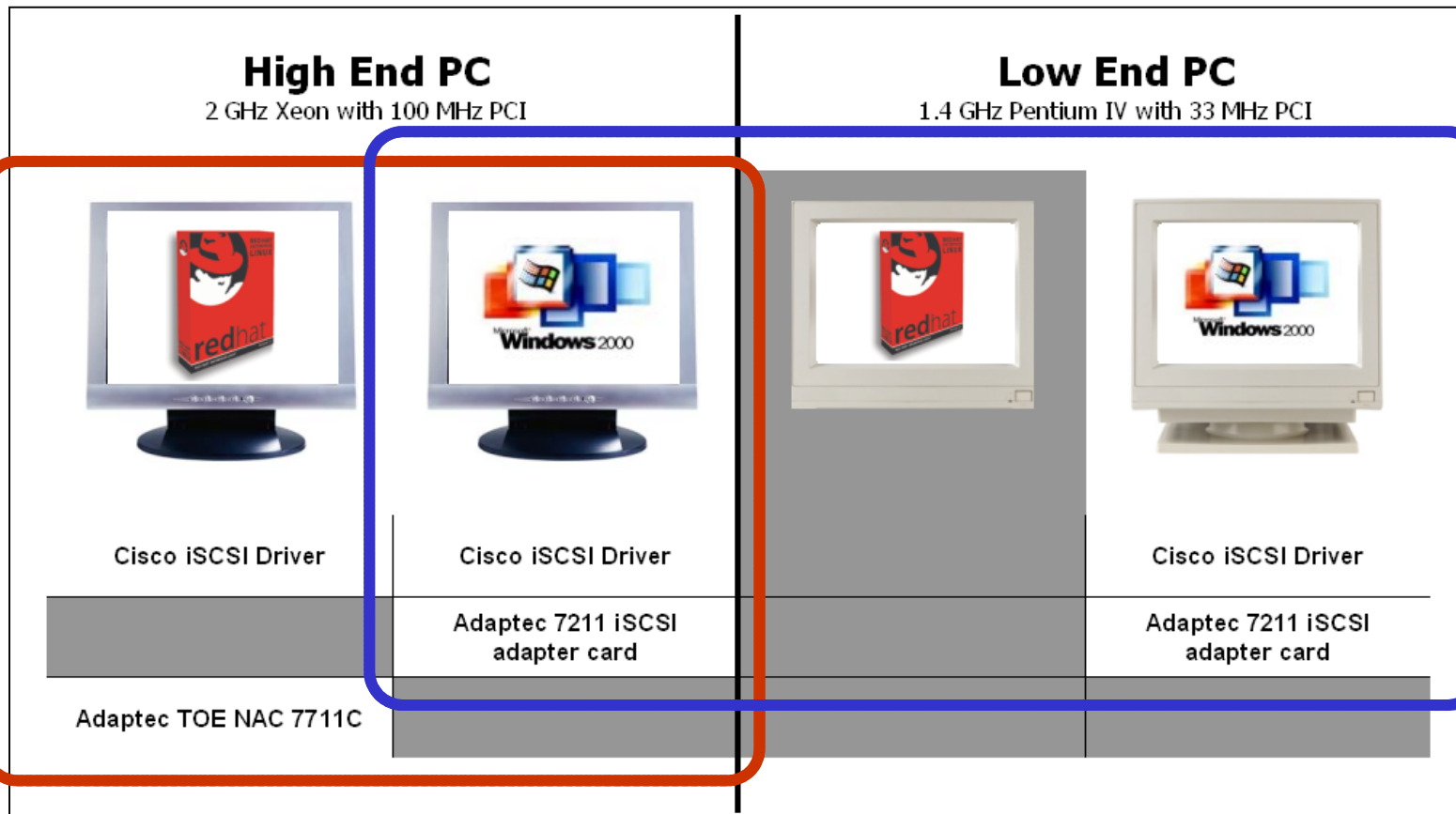


Low End PC Running Windows 2000 Pro

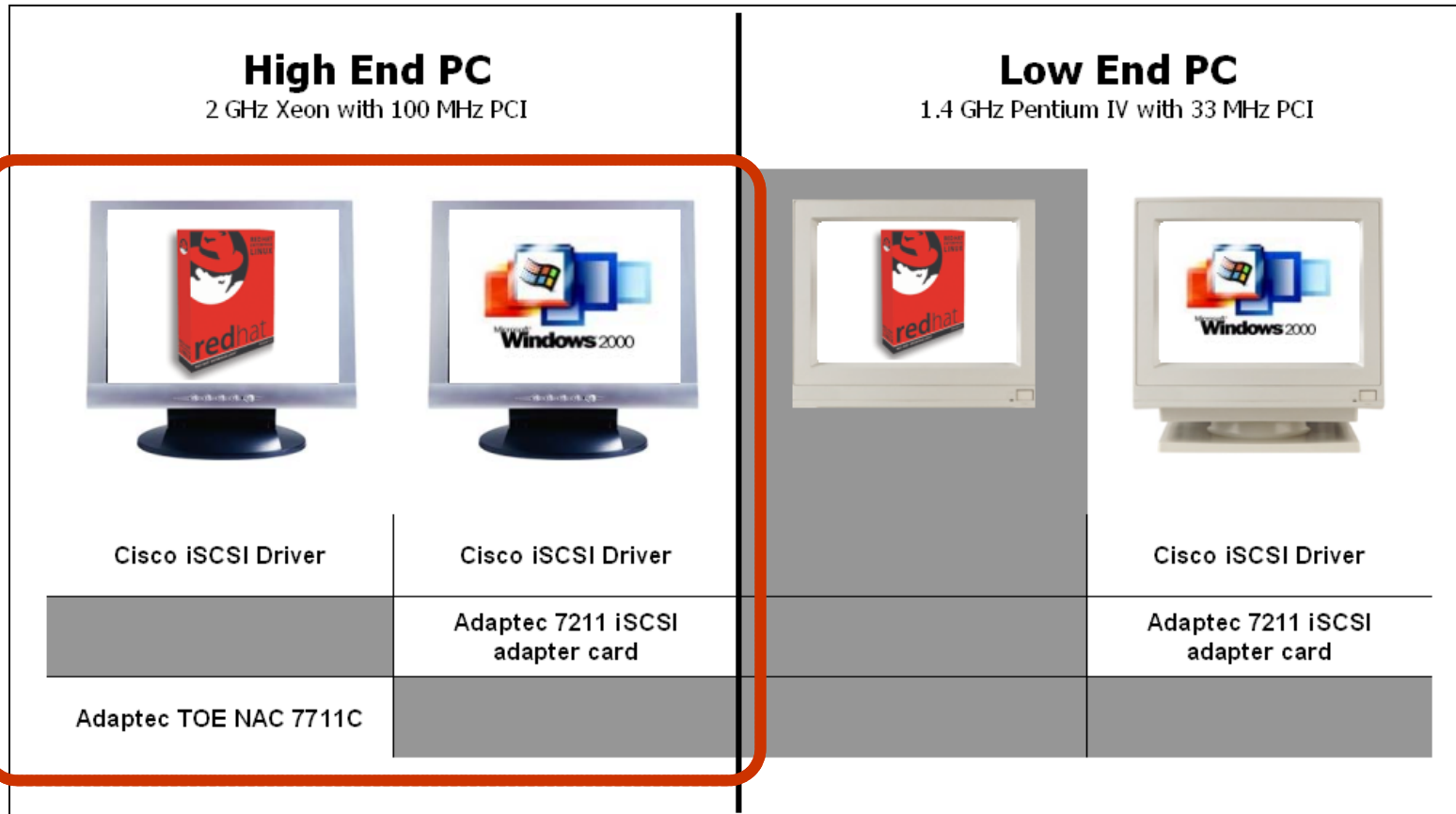
	Performance		CPU Usage	
	Cisco iSCSI Driver	Adaptec 7211 iSCSI	Cisco iSCSI Driver	Adaptec 7211 iSCSI
Overall Write	100%	122%	100%	74%
Overall Read	100%	127%	100%	67%

- Generally, hardware initiator out performs software initiator in both data writing and reading
 - Exception – data reading with Windows 2000 on the high end PC
- Generally, more threads yield better write/read performance
 - Exception – data writing with Linux
 - Exception – data writing/reading with Windows 2000 on the low end PC when implementing software initiator
- CPU usage is always greater when using the software initiator
- More threads consume more CPU processing power
 - Exception – data reading with Windows 2000 on the low end PC when implementing software initiator

Analysis (Continued)



Analysis (Continued)



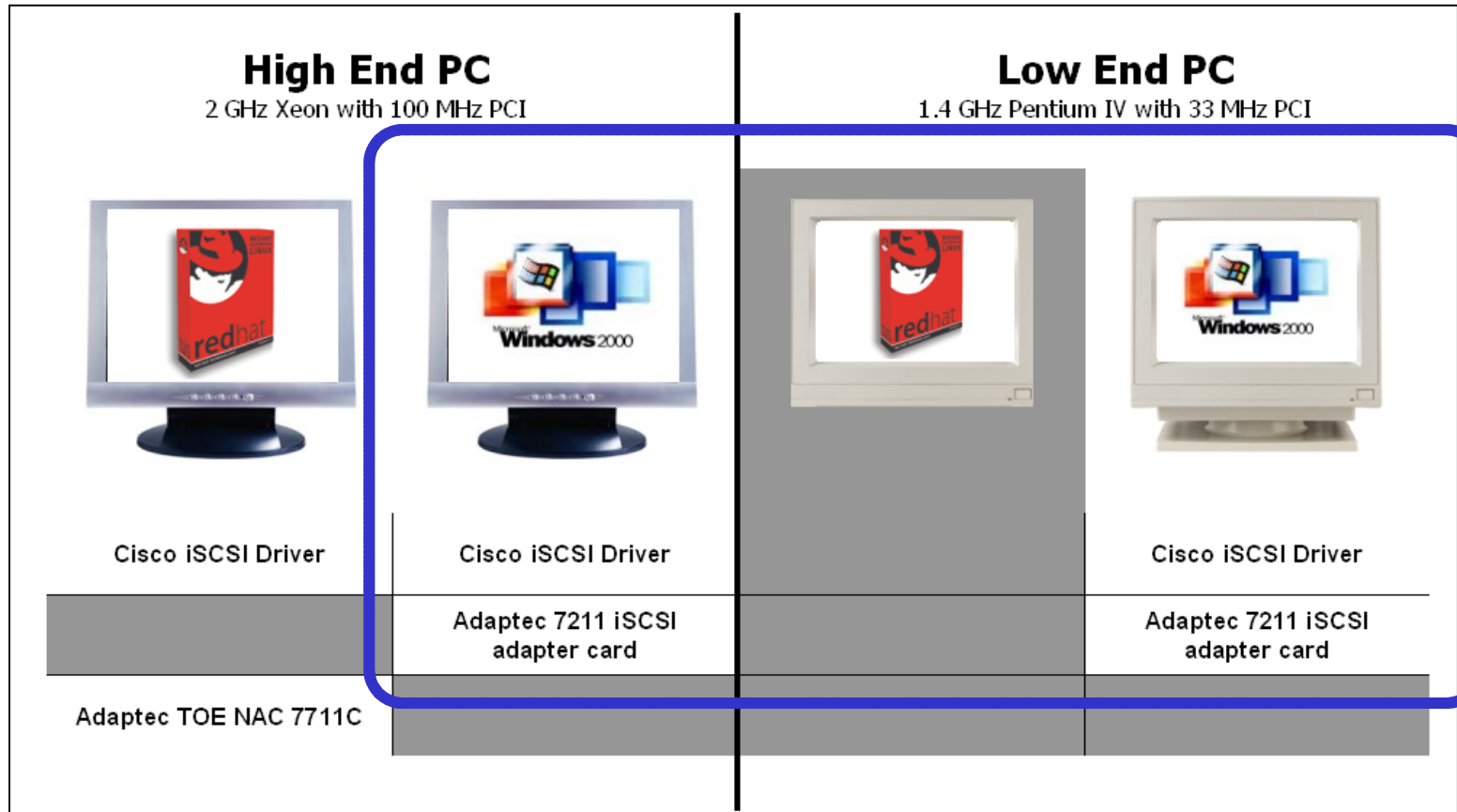
Analysis (Continued)



Windows and Linux Performance Comparison

	Software Initiator		Hardware Initiator	
	Windows 2000 Pro	Linux Red Hat 9	Windows 2000 Pro	Linux Red Hat 9
Overall Write	44%	100%	53%	100%
Overall Read	81%	100%	66%	100%

Analysis (Continued)



Analysis (Continued)



High End PC & Low End PC Performance Comparison

		Software Initiator		Hardware Initiator	
		Low End PC	High End PC	Low End PC	High End PC
Overall Write	Overall Write	69%	100%	71%	100%
	Overall Read	57%	100%	85%	100%

Analysis (Continued)



High End PC & Low End PC CPU Usage Comparison

	Software Initiator		Hardware Initiator	
	Low End PC	High End PC	Low End PC	High End PC
Overall Write	216%	100%	165%	100%
Overall Read	189%	100%	226%	100%

- CPU offloading works well
- Linux outperforms Windows
- Hardware initiator is justified better in the case of a Low End PC



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- Aruna Muppalla (ADNET)
- Paul Lang (ADNET)
- Rich Bono (Adaptec)
- Jeff Martz (CSC)
- Rich Isley (GMRS)

- Cisco iSCSI Driver
 - www.cisco.com
- Microsoft iSCSI Driver Software
 - www.microsoft.com
- IOZONE by Don Capps
 - www.iozone.org