



Subsystem Performance Testing Report for

EonStor[®] DS B24F-R2840-4

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1. Performance Configuration

Below is a description of the benchmarking testing environment and includes specifications for the server hardware, disk drive, subsystem, management tools of the subsystem and the software-testing tool. The industry standard test application IOMeter was used to measure the performance of the unit. This system comes with the standard Infortrend management software SANWatch®. Telnet and RS-232 connections can be used to manage the subsystem as well.

1.1 Testing Configuration

RAID	Controller	DS B24F-R2840-4
	FW	3.85C.36 (FA385C36_223_IPT_ESDSG6S6G.BIN)
	RAM	1GB DDR II SDRAM
	Drives	RAID: Toshiba SAS 450GB (Model: MBF2450RC; Capacity: 450GB; Speed: 6G; 10,000 RPM)
		JBOD: Toshiba SAS 450GB (Model: MBF2450RC; Capacity: 450GB; Speed: 6G; 10,000 RPM)
	Channels	Host Channel - Channel 0, 1, 2, 3
		Drive Channel - Channel 4, 5
		RCC Channel – Channel 6
	Virtual Volumes (RAID5/6) (Dual Hosts)	LV0 - Host channel 0; AID 112; LUN 0; 24 drives/channel; 1 partition
		LV1 - Host channel 1; BID 113; LUN 0; 24 drives/channel; 1 partition
	Virtual Volumes (RAID5/6) (Four Hosts)	LV0 - Host channel 0; AID 112; LUN 0; 12 drives/channel; 1 partition
		LV1 - Host channel 0; BID 113; LUN 0; 12 drives/channel; 1 partition
		LV2 - Host channel 1; AID 112; LUN 0; 12 drives/channel; 1 partition

	Virtual Volumes (RAID5/6) All Cache Hit (Eight Hosts)	LV3 - Host channel 1; BID 113; LUN 0; 12 drives/channel; 1 partition
		LV0 - Host channel 0; AID 112; LUN 0; Host channel 1; AID 112; LUN 0; 12 drives/channel; 1 partition
		LV1 - Host channel 0; BID 113; LUN 0; Host channel 1; BID 113; LUN 0; 12 drives/channel; 1 partition
		LV2 - Host channel 2; AID 112; LUN 0; Host channel 3; AID 112; LUN 0; 12 drives/channel; 1 partition
		LV3 - Host channel 2; BID 113; LUN 0; Host channel 3; BID 113; LUN 0; 12 drives/channel; 1 partition
	Setting	Optimization for – Sequential, (Raid 5 / 6 Default stripe size 128K)
		Periodic Drive Check Time – Disable
		Periodic SAF-TE and SES Device Check Time – Disable
		Verification on Normal Drive Writes – Disable
		Verification on LD Rebuild Writes – Disable
Max Drive Response Timeout – Disable		
Drive Delayed Write – Disable		
SDRAM ECC – Enable		
BBU – On		
Data Service	Snapshot Copy on Write	V.V Size : 100GB Virtual Volume 1: Host channel 0; ID 112; LUN 0 Virtual Volume 2: Host channel 1; ID 112; LUN 0
	Split mirror	V.V Size: 100GB (Source) Virtual Volume 1: Host channel 0; ID 112; LUN 0 (Target) Virtual Volume 2
Software	SANWatch	SANWatch_2.1.c.10
HBA	OS Register	MaximumSGList: FF (Hexadecima)
		NumberOfRequests: FF (Hexadecima)
	QLogic	QLE2562 (Driver VER: 9.1.7.18), Bios: v2.02
Server * 2 (Host)	M/B	SUPERMICRO X7DBE Single
	CPU	Intel Quad-Core Xeon 2.0GHz
	RAM	Kingston 2GB DDRII 667 DIMM * 2
	PCI	PCI-X 64-bit/133MHz *3

	System Drive	IDE Seagate 120G (ST3120026A)
	OS.	Microsoft Windows Server 2003 Enterprise R2 (With Service Pack 2)
Benchmark	IOmeter	2004.07.30
	I/O Tool Setting	Outstanding I/O - 16 for MB/s; (Random - 256 for IO/s, Sequential - 64 for IO/s)
		Ramp Up Time: 40 sec.
		Run Time: 30 sec.
		One LD Corresponds to One Worker.
		All Cache: Maximum Disk Size 10240
		Align I/Os on

2. Performance Test Results

The Performance test results are listed below.



NOTE:

1. In the following sections, “write-back” is abbreviated as **WB** and “write-through” is abbreviated as **WT**.
2. End-to-End four-channel IOPS Read having a lower performance than dual-channel configuration is a known issue, and will be resolved in the coming release of firmware.

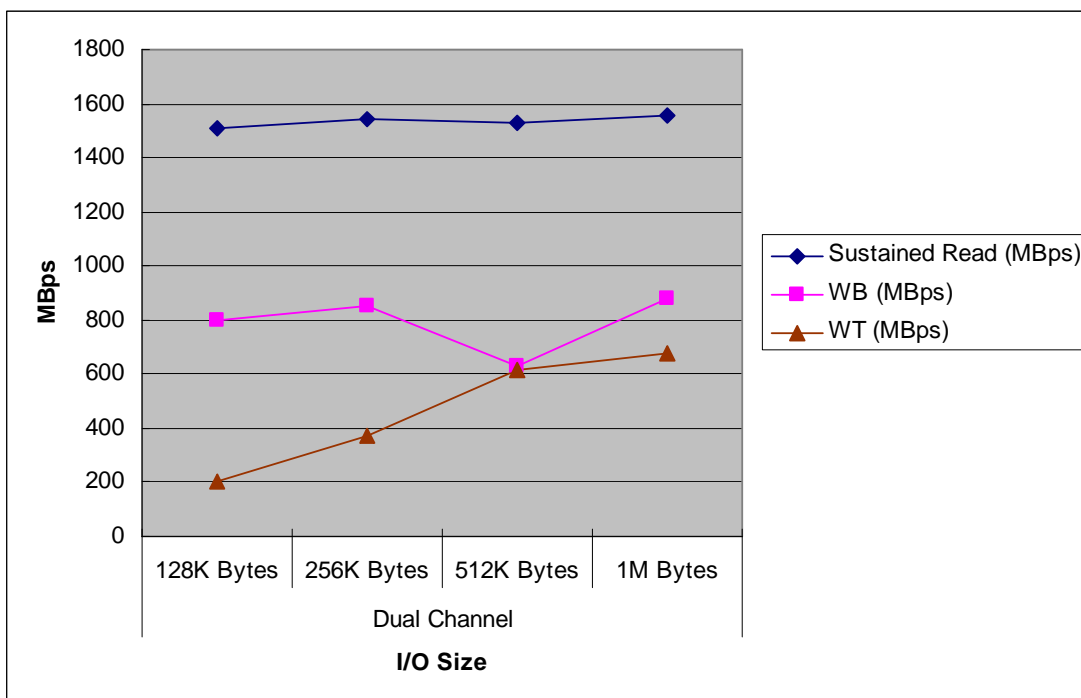
2.1 End-to-End RAID 5 Performance

2.11 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read	WB	WT
Host Channels	I/O Size	(MB/sec)	(MB/sec)	(MB/sec)
Dual Channel	128K Bytes	1506.73	797.88	204.68
	256K Bytes	1540.76	851.69	371.01
	512K Bytes	1531.66	626.15	616.52
	1M Bytes	1555.45	877.59	677.40



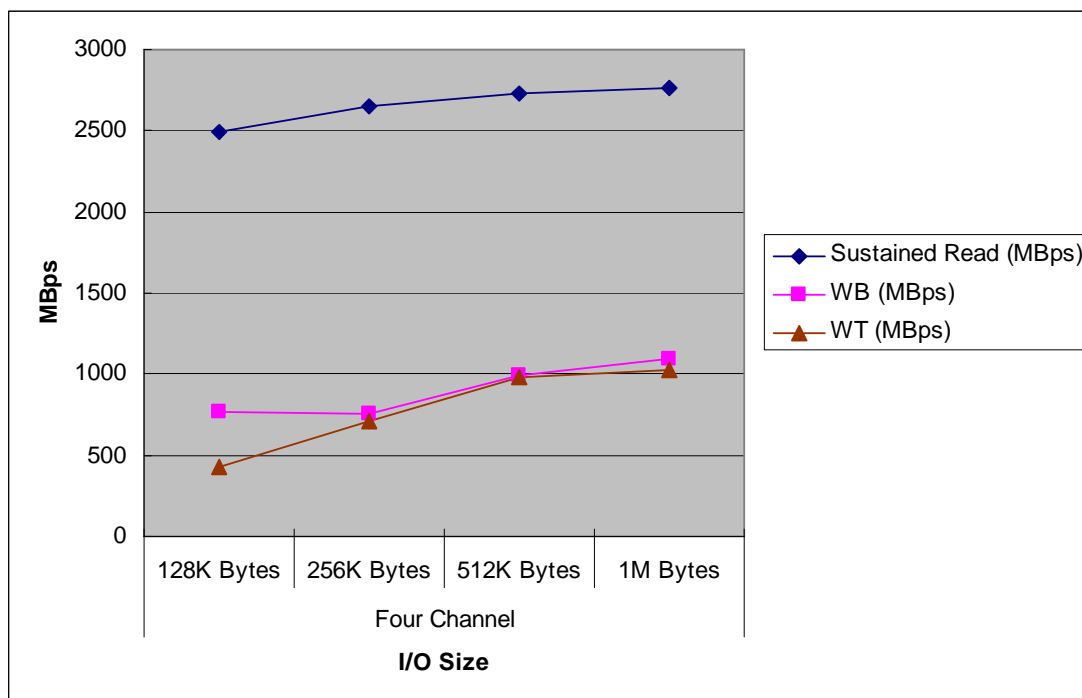
Data Access Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Dual Channel	512 Bytes	149610.26	67879.85
	4K Bytes	130165.62	50874.83

>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)	WT (MB/sec)
Host Channels	I/O Size			
Four Channel	128K Bytes	2488.20	767.65	427.24
	256K Bytes	2645.47	755.10	710.72
	512K Bytes	2731.13	992.69	986.63
	1M Bytes	2767.18	1094.14	1021.55



Data Access Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Four Channel	512 Bytes	145655.88	71660.13
	4K Bytes	122878.17	51071.79

2.12 Random I/O

>> Dual Channel

Data Transfer Rate (Mbps)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Dual Channel	512 Bytes	10076.00	3370.24
	4K Bytes	10064.94	3314.77

>> Four Channel**Data Transfer Rate (MBps)**

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Four Channel	512 Bytes	11533.12	3638.31
	4K Bytes	11485.08	3594.89

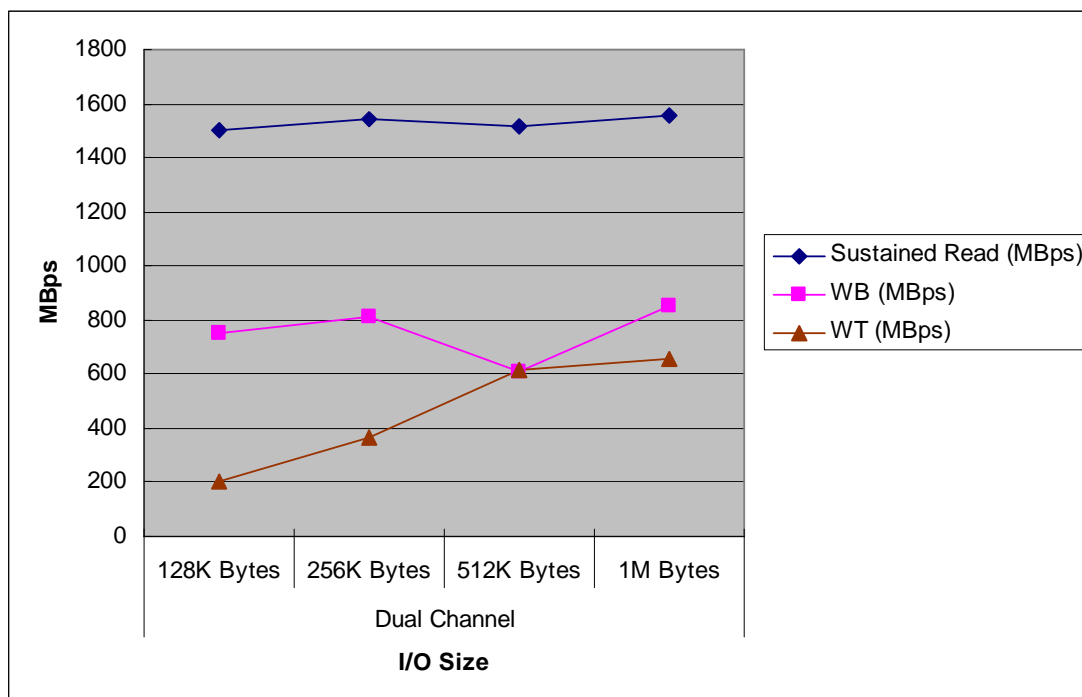
2.2 End-to-End RAID 6 Performance

2.2.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read	WB	WT
Host Channels	I/O Size	(MB/sec)	(MB/sec)	(MB/sec)
Dual Channel	128K Bytes	1502.54	749.73	201.75
	256K Bytes	1541.53	811.98	365.64
	512K Bytes	1515.99	607.94	613.92
	1M Bytes	1555.79	849.34	657.99



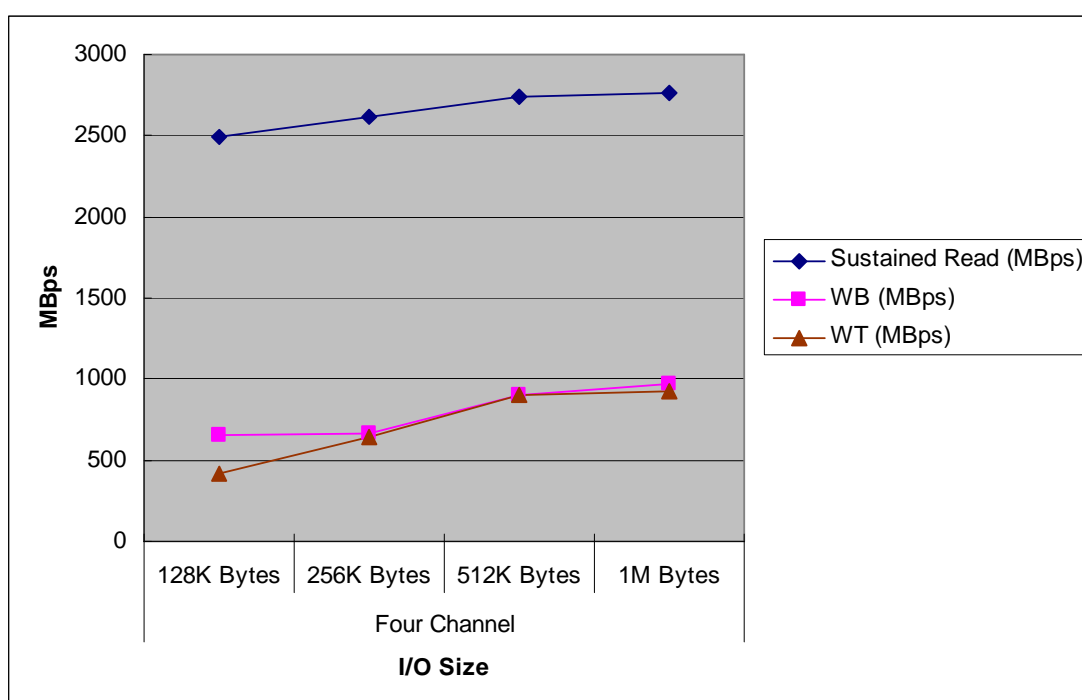
Data Access Rate (IOPS)

I/O Parameters		Read	WB
Host Channels	I/O Size	(IOPS)	(IOPS)
Dual Channel	512 Bytes	149407.86	67346.93
	4K Bytes	131535.86	49453.46

>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read	WB	WT
Host Channels	I/O Size	(MB/sec)	(MB/sec)	(MB/sec)
Four Channel	128K Bytes	2492.39	652.28	418.39
	256K Bytes	2613.90	668.12	639.45
	512K Bytes	2737.24	899.29	899.64
	1M Bytes	2758.58	969.85	923.49



Data Access Rate (IOPS)

I/O Parameters		Read	WB
Host Channels	I/O Size	(IOPS)	(IOPS)
Four Channel	512 Bytes	144963.22	71436.18
	4K Bytes	122253.57	48964.87

2.22 Random I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Dual Channel	512 Bytes	10066.02	2402.35
	4K Bytes	10066.97	2340.24

>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Four Channel	512 Bytes	11513.71	2580.71
	4K Bytes	11542.99	2561.96

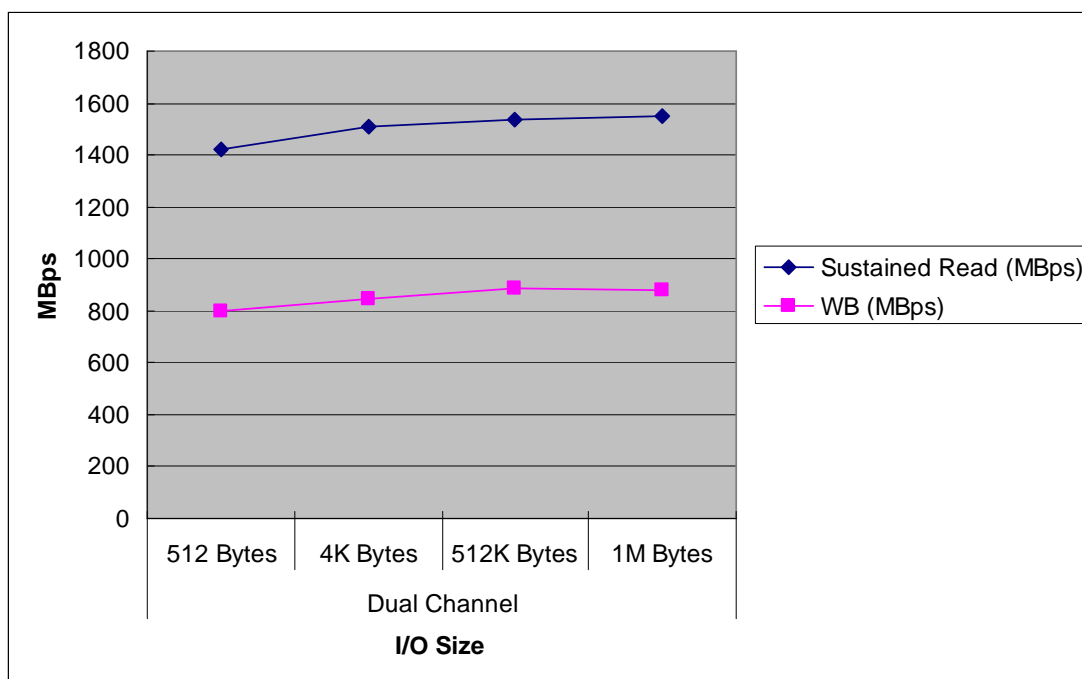
2.3 Degraded RAID 5 Performance

2.3.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

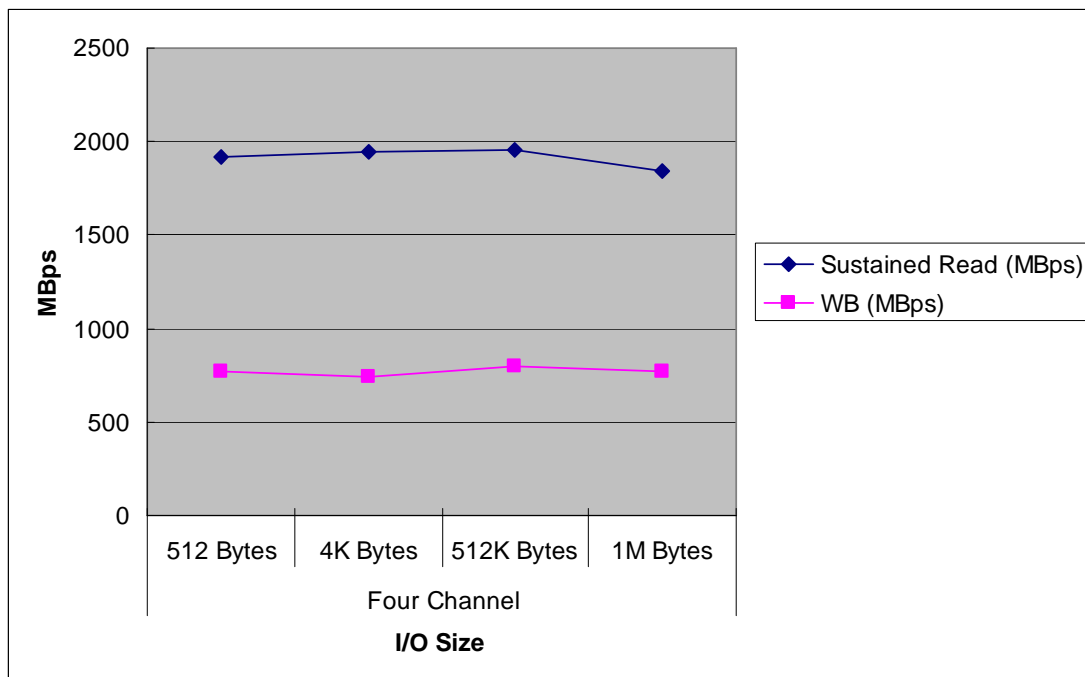
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1423.68	796.94
	256K Bytes	1508.16	846.35
	512K Bytes	1537.69	888.49
	1M Bytes	1546.93	882.63



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1914.76	773.84
	256K Bytes	1949.36	738.61
	512K Bytes	1951.03	802.34
	1M Bytes	1844.69	767.31



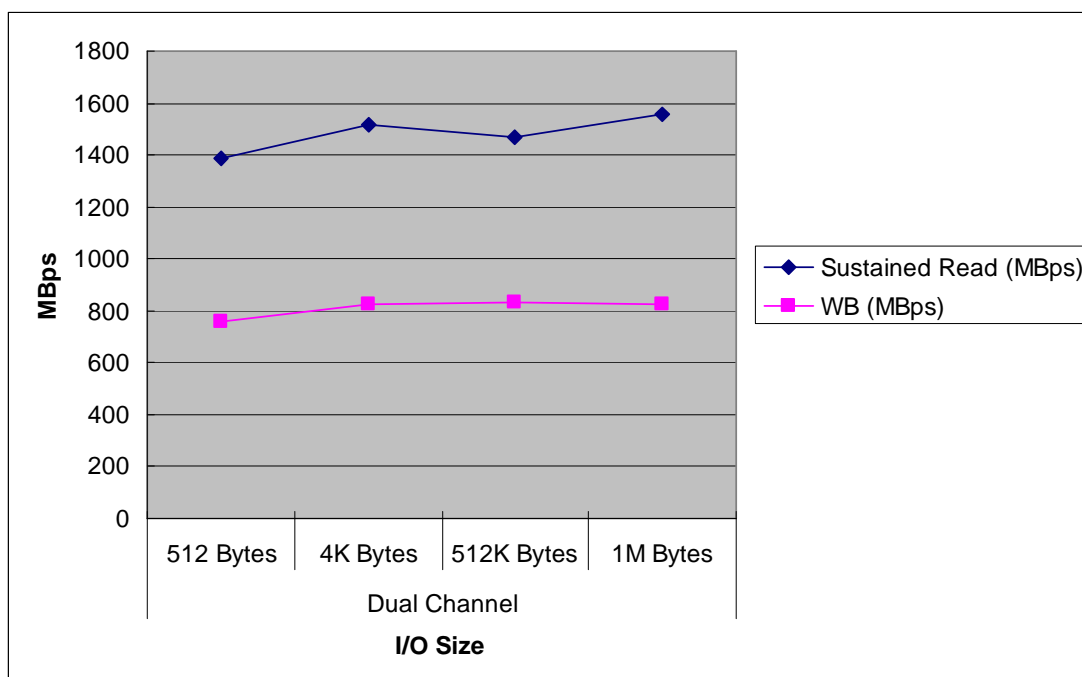
2.4 Degraded RAID 6 Performance

2.41 Sequential I/O – 1 Drive Failed

>> Dual Channel

Data Transfer Rate (MBps)

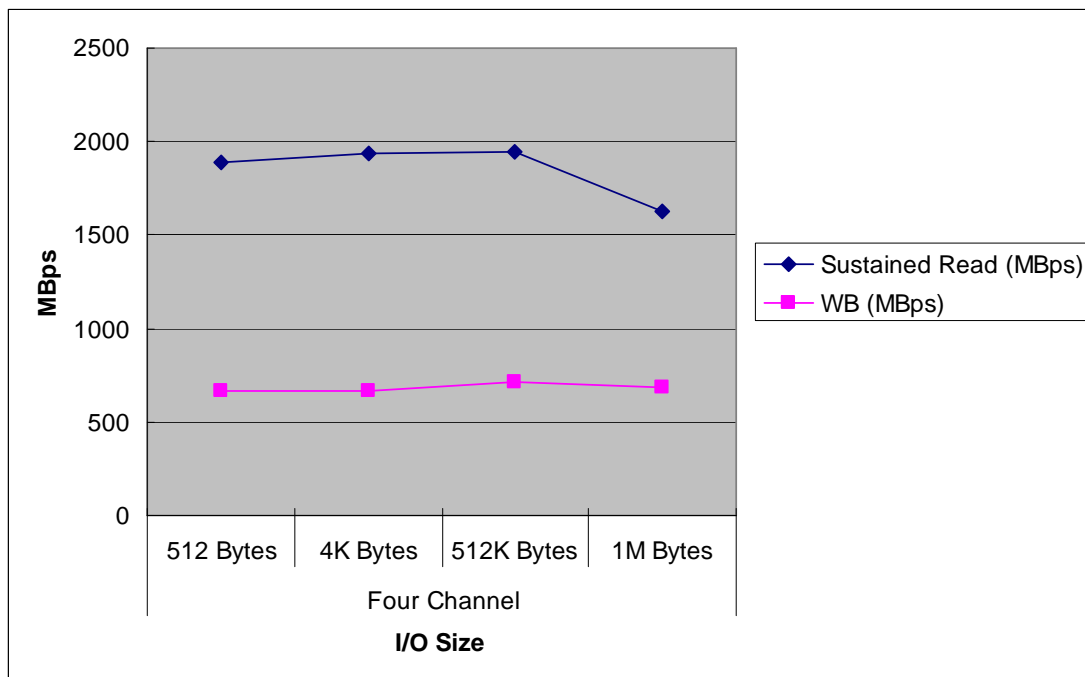
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1388.25	758.34
	256K Bytes	1512.88	825.05
	512K Bytes	1469.71	831.41
	1M Bytes	1553.84	823.07



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1889.55	668.09
	256K Bytes	1934.11	668.85
	512K Bytes	1945.41	711.81
	1M Bytes	1623.62	686.98

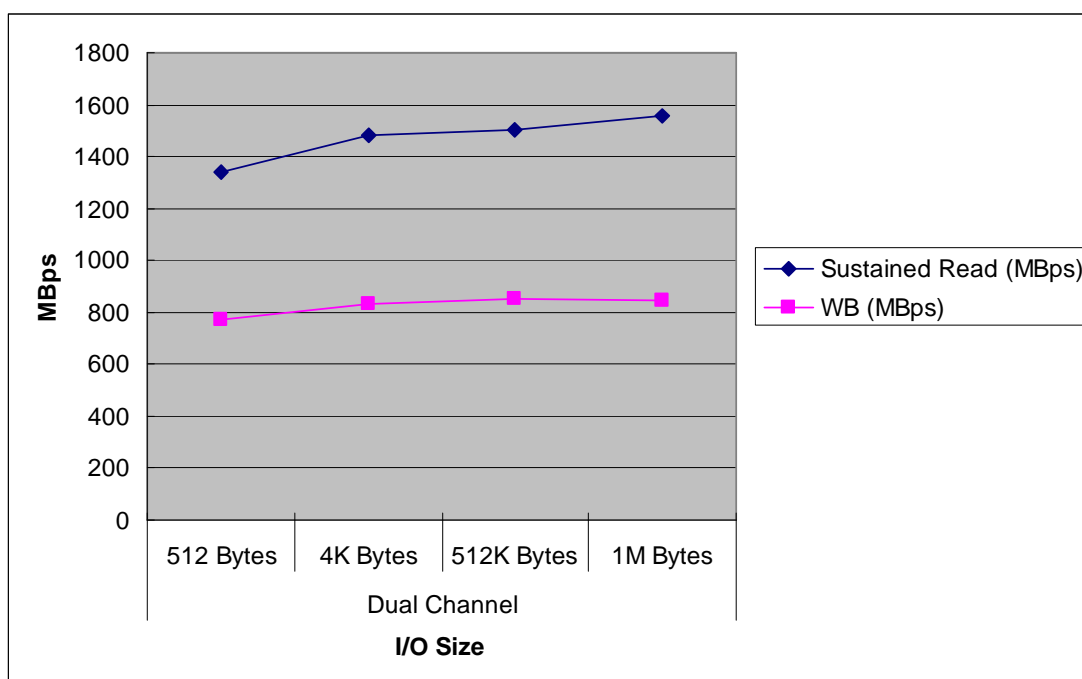


2.42 Sequential I/O – 2 Drives Failed

>> Dual Channel

Data Transfer Rate (MBps)

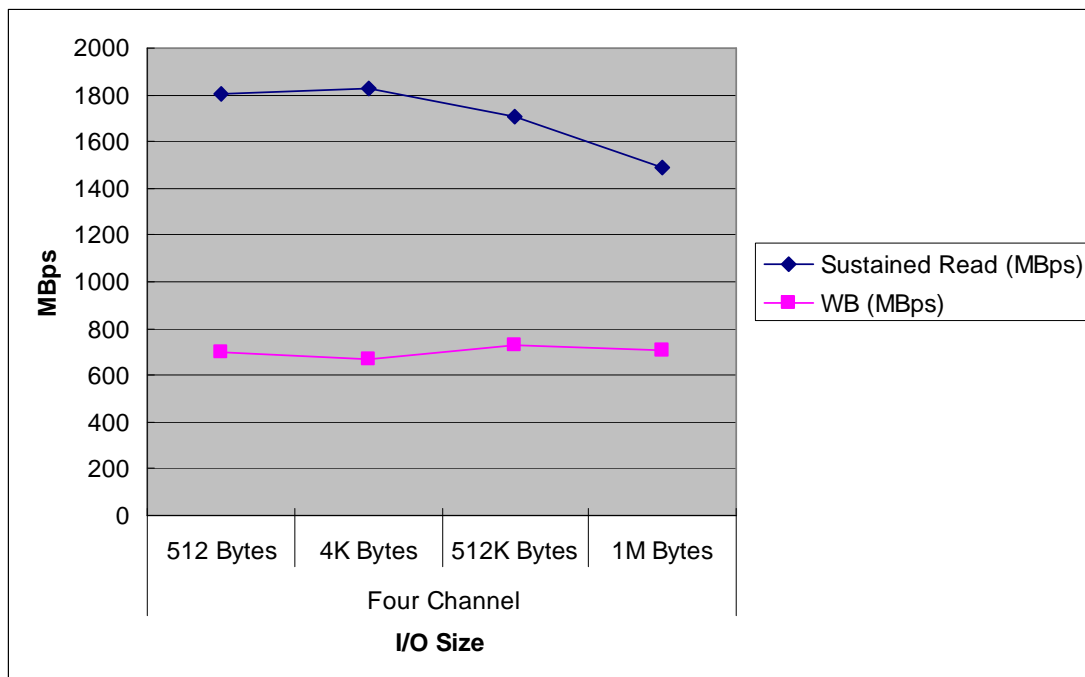
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1337.85	768.46
	256K Bytes	1484.25	831.98
	512K Bytes	1502.63	849.28
	1M Bytes	1554.66	844.93



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1806.18	699.41
	256K Bytes	1826.03	665.81
	512K Bytes	1704.44	728.33
	1M Bytes	1485.81	705.41



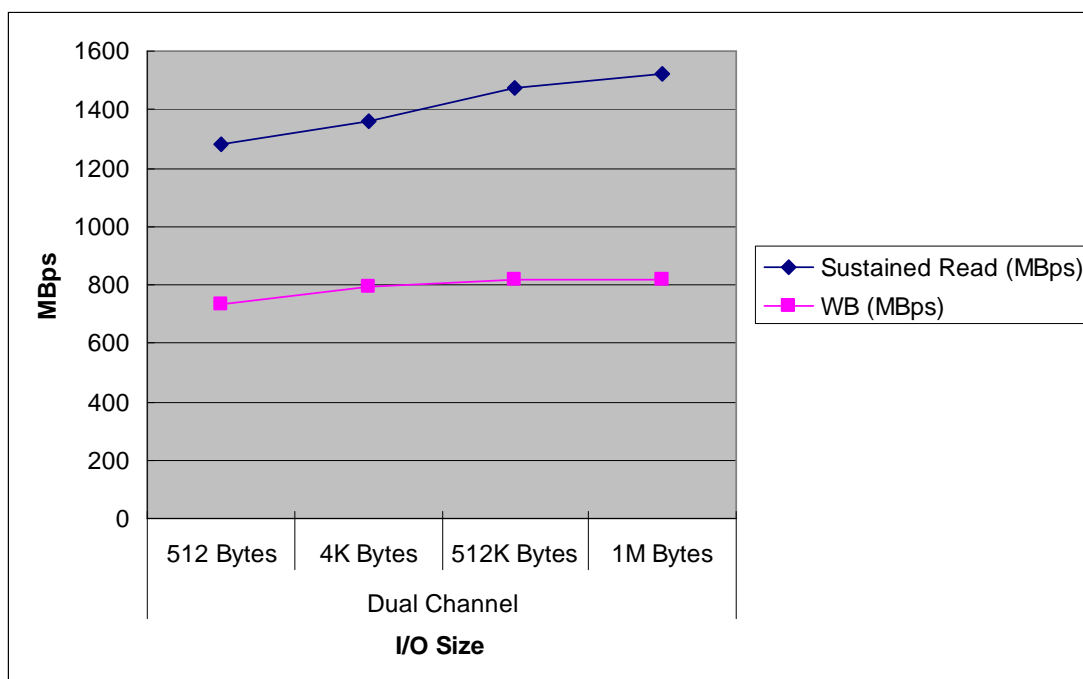
2.5 Rebuilding RAID 5 Performance

2.5.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

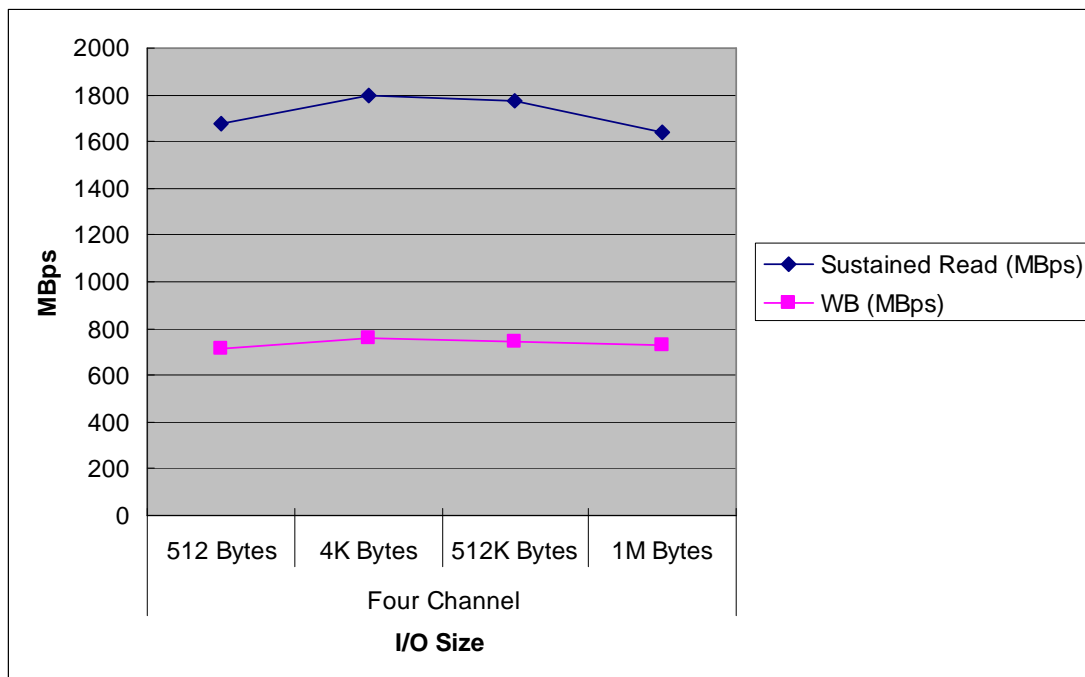
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1278.91	733.77
	256K Bytes	1360.62	793.68
	512K Bytes	1471.90	818.80
	1M Bytes	1520.59	816.93



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1679.03	717.64
	256K Bytes	1793.30	759.73
	512K Bytes	1773.57	745.36
	1M Bytes	1635.73	727.57



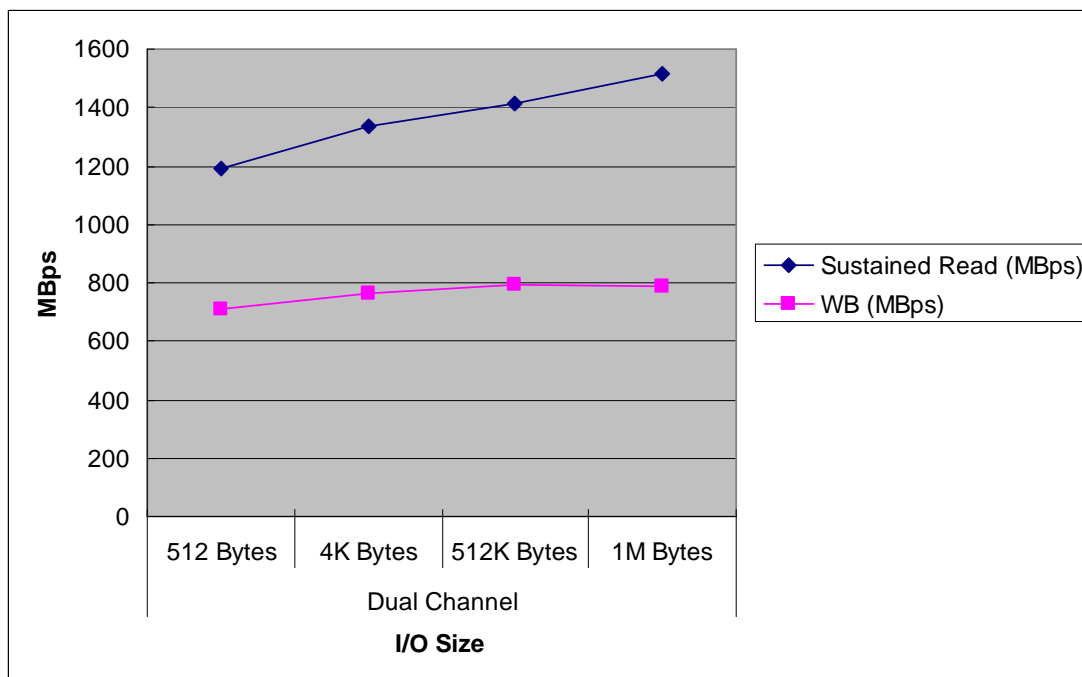
2.6 Rebuilding RAID 6 Performance

2.6.1 Sequential I/O – 2 Drives Rebuilding

>> Dual Channel

Data Transfer Rate (MBps)

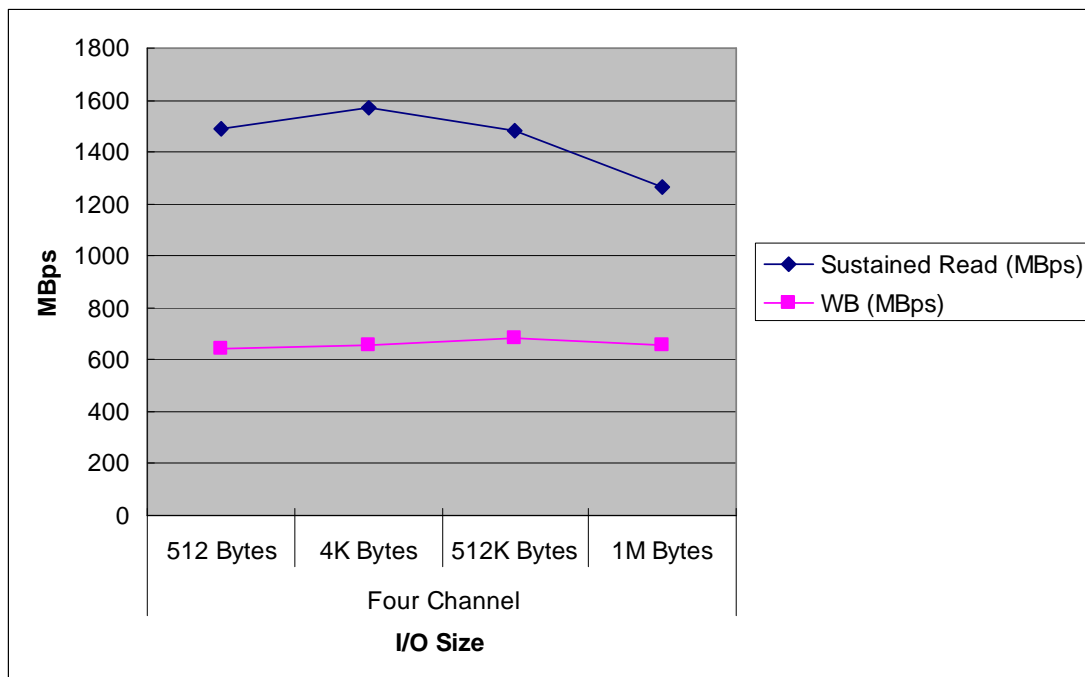
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1188.10	710.51
	256K Bytes	1332.70	766.39
	512K Bytes	1415.12	794.19
	1M Bytes	1517.11	786.61



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1489.85	645.72
	256K Bytes	1568.98	658.97
	512K Bytes	1483.02	686.61
	1M Bytes	1268.34	659.43



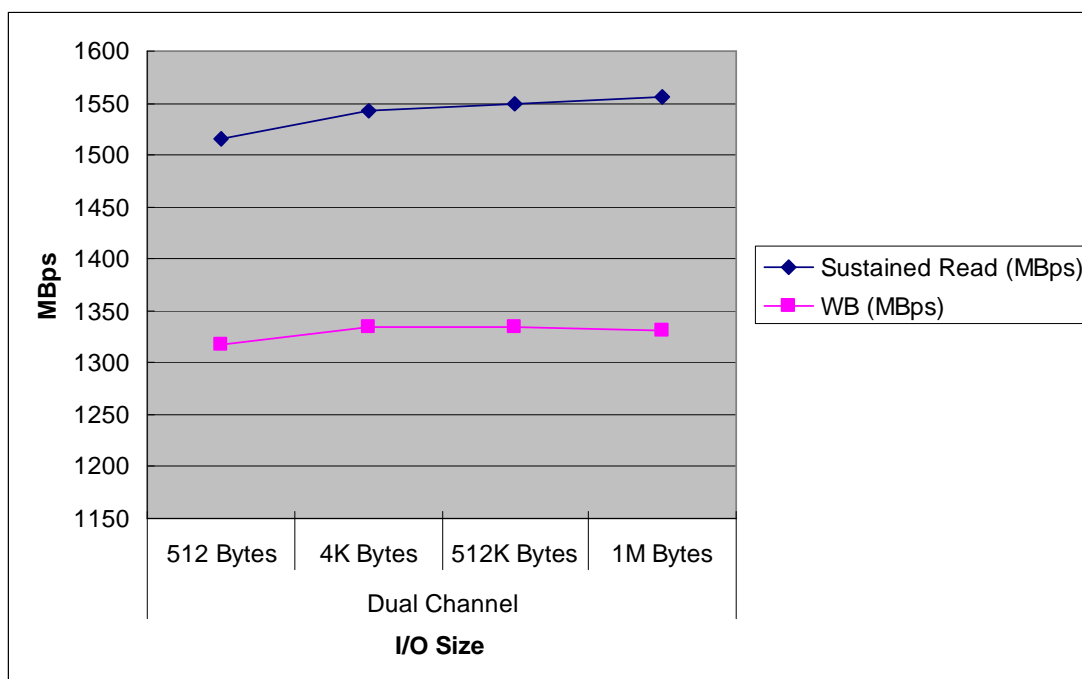
2.7 All Cache Hit RAID 5 Performance

2.7.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

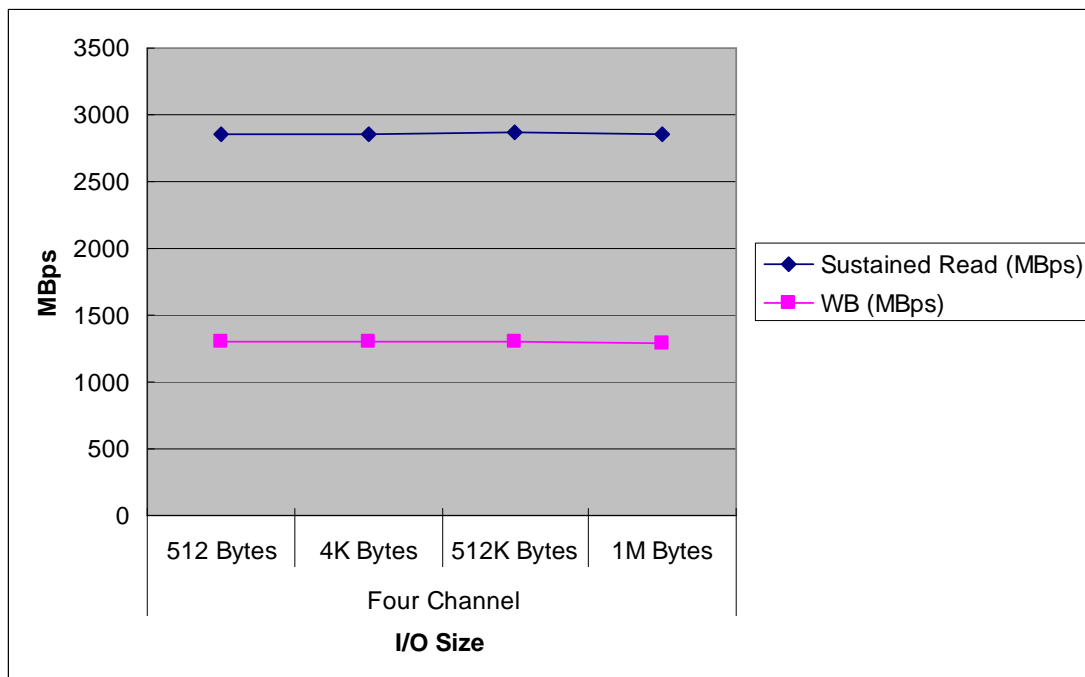
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1515.35	1317.26
	256K Bytes	1543.16	1333.79
	512K Bytes	1548.92	1335.17
	1M Bytes	1555.60	1330.43



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	2854.59	1304.44
	256K Bytes	2851.43	1304.64
	512K Bytes	2864.15	1303.78
	1M Bytes	2858.36	1293.72



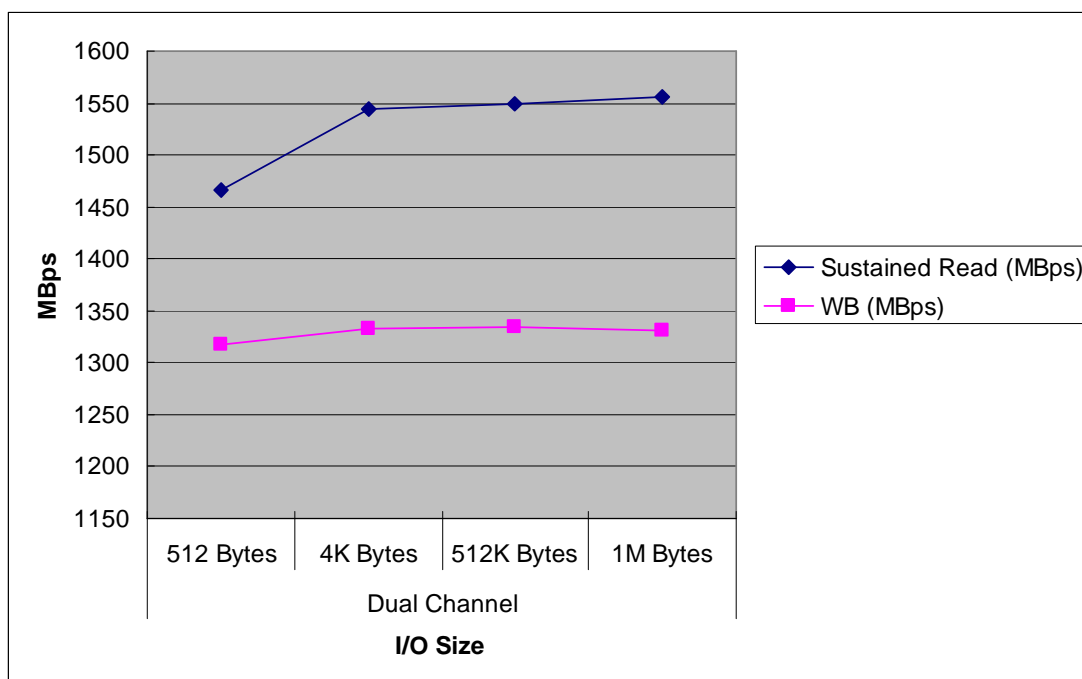
2.8 All Cache Hit RAID 6 Performance

2.8.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

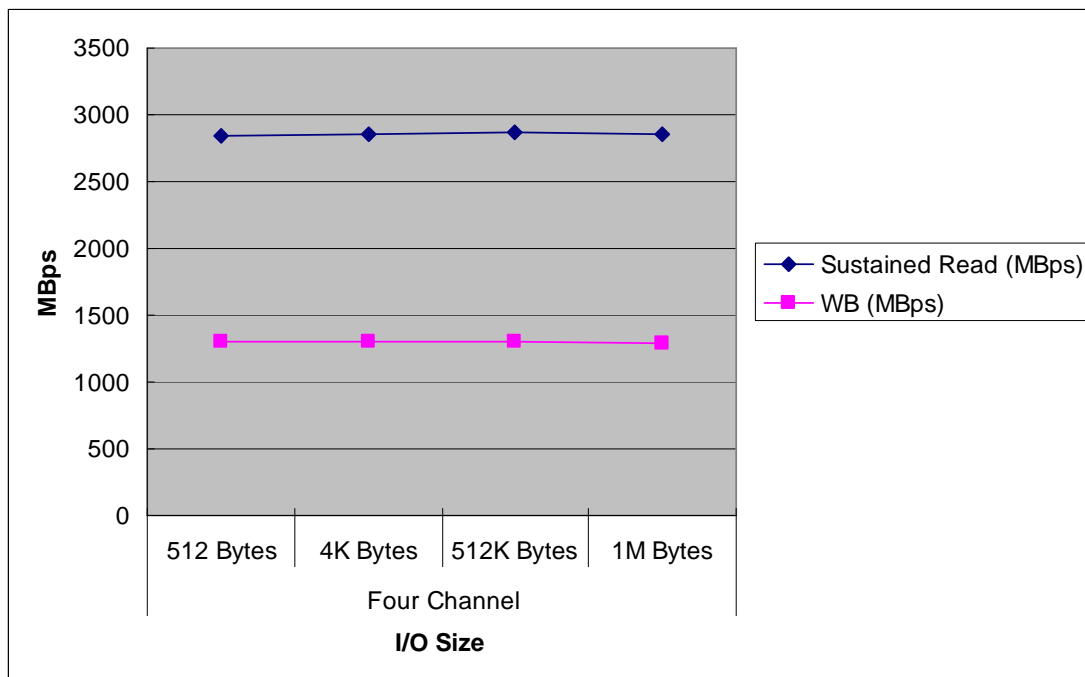
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1466.55	1317.20
	256K Bytes	1543.91	1332.60
	512K Bytes	1549.19	1334.86
	1M Bytes	1555.57	1330.18



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	2840.11	1304.26
	256K Bytes	2852.80	1304.14
	512K Bytes	2862.21	1303.43
	1M Bytes	2858.61	1293.61



3. Performance Test Results with Data Service enable

3.1 Snapshot Copy-on-Write End-to-End RAID 5

Performance

3.11 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	1M Bytes	723.04	723.04	262.64	262.64

3.12 Random I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	8k Bytes	1975.92	15.44	533.18	4.17

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
Dual Channel	8K Bytes	845.52		6.61	

3.2 Split Mirror End-to-End RAID 5 Performance (Source to 1 Target)

3.2.1 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	779.06	779.06	229.23	229.23

3.2.2 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3800.56	29.69	1349.57	10.54

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	2462.83		19.24	

3.3 Split Mirror End-to-End RAID 5 Performance (Source to 2 Targets)

3.31 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	779.04	779.04	143.42	143.42

3.32 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3725.90	29.11	882.10	6.89

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	1815.17		14.18	

3.4 Snapshot Copy-on-Write End-to-End RAID 6

Performance

3.41 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	1M Bytes	710.82	710.82	254.26	254.26

3.42 Random I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	8k Bytes	1972.00	15.41	512.00	4.00

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
Dual Channel	8K Bytes	816.68		6.38	

3.5 Split Mirror End-to-End RAID 6 Performance (Source to 1 Target)

3.51 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	769.38	769.38	229.57	229.57

3.52 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3777.49	29.51	1131.64	8.84

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	2168.75		16.94	

3.6 Split Mirror End-to-End RAID 6 Performance (Source to 2 Targets)

3.6.1 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	778.30	778.30	140.41	140.41

3.6.2 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3755.80	29.34	747.48	5.84

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	1576.69		12.32	

3.7 Volume Copy / Virtual Volume Size 100GB / Data Size 10GB

Subsystem	1 Raid
Parameters	1 Source to 1 Target
Finish Time	1 hr. 1 min.



Subsystem Performance Testing Report for

EonStor[®] DS B24F-R2840-4

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1. Performance Configuration

Below is a description of the benchmarking testing environment and includes specifications for the server hardware, disk drive, subsystem, management tools of the subsystem and the software-testing tool. The industry standard test application IOMeter was used to measure the performance of the unit. This system comes with the standard Infortrend management software SANWatch®. Telnet and RS-232 connections can be used to manage the subsystem as well.

1.1 Testing Configuration

RAID	Controller	DS B24F-R2840-4
	FW	3.85C.36 (FA385C36_223_IPT_ESDSG6S6G.BIN)
	RAM	1GB DDR II SDRAM
	Drives	RAID: Toshiba SAS 450GB (Model: MBF2450RC; Capacity: 450GB; Speed: 6G; 10,000 RPM)
		JBOD: Toshiba SAS 450GB (Model: MBF2450RC; Capacity: 450GB; Speed: 6G; 10,000 RPM)
	Channels	Host Channel - Channel 0, 1, 2, 3
		Drive Channel - Channel 4, 5
		RCC Channel – Channel 6
	Virtual Volumes (RAID5/6) (Dual Hosts)	LV0 - Host channel 0; AID 112; LUN 0; 24 drives/channel; 1 partition
		LV1 - Host channel 1; BID 113; LUN 0; 24 drives/channel; 1 partition
	Virtual Volumes (RAID5/6) (Four Hosts)	LV0 - Host channel 0; AID 112; LUN 0; 12 drives/channel; 1 partition
		LV1 - Host channel 0; BID 113; LUN 0; 12 drives/channel; 1 partition
		LV2 - Host channel 1; AID 112; LUN 0; 12 drives/channel; 1 partition

	Virtual Volumes (RAID5/6) All Cache Hit (Eight Hosts)	LV3 - Host channel 1; BID 113; LUN 0; 12 drives/channel; 1 partition
		LV0 - Host channel 0; AID 112; LUN 0; Host channel 1; AID 112; LUN 0; 12 drives/channel; 1 partition
		LV1 - Host channel 0; BID 113; LUN 0; Host channel 1; BID 113; LUN 0; 12 drives/channel; 1 partition
		LV2 - Host channel 2; AID 112; LUN 0; Host channel 3; AID 112; LUN 0; 12 drives/channel; 1 partition
		LV3 - Host channel 2; BID 113; LUN 0; Host channel 3; BID 113; LUN 0; 12 drives/channel; 1 partition
	Setting	Optimization for – Sequential, (Raid 5 / 6 Default stripe size 128K)
		Periodic Drive Check Time – Disable
		Periodic SAF-TE and SES Device Check Time – Disable
		Verification on Normal Drive Writes – Disable
		Verification on LD Rebuild Writes – Disable
Max Drive Response Timeout – Disable		
Drive Delayed Write – Disable		
SDRAM ECC – Enable		
BBU – On		
Data Service	Snapshot Copy on Write	V.V Size : 100GB Virtual Volume 1: Host channel 0; ID 112; LUN 0 Virtual Volume 2: Host channel 1; ID 112; LUN 0
	Split mirror	V.V Size: 100GB (Source) Virtual Volume 1: Host channel 0; ID 112; LUN 0 (Target) Virtual Volume 2
Software	SANWatch	SANWatch_2.1.c.10
HBA	OS Register	MaximumSGList: FF (Hexadecima)
		NumberOfRequests: FF (Hexadecima)
	QLogic	QLE2562 (Driver VER: 9.1.7.18), Bios: v2.02
Server * 2 (Host)	M/B	SUPERMICRO X7DBE Single
	CPU	Intel Quad-Core Xeon 2.0GHz
	RAM	Kingston 2GB DDRII 667 DIMM * 2
	PCI	PCI-X 64-bit/133MHz *3

	System Drive	IDE Seagate 120G (ST3120026A)
	OS.	Microsoft Windows Server 2003 Enterprise R2 (With Service Pack 2)
Benchmark	IOmeter	2004.07.30
	I/O Tool Setting	Outstanding I/O - 16 for MB/s; (Random - 256 for IO/s, Sequential - 64 for IO/s)
		Ramp Up Time: 40 sec.
		Run Time: 30 sec.
		One LD Corresponds to One Worker.
		All Cache: Maximum Disk Size 10240
		Align I/Os on

2. Performance Test Results

The Performance test results are listed below.



NOTE:

1. In the following sections, “write-back” is abbreviated as **WB** and “write-through” is abbreviated as **WT**.
2. End-to-End four-channel IOPS Read having a lower performance than dual-channel configuration is a known issue, and will be resolved in the coming release of firmware.

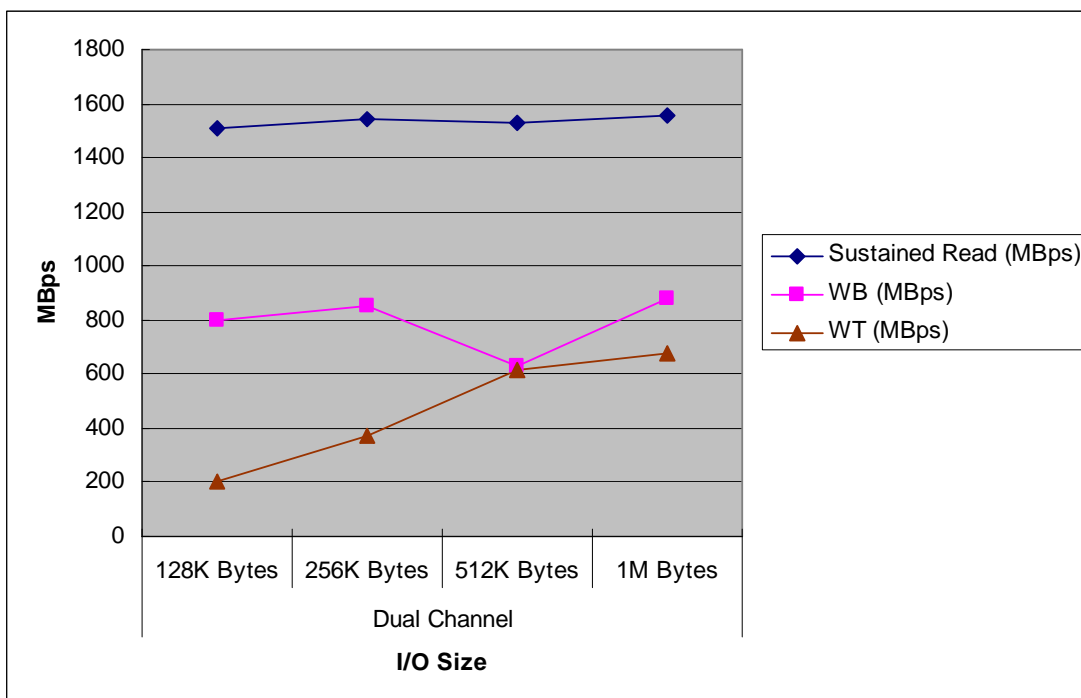
2.1 End-to-End RAID 5 Performance

2.11 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read	WB	WT
Host Channels	I/O Size	(MB/sec)	(MB/sec)	(MB/sec)
Dual Channel	128K Bytes	1506.73	797.88	204.68
	256K Bytes	1540.76	851.69	371.01
	512K Bytes	1531.66	626.15	616.52
	1M Bytes	1555.45	877.59	677.40



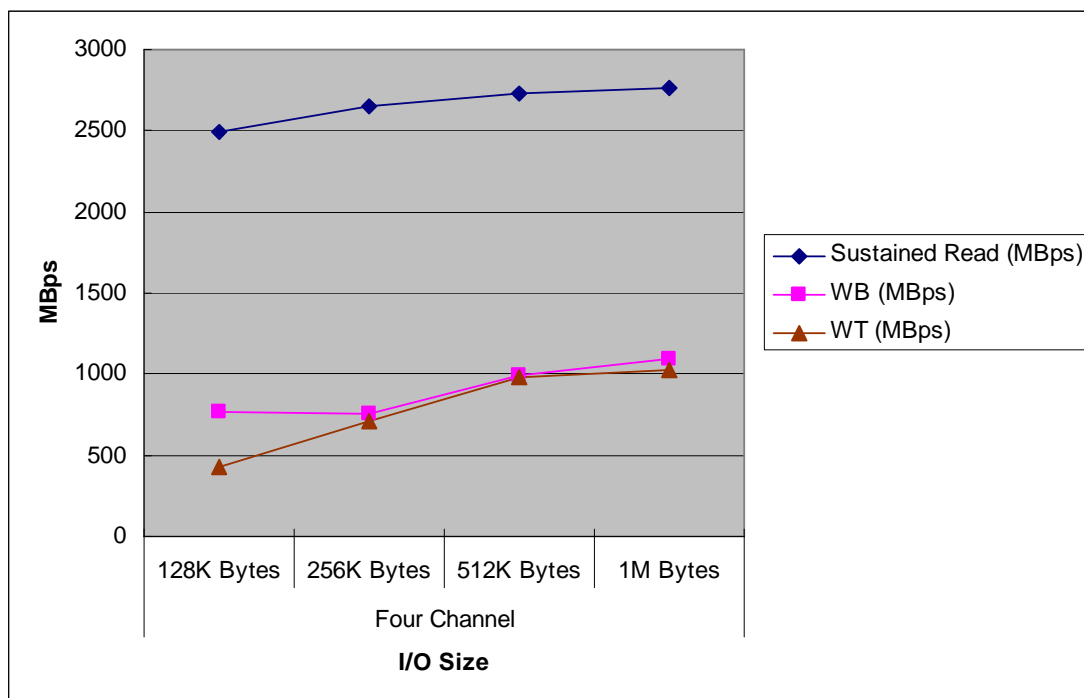
Data Access Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Dual Channel	512 Bytes	149610.26	67879.85
	4K Bytes	130165.62	50874.83

>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)	WT (MB/sec)
Host Channels	I/O Size			
Four Channel	128K Bytes	2488.20	767.65	427.24
	256K Bytes	2645.47	755.10	710.72
	512K Bytes	2731.13	992.69	986.63
	1M Bytes	2767.18	1094.14	1021.55



Data Access Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Four Channel	512 Bytes	145655.88	71660.13
	4K Bytes	122878.17	51071.79

2.12 Random I/O

>> Dual Channel

Data Transfer Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Dual Channel	512 Bytes	10076.00	3370.24
	4K Bytes	10064.94	3314.77

>> Four Channel**Data Transfer Rate (IOPS)**

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Four Channel	512 Bytes	11533.12	3638.31
	4K Bytes	11485.08	3594.89

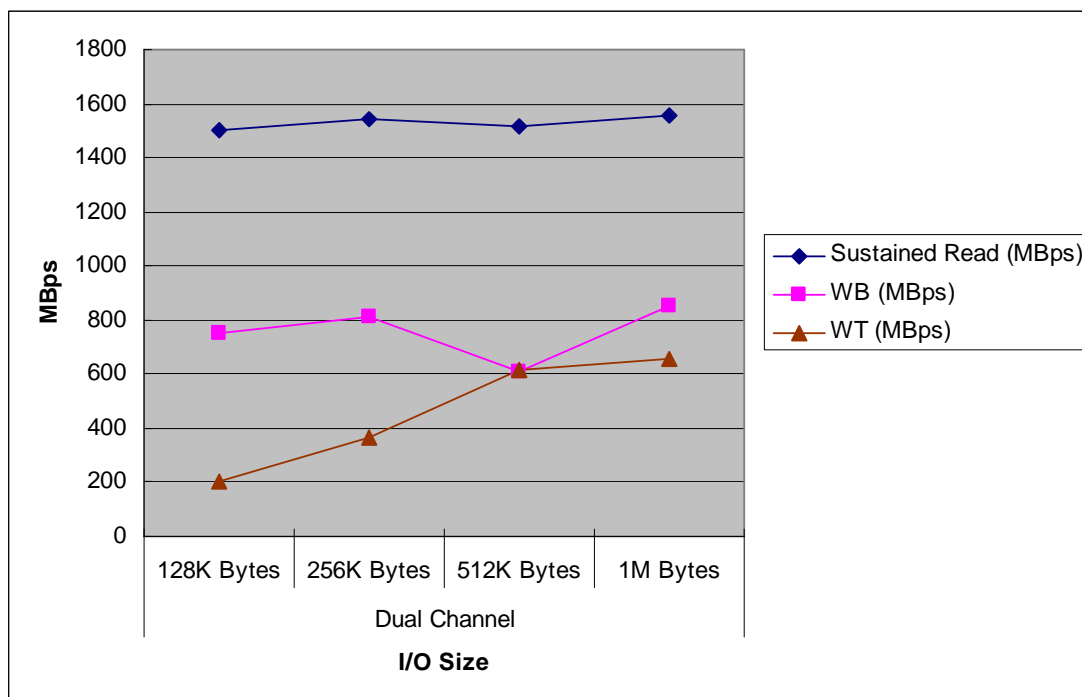
2.2 End-to-End RAID 6 Performance

2.2.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read	WB	WT
Host Channels	I/O Size	(MB/sec)	(MB/sec)	(MB/sec)
Dual Channel	128K Bytes	1502.54	749.73	201.75
	256K Bytes	1541.53	811.98	365.64
	512K Bytes	1515.99	607.94	613.92
	1M Bytes	1555.79	849.34	657.99



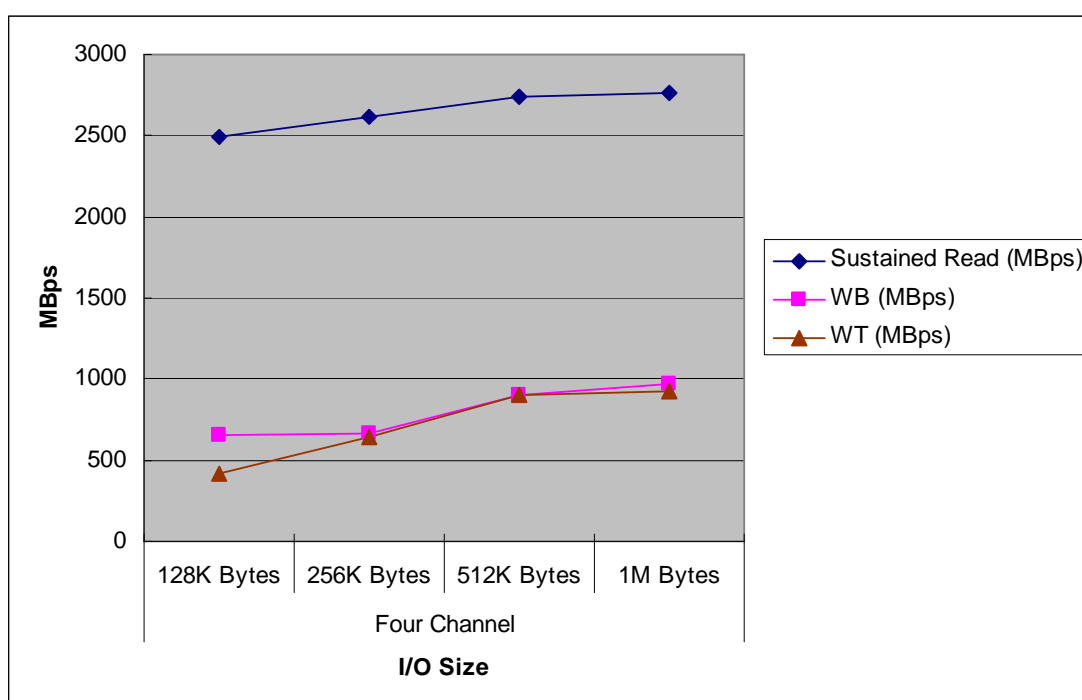
Data Access Rate (IOPS)

I/O Parameters		Read	WB
Host Channels	I/O Size	(IOPS)	(IOPS)
Dual Channel	512 Bytes	149407.86	67346.93
	4K Bytes	131535.86	49453.46

>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read	WB	WT
Host Channels	I/O Size	(MB/sec)	(MB/sec)	(MB/sec)
Four Channel	128K Bytes	2492.39	652.28	418.39
	256K Bytes	2613.90	668.12	639.45
	512K Bytes	2737.24	899.29	899.64
	1M Bytes	2758.58	969.85	923.49



Data Access Rate (IOPS)

I/O Parameters		Read	WB
Host Channels	I/O Size	(IOPS)	(IOPS)
Four Channel	512 Bytes	144963.22	71436.18
	4K Bytes	122253.57	48964.87

2.22 Random I/O

>> Dual Channel

Data Transfer Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Dual Channel	512 Bytes	10066.02	2402.35
	4K Bytes	10066.97	2340.24

>> Four Channel

Data Transfer Rate (IOPS)

I/O Parameters		Read (IOPS)	WB (IOPS)
Host Channels	I/O Size		
Four Channel	512 Bytes	11513.71	2580.71
	4K Bytes	11542.99	2561.96

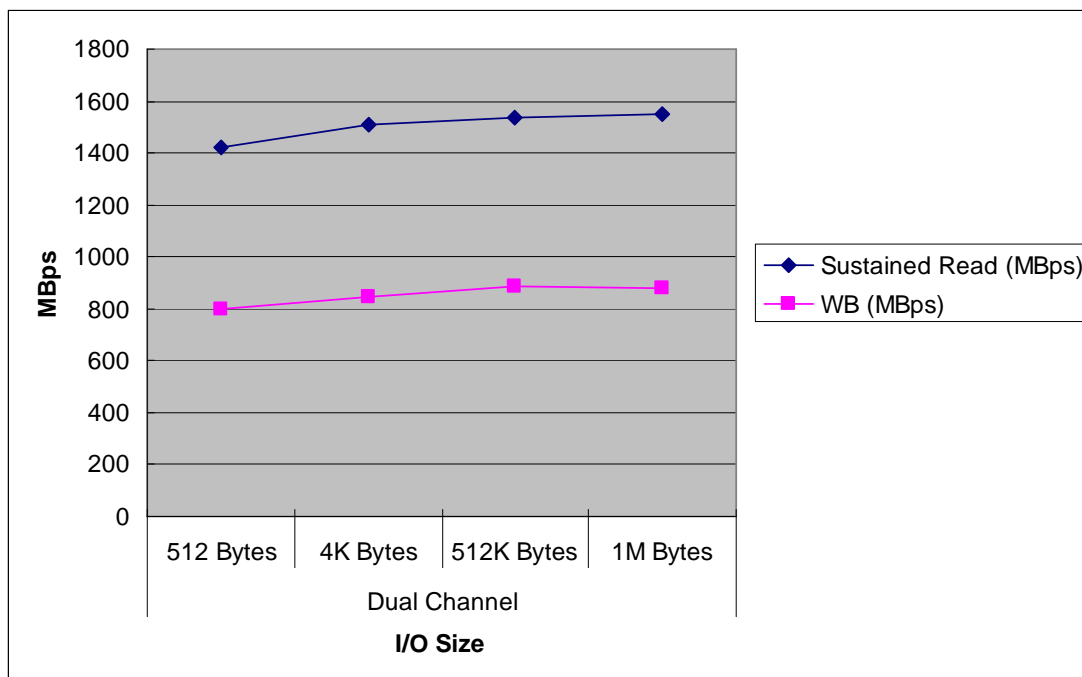
2.3 Degraded RAID 5 Performance

2.3.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

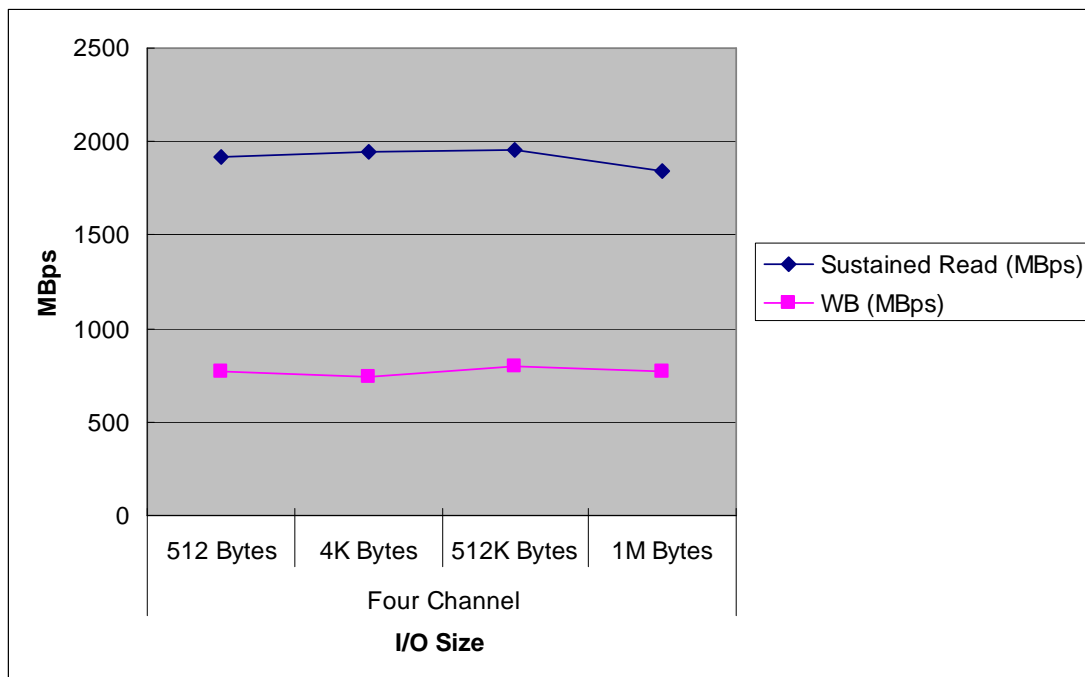
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1423.68	796.94
	256K Bytes	1508.16	846.35
	512K Bytes	1537.69	888.49
	1M Bytes	1546.93	882.63



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1914.76	773.84
	256K Bytes	1949.36	738.61
	512K Bytes	1951.03	802.34
	1M Bytes	1844.69	767.31



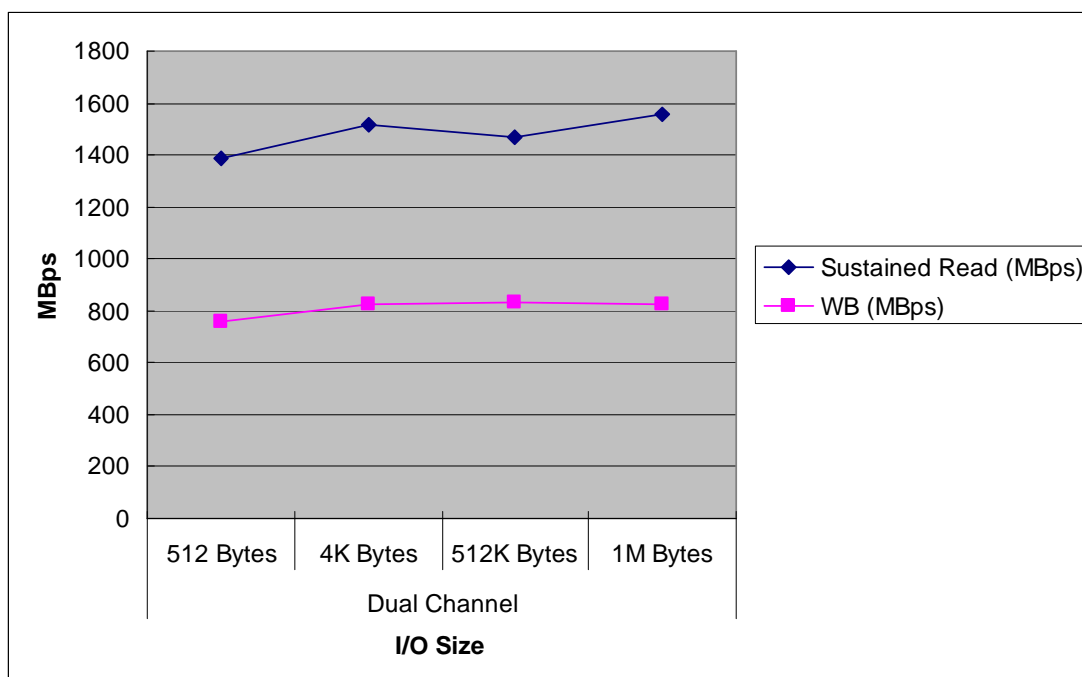
2.4 Degraded RAID 6 Performance

2.41 Sequential I/O – 1 Drive Failed

>> Dual Channel

Data Transfer Rate (MBps)

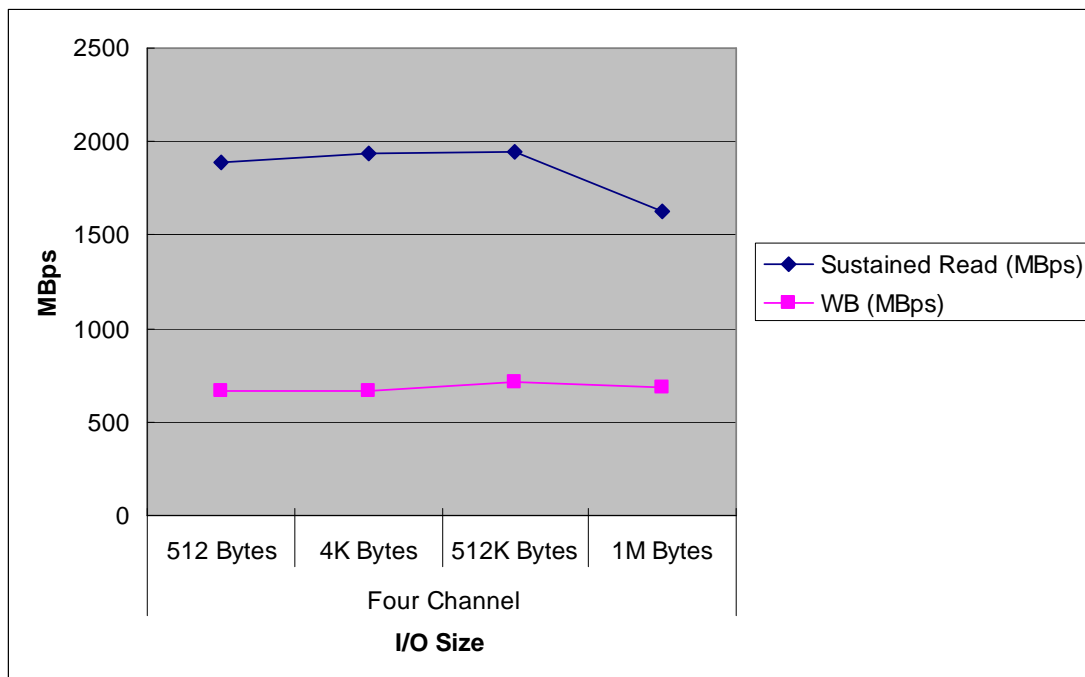
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1388.25	758.34
	256K Bytes	1512.88	825.05
	512K Bytes	1469.71	831.41
	1M Bytes	1553.84	823.07



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1889.55	668.09
	256K Bytes	1934.11	668.85
	512K Bytes	1945.41	711.81
	1M Bytes	1623.62	686.98

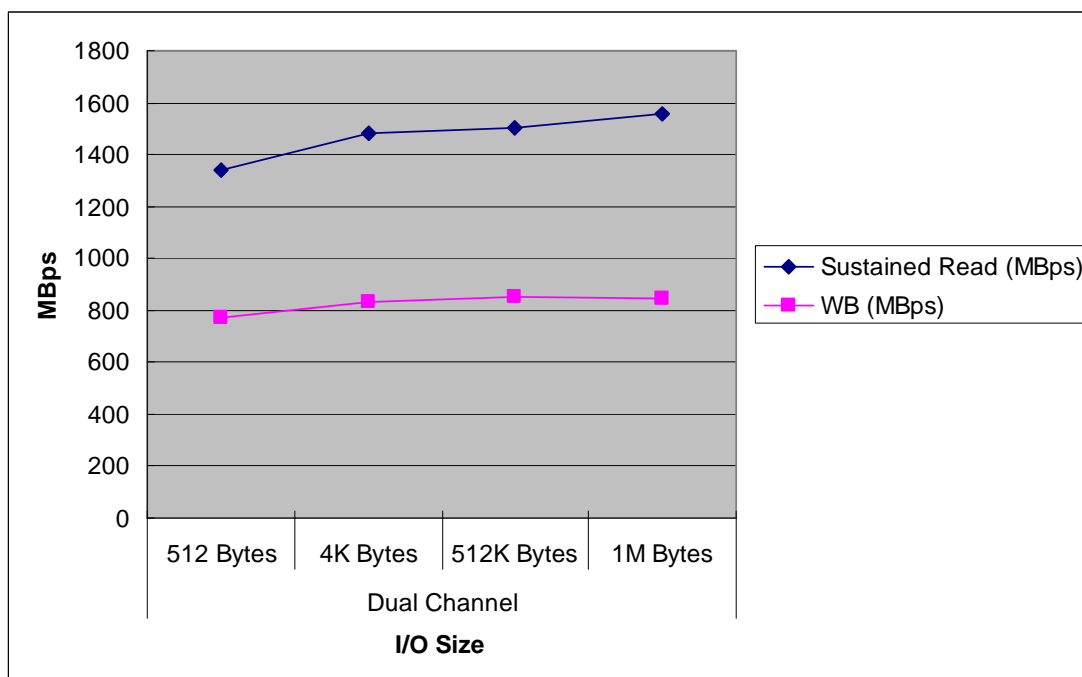


2.42 Sequential I/O – 2 Drives Failed

>> Dual Channel

Data Transfer Rate (MBps)

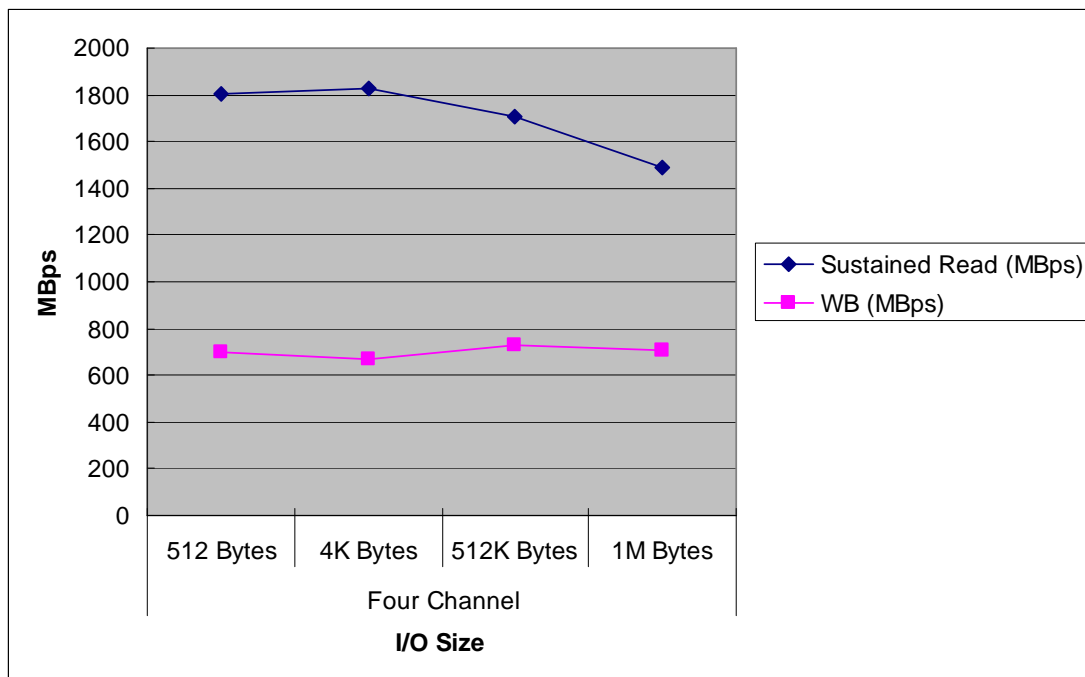
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1337.85	768.46
	256K Bytes	1484.25	831.98
	512K Bytes	1502.63	849.28
	1M Bytes	1554.66	844.93



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1806.18	699.41
	256K Bytes	1826.03	665.81
	512K Bytes	1704.44	728.33
	1M Bytes	1485.81	705.41



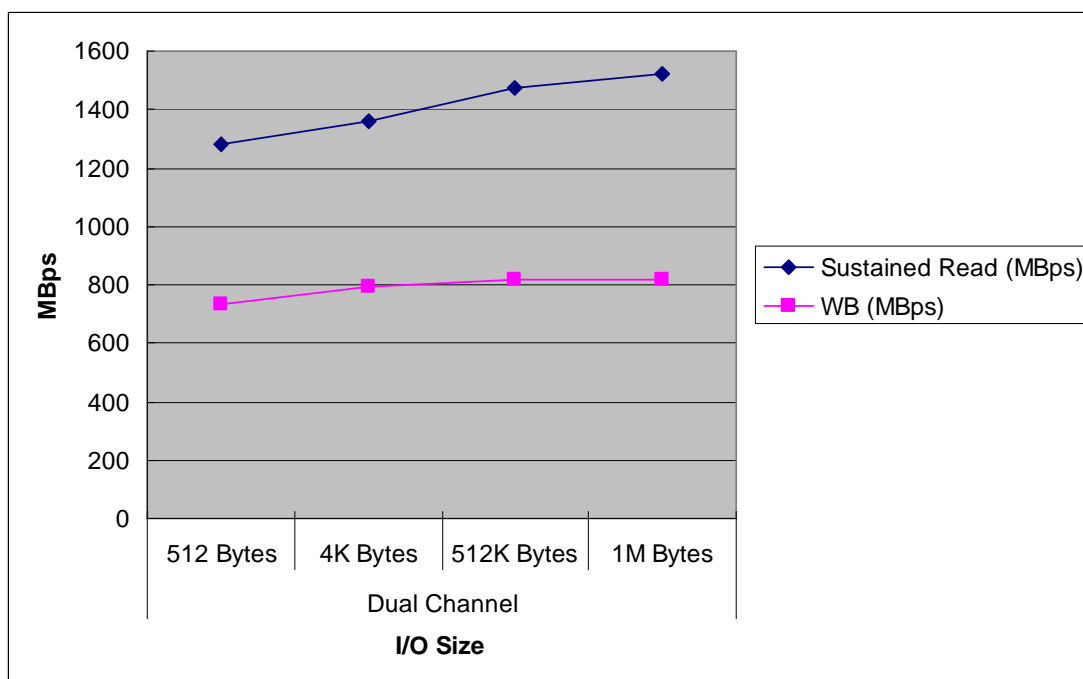
2.5 Rebuilding RAID 5 Performance

2.5.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

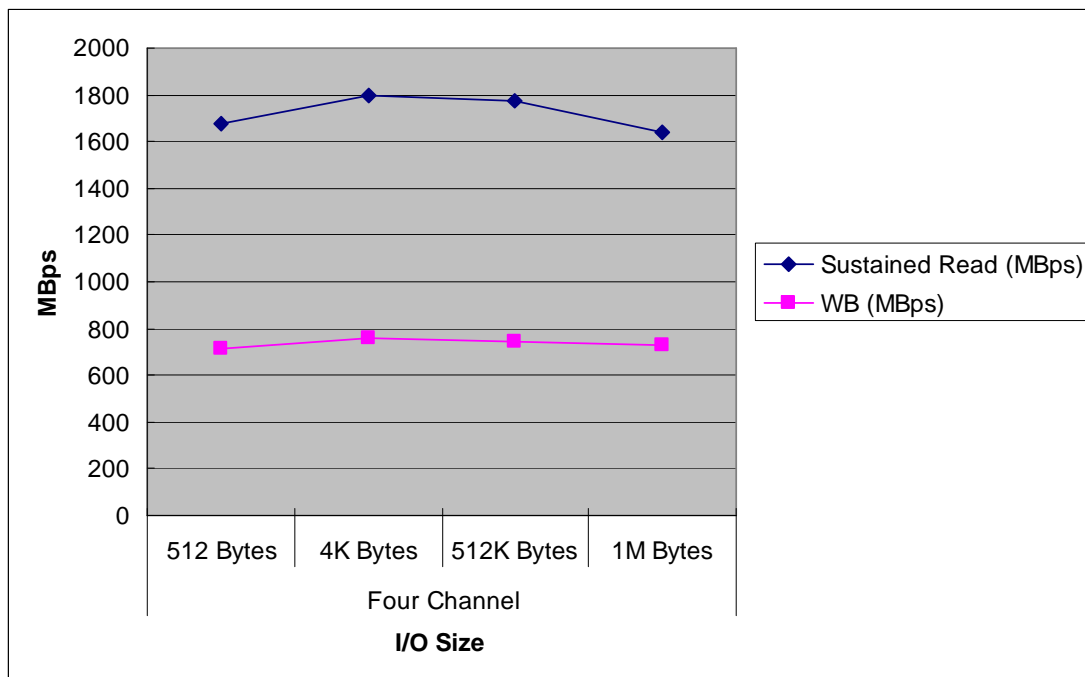
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1278.91	733.77
	256K Bytes	1360.62	793.68
	512K Bytes	1471.90	818.80
	1M Bytes	1520.59	816.93



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1679.03	717.64
	256K Bytes	1793.30	759.73
	512K Bytes	1773.57	745.36
	1M Bytes	1635.73	727.57



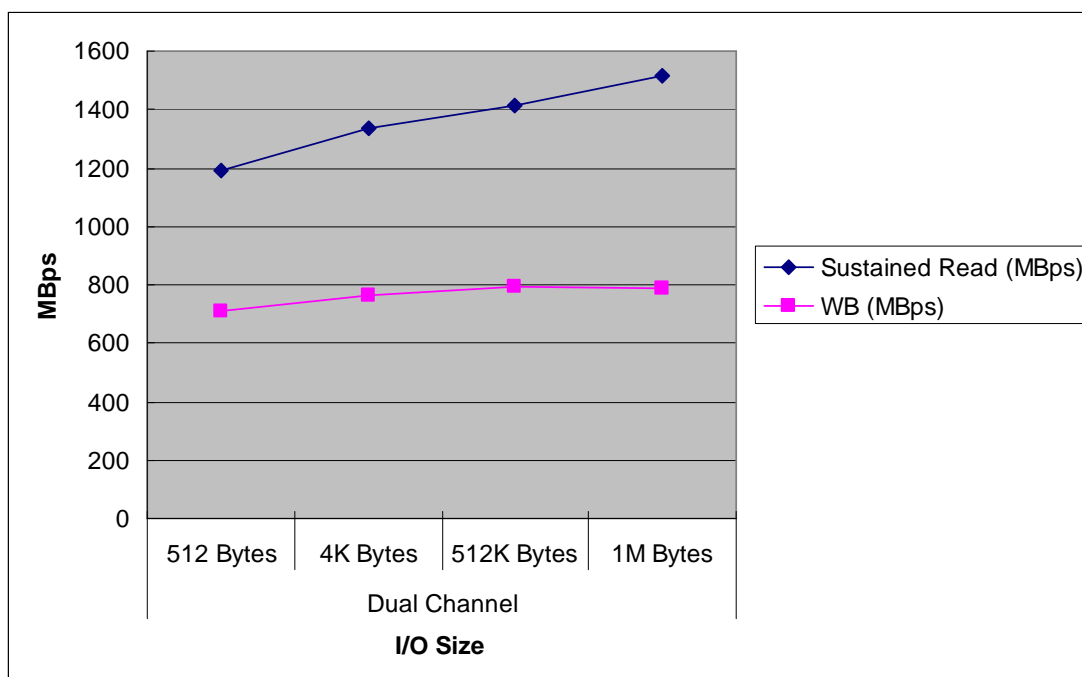
2.6 Rebuilding RAID 6 Performance

2.6.1 Sequential I/O – 2 Drives Rebuilding

>> Dual Channel

Data Transfer Rate (MBps)

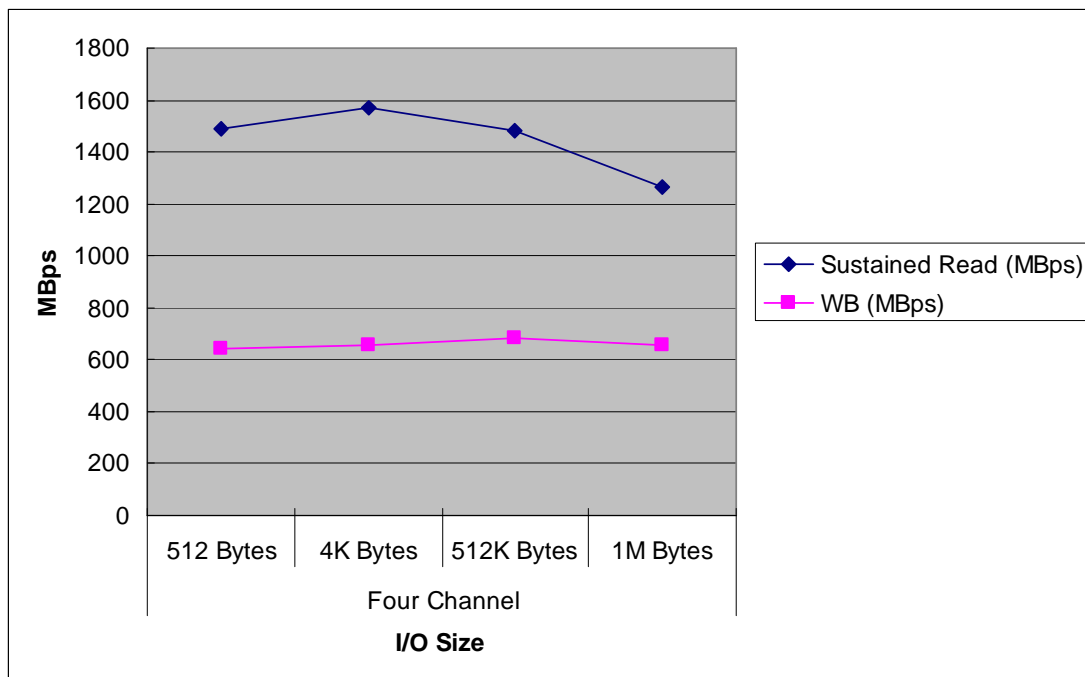
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1188.10	710.51
	256K Bytes	1332.70	766.39
	512K Bytes	1415.12	794.19
	1M Bytes	1517.11	786.61



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	1489.85	645.72
	256K Bytes	1568.98	658.97
	512K Bytes	1483.02	686.61
	1M Bytes	1268.34	659.43



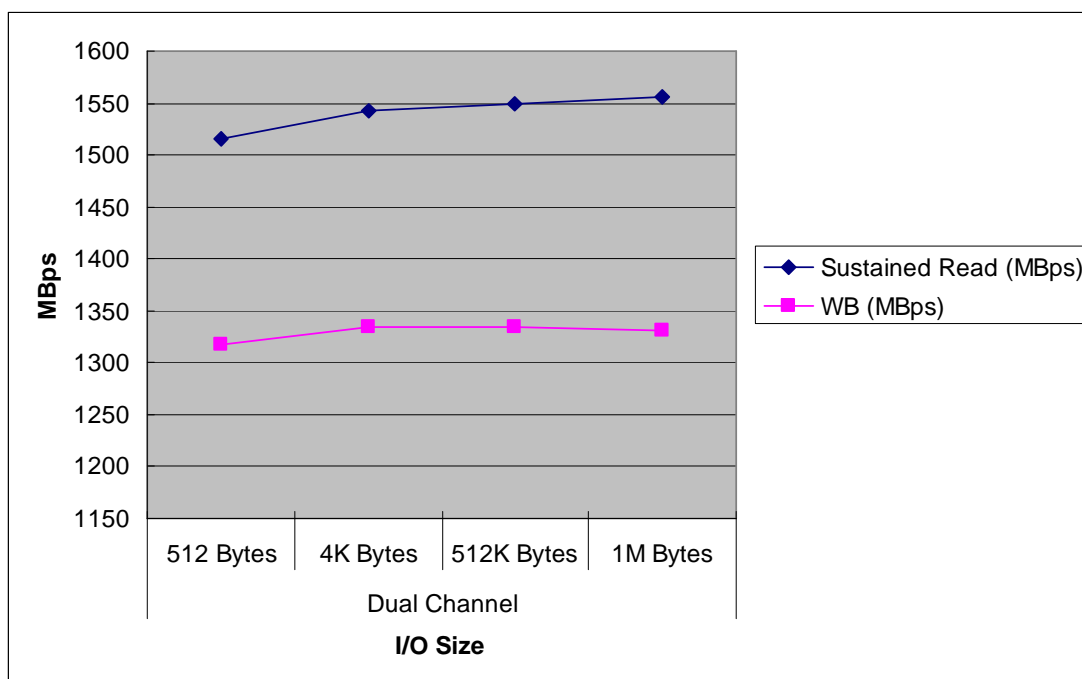
2.7 All Cache Hit RAID 5 Performance

2.7.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

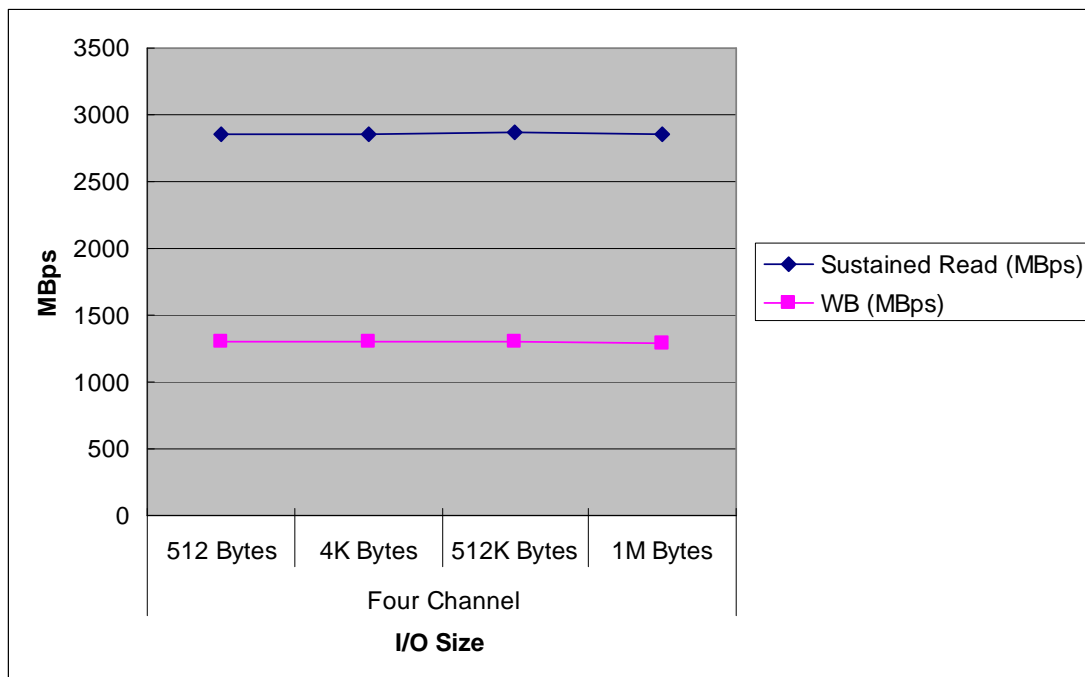
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1515.35	1317.26
	256K Bytes	1543.16	1333.79
	512K Bytes	1548.92	1335.17
	1M Bytes	1555.60	1330.43



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	2854.59	1304.44
	256K Bytes	2851.43	1304.64
	512K Bytes	2864.15	1303.78
	1M Bytes	2858.36	1293.72



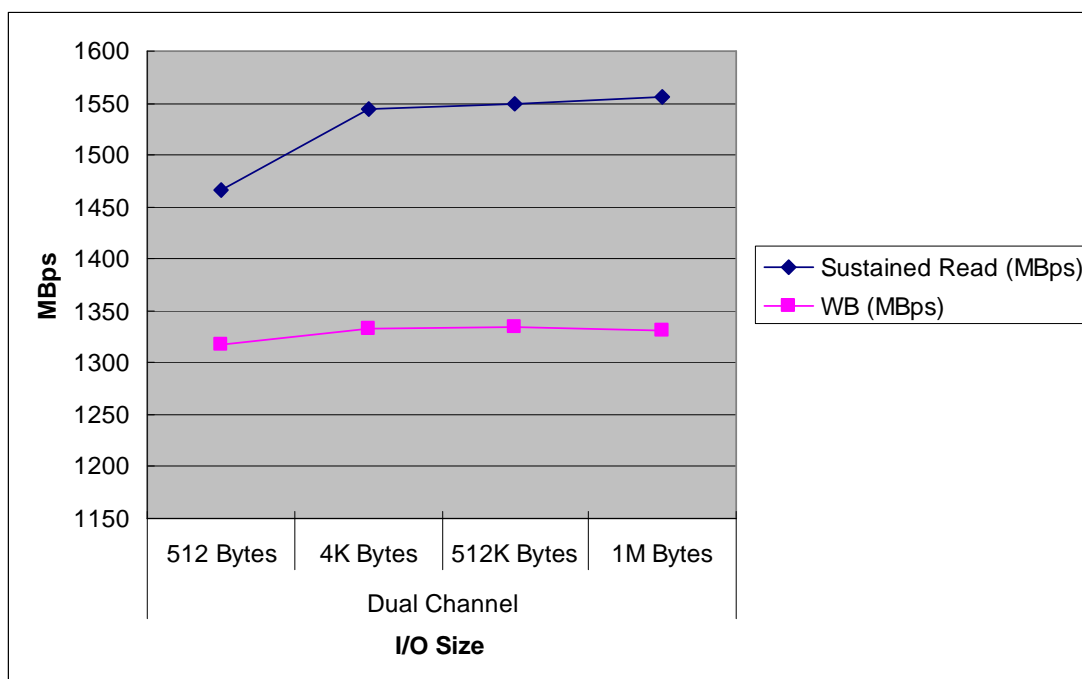
2.8 All Cache Hit RAID 6 Performance

2.8.1 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

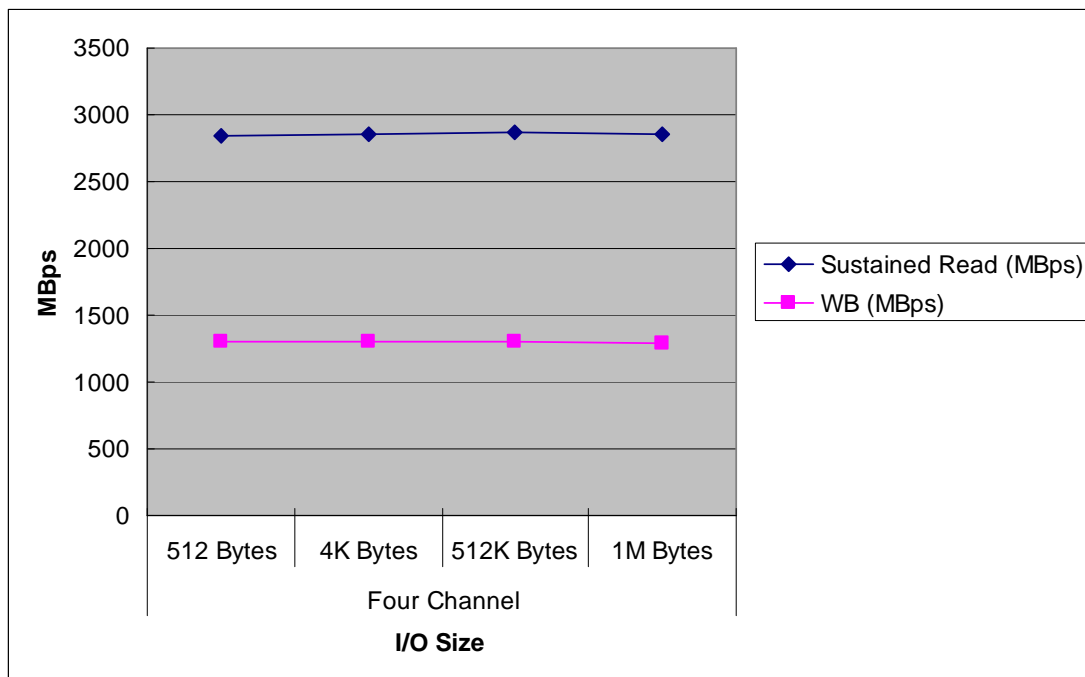
I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Dual Channel	128K Bytes	1466.55	1317.20
	256K Bytes	1543.91	1332.60
	512K Bytes	1549.19	1334.86
	1M Bytes	1555.57	1330.18



>> Four Channel

Data Transfer Rate (MBps)

I/O Parameters		Read (MB/sec)	WB (MB/sec)
Host Channels	I/O Size		
Four Channel	128K Bytes	2840.11	1304.26
	256K Bytes	2852.80	1304.14
	512K Bytes	2862.21	1303.43
	1M Bytes	2858.61	1293.61



3. Performance Test Results with Data Service enable

3.1 Snapshot Copy-on-Write End-to-End RAID 5

Performance

3.11 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	1M Bytes	723.04	723.04	262.64	262.64

3.12 Random I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	8k Bytes	1975.92	15.44	533.18	4.17

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
Dual Channel	8K Bytes	845.52		6.61	

3.2 Split Mirror End-to-End RAID 5 Performance (Source to 1 Target)

3.2.1 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	779.06	779.06	229.23	229.23

3.2.2 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3800.56	29.69	1349.57	10.54

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	2462.83		19.24	

3.3 Split Mirror End-to-End RAID 5 Performance (Source to 2 Targets)

3.31 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	779.04	779.04	143.42	143.42

3.32 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3725.90	29.11	882.10	6.89

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	1815.17		14.18	

3.4 Snapshot Copy-on-Write End-to-End RAID 6

Performance

3.41 Sequential I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	1M Bytes	710.82	710.82	254.26	254.26

3.42 Random I/O

>> Dual Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
Dual Channel	8k Bytes	1972.00	15.41	512.00	4.00

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
Dual Channel	8K Bytes	816.68		6.38	

3.5 Split Mirror End-to-End RAID 6 Performance (Source to 1 Target)

3.51 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	769.38	769.38	229.57	229.57

3.52 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3777.49	29.51	1131.64	8.84

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	2168.75		16.94	

3.6 Split Mirror End-to-End RAID 6 Performance (Source to 2 Targets)

3.6.1 Sequential I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	1M Bytes	778.30	778.30	140.41	140.41

3.6.2 Random I/O

>> One Channel

Data Transfer Rate (MBps)

I/O Parameters		Read		WB	
Host Channels	I/O Size	IOPS	MB/sec	IOPS	MB/sec
One Channel	8k Bytes	3755.80	29.34	747.48	5.84

I/O Parameters		OLTP : 60 % Read / 40 % Write			
Host Channels	I/O Size	IOPS		MB/sec	
One Channel	8K Bytes	1576.69		12.32	

3.7 Volume Copy / Virtual Volume Size 100GB / Data Size 10GB

Subsystem	1 Raid
Parameters	1 Source to 1 Target
Finish Time	1 hr. 1 min.