

D-Link System, Inc.™ xStack Storage DSN-Series SAN Arrays Performance Test with Intel 32GB Solid State Drives

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### **Overview**

The xStack Storage product line (DSN-1100/2100/3200/3400) uses a high-speed RISC processor allowing full line speeds to be maintained for each of their respective host network interfaces.

The purpose of this set of tests is to determine the full speed supported by a single volume created on a RAID-0 volume spanning four standard spindle-based hard drives vs. the same test scenario with four Intel X25-E solid state hard drives.

An Apple X Serve server is directly attached to a DSN-1100 by means of an iSCSI connection comprised of four trunked 1GbE Ethernet connections, and the test results observed. The theoretical maximum raw speed should be approximately 425 MB/s, but the test software will drop this figure to a lower level due to overhead of test data transfer. The testing software used is AJA Video Systems - System Test-Video Frame Sweep.

Tests were conducted with four drives configured as a single RAID-0 stripe for maximum speed.

## Performance for each Drive Type

- Intel X25-E 32GB SATA Solid State Drive

Maximum Sustained Read and Write Bandwidth Access Type MB/s Sequential Read up to 250 Sequential Write up to 170

- Hitachi 160GB DeskStar HDD

Sustained data rate 32.9 to 67.8 MB/s



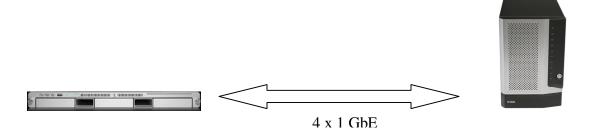
## **Testing Environment**

iSCSI Initiator

-Studio Network Solutions globalSAN iSCSI Initiator

Benchmarking Tool

- AJA System Test – Video Frame Sweep



Machine: Apple X Serve

Operating System: Apple OSX 10.5.7

Processor: Quad-Core Intel(R) Xeon(TM) "Nehalem" CPU 2.66GHz

Memory: 3,096 MB RAM (1066 MHz DDR3) Two (2) built-in Broadcom 1GbE ports

Intel Pro 1000 MT Dual Port 1GbE Server adapter

D-Link DSN-1100 with firmware 2.6.0.23

4 x 1GbE ports

RAID-O Stripe Over Four Drives Single Volume

Test drives #1:

160GB Hitachi DeskStar HDD (x 4)

Part # T7K250

Test drives #2:

32GB Intel X25-E 32GB SATA Solid State Drive (x 4)

Part # SSDSA2SH032G1

Figure 1



# **Testing Results**

160GB Hitacl	ni Deskstar HDDs	32GB Intel X	25-E SATA SSDs
128MB payload		128MB payload	
Frame Size	Sweep	Frame Size	Sweep
KB	MB/sec	KB	MB/sec
KD	Read Write	KD	Read Write
684.0	89.0 100.8	684.0	185.7 139.5
812.0	104.1 101.8 <u>/</u>	812.0	229.6 119.1
912.0	98.4 100.1	912.0	263.5 119.8
1080.0	100.9 97.0	1080.0	279.6 126.6
1800.0	102.3 101.0	1800.0	279.0 120.0 279.1 125.2
2400.0 4052.0	101.6 99.2 102.5 102.1	2400.0 4052.0	334.2 143.8
			330.8 126.3
5400.0	102.5 75.2	5400.0	364.7 132.3
8100.0	98.4 75.8	8100.0	370.3 129.8
256MB payload		256MB payload	
Frame Size	Sweep	Frame Size	Sweep
KB	MB/sec	KB	MB/sec
	Read Write		Read Write
684.0	135.6 132.3	684.0	173.1 139.5
812.0	154.5 114.3	812.0	222.7 121.1
912.0	172.7 111.9	912.0	273.3 119.5
1080.0	190.7 122.6	1080.0	276.6 130.7
1800.0	177.9 115.1	1800.0	293.2 124.2
2400.0	138.7 132.9	2400.0	296.7 141.3
4052.0	222.9 111.6	4052.0	362.6 128.9
5400.0	166.9 124.0	5400.0	230.8 133.5
8100.0	231.1 119.5	8100.0	360.8 130.3
0100.0	231.1 119.3	0100.0	300.0 130.3
512MB payload	_	512MB payload	
Frame Size	Sweep	Frame Size	Sweep
	MB/sec		MB/sec
Frame Size KB	MB/sec Read Write	Frame Size KB	MB/sec Read Write
Frame Size KB 684.0	MB/sec Read Write 132.2 132.0	Frame Size KB 684.0	MB/sec Read Write 184.5 139.2
Frame Size KB 684.0 812.0	MB/sec Read Write 132.2 132.0 149.4 114.6	Frame Size KB 684.0 812.0	MB/sec Read Write 184.5 139.2 213.2 121.2
Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9	Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2
Frame Size KB 684.0 812.0	MB/sec Read Write 132.2 132.0 149.4 114.6	Frame Size KB 684.0 812.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2
Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9	Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2
Frame Size KB 684.0 812.0 912.0 1080.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2	Frame Size KB 684.0 812.0 912.0 1080.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0	MB/sec  Read Write  132.2 132.0  149.4 114.6  187.8 113.9  187.6 122.2  174.3 115.5  234.3 133.4	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0	MB/sec  Read Write  132.2 132.0  149.4 114.6  187.8 113.9  187.6 122.2  174.3 115.5  234.3 133.4  234.7 119.6	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 1,024MB payload Frame Size	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  B Sweep MB/sec
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 1,024MB payload Frame Size KB	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  Sweep MB/sec Read Write
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 1,024MB payload Frame Size KB	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write 136.9 132.1	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  B Sweep MB/sec Read Write 182.0 138.0
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 1,024MB payload Frame Size KB	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB 684.0 812.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  B Sweep MB/sec Read Write 182.0 138.0 211.4 122.1
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 1,024MB payload Frame Size KB	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8 189.3 112.9	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  MB/sec Read Write 182.0 138.0 211.4 122.1 242.9 120.4
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 1,024MB payload Frame Size KB	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB 684.0 812.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  B Sweep MB/sec Read Write 182.0 138.0 211.4 122.1
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8 189.3 112.9	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0 <b>1,024MB payload</b> Frame Size KB 684.0 812.0 912.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  MB/sec Read Write 182.0 138.0 211.4 122.1 242.9 120.4
Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2  I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8 189.3 112.9 200.5 122.8	Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  MB/sec Read Write 182.0 138.0 211.4 122.1 242.9 120.4 271.6 131.4
Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0 1800.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2   I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8 189.3 112.9 200.5 122.8 178.1 116.5 226.4 132.5	Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0 1800.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9   Sweep MB/sec Read Write 182.0 138.0 211.4 122.1 242.9 120.4 271.6 131.4 281.3 125.1 333.4 143.2
Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2   I  Sweep MB/sec Read Write 136.9 132.1 153.5 114.8 189.3 112.9 200.5 122.8 178.1 116.5 226.4 132.5 237.3 118.7	Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  MB/sec Read Write 182.0 138.0 211.4 122.1 242.9 120.4 271.6 131.4 281.3 125.1 333.4 143.2 346.2 130.0
Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0	MB/sec Read Write 132.2 132.0 149.4 114.6 187.8 113.9 187.6 122.2 174.3 115.5 234.3 133.4 234.7 119.6 217.8 123.2 248.0 120.2   I Sweep MB/sec Read Write 136.9 132.1 153.5 114.8 189.3 112.9 200.5 122.8 178.1 116.5 226.4 132.5	Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0 5400.0 8100.0  1,024MB payload Frame Size KB  684.0 812.0 912.0 1080.0 1800.0 2400.0 4052.0	MB/sec Read Write 184.5 139.2 213.2 121.2 241.2 120.2 272.6 132.2 264.9 125.3 300.8 141.4 351.6 129.3 338.7 134.1 312.8 128.9  MB/sec Read Write 182.0 138.0 211.4 122.1 242.9 120.4 271.6 131.4 281.3 125.1 333.4 143.2

### 160GB Hitachi Deskstar HDDs

#### 32GB Intel X25-E SATA SSDs

2,048MB payload		2,048MB payload		
Frame Size	Sweep	Frame Size	Sweep	
KB	MB/sec	KB	MB/sec	
	Read Write			
684.0	135.9 130.2	684.0	185.0	139.0
812.0	152.6 114.9	812.0	217.3	121.7
912.0	180.6 113.6	912.0	255.4	121.0
1080.0	187.9 123.1	1080.0	264.1	131.7
1800.0	187.2 115.8	1800.0	283.4	124.7
2400.0	227.5 132.1	2400.0	337.0	143.2
4052.0	228.7 119.5	4052.0	350.4	130.2
5400.0	223.8 123.6	5400.0	343.8	135.1
8100.0	220.2 118.8	8100.0	343.5	130.5
4,096MB payloa	d	4,096MB payload		
<b>4,096MB payloa</b> Frame Size	<b>d</b> Sweep	<b>4,096MB payload</b> Frame Size	Sweep	
Frame Size	Sweep	Frame Size	Sweep	Write
Frame Size	Sweep MB/sec	Frame Size	Sweep MB/sec	Write 138.8
Frame Size KB	Sweep MB/sec Read Write	Frame Size KB	Sweep MB/sec Read	
Frame Size KB 684.0	Sweep MB/sec Read Write 137.8 124.0	Frame Size KB 684.0	Sweep MB/sec Read 186.1	138.8
Frame Size KB 684.0 812.0	Sweep MB/sec Read Write 137.8 124.0 153.4 114.1	Frame Size KB 684.0 812.0	Sweep MB/sec Read 186.1 215.9	138.8 121.6
Frame Size KB 684.0 812.0 912.0	Sweep MB/sec Read Write 137.8 124.0 153.4 114.1 190.7 113.6	Frame Size KB 684.0 812.0 912.0	Sweep MB/sec Read 186.1 215.9 251.6	138.8 121.6 120.9
Frame Size KB 684.0 812.0 912.0 1080.0	Sweep MB/sec Read Write 137.8 124.0 153.4 114.1 190.7 113.6 184.6 119.5	Frame Size KB 684.0 812.0 912.0 1080.0	Sweep MB/sec Read 186.1 215.9 251.6 271.3	138.8 121.6 120.9 131.1
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0	Sweep MB/sec Read Write 137.8 124.0 153.4 114.1 190.7 113.6 184.6 119.5 187.5 114.5	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0	Sweep MB/sec Read 186.1 215.9 251.6 271.3 284.6	138.8 121.6 120.9 131.1 125.2
Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0	Sweep MB/sec Read Write 137.8 124.0 153.4 114.1 190.7 113.6 184.6 119.5 187.5 114.5 227.6 128.2	Frame Size KB 684.0 812.0 912.0 1080.0 1800.0 2400.0	Sweep MB/sec Read 186.1 215.9 251.6 271.3 284.6 336.0	138.8 121.6 120.9 131.1 125.2 142.6



## **AJA-System Test: Video Video Frame Sweep**

**Abstract:** this is a series of Disk Read/Write tests that automatically tests with each of the available video frame sizes. The results are shown in graphical form and as a text table.

- -Payload FileSize: the total amount of data that will be written and read in each test. Larger file sizes will make the test(s) longer, but in some cases may more accurately show true disk performance when a drive has its own hardware cache.
- -Video Frame Size: the amount of data that will be written or read in each I/O transaction. The list contains most of the standard broadcast video frame sizes and formats.