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Open-E NAS Enterprise and Microsoft Windows Storage Server 2003 competitive performance comparison

White Paper 2006

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Abstract

This white paper compares two NAS operating systems and examines their performance. The term Network Attached Storage (NAS) may refer to any storage system that is directly attached to a network infrastructure and not directly connected to a server. The word "storage"in this case refers to a system that provides data storage and allows data to be backed up and organised. All these tasks require the provision of data at high speeds. The speed at which the data is made available is measured in data throughput and latency. In general, a good NAS system will be characterised by a high throughput and a low latency.

Key findings

- The Open-E NAS Enterprise delivered up to 100% better data throughput compared to Microsoft Windows Storage Server by varying block size.
- The Open-E NAS Enterprise achieved 47% better results overall in tests with variable block sizes.
- The Open-E NAS Enterprise delivered up to 20% better data throughput compared to Microsoft Windows Storage Server by varying number of clients.
- The response times of the Open-E NAS Enterprise are up to 78% better compared to the Windows Storage Server 2003.

Testing Methodology

- The following operating systems were tested on performance:
  - Open-E NAS Enterprise
  - Microsoft Windows Storage Server 2003
- The tests with variable block sizes were based on the following hardware components:
  2.8 GHz Intel Xeon server with 1 GB DDR RAM, Intel RAID controller and Intel Pro1000 network card
- The tests with variable numbers of clients were performed using the following hardware:
  3.0 GHz Intel Xeon server with 1 GB DDR RAM, 3Ware RAID controller and two Intel Pro/1000 network cards
- A detailed list of the hardware used in this test can be found at the end of this document in Appendixes A1 and A2.

Testing Methodology

Measuring data throughput by varying block size

- The performance tests with variable block sizes were recorded using the Iometer tool, version 2004.07.30. Block sizes of 512 bytes, 1 KB, 2 KB, 4 KB, 8 KB, 16 KB, 32 KB, 64 KB, 128 KB, 256 KB, 512 KB, 1 MB, 2 MB, 4 MB, 8 MB, 16 MB, 32 MB and 63 MB were used for the tests. Each block size was measured over a period of 30 seconds. The number of I/O operations per second and the throughput in MB for various scenarios were determined for the evaluation. Specifically, sequential read and write, random read and write and a mixed mode of sequential and random read and write were measured. Detailed performance data is in Appendix B1.

Measuring data throughput and latency by varying number of clients

- The tests with variable numbers of clients were based on the performance data recorded by Ziff Davis Media NetBench 7.03. This program determines the performance with which a file server processes file requests from clients. Its main load is on the storage subsystem; it is almost entirely memory-independent. This benchmark tool allows a server to be accessed with a variable number of clients. The benchmark test was first performed with a single client. In the course of the test, the number of clients was gradually increased to 4, 8, 12, 16, 20, 24, 28, 32 and 36 clients. The throughput rate in KB per second and the latency in milliseconds were measured for the respective servers to determine the results. The performance data for variable client numbers can be found in Appendix B2.

Test results Open-E NAS Enterprise vs. Microsoft WSS2003

Data throughput by varying block sizes

- To compare the Open-E NAS Enterprise and the Microsoft Windows Storage Server 2003, we calculated the percentage relationship between the measured values from the individual test series. Measured values above the 100% axis represent performance advantages for the Open-E NAS Enterprise, the values below it represent advantages for the Microsoft Windows Storage Server 2003 (see Figure 1).

In %	Sequential read	Sequential write	Random read	Random write	Mixed
Minimum	69.75	124.95	42.30	120.74	78.53
Maximum	123.97	625.62	129.23	294.80	230.55
Average	92.93	210.16	97.88	193.14	143.31

Table 1: Percentage relationship of throughput values

- In this competitive comparison, the Open-E NAS Enterprise performs better than the Microsoft Windows Storage Server 2003 in sequential writes (purple) and random writes (blue). This is demonstrated by the minimum percentage values of 124.95% and 120.74%. The average throughput for random write (blue) is 93.14% higher than that of the Microsoft Windows Storage Server 2003. For sequential write a 110.16% higher value is achieved.

- In addition, with the exception of two measured values the results in mixed mode (red) are in favour of the Open-E NAS Enterprise. Overall, the measured values of the Open-E NAS Enterprise are 43.31% above those of the Microsoft Windows Storage Server 2003. Figure 1 shows that the Open-E NAS Enterprise performs well with large block sizes in all test series.

- Slight advantages for the Microsoft Windows Storage Server 2003 were found only for sequential read (dark grey) and random read (green). Compared to previous test series, these advantages are lower than the advantages of the Open-E NAS Enterprise. The Microsoft Windows Storage Server 2003 achieves its best results for sequential read (dark grey). The average value calculated here is 92.93%, and thus 7.07% above the values of its counterpart. The percentage difference to the Open-E NAS Enterprise is greatest for random read (green), as the minimum of 42.30% shows. Overall, the Microsoft Windows Storage Server 2003 owes this advantage to better throughput rates in the range of block sizes between 16 KB and 1 MB in the two previously mentioned test series. At larger block sizes, the Open-E NAS Enterprise achieves better values again.

Conclusion

- If these results are considered as a whole, it becomes clear that the Open-E NAS Enterprise works better with variable block sizes than the Microsoft Windows Storage Server 2003. The average of all test series shows that the Open-E NAS Enterprise has 47.48% better throughput values than the Microsoft Windows Storage Server 2003. The same also applies for the number of I/O operations, which is inverse to throughput. In writing, the Open-E NAS Enterprise delivers a 100% better throughput. The measured values for read are similar to those of the Microsoft Windows Storage Server 2003.

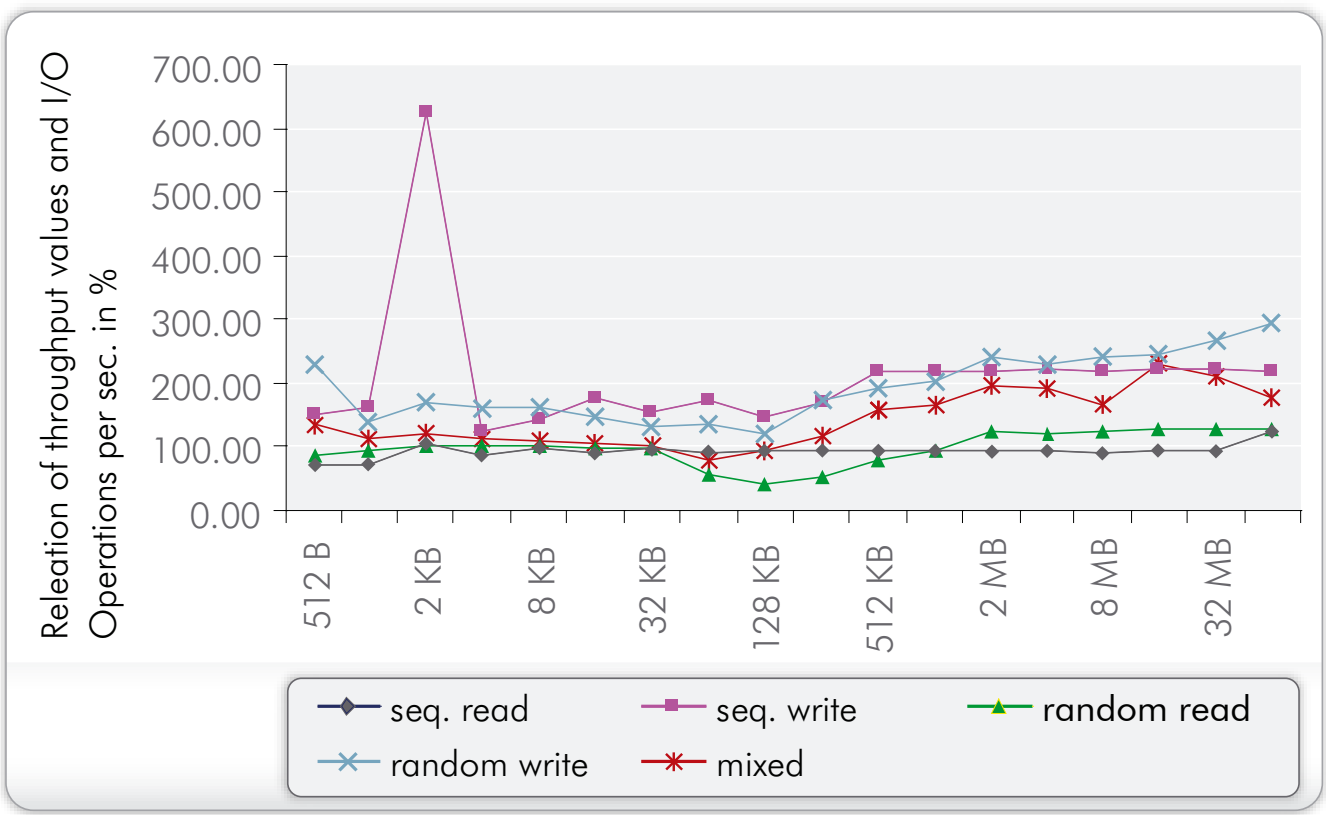

Figure 1: Relation of throughput values and I/O operations per second in %

Data throughput by varying number of clients

- The throughput of the Open-E NAS Enterprise and WSS2003 based on a variable number of clients was measured in another, independent test series. The measured values show that the Open-E NAS Enterprise delivers significantly better throughput values under the same test conditions than the Microsoft Windows Storage Server. Regarding the throughput values for a small number of clients (up to 12 clients), the throughput values of the Open-E NAS Enterprise are up to 7% higher than the values of the Microsoft Windows Storage Server 2003. If the number of clients increases further, as is common in normal network environments and corresponds to high utilization, the Open-E NAS Enterprise achieves up to 20% better throughput values. The maximum throughput for the Open-E NAS Enterprise is 133,884 KB per second with 32 clients accessing the server simultaneously. At 112,032 KB per second, the throughput values for the Microsoft Windows Storage Server 2003 for the same number of clients are significantly lower.

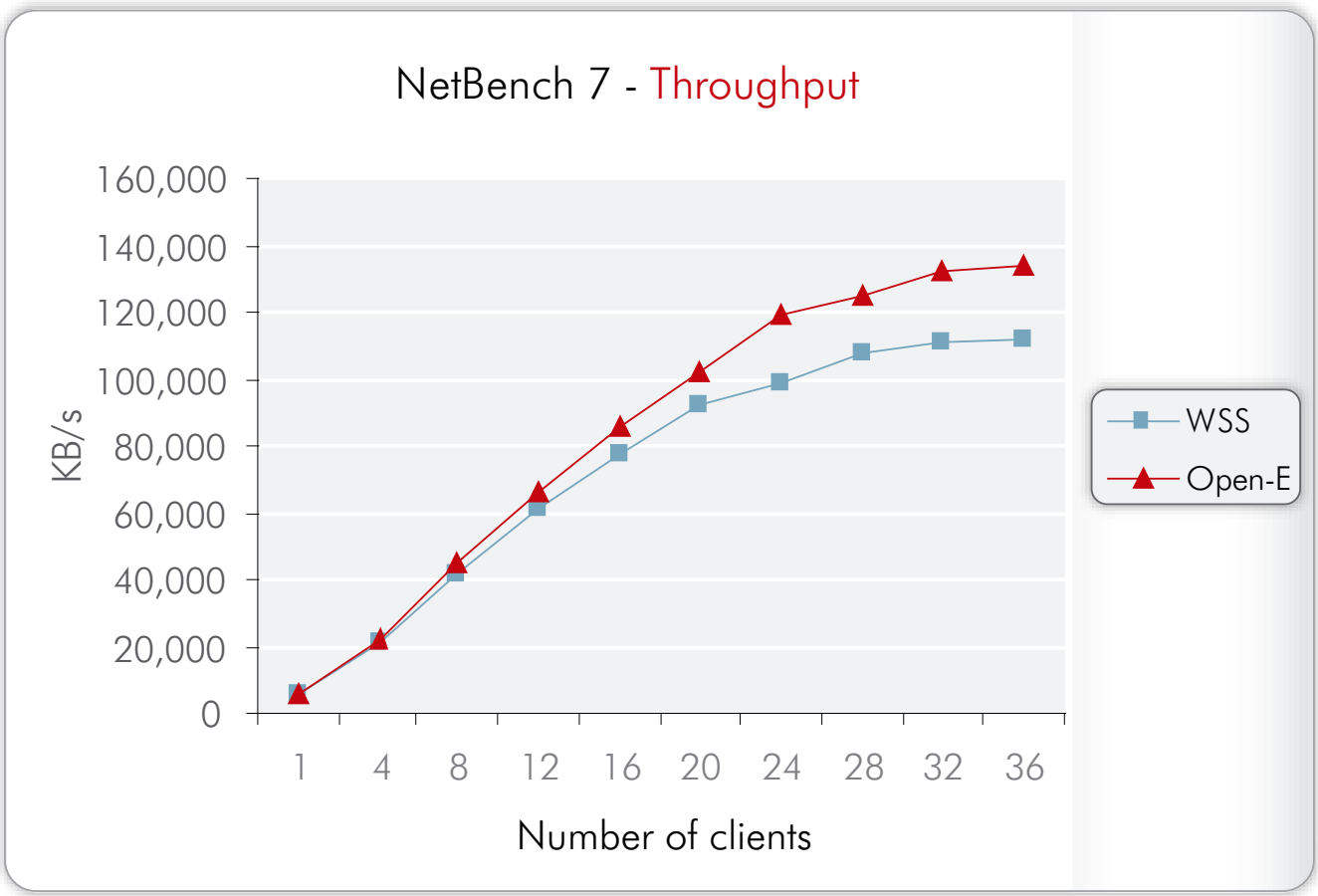

Figure 2: Throughput at variable client numbers

Latency by varying number of clients

The latency values for the Open-E NAS Enterprise and the Microsoft Windows Storage Server 2003 are also based on tests with a variable number of clients. Over the entire measurement series, the latency of the Microsoft Windows Storage Server 2003 was always higher than that of the Open-E NAS Enterprise. On average, the Open-E NAS Enterprise is able to handle client requests up to 50% faster. At a maximum, the Open-E NAS Enterprise responds to requests up to 78% faster than its Microsoft counterpart. Especially at increasing client numbers the advantages are very clearly in favour of the Open-E NAS Enterprise. Even at the maximum of 36 clients the latency of the Open-E NAS Enterprise does not exceed the two-second mark. The latency of the Microsoft Windows Storage Server 2003 at that number of clients is almost at the three-second mark.

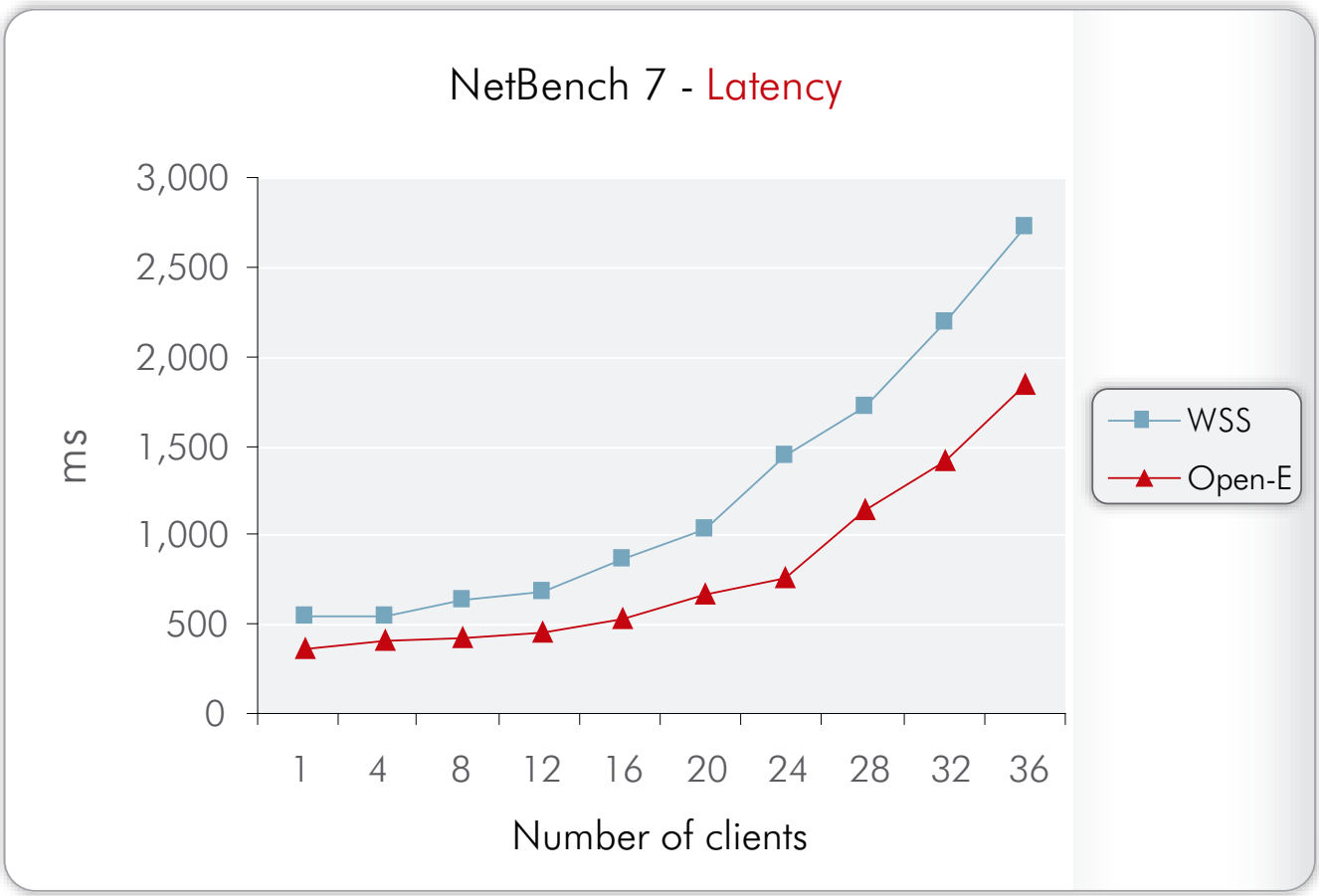

Figure 3: Latency at variable client numbers

Appendix A1

Test environment for variable block sizes

- The tests were performed in separate test environments. This ensures that measured values are not affected by other variables, such as a network load arising from necessary tasks. The schematic design of the test environment can be seen in Fig. 4. The server and the test client are connected by gigabit Ethernet. The coupling element is an 8-port gigabit switch (DGS-1008D) from D-Link.

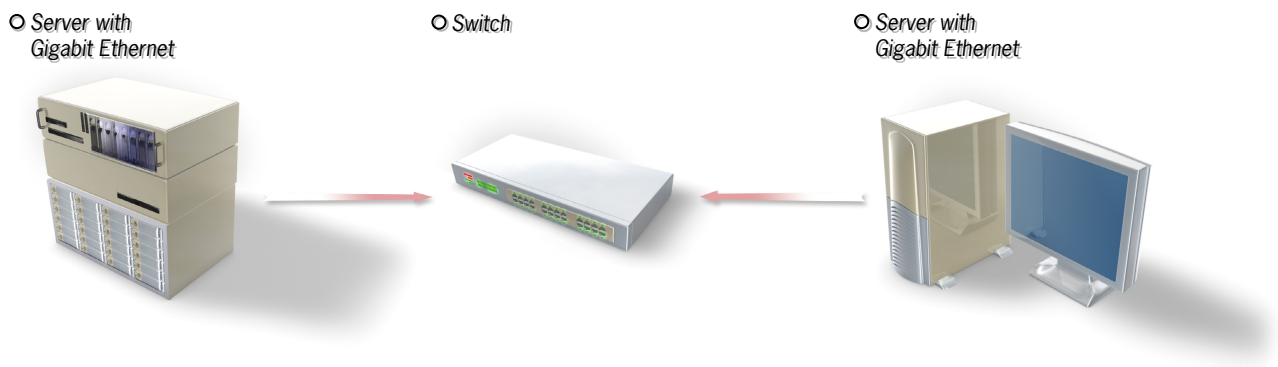

Figure 4: Test environment for variable block sizes

- The performance tests with the Iometer program were measured on an Intel Pentium 4, 2.4 GHz, Windows XP Professional client. Table 2 provides an overview of the technical specifications of the client PC.

- All tests were performed on connected network drives with a size of 20 GB to ensure better and consistent comparability.

Appendix A1

Test environment for variable block sizes

CPU	1 x INTEL CPU XEON 2,8GHZ MPGA FSB800
Motherboard	INTEL server board SE7520BD2 with VGA, gigabit LAN, USB 2.0 on board
Memory	1 GB RAM DDR PC333 with ECC error correction
RAID controller	Intel SRCZCRX RAID controller
Hard disks	2 x Fujitsu MAT3073NC 73GB SCSI at 10,000 rpm in RAID 1 (hardware) 2 x Fujitsu MAT3147NC 147GB SCSI at 10,000 rpm in RAID 1 (hardware)
Other components	INTEL SC5300 server tower INTEL 2nd mains adaptor 730W SC5300 module INTEL SC5300 backplane for up to six SCSI disks DVD-ROM 16x52x IDE Bulk black Internal floppy drive

Table 2: Technical data of the server for tests with variable block sizes

CPU	Intel Pentium 4 at 2,4 GHz
Motherboard	Intel D865PERC
Chipset	Intel 865PE
RAM (total / effective)	512 MB / 496 MB
Hard drive	20 GB (10 GB Systempartition)
Graphics	Onboard 16 MB shared Memory
Network	Gigabit Ethernet (onboard)
Operating system	Windows XP Professional Service Pack 1

Table 3: Technical data of the client PC for test with variable block sizes

Appendix A2

Test environment for variable client numbers

Like the tests based on variable block sizes, the tests based on variable client numbers were also performed in a separate test environment. This allowed measurement errors caused by interfering components to be avoided. The schematic structure of the test environment can be seen in Fig. 5. The individual components are connected via a D-Link gigabit switch that supports port trunking for up to six ports. Server and clients were connected via port trunking as appropriate to the required number of clients.

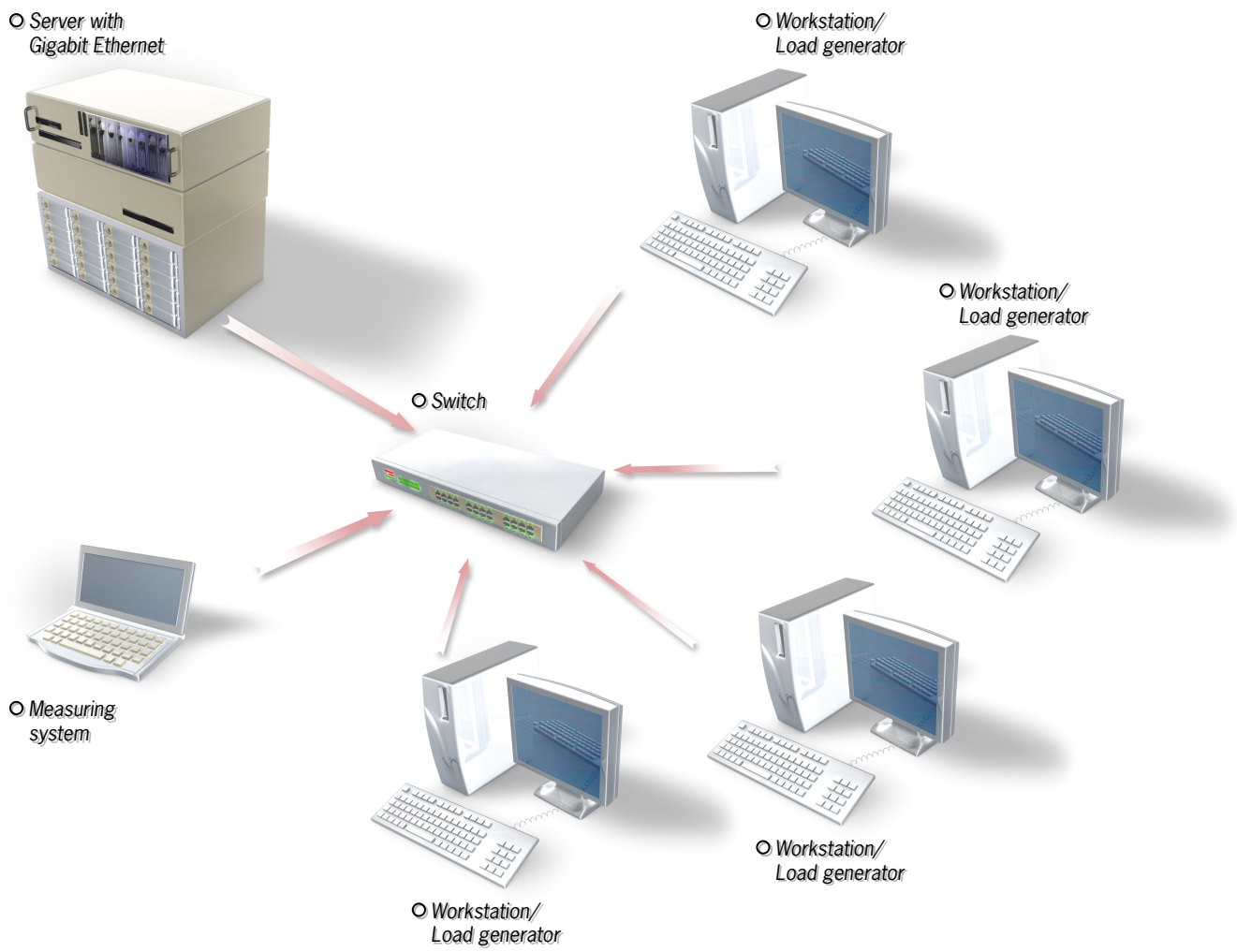

Figure 5: Test environment for variable client number

The tests with the Open-E NAS Enterprise were based on an N-Tec rapidNAS SR208. The values for the Microsoft Windows Storage Server 2003 were determined with an N-Tec rapidNAS MS208. The technical data for the two NAS servers can be found in the following table 4. The same hardware was used for the clients.

Appendix A2

Test environment for variable client numbers

	N-Tec rapidNAS SR208	N-Tec rapidNAS MS208
Size	2 HE	2 HE
Motherboard	Supermicro P4SCi	Supermicro P4SCi
RAM	2 x 512 MB ECC PC400 RAM	2 x 512 MB ECC PC400 RAM
Processor	Intel Pentium at 3 GHz	Intel Pentium at 3 GHz
Mains adaptor	2x500 watts	2x500 watts
RAID controller	3WARE 9500S-8	3WARE 9500S-8
Hard disks	8 x Hitachi 250 GB HDDs (7,200 rpm - 8 MB cache)	8 x Hitachi 250 GB HDDs (7,200 rpm - 8 MB cache)
Network	2 x Gigabit (Copper) LAN connection and Intel Quad Gigabit card	2 x Gigabit (Copper) LAN connection and Intel Quad Gigabit card

Table 4: Server for tests with variable client numbers

Appendix B1

Measured values based on variable block sizes

Microsoft Windows Storage Server 2003			Throughput in MB/s		
Block size	Sequential read	Sequential write	Random read	Random write	Mixed
512 B	1.36	0.62	0.08	0.04	0.09
1 KB	2.70	1.15	0.17	0.08	0.18
2 KB	4.79	0.60	0.33	0.14	0.34
4 KB	8.79	6.09	0.66	0.31	0.70
8 KB	15.19	10.49	1.28	0.61	1.33
16 KB	26.22	16.86	2.47	1.26	2.57
32 KB	39.95	26.00	4.64	2.59	4.98
64 KB	42.99	34.23	7.64	4.66	8.70
128 KB	49.42	46.54	12.87	6.15	11.07
256 KB	53.25	48.90	19.86	8.03	13.62
512 KB	56.30	30.66	26.69	9.64	15.93
1 MB	56.72	28.97	27.04	11.56	17.62
2 MB	57.33	28.88	28.25	11.84	17.84
4 MB	57.02	28.61	34.95	12.80	20.10
8 MB	58.32	28.85	38.78	13.45	23.78
16 MB	57.87	28.35	40.04	13.72	18.58
32 MB	56.81	28.33	40.52	13.16	19.73
63 MB	41.85	27.94	40.12	11.72	25.13
Maximum	58.32	48.90	40.52	13.72	25.13

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Appendix B1

Measured values based on variable block sizes

Microsoft Windows Storage Server 2003			Number of I/O operations per second		
Block size	Sequential read	Sequential write	Random read	Random write	Mixed
512 B	2,914.03	1,337.10	178.84	79.13	195.06
1 KB	2,896.91	1,237.62	178.58	80.70	190.69
2 KB	2,572.47	322.46	178.73	75.39	181.47
4 KB	2,360.86	1,633.53	176.86	83.59	186.58
8 KB	238.57	1,408.41	172.11	82.08	178.42
16 KB	1,759.49	1,131.16	166.02	84.24	172.67
32 KB	1,340.41	872.55	155.73	86.81	167.18
64 KB	721.26	574.32	128.13	78.16	145.91
128 KB	414.57	390.39	108.00	51.59	92.86
256 KB	223.35	205.12	83.32	33.66	57.13
512 KB	118.06	64.30	55.98	20.21	33.40
1 MB	59.47	30.37	28.35	12.12	18.48
2 MB	30.06	15.14	14.81	6.21	9.35
4 MB	14.95	7.50	9.16	3.35	5.27
8 MB	7.64	3.78	5.08	1.76	3.12
16 MB	3.79	1.86	2.62	0.90	1.22
32 MB	1.86	0.93	1.33	0.43	0.65
63 MB	0.70	0.47	0.67	0.19	0.42
Maximum	2,914.03	1,633.53	178.84	86.81	195.06

Open-E NAS Enterprise			Throughput in MB/s		
Block size	Sequential read	Sequential write	Random read	Random write	Mixed
512 B	0.95	0.94	0.07	0.08	0.12
1 KB	1.90	1.88	0.16	0.10	0.20
2 KB	4.99	3.76	0.34	0.24	0.41
4 KB	7.60	7.60	0.66	0.50	0.79
8 KB	15.09	15.19	1.29	0.98	1.44
16 KB	24.10	29.79	2.45	1.85	2.71
32 KB	39.82	39.96	4.62	3.45	5.02
64 KB	39.47	58.87	4.45	6.24	6.83
128 KB	45.88	68.00	5.45	7.43	10.24
256 KB	49.43	82.20	10.75	13.83	15.65
512 KB	51.93	67.37	21.51	18.33	25.02
1 MB	52.42	63.68	25.48	23.49	29.35
2 MB	53.37	62.88	34.72	28.57	34.60
4 MB	53.76	63.36	42.02	29.59	38.50
8 MB	53.48	62.79	47.63	32.60	39.64
16 MB	53.75	62.71	50.68	33.32	42.83
32 MB	52.69	62.53	51.68	35.00	41.34
63 MB	51.88	61.14	51.85	34.54	44.84
Maximum	53.76	82.20	51.85	35.00	44.84

Appendix B1

Measured values based on variable block sizes

Open-E NAS Enterprise			Number of I/O operations per second		
Block size	Sequential read	Sequential write	Random read	Random write	Mixed
512 B	2,032.51	2,014.33	155.45	180.67	265.43
1 KB	2,044.36	2,020.78	168.93	111.22	218.86
2 KB	2,680.95	2,017.36	182.71	127.57	219.22
4 KB	2,039.69	2,041.07	177.61	133.99	210.97
8 KB	2,025.12	2,038.66	172.63	132.19	193.42
16 KB	1,617.52	1,999.30	164.46	124.08	182.08
32 KB	1,336.08	1,340.73	154.88	115.84	168.31
64 KB	662.12	987.66	74.60	104.74	114.58
128 KB	384.88	570.42	45.68	62.29	85.92
256 KB	207.34	344.77	45.11	58.02	65.66
512 KB	108.90	141.28	45.11	38.44	52.47
1 MB	54.97	66.78	26.71	24.63	30.78
2 MB	27.98	32.97	18.21	14.98	18.14
4 MB	14.09	16.61	11.01	7.76	10.09
8 MB	7.01	8.23	6.24	4.27	5.20
16 MB	3.52	4.11	3.32	2.18	2.81
32 MB	1.73	2.05	1.69	1.15	1.35
63 MB	0.86	1.02	0.86	0.57	0.75
Maximum	2,680.95	2,041.07	182.71	180.67	265.43

Appendix B2

Measured values based on variable client numbers

Throughput in KB at variable client numbers										
Servers / number of clients	1	4	8	12	16	20	24	28	32	36
Windows Storage Server 2003	5.32	21.28	41.44	61.38	77.47	92.06	98.95	107.58	110.75	112.03
Open-E NAS Enterprise	5.69	22.43	44.54	65.92	85.76	102.32	119.44	124.93	132.06	133.88
Higher performance of Open-E NAS Enterprise	7 %	5 %	7 %	7 %	11 %	11 %	21 %	16 %	19 %	20 %

Latency in ms at variable number clients										
Servers / number of clients	1	4	8	12	16	20	24	28	32	36
Windows Storage Server 2003	640	646	736	775	952	1,133	1,533	1,817	2,289	2,811
Open-E NAS Enterprise	454	496	515	555	631	768	860	1,226	1,512	1,939
Higher performance of Open-E NAS Enterprise	41 %	30 %	43 %	40 %	51 %	48 %	78 %	48 %	51 %	45 %

About Open-E GmbH

Open-E – Guaranteed storage economy

Open-E was founded on 9th September, 1998, in Bremen, Germany. In late 2001 a dedicated software team for developing storage products was formed at Open-E. Our many years of professional experience in supplying, supporting and providing technical consulting for the use of storage products showed us that there was a gap in the market for tools enabling small, medium and large companies to meet the growing demand for storage solutions.
Now, Open-E GmbH in Puchheim near Munich is a software company that focuses on developing storage software that allows system integrators to set up high-performance but easy-to-use storage systems that require no special knowledge to install and are fully compatible with leading operating systems and iSCSI initiators. Open-E GmbH distributes its products through a worldwide network of partners who are already established on the storage and networking market.
More information about Open-E and Open-E products is available at: www.open-e.com