Intel Server System R2224GZ4GC4

Executive summary

After performing all tests, the Intel Server System R2224GZ4GC4 has been officially certified according to the Open-E Hardware Certification Program Guide 2.1.

During the tests, it was found that the system is functional and efficient. With the Open-E DSS V7 operating system installed, the Intel Server System R2224GZ4GC4 is stable and performs well.

In general, the system can be used for many different applications, but the following are recommended:

✓ **NAS filer**

The following features make Intel Server System R2224GZ4GC4 a great NAS filer solution:

➢ Twenty four high capacity hard drives and high RAID levels ensure a lot of safe storage space.

➢ Four 1GbE and four 10GbE interfaces for an independent connection to different networks or link aggregation for improved throughput.

➢ SSD cache for faster access to frequently used files

✓ **Storage for databases**

The following features decides that Intel Server System R2224GZ4GC4 is a great Storage for databases:

➢ Hardware RAID10 for high performance, best iops ratio and data safety.

➢ Twenty four high class, enterprise SAS drives combined with fast RAID controller and SSD cache, ensure fast random data access and reliability.

➢ Four 10GbE interfaces which can be aggregated for improved fault tolerance and increased performance for fast database connection.

➢ Redundant power supply for system reliability.

✓ **Storage for Virtualization**

For this application the following can be used:

➢ Hardware RAID5, RAID6, RAID10, RAID50 or RAID60 for high performance and data safety.

➢ Four 1GbE interfaces for flexible network topology or fast MPIO connection.

➢ Four 10GbE interfaces for efficient network connections to virtualization platforms.

➢ SSD cache for I/O bottlenecks elimination and increased virtual machine density.

Certification notes

It is recommended to use 802.3ad bonding mode for 10GbE and balance-alb for 1GbE.

Intel Server System R2224GZ4GC4 hardware components

Technical specifications about the certified system are listed below:

Model	Intel Server System R2224GZ4GC4
Operating system	Open-E DSS V7 build 10529
Enclosure/chassis	Intel R2224GZ4GC4 2U Chassis
CPU	2x Intel Xeon Processor E5-2680 2.70GHz
Motherboard	Intel Server Board S2600GZ4
Memory	8x 8GB Kingston DDR3 1600 ECC KVR1600D3D4R11S/8G
Network	1GbE Intel I350 Quad Port Ethernet Controller (on-board)
Network	10GbE Intel AXX10GBNIAIOM Dual Port I/O Module (i82599EB)
Network	Intel Ethernet Converged Network Adapter X520-SR2
HW RAID	Intel Integrated RAID Module RMS25PB080
Hard disk drives	24x 900GB Western Digital XE WD9001BKHG
Hard disk drives	2x 100GB Intel SSD DC S3700 series

TABLE 1: *Hardware components list of Certified System with Open-E DSS V7*

Intel Server System R2224GZ4GC4 photos

FIGURE 1: Front photo

FIGURE 2: Rear photo

FIGURE 3: Top photo

Auxiliary systems hardware components

Auxiliary systems with MS Windows or Open-E DSS V7 installed, used in Open-E Hardware Certification Process.

Model	Custom
Operating system	MS Windows Server 2012 R2
Enclosure/chassis	Inter-Tech IPC 4088 4HE
Motherboard	Asus P8B-E/4L
CPU	Intel Xeon Processor E3-1230 3.20 GHz
Memory	3x 4GB DDR3 Kingston KVR1333D3E9S/4G
Network	4x Intel 82574L Gigabit Ethernet Controller (on-board)
Network	Intel Ethernet Converged Network Adapter X520-SR2
Hard disk drives	1TB Hitachi Ultrastar A7K2000 HUA722010CLA330

TABLE 2: Hardware components of first Workstation with MS Windows

Model	Custom
Operating system	MS Windows Server 2012 R2
Enclosure/chassis	Inter-Tech IPC 4088 4HE
Motherboard	Asus P8B-E/4L
CPU	Intel Xeon Processor E3-1230 3.20 GHz
Memory	3x 4GB DDR3 Kingston KVR1333D3E9S/4G
Network	4x Intel 82574L Gigabit Ethernet Controller (on-board)
Network	Intel Ethernet Converged Network Adapter X520-SR2
Hard disk drives	1TB Hitachi Ultrastar A7K2000 HUA722010CLA330

TABLE 3: Hardware components of second Workstation with MS Windows

Model	Custom
Operating system	Open-E DSS V7 build 9331
Enclosure/chassis	Inter-Tech IPC 4088 4HE
Motherboard	Asus P8B-E/4L
CPU	Intel Xeon Processor E3-1230 3.20 GHz
Memory	3x 4GB DDR3 Kingston KVR1333D3E9S/4G
Network	4x Intel 82574L Gigabit Ethernet Controller (on-board)
Network	Intel Ethernet Converged Network Adapter X520-SR2
HW RAID	Intel RAID Controller RS2WC080
Hard disk drives	500GB Hitachi Deskstar 7K1000.C HDS721050CLA362
Hard disk drives	8x 1TB Hitachi Ultrastar A7K2000 HUA722010CLA330

TABLE 4: Hardware components of Workstation with Open-E DSS V7

Model	Supermicro SSE-G24-TG4
Description	24x 1GbE port and 4x 10GbE port

TABLE 5: *Network switch details for 1GbE and 10GbE connections*

Administration functionality

The following functionality has been tested.

Drive identifier	OK
Power button	OK
Front and rear LEDs	OK

TABLE 6: *Administration functionality test results*

Network functionality

Tests performed in this section check the functionality, performance and stability of the network solutions available in the Open-E DSS V7 product on the certified system.

The tests rely on configuring the iSCSI targets and copying the data from many *Workstations with MS Windows* through various network connections with big block size using appropriate testing tools.

Network test topology

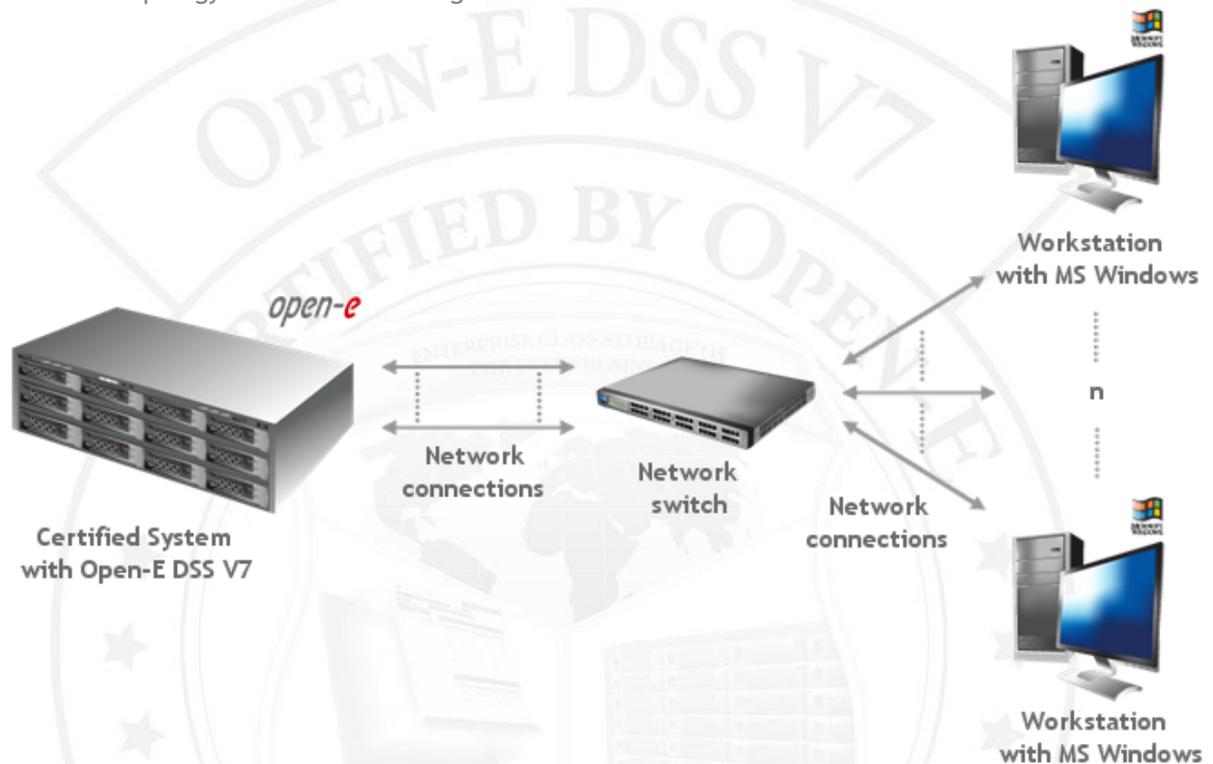Network topology for Network testing is shown below.

FIGURE 4: Network topology for Network testing

802.3ad bonding mode test

1. Test description

The test relies on configuring the iSCSI targets and copying the data from many *Workstations with MS Windows* through an 802.3ad bonding mode network connection with a 4MB block size using the Iometer testing tool.

2. Test results for 802.3ad bonding mode test performed on Intel I350 Quad Port Ethernet Controller (on-board)

802.3ad bonding mode performance test results			
NIC model	Intel I350 Quad Port Ethernet Controller (on-board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	108.21	53.50	passed
2nd Workstation	108.28	59.17	passed
3rd Workstation	102.77	56.32	passed
4th Workstation	109.38	108.73	passed

TABLE 7: *802.3ad bonding mode performance test results table for Intel I350 Quad Port Ethernet Controller (on-board)*
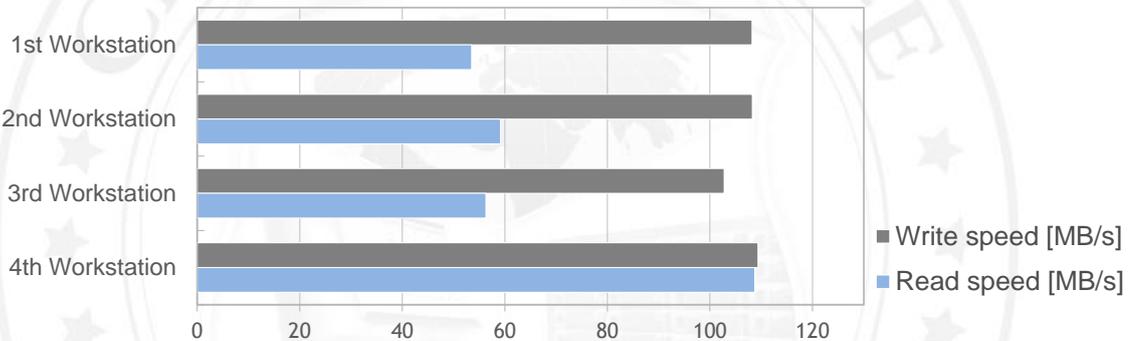

FIGURE 5: *802.3ad bonding mode performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)*

3. Test results for 802.3ad bonding mode test performed on Intel Ethernet Converged Network Adapter X520-SR2

802.3ad bonding mode performance test results			
NIC model	Intel Ethernet Converged Network Adapter X520		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	582.23	544.08	passed
2nd Workstation	627.05	512.53	passed

TABLE 8: *802.3ad bonding mode performance test results table for Intel Ethernet Converged Network Adapter X520-SR2*
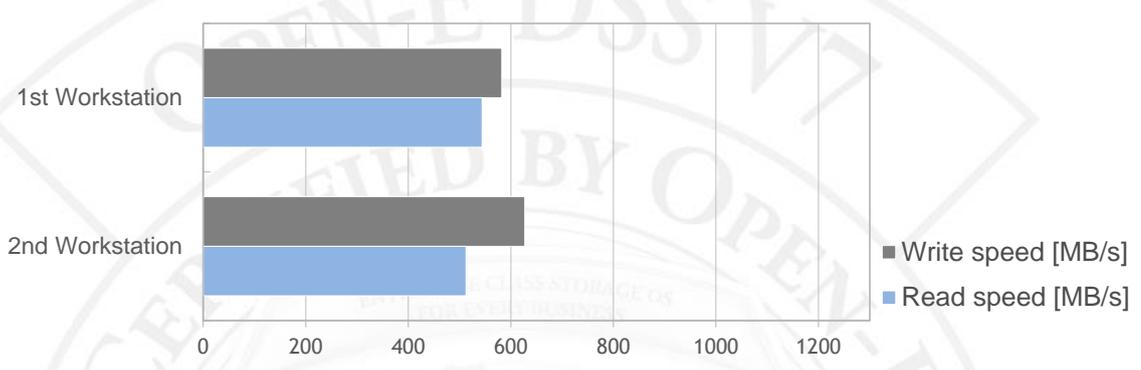

FIGURE 6: *802.3ad bonding mode performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2*

Balance-alb bonding mode test

1. Test description

The test relies on configuring the iSCSI targets and copying the data from many *Workstations with MS Windows* through a Balance-alb bonding mode network connection with a 4MB block size using the Iometer testing tool.

2. Test results for Balance-alb bonding mode test performed on Intel I350 Quad Port Ethernet Controller (on-board)

Balance-alb bonding mode performance test results			
NIC model	Intel I350 Quad Port Ethernet Controller (on-board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	55.84	110.94	passed
2nd Workstation	110.10	111.42	passed
3rd Workstation	53.60	89.96	passed
4th Workstation	110.36	111.29	passed

TABLE 9: *Balance-alb bonding mode performance test results table for Intel I350 Quad Port Ethernet Controller (on-board)*
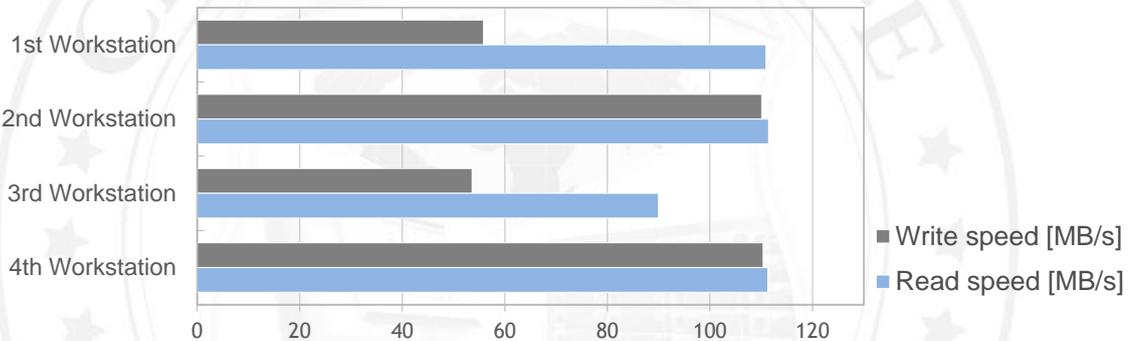

FIGURE 7: *Balance-alb bonding mode performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)*

3. Test results for Balance-alb bonding mode test performed on Intel Ethernet Converged Network Adapter X520-SR2

Balance-alb bonding mode performance test results			
NIC model	Intel Ethernet Converged Network Adapter X520		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	385.31	455.95	passed
2nd Workstation	483.08	584.12	passed

TABLE 10: *Balance-alb bonding mode performance test results table for Intel Ethernet Converged Network Adapter X520-SR2*
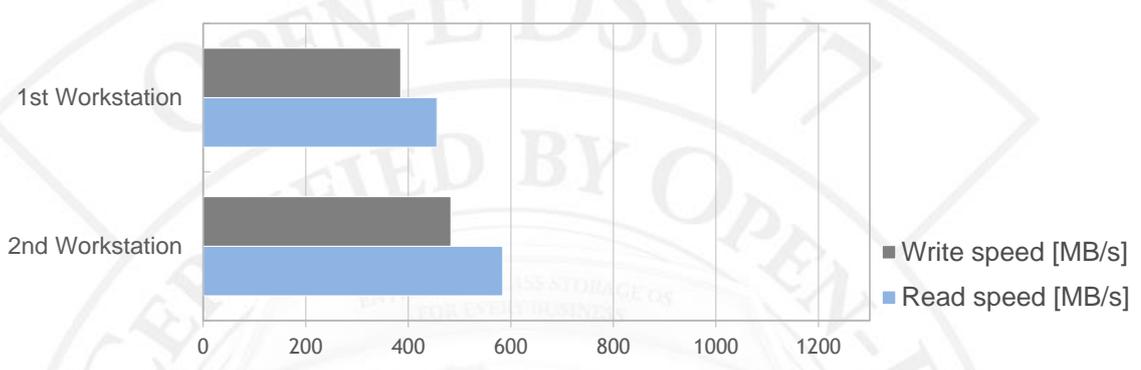

FIGURE 8: *Balance-alb bonding mode performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2*

Balance-rr bonding mode test

1. Test description

The test relies on configuring the iSCSI targets and copying the data from many *Workstations with MS Windows* through a Balance-rr bonding mode network connection with a 4MB block size using the Iometer testing tool.

2. Test results for Balance-rr bonding mode test performed on Intel I350 Quad Port Ethernet Controller (on-board)

Balance-rr bonding mode performance test results			
NIC model	Intel I350 Quad Port Ethernet Controller (on-board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	109.83	65.29	passed
2nd Workstation	110.21	65.26	passed
3rd Workstation	103.09	67.47	passed
4th Workstation	109.39	89.93	passed

TABLE 11: Balance-rr bonding mode performance test results table for Intel I350 Quad Port Ethernet Controller (on-board)
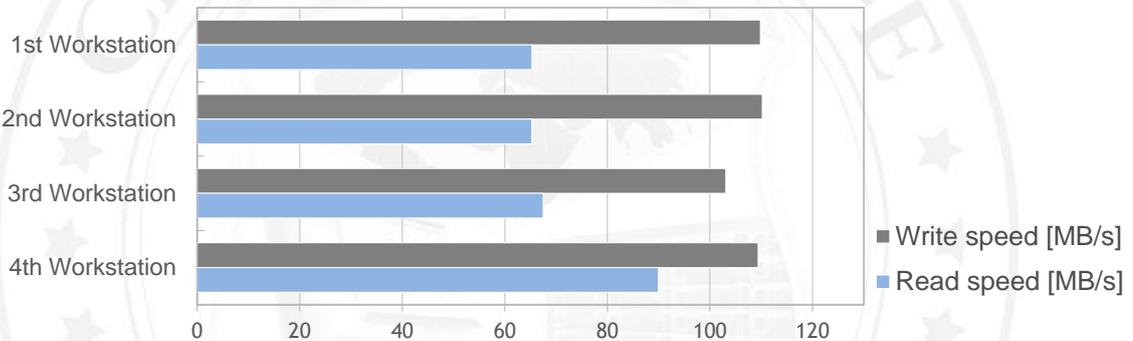

FIGURE 9: Balance-rr bonding mode performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)

3. Test results for Balance-rr bonding mode test performed on Intel Ethernet Converged Network Adapter X520-SR2

Balance-rr bonding mode performance test results			
NIC model	Intel Ethernet Converged Network Adapter X520		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	659.89	320.23	passed
2nd Workstation	663.17	318.72	passed

TABLE 12: Balance-rr bonding mode performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
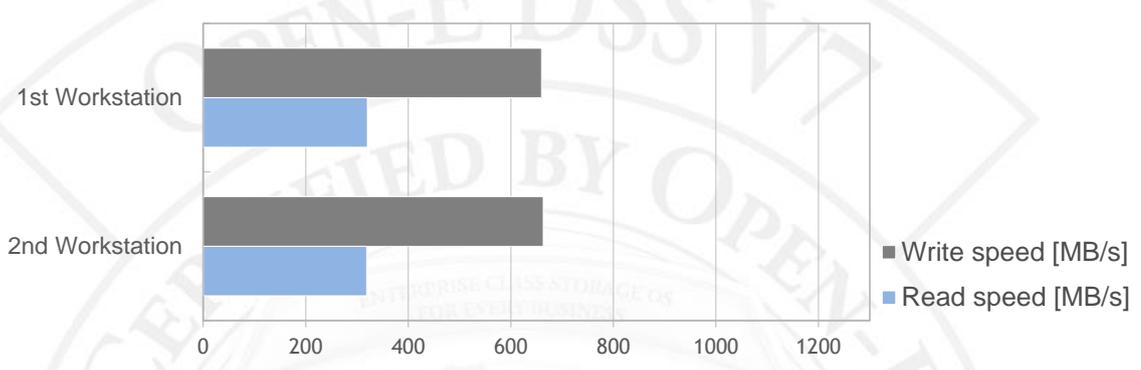

FIGURE 10: Balance-rr bonding mode performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

Single NIC performance test

1. Test description

The test relies on configuring the iSCSI targets and copying the data from *Workstations with MS Windows* through single NIC with a 4MB block size using the Iometer testing tool.

2. Test results for single NIC test performed on Intel I350 Quad Port Ethernet Controller (on-board)

Single NIC performance test results			
NIC model	Intel I350 Quad Port Ethernet Controller (on-board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	109.01	111.82	passed

TABLE 13: *Single NIC performance test results table for Intel I350 Quad Port Ethernet Controller (on-board)*
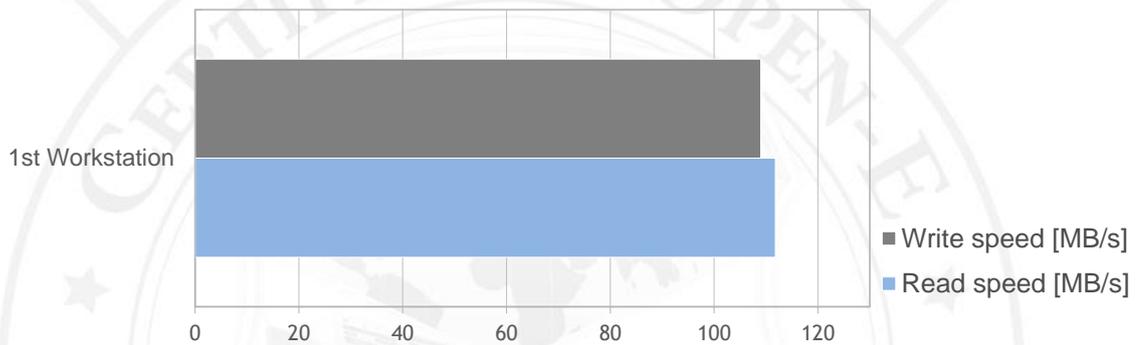

FIGURE 11: *Single NIC performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)*

3. Test results for single NIC test performed on Intel Ethernet Converged Network Adapter X520-SR2

Single NIC performance test results			
NIC model	Intel Ethernet Converged Network Adapter X520		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	743.09	509.56	passed

TABLE 14: *Single NIC performance test results table for Intel Ethernet Converged Network Adapter X520-SR2*
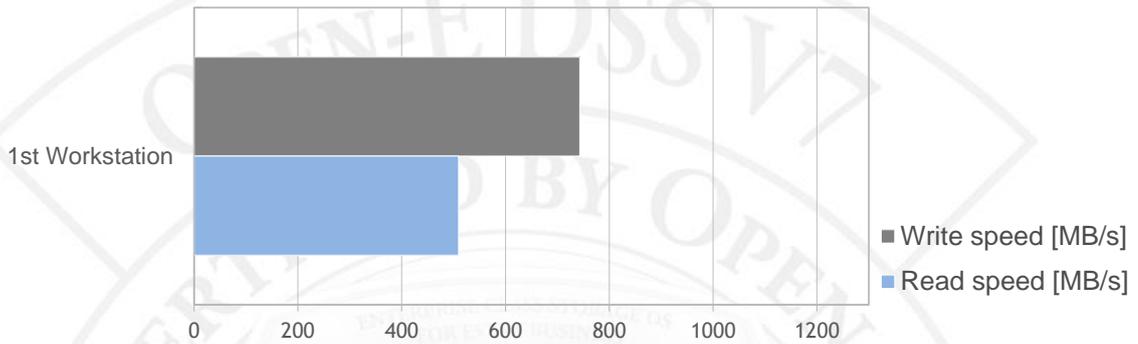

FIGURE 12: *Single NIC performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2*

RAID functionality

Tests performed in this section check the functionality, performance and stability of Open-E DSS V7 storage devices on the certified system.

Tests in this section rely on the creation of the RAID units on 0, 5, 6, 10, 50 and 60 levels, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

RAID test topology
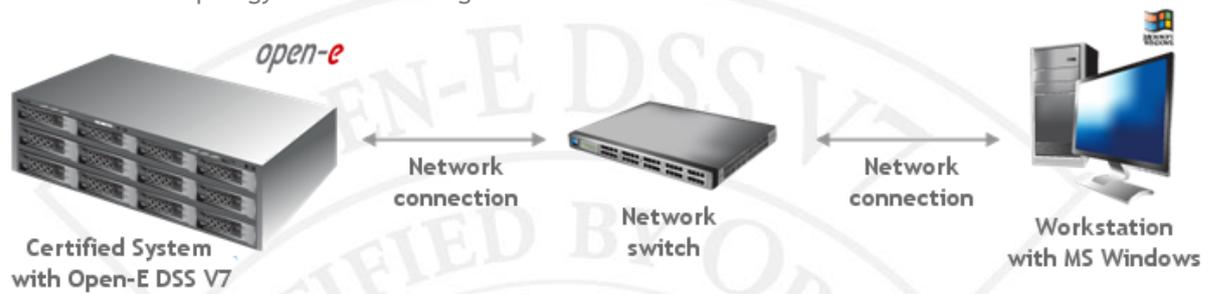
Network test topology for RAID testing is shown below

FIGURE 13: Network test topology for RAID testing

Hardware RAID0 test

1. Test description

The test relies on creation of the RAID0 unit on all hard disk drives, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for RAID0 and Intel Ethernet Converged Network Adapter X520-SR2

RAID0 performance test results			
Block size [KB]	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
4	72.59	96.13	passed
32	330.34	416.37	passed
64	310.69	443.41	passed
128	523.90	525.29	passed
256	694.36	340.75	passed
512	698.80	457.56	passed
1024	680.34	517.49	passed
4096	769.03	542.14	passed

TABLE 15: RAID0 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
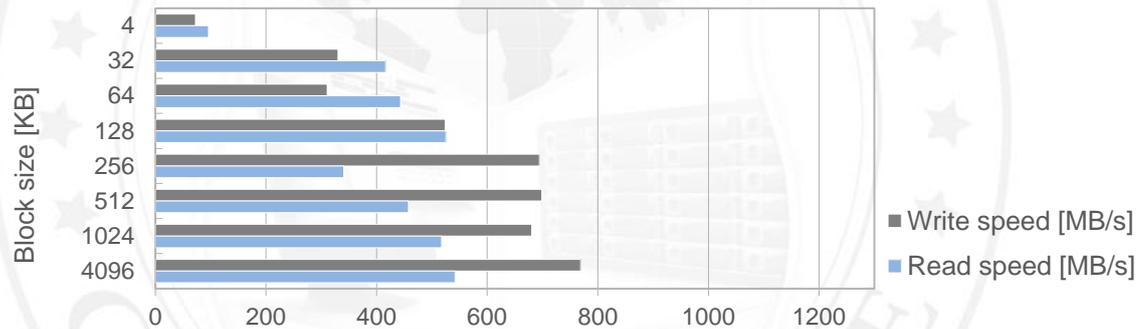

FIGURE 14: RAID0 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

Hardware RAID5 test

1. Test description

The test relies on creation of the RAID5 unit on all hard disk drives, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for RAID5 and Intel Ethernet Converged Network Adapter X520-SR2

RAID5 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	77.66	103.83	passed
32	397.74	505.79	passed
64	577.08	562.69	passed
128	785.19	666.67	passed
256	810.68	537.56	passed
512	795.34	500.72	passed
1024	793.08	654.68	passed
4096	835.90	660.51	passed

TABLE 16: RAID5 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
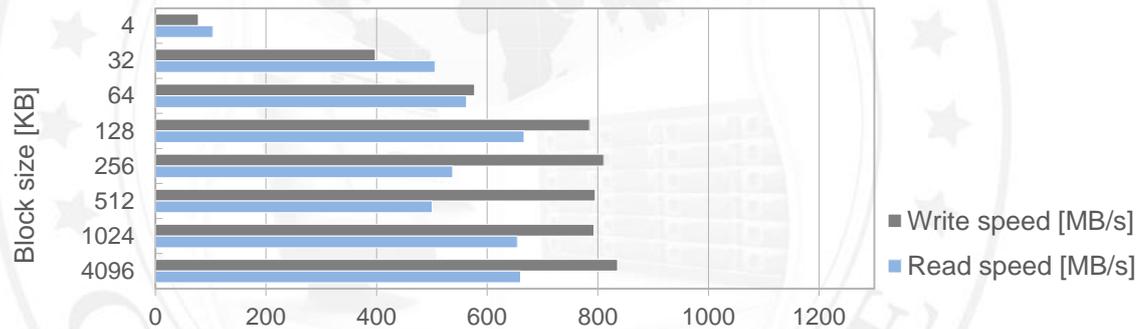

FIGURE 15: RAID5 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

Hardware RAID6 test

1. Test description

The test relies on creation of the RAID6 unit on all hard disk drives, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for RAID6 and Intel Ethernet Converged Network Adapter X520-SR2

RAID6 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	72.86	93.86	passed
32	335.51	409.03	passed
64	425.26	458.37	passed
128	497.69	471.44	passed
256	726.56	425.74	passed
512	563.73	529.77	passed
1024	651.94	508.10	passed
4096	754.84	546.03	passed

TABLE 17: RAID6 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
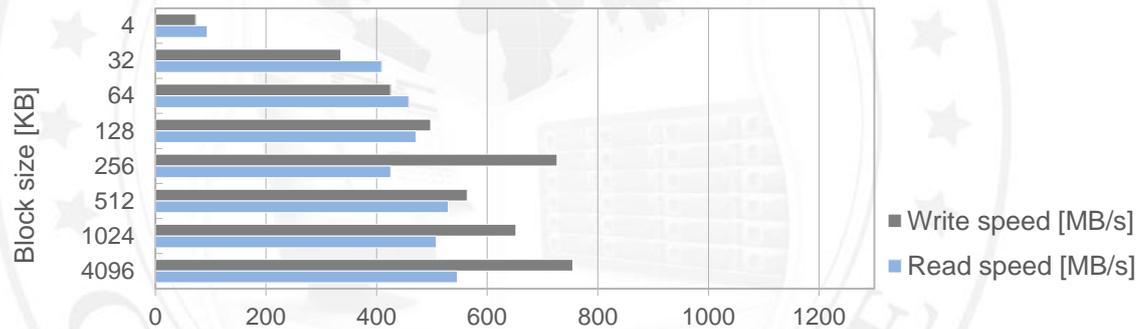

FIGURE 16: RAID6 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

Hardware RAID10 test

1. Test description

The test relies on creation of the RAID10 unit on all hard disk drives, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for RAID10 and Intel Ethernet Converged Network Adapter X520-SR2

RAID10 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	73.37	88.56	passed
32	329.12	406.36	passed
64	364.30	443.52	passed
128	564.56	404.29	passed
256	701.66	488.87	passed
512	665.58	491.99	passed
1024	671.88	427.31	passed
4096	642.91	474.21	passed

TABLE 18: *RAID10 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2*
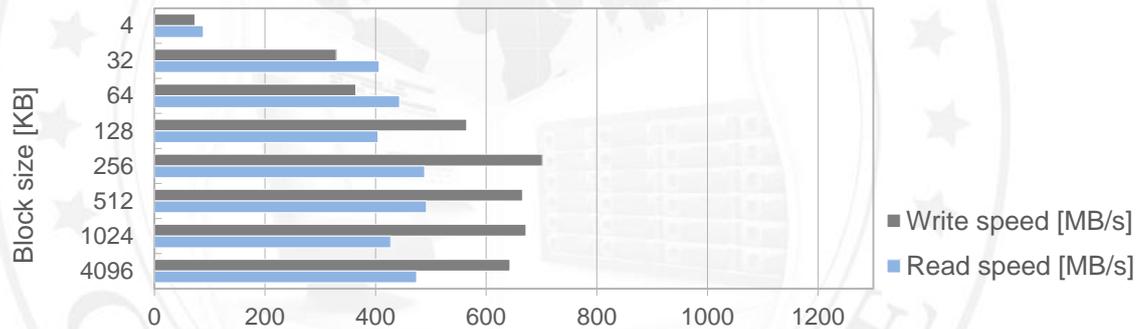

FIGURE 17: *RAID10 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2*

Hardware RAID50 test

1. Test description

The test relies on creation of the RAID50 unit on all hard disk drives, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for RAID50 and Intel Ethernet Converged Network Adapter X520-SR2

RAID50 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	74.37	92.47	passed
32	338.84	364.04	passed
64	437.70	445.61	passed
128	530.35	512.30	passed
256	736.22	537.67	passed
512	728.10	461.78	passed
1024	753.39	529.18	passed
4096	725.54	571.39	passed

TABLE 19: RAID50 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
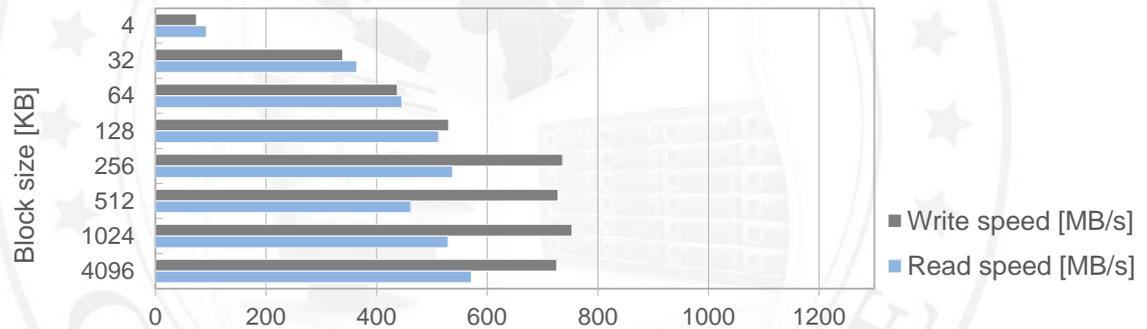

FIGURE 18: RAID50 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

Hardware RAID60 test

1. Test description

The test relies on creation of the RAID60 unit on all hard disk drives, configuring the iSCSI target and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for RAID60 and Intel Ethernet Converged Network Adapter X520-SR2

RAID60 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	72.74	87.99	passed
32	290.67	388.80	passed
64	433.30	446.89	passed
128	484.29	518.92	passed
256	714.61	277.17	passed
512	557.65	380.44	passed
1024	664.87	508.15	passed
4096	762.93	540.18	passed

TABLE 20: *RAID60 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2*
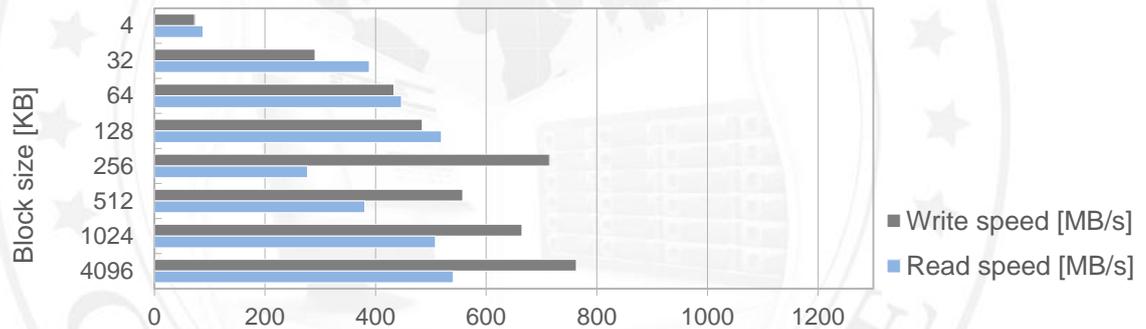

FIGURE 19: *RAID60 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2*

NAS functionality

Tests performed in this section check the functionality, performance and stability of the NAS protocols in the Open-E DSS V7 product on the certified system.

The tests rely on creating NAS shares and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

NAS test topology

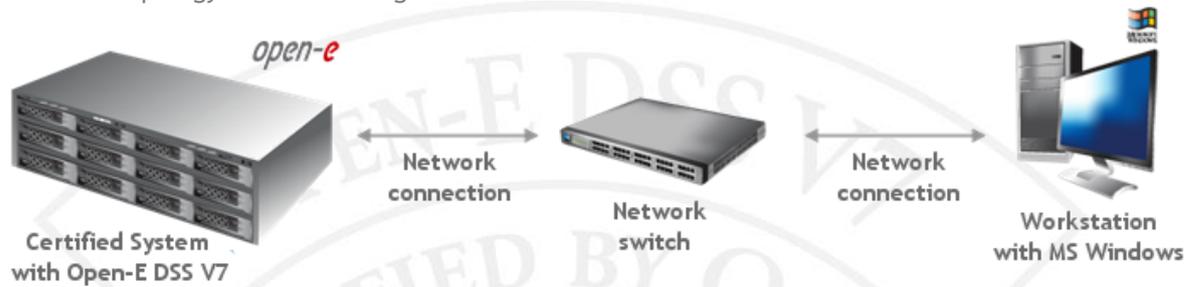Network topology for NAS testing is shown below.

FIGURE 20: Network topology for NAS testing

SMB test

1. Test description

The tests rely on creating NAS shares and copying the data from a *Workstation with MS Windows* via network connection with various block sizes using the Iometer testing tool.

2. Test results for SMB and Intel Ethernet Converged Network Adapter X520-SR2

SMB performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	115.44	109.42	passed
32	525.53	446.31	passed
64	700.43	438.53	passed
128	730.36	493.13	passed
256	637.43	519.41	passed
512	626.48	535.08	passed
1024	630.18	536.52	passed
4096	611.56	539.51	passed

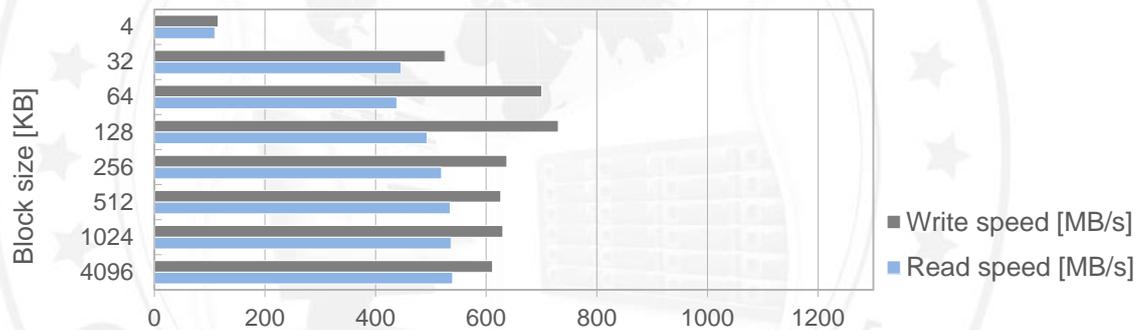*TABLE 21: SMB performance test results table for Intel Ethernet Converged Network Adapter X520-SR2*

FIGURE 21: SMB performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

iSCSI functionality

Tests performed in this section check the functionality, performance and stability of the iSCSI protocol in the Open-E DSS V7 product on the certified system.

iSCSI Initiator test topology

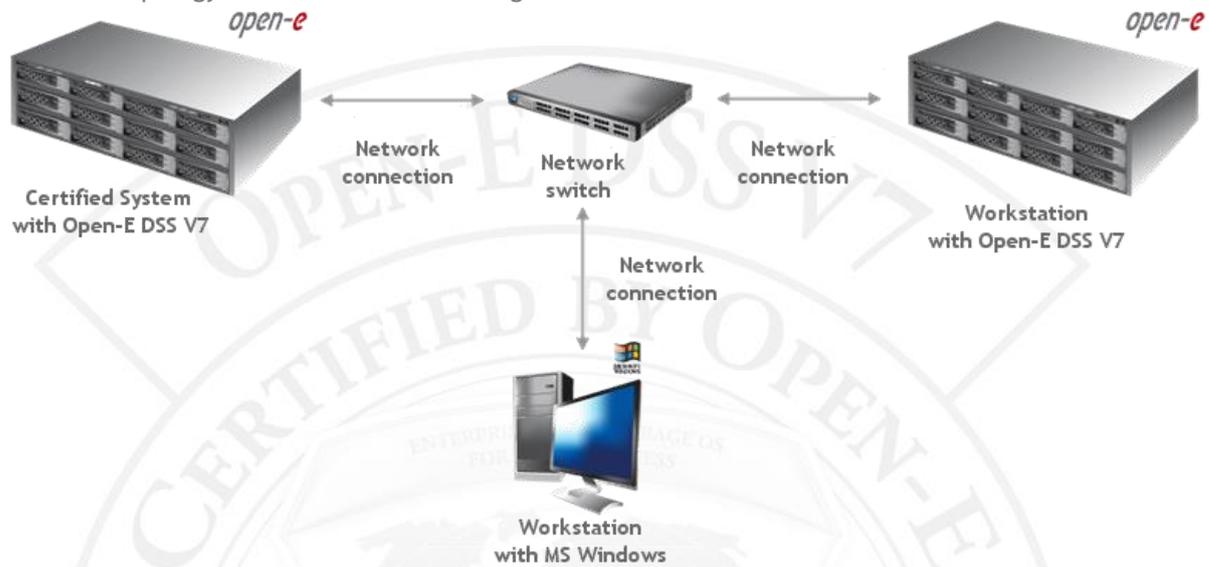Network topology for iSCSI Initiator testing is shown below.

FIGURE 22: Network topology for iSCSI Initiator testing

iSCSI Target test topology

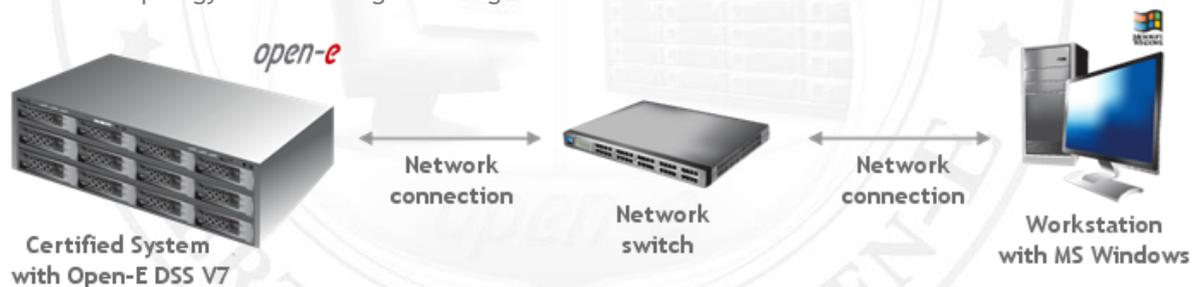Network topology for iSCSI Target testing is shown below.

FIGURE 23: Network topology for iSCSI Target testing

iSCSI Initiator test

1. Test description

The test relies on using the storage connected via the built-in iSCSI Initiator for NAS volumes, creating SMB shares on these NAS volumes and copying data from a *Workstation with MS Windows* to them with various block sizes using the Iometer testing tool.

2. Test results for iSCSI Initiator and Intel Ethernet Converged Network Adapter X520-SR2

iSCSI Initiator performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	114.03	106.84	passed
32	525.16	441.52	passed
64	692.29	436.70	passed
128	685.18	493.92	passed
256	634.18	526.07	passed
512	613.94	541.36	passed
1024	632.31	540.43	passed
4096	608.70	540.72	passed

TABLE 22: iSCSI Initiator performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
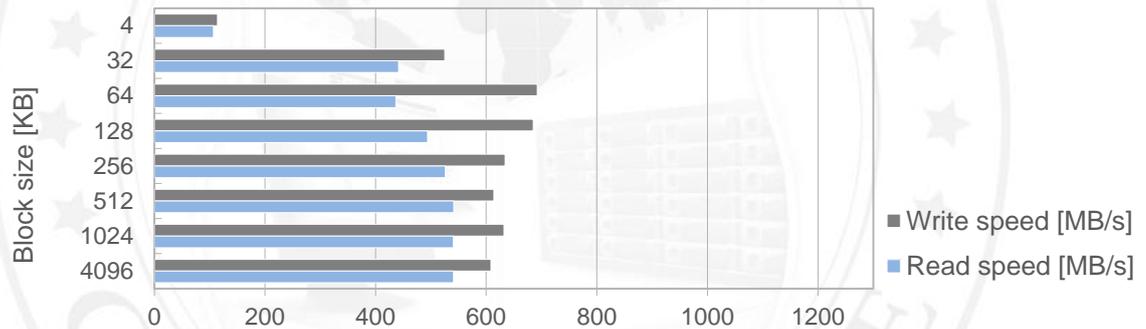

FIGURE 24: iSCSI Initiator performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

iSCSI Target test

1. Test description

The test relies on creating the iSCSI target on the certified system and copying the data from a *Workstation with MS Windows* to it with various block sizes using the Iometer tool.

2. Test results for iSCSI Target and Intel Ethernet Converged Network Adapter X520-SR2

iSCSI Target performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	70.97	95.17	passed
32	338.73	357.18	passed
64	442.83	438.24	passed
128	570.07	536.32	passed
256	707.13	507.37	passed
512	663.96	508.18	passed
1024	755.09	530.59	passed
4096	713.28	523.12	passed

TABLE 23: iSCSI Target performance test results table for Intel Ethernet Converged Network Adapter X520-SR2
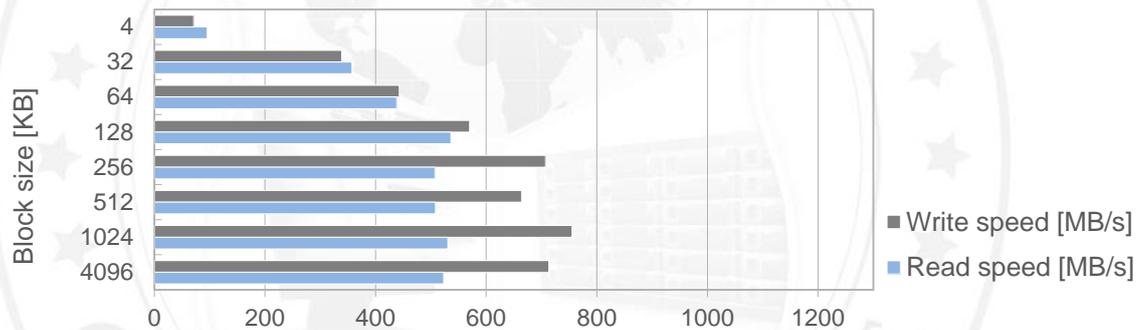

FIGURE 25: iSCSI Target performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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SSD Cache performance

Tests performed in this section check the performance of SSD cache in the Open-E DSS V7 product on the certified system.

SSD Cache test topology

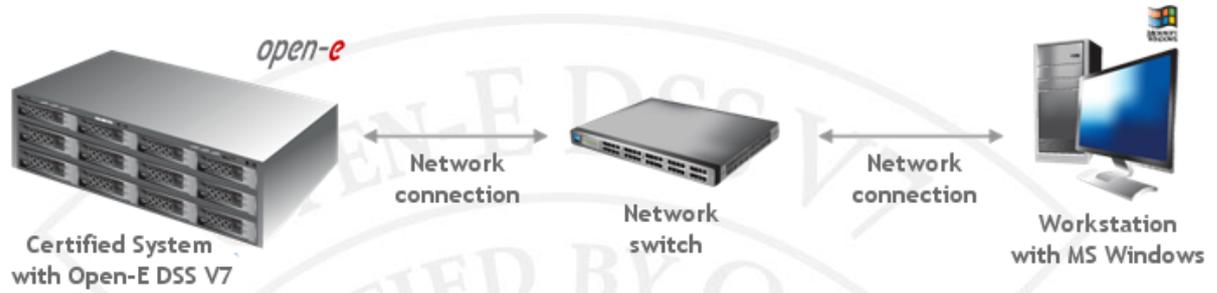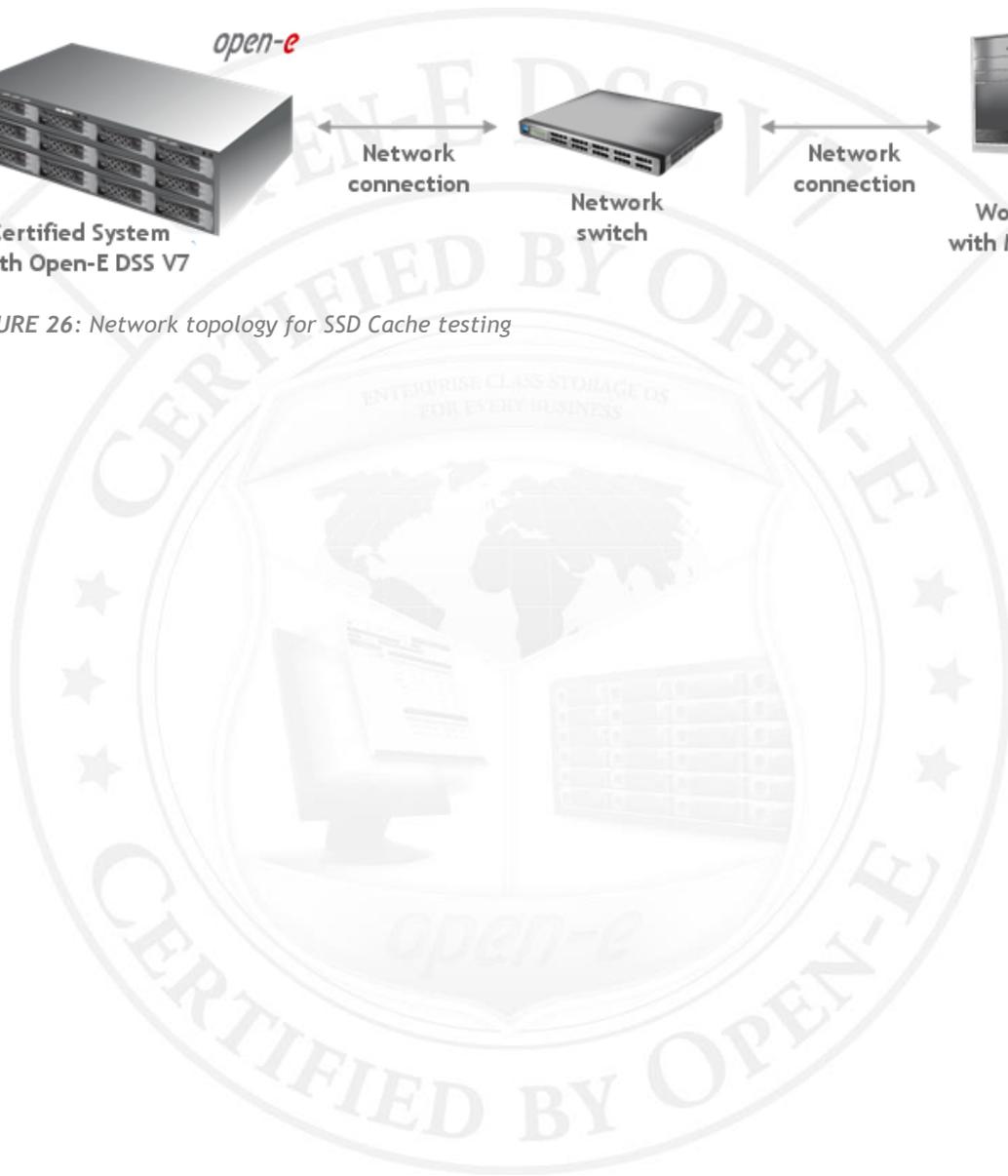Network topology for SSD Cache testing is shown below.

FIGURE 26: Network topology for SSD Cache testing

SSD Cache with real life pattern test

1. Test description

The test relies on creating the iSCSI target on the certified system, writing (35%) and reading (65%) random data from a *Workstation with MS Windows* to it with various block sizes using the Iometer tool.

2. Test results for SSD Cache with real life pattern and Intel Ethernet Converged Network Adapter X520-SR2

SSD Cache with real life pattern test results		
Block size [KB]	**Performance [IOPS]**	**Performance test results**
1	14580.28	passed
2	17904.01	passed
4	11803.09	passed

TABLE 24: SSD Cache with real life pattern test results table for Intel Ethernet Converged Network Adapter X520-SR2
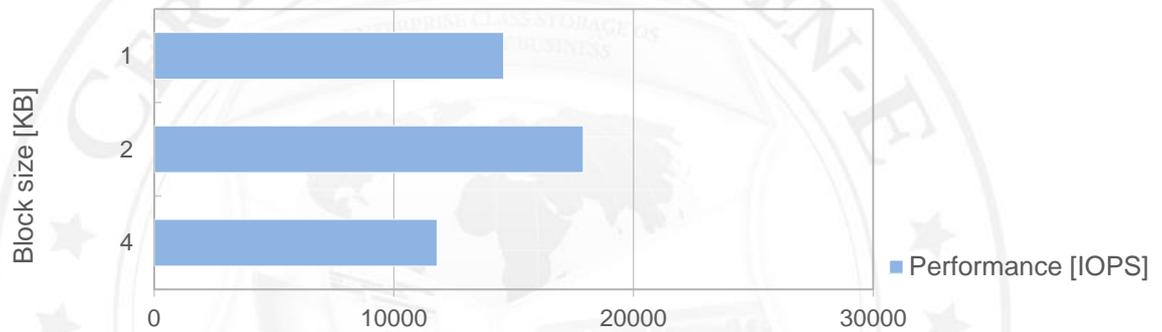

FIGURE 27: SSD Cache with real life pattern test results chart for Intel Ethernet Converged Network Adapter X520-SR2

SSD Cache with random read/write pattern test

3. Test description

The test relies on creating the iSCSI target on the certified system and copying random data from a *Workstation with MS Windows* to it with various block sizes using the Iometer tool.

4. Test results for SSD cache with random read/write pattern on Intel Ethernet Converged Network Adapter X520-SR2

SSD cache with random read/write pattern test results			
Block size [KB]	Write speed [IOPS]	Read speed [IOPS]	Performance test results
1	18676.91	26175.88	passed
2	16277.36	25439.34	passed
4	15767.69	20726.61	passed

TABLE 25: *SSD cache with random read/write pattern test results table for Intel Ethernet Converged Network Adapter X520-SR2*
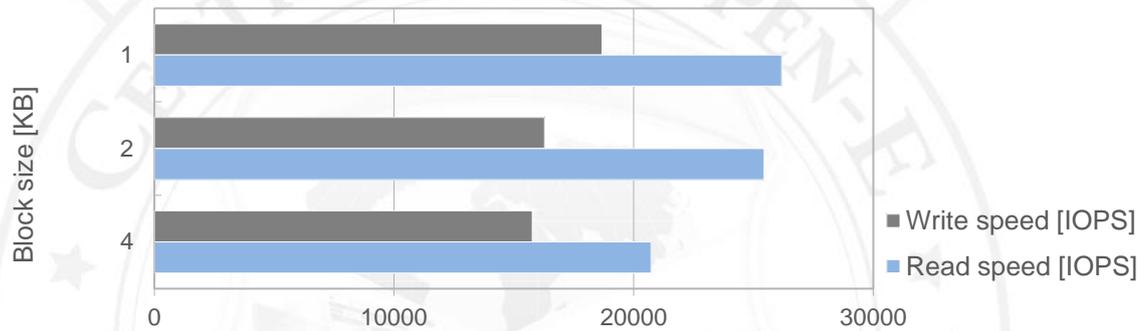

FIGURE 28: *SSD cache with random read/write pattern test results chart for Intel Ethernet Converged Network Adapter X520-SR2*