Intel R2312IP4LHPC system

Executive summary

After performing all tests, the Certification Document Intel R2312IP4LHPC system 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 R2312IP4LHPC 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 R2312IP4LHPC a good NAS filer solution:

  - Ten high capacity SAS hard drives provide a plenty of space for user files.
  - Hardware RAID5, RAID6, RAID50 and RAID60 for fault tolerance and the most efficient use of available disk space.
  - Two 10GbE and four 1GbE interfaces for independent connection to different networks or link aggregation for improved throughput.
  - SSD cache for faster access to frequently used files.

- ✓ **Storage for virtualization**

  For this application the following can be used:

  - Hardware RAID5, RAID6, RAID50 and RAID60 for high performance and data safety.
  - Two 10GbE interfaces for efficient network connections to virtualization systems.
  - Four 1GbE interfaces, which may be aggregated, for connections with virtualized systems.
  - Redundant power supply for system reliability.
  - SSD cache for I/O bottlenecks elimination and increased virtual machine density.

- ✓ **iSCSI storage**

  The following features make Intel R2312IP4LHPC a good iSCSI storage:

  - Ten high capacity SAS hard drives with SSD cache ensure lot of fast storage space.
  - For 1GbE and two 10GBE interfaces for fast MPIO connection and flexible network topology.
  - Redundant power supply for system reliability.

Certification notes

It is recommended to use 802.3ad bonding mode for 10GbE and balance-alb mode for 1GbE aggregation. It is not possible to build RAID10 with all available hard drives. Such configuration is not recommended, as it is inefficient.

Intel R2312IP4LHPC hardware components

Technical specifications about the certified system are listed below:

Model	Intel R2312IP4LHPC
Operating system	Open-E DSS V7 build 8826
Enclosure/chassis	Intel R2312IP4LHPC 2U Chassis
CPU	2x Intel Xeon E5-2643 3.3GHz
Motherboard	Intel Server Board S2600IP
Memory	8x 8GB Kingston DDR3 1600 ECC KVR1600D3D4R11S/8G
Network	4x 1GbE Intel I350 Quad Port Ethernet Controller (on-board)
Network	2x 10GbE Intel Ethernet Converged Network Adapter X520-SR2
HW RAID	Intel Integrated RAID Module RMS25CB080
Hard disk drives	10x 4TB Seagate Constellation ES.3 ST4000NM0023
Hard disk drives	2x 100GB Intel Solid-State Drive DC S3700 Series

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

Intel R2312IP4LHPC photos

FIGURE 1: Front photo

FIGURE 2: Rear photo

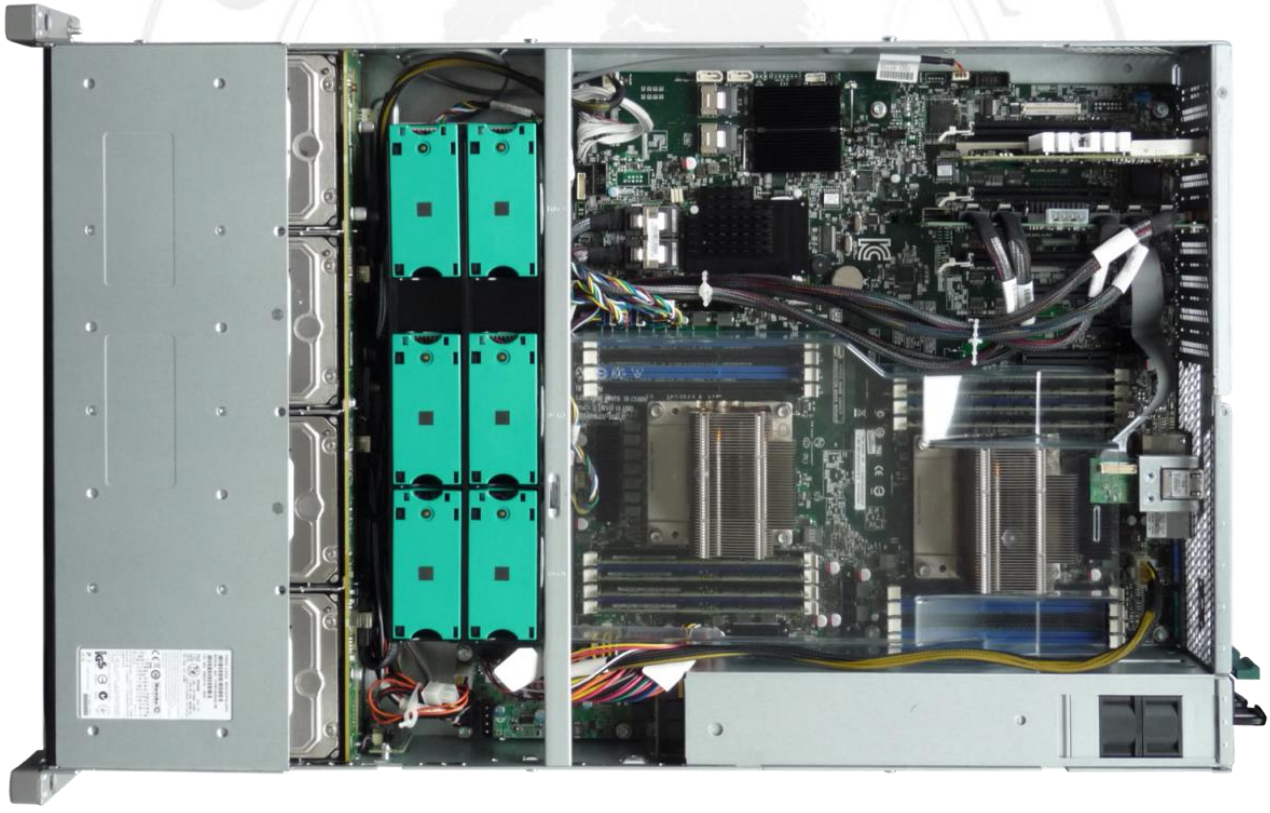

FIGURE 3: Top photo

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 2008 R2
Enclosure/chassis	Inter-Tech IPC 4088 4HE
Motherboard	Asus P8B-E / 4L
CPU	Intel Xeon E3-1230 3.20 GHz
Memory	3x 4BG Kingston DDR3 KVR1333D3E9S/4G
Network	Intel 82574L Gigabit Ethernet Controller (on-board)
Network	2x 10GbE Intel Ethernet Converged Network Adapter X520-DA2
Hard disk drives	500GB Hitachi Deskstar 7K1000.C HDS721050CLA362

TABLE 2: Hardware components of first Workstation with MS Windows

Model	Custom
Operating system	MS Windows Server 2008 R2
Enclosure/chassis	Inter-Tech IPC 4088 4HE
Motherboard	Asus P8B-E / 4L
CPU	Intel Xeon E3-1230 3.20 GHz
Memory	3x 4BG Kingston DDR3 KVR1333D3E9S/4G
Network	Intel 82574L Gigabit Ethernet Controller (on-board)
Network	2x 10GbE Intel Ethernet Converged Network Adapter X520-DA2
Hard disk drives	500GB Hitachi Deskstar 7K1000.C HDS721050CLA362

TABLE 3: Hardware components of second Workstation with MS Windows

Model	Intel R2312IP4LHPC
Operating system	Open-E DSS V7 build 8826
Enclosure/chassis	Intel R2312IP4LHPC 2U Chassis
CPU	2x Intel Xeon E5-2643 3.3GHz
Motherboard	Intel Server Board S2600IP
Memory	8x 8GB Kingston DDR3 1600 ECC KVR1600D3D4R11S/8G
Network	4x 1GbE Intel I350 Quad Port Ethernet Controller (on-board)
Network	2x 10GbE Intel Ethernet Converged Network Adapter X520-SR2
HW RAID	Intel Integrated RAID Module RMS25CB080
Hard disk drives	10x 4TB Seagate Constellation ES.3 ST4000NM0023
Hard disk drives	2x 100GB Intel Solid-State Drive DC S3700 Series

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

Model	Supermicro SSE-G24-TG4
Description	24-ports 1GbE and 4-ports 10GbE switch

TABLE 5: Network switch details for 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.

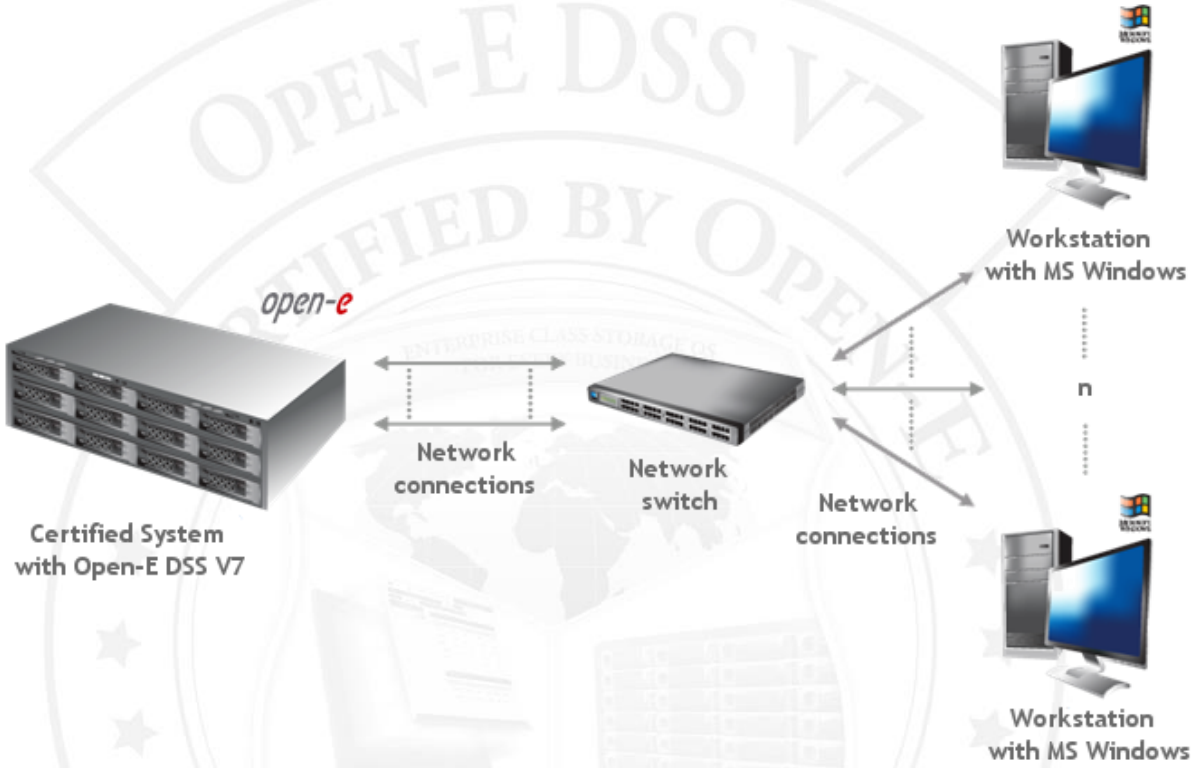

FIGURE 4: Network topology for Network testing

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	112.00	111.77	passed
2nd Workstation	111.61	111.78	passed
3rd Workstation	111.03	64.30	passed
4th Workstation	108.80	49.44	passed

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

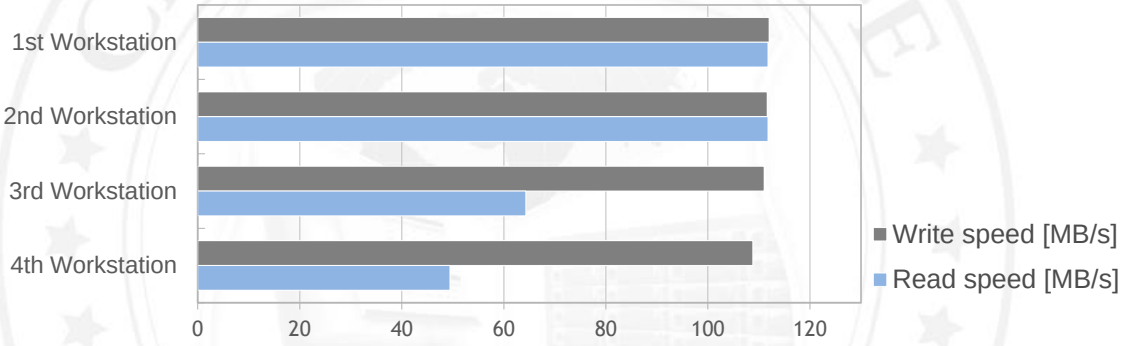

FIGURE 5: 802.3ad bonding mode performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)

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	744.67	444.60	passed
2nd Workstation	740.52	450.34	passed

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

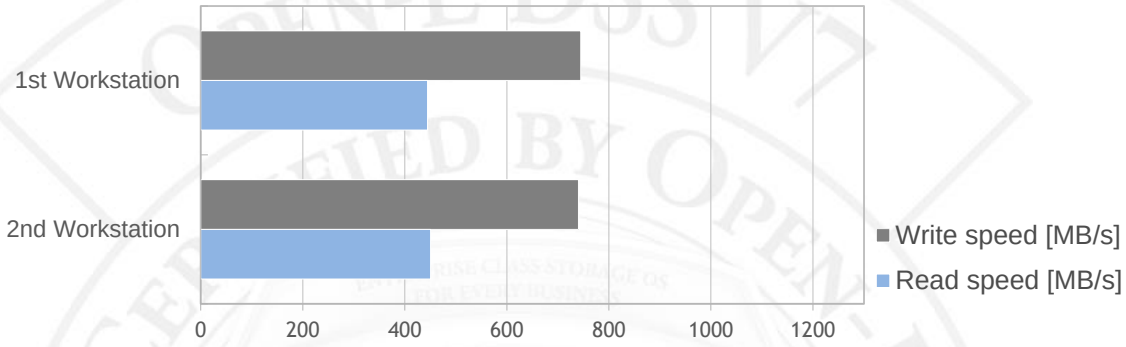

FIGURE 6: 802.3ad bonding mode performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	110.03	111.00	passed
2nd Workstation	111.39	110.96	passed
3rd Workstation	107.05	108.64	passed
4th Workstation	111.97	110.98	passed

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

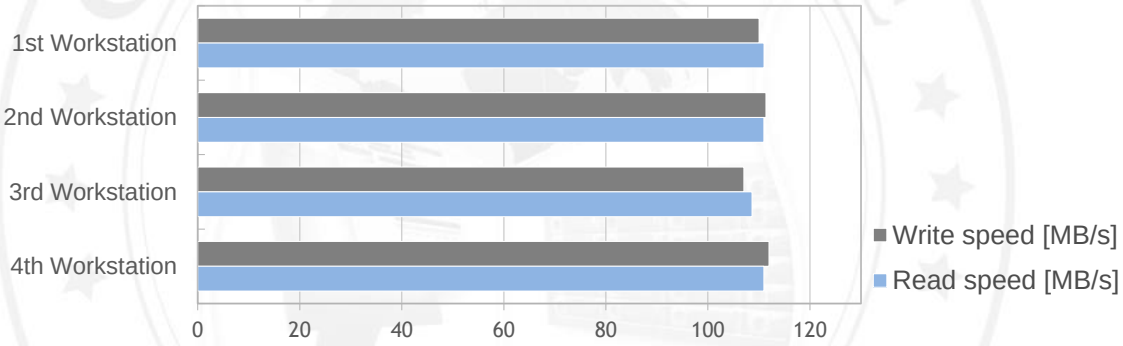

FIGURE 7: Balance-alb bonding mode performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)

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	621.75	380.60	passed
2nd Workstation	633.15	420.81	passed

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

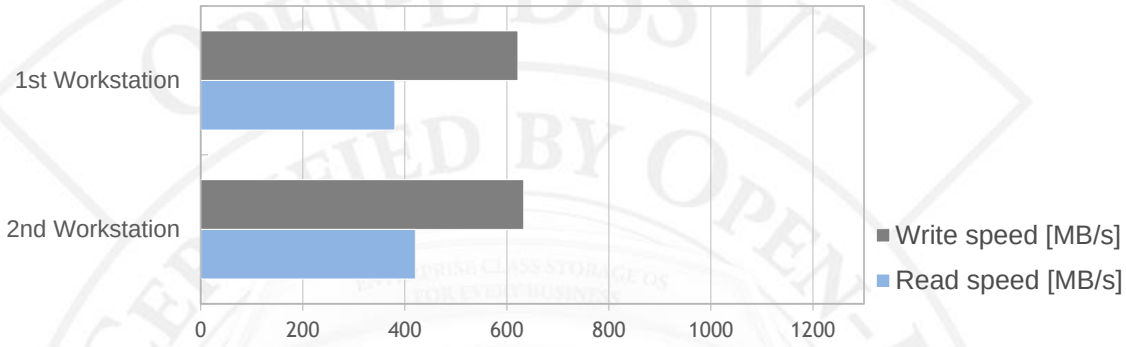

FIGURE 8: Balance-alb bonding mode performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	111.86	64.25	passed
2nd Workstation	111.90	81.96	passed
3rd Workstation	111.87	82.24	passed
4th Workstation	111.97	82.56	passed

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

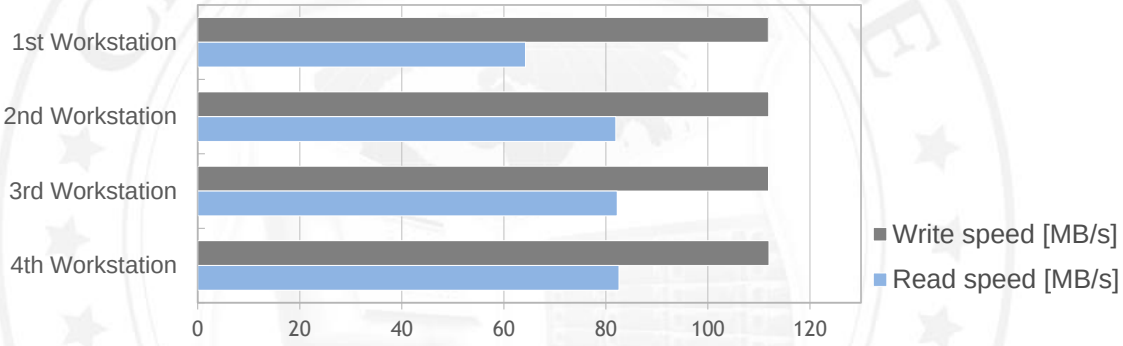

FIGURE 9: Balance-rr bonding mode performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)

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	632.04	188.17	passed
2nd Workstation	651.58	239.21	passed

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

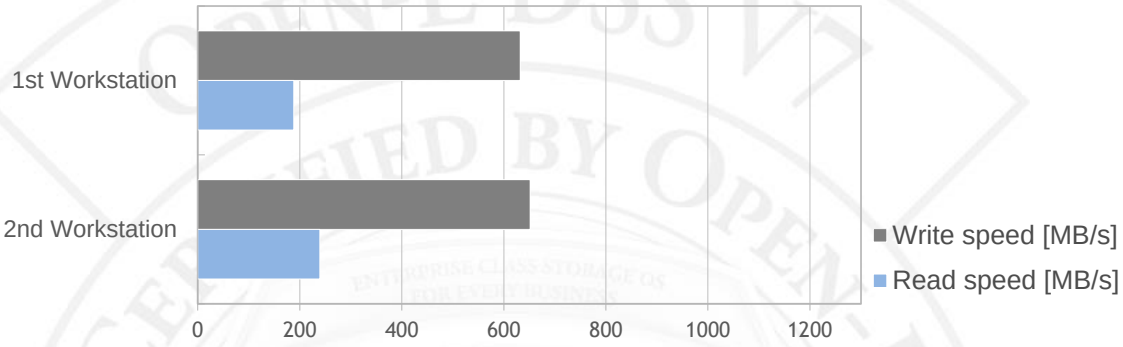

FIGURE 10: Balance-rr bonding mode performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	108.59	111.83	passed

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

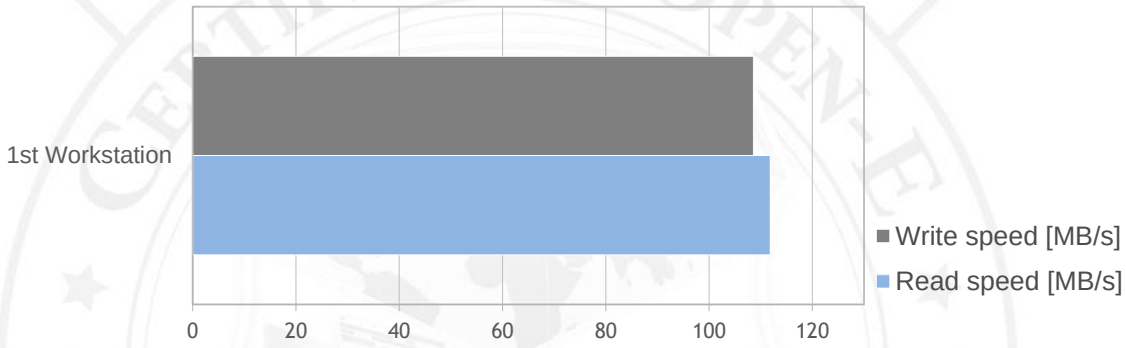

FIGURE 11: Single NIC performance test results chart for Intel I350 Quad Port Ethernet Controller (on-board)

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	550,79	473,20	passed

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

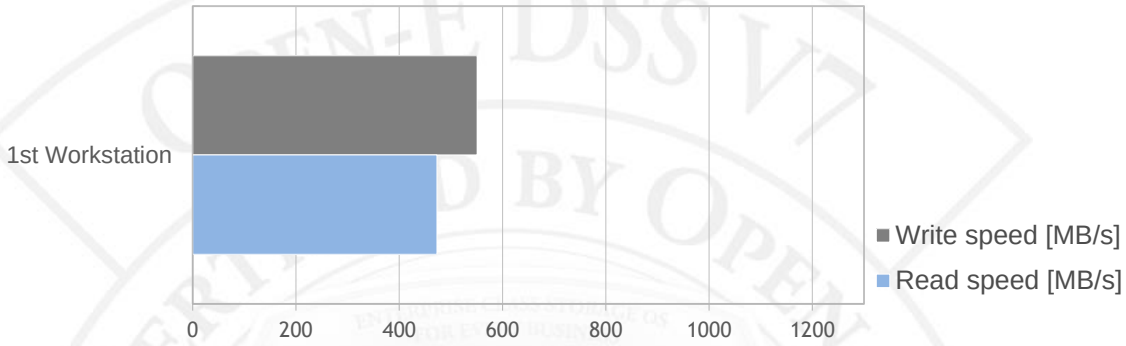

FIGURE 12: Single NIC performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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, 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

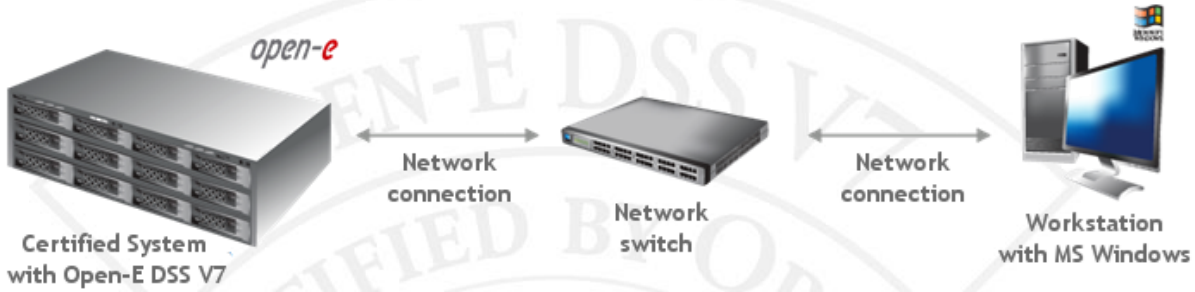

FIGURE 13: Network test topology for RAID testing

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	51.54	71.03	passed
32	280.53	337.10	passed
64	351.86	397.70	passed
128	424.78	400.05	passed
256	529.00	441.19	passed
512	523.90	470.80	passed
1024	529.93	484.65	passed
4096	536.78	512.17	passed

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

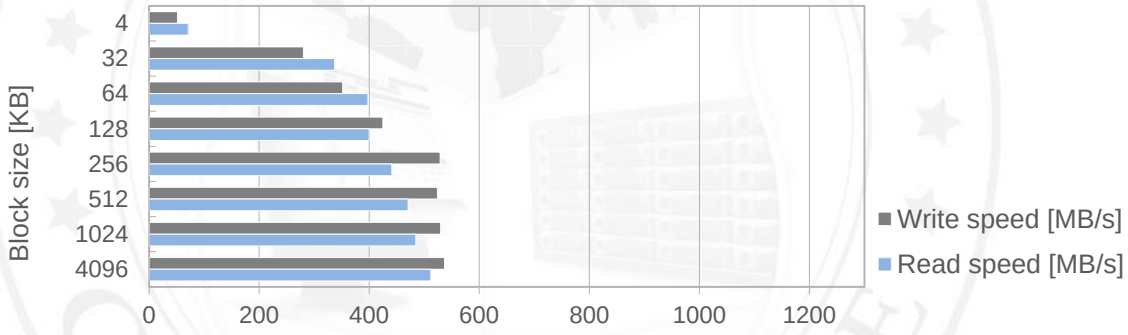

FIGURE 14: RAID0 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	49.76	63.80	passed
32	270.94	338.10	passed
64	322.58	392.47	passed
128	262.22	397.79	passed
256	370.07	478.52	passed
512	421.79	453.41	passed
1024	522.62	490.99	passed
4096	534.06	501.17	passed

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

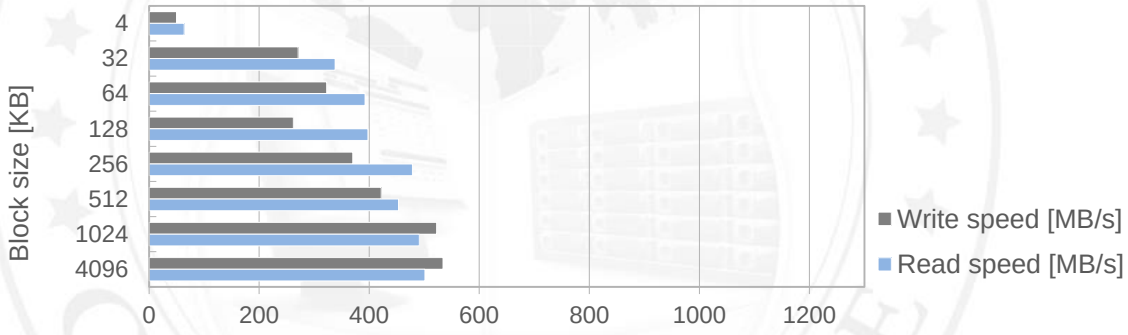

FIGURE 15: RAID5 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	49.12	49.12	passed
32	271.39	271.39	passed
64	336.67	336.67	passed
128	329.05	329.05	passed
256	413.04	413.04	passed
512	448.54	448.54	passed
1024	508.08	508.08	passed
4096	540.17	540.17	passed

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

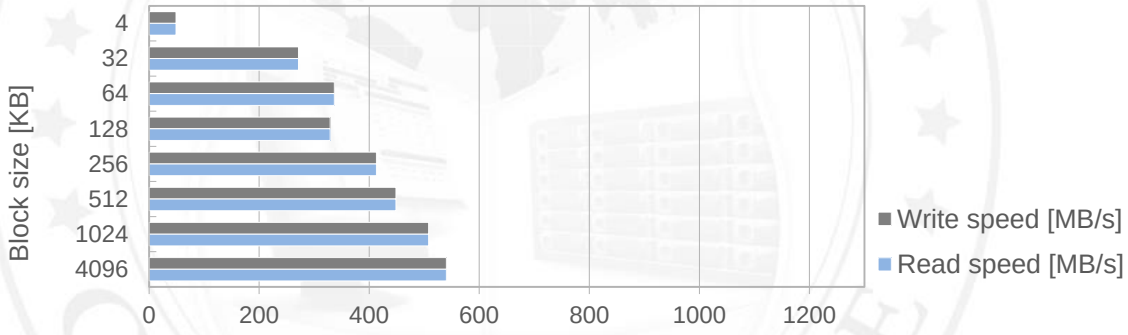

FIGURE 16: RAID6 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

Hardware 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	51.39	70.31	passed
32	278.46	324.75	passed
64	342.10	390.76	passed
128	412.48	417.14	passed
256	523.80	461.48	passed
512	512.62	448.20	passed
1024	545.75	455.75	passed
4096	537.89	456.19	passed

TABLE 18: RAID50 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2

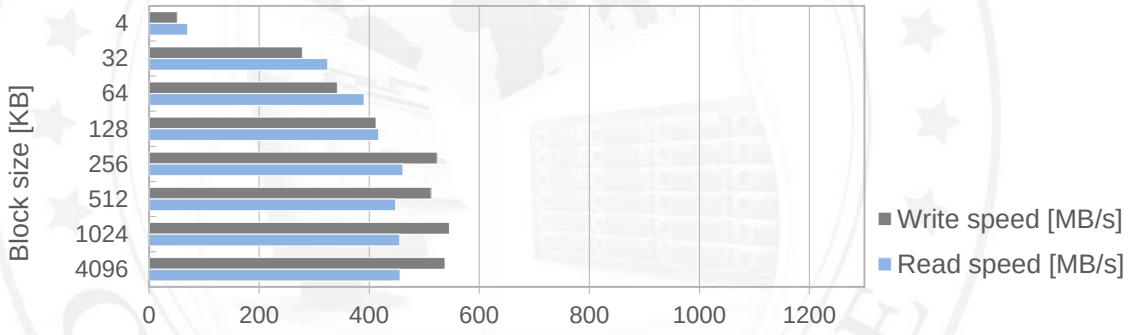

FIGURE 17: RAID50 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	50.02	67.38	passed
32	266.47	334.45	passed
64	331.17	343.42	passed
128	278.07	349.50	passed
256	332.74	429.24	passed
512	409.18	431.88	passed
1024	495.64	445.75	passed
4096	533.19	458.00	passed

TABLE 19: RAID60 performance test results table for Intel Ethernet Converged Network Adapter X520-SR2

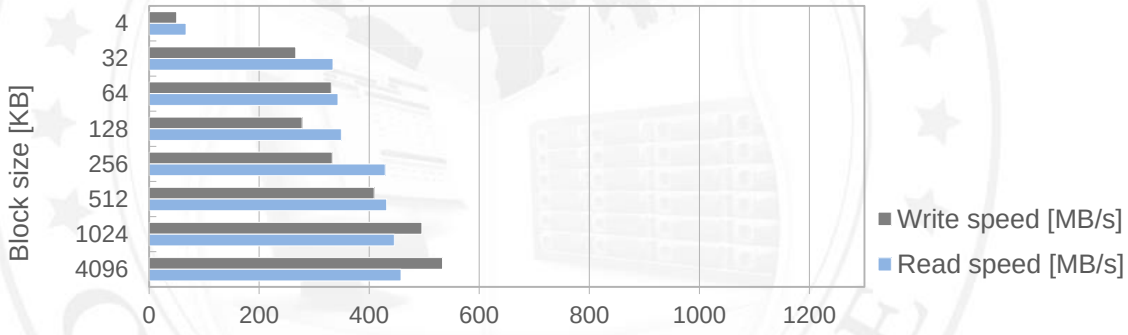

FIGURE 18: RAID60 performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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.

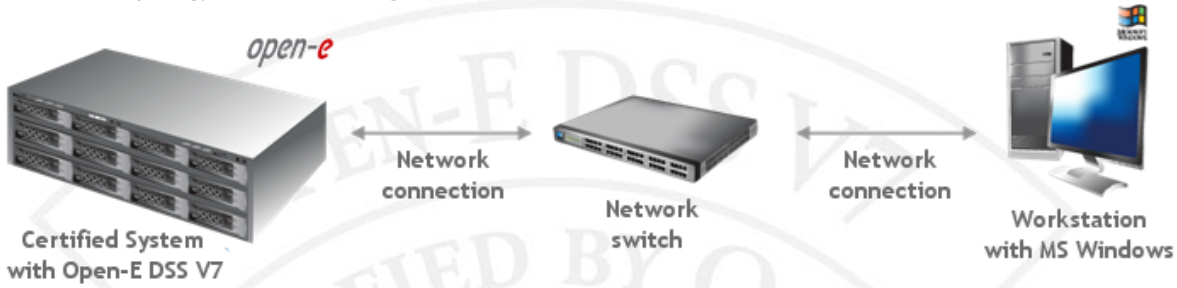

FIGURE 19: Network topology for NAS testing

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	98,26	100,08	passed
32	471,61	612,58	passed
64	439,23	431,80	passed
128	433,35	455,48	passed
256	444,44	469,60	passed
512	455,04	478,53	passed
1024	454,48	479,83	passed
4096	459,83	486,03	passed

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

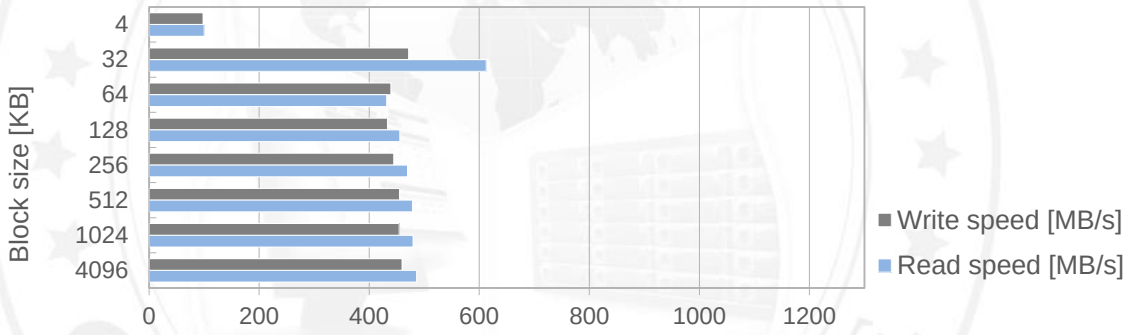

FIGURE 20: SMB performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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.

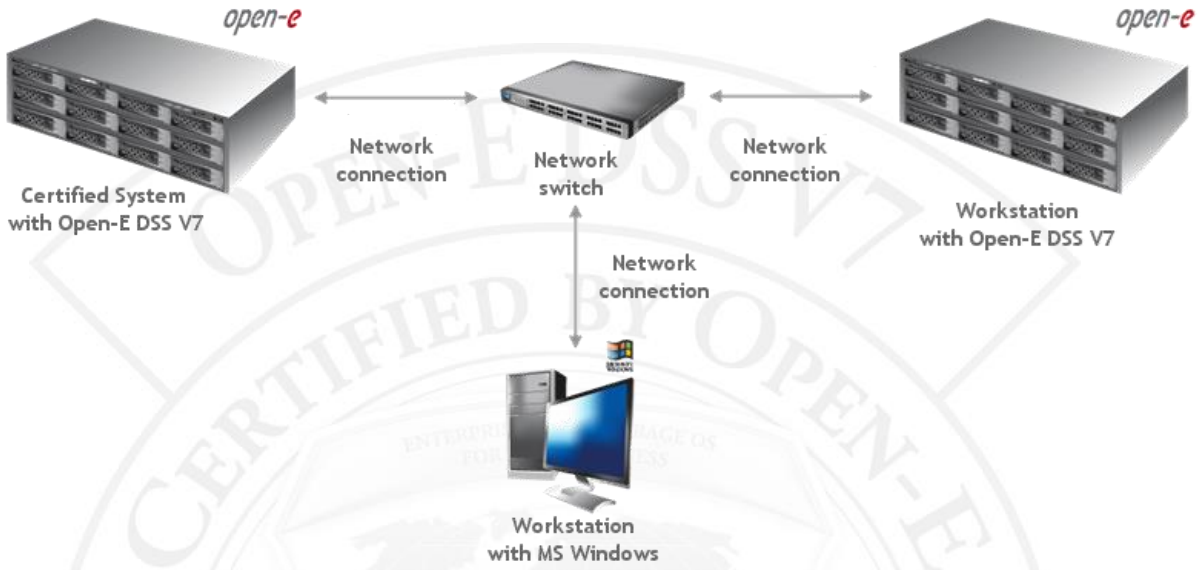

FIGURE 21: Network topology for iSCSI Initiator testing

iSCSI Target test topology

Network topology for iSCSI Target testing is shown below.

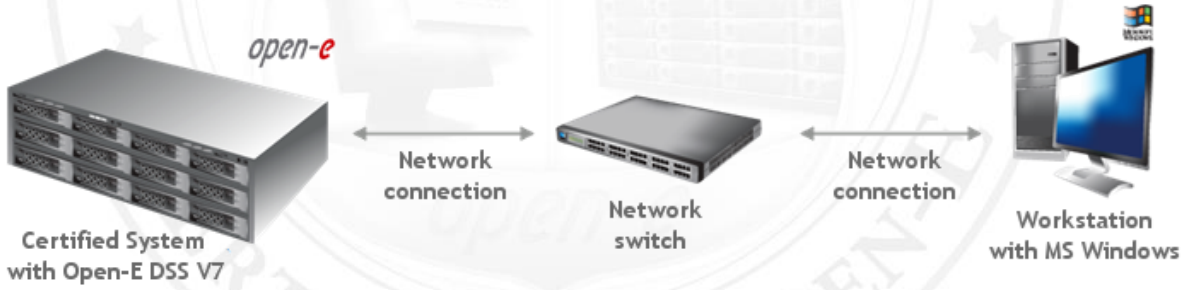

FIGURE 22: Network topology for iSCSI Target testing

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	116.26	113.50	passed
32	692.66	668.47	passed
64	1116.05	531.36	passed
128	1113.97	547.64	passed
256	1115.02	514.92	passed
512	1099.08	490.75	passed
1024	1115.47	498.82	passed
4096	1115.18	493.92	passed

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

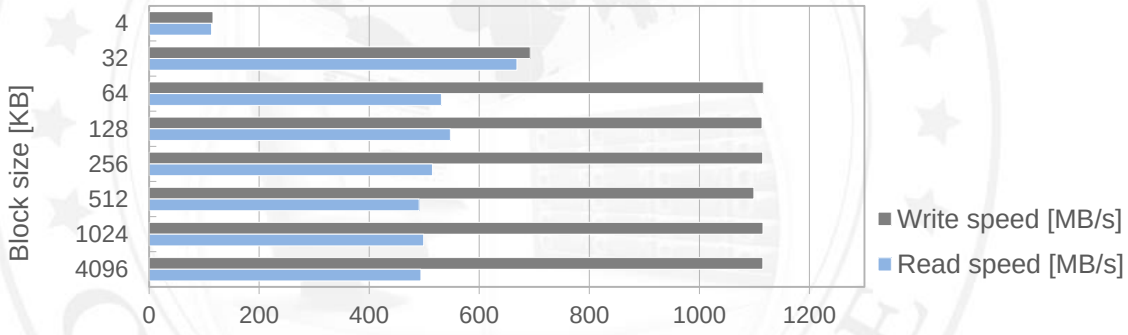

FIGURE 23: iSCSI Initiator performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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	49.55	71.20	passed
32	292.21	339.75	passed
64	348.63	417.52	passed
128	429.44	429.80	passed
256	531.64	483.98	passed
512	539.70	463.84	passed
1024	532.58	496.48	passed
4096	546.57	478.18	passed

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

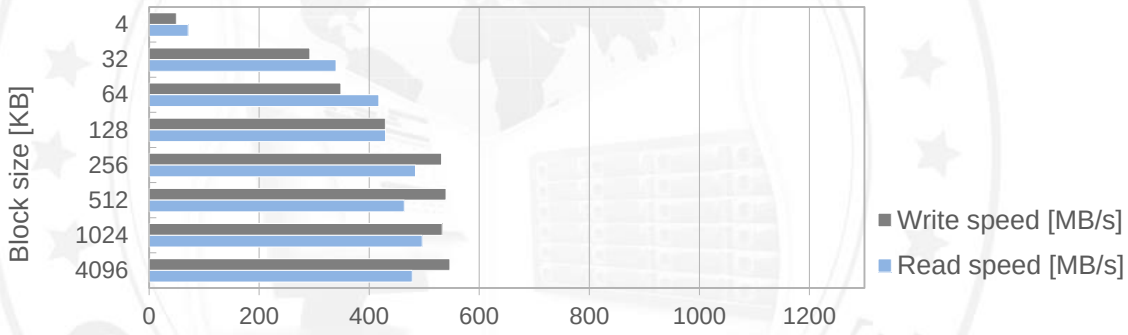

FIGURE 24: iSCSI Target performance test results chart for Intel Ethernet Converged Network Adapter X520-SR2

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.

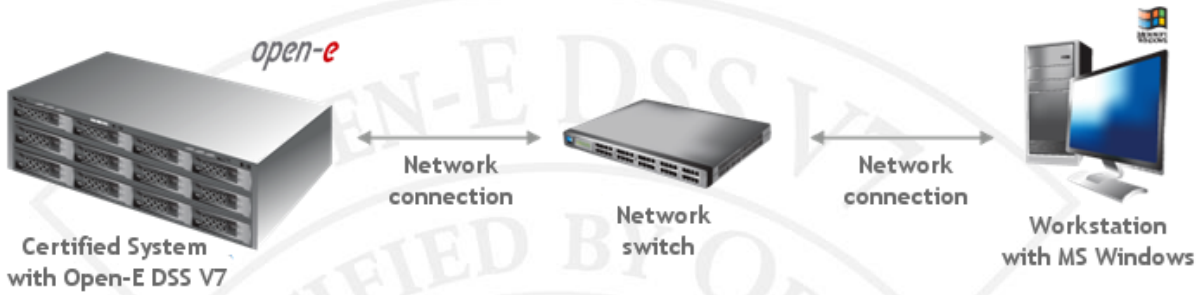

FIGURE 25: Network topology for SSD Cache testing

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	16189.16	passed
2	16972.43	passed
4	16444.78	passed

TABLE 23: SSD Cache with real life pattern test results table for Intel Ethernet Converged Network Adapter X520-SR2

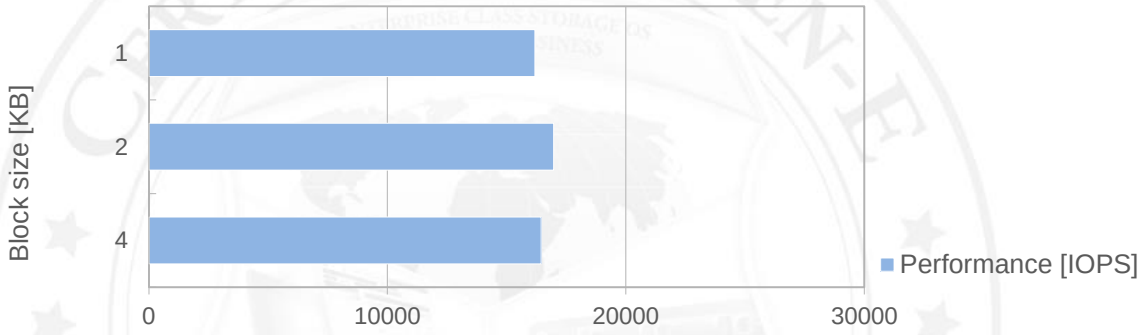

FIGURE 26: SSD Cache with real life pattern test results chart for Intel Ethernet Converged Network Adapter X520-SR2

SSD Cache with random read/write pattern test

1. 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.

2. Test results for SSD cache with random read/write pattern and 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	18835.14	25815.87	passed
2	17714.63	25016.70	passed
4	17371.51	23644.02	passed

TABLE 24: SSD cache with random read/write pattern test results table for Intel Ethernet Converged Network Adapter X520-SR2

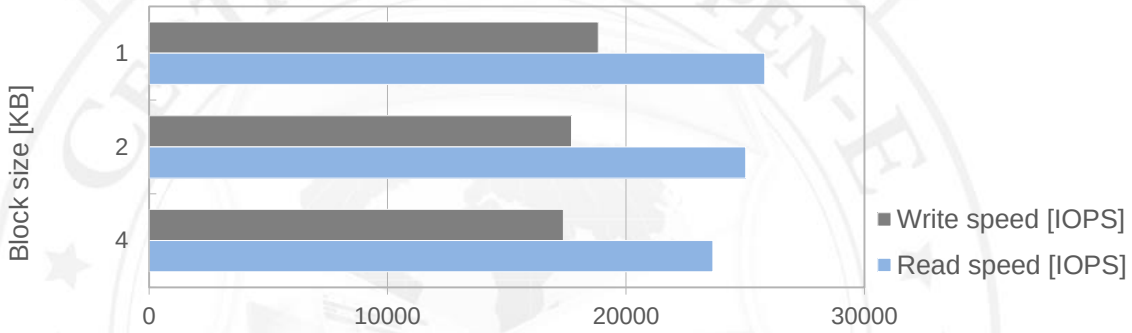

FIGURE 27: SSD cache with random read/write pattern test results chart for Intel Ethernet Converged Network Adapter X520-SR2