Dell PowerEdge R720xd storage system

Executive summary

After performing all tests, the Dell PowerEdge R720xd system has been officially certified according to the Open-E Hardware Certification Program.

During the tests, it was found that the system is functional and efficient. With the Open-E DSS V7 operating system installed, the Dell PowerEdge R720xd 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 Dell PowerEdge R720xd a great NAS filer solution:

- Twenty-four high class SAS hard drives for failure-free work and fast random data access.
- Plenty of RAM for caching.
- Hardware RAID5, RAID6, RAID50 and RAID60 for fault tolerance and the most efficient use of available disk space.

✓ Storage for databases

The following features make the Dell PowerEdge R720xd great storage for a database:

- Two 1GbE interfaces for a fast MPIO network connection to a target.
- Two 10GbE interfaces which can be aggregated for improved fault tolerance and increased performance for fast database connection.
- Redundant power supply for system reliability.
- Hardware RAID10 for high performance, best I/Ops ratio and data safety.
- Twenty-four high class enterprise SAS drives ensure fast random data access and reliability.
- Huge amount of RAM that may be used for caching.

✓ Storage for virtualization

For this application the following can be used:

- HW RAID5 RAID6, RAID50 or RAID60 for high performance and data safety.
- Two 10GbE interfaces for efficient network connections to virtualization systems.
- Two 1GbE interfaces for fast MPIO connection.
- Redundant power supply for system reliability.
- Twenty-four fast, high class SAS hard drives for good virtual machine density.

Certification notes

Certification was performed according to the Open-E Hardware Certification Program Guide 2.0.

Dell PowerEdge R720xd hardware components

Technical specifications about the certified system are listed below:

Model	Dell PowerEdge R720xd
Operating system	Open-E DSS V7 build 6806
Enclosure/chassis	PowerEdge R720xd
CPU	2x Intel Xeon E5-2640 2.50 GHz
Motherboard	Dell Power Edge R720xd based on Intel C600
Memory	16x Hynix 8GB PC3-10600 DDR3-1333MHz
Network	Intel Ethernet X540 DP 10GbE BT + I350 1GbE BT DP Network Daughter Card
HW RAID	Perc H710P Min Integrated RAID Controller
Hard disk drives	22x Dell Savvio 10K.5 300GB SAS ST9300605SS
Hard disk drives	2x Dell Savvio 15K.3 146GB SAS ST9146853SS

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

Dell PowerEdge R720xd photos

FIGURE 1: Front photo

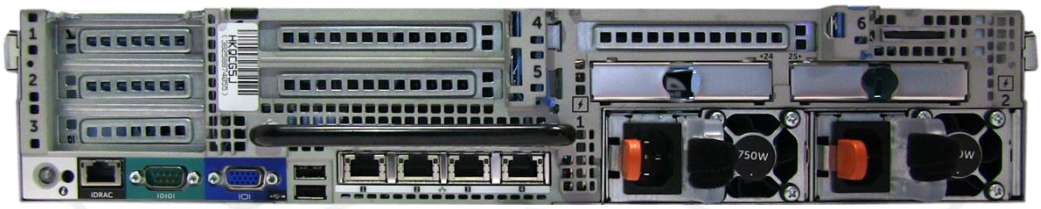

FIGURE 2: Rear photo

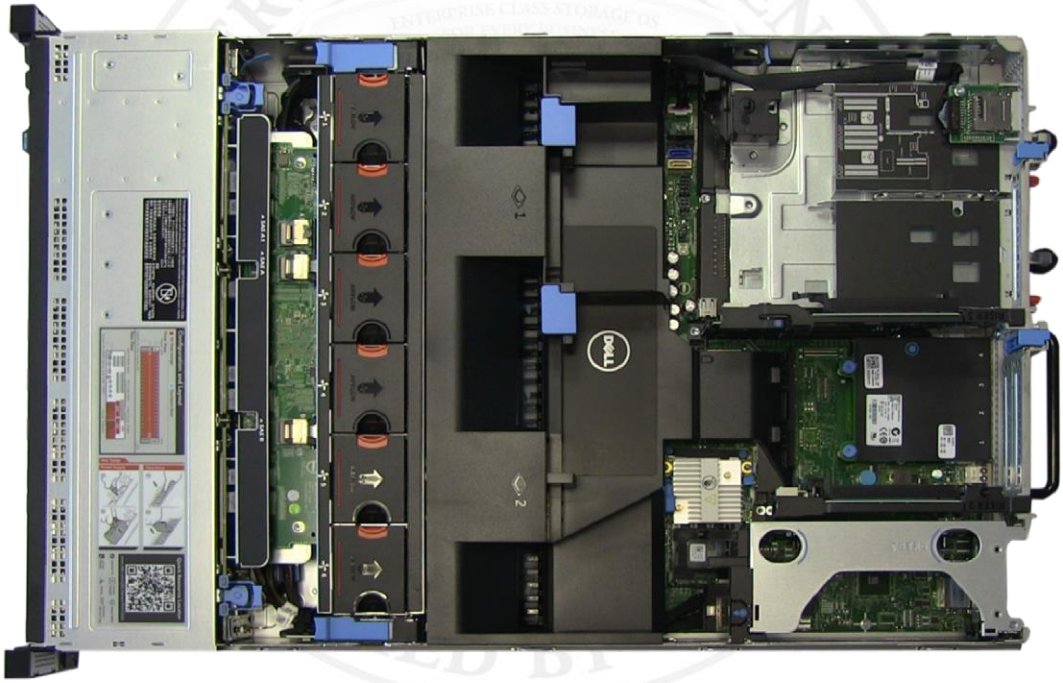

FIGURE 3: Top photo

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	Intel Tech 19" IPC - 4088 4U
Motherboard	Asus Workstation P8B-E / 4L
CPU	Intel Xeon Processor E3
Memory	4x 4GB 1333MHz DDR3 Kingston
Network	Intel Ethernet Server Adapter X520-SR2
Network	Intel 82574L Gigabit (on board)
HW RAID	LSI SAS9240-8i
Hard disk drives	9x Hitachi 1TB SATA

TABLE 2: Hardware components of first Workstation with MS Windows

Model	Custom
Operating system	MS Windows Server 2008 R2
Enclosure/chassis	Intel Tech 19" IPC - 4088 4U
Motherboard	Asus Workstation P8B-E / 4L
CPU	Intel Xeon Processor E3
Memory	4x 4GB 1333MHz DDR3 Kingston
Network	Intel Ethernet Server Adapter X520-SR2
Network	Intel 82574L Gigabit (on board)
HW RAID	LSI SAS9240-8i
Hard disk drives	1x Hitachi 1TB SATA

TABLE 3: Hardware components of second Workstation with MS Windows

Model	PowerEdge R720xd
Operating system	Open-E DSS V7 build 6806
Enclosure/chassis	PowerEdge R720xd
CPU	2x Intel Xeon E5-2640 2.50 GHz
Motherboard	Dell Power Edge R720xd based on Intel C600
Memory	16x Hynix 8GB PC3-10600 DDR3-1333MHz
Network	Intel Ethernet X540 DP 10Gb BT + I350 1Gb BT DP Network Daughter Card
HW RAID	Perc H710P Min Integrated RAID Controller
Hard disk drives	22x Dell Savvio 10K.5 300GB SAS ST9300605SS
Hard disk drives	2x Dell Savvio 15K.3 146GB SAS ST9146853SS

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

Model	Dell PowerConnect 6224
Description	24-ports 1GbE managed network switch

TABLE 5: Network switch details for 1GbE connections

Model	Dell PowerConnect 8024F
Description	24-ports 10GbE managed network switch

TABLE 6: Network switch details for 10 GbE connections

Administration functionality

The following functionality has been tested.

Drive identifier	OK
Power button	OK
Front and rear LEDs	OK

TABLE 7: 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.

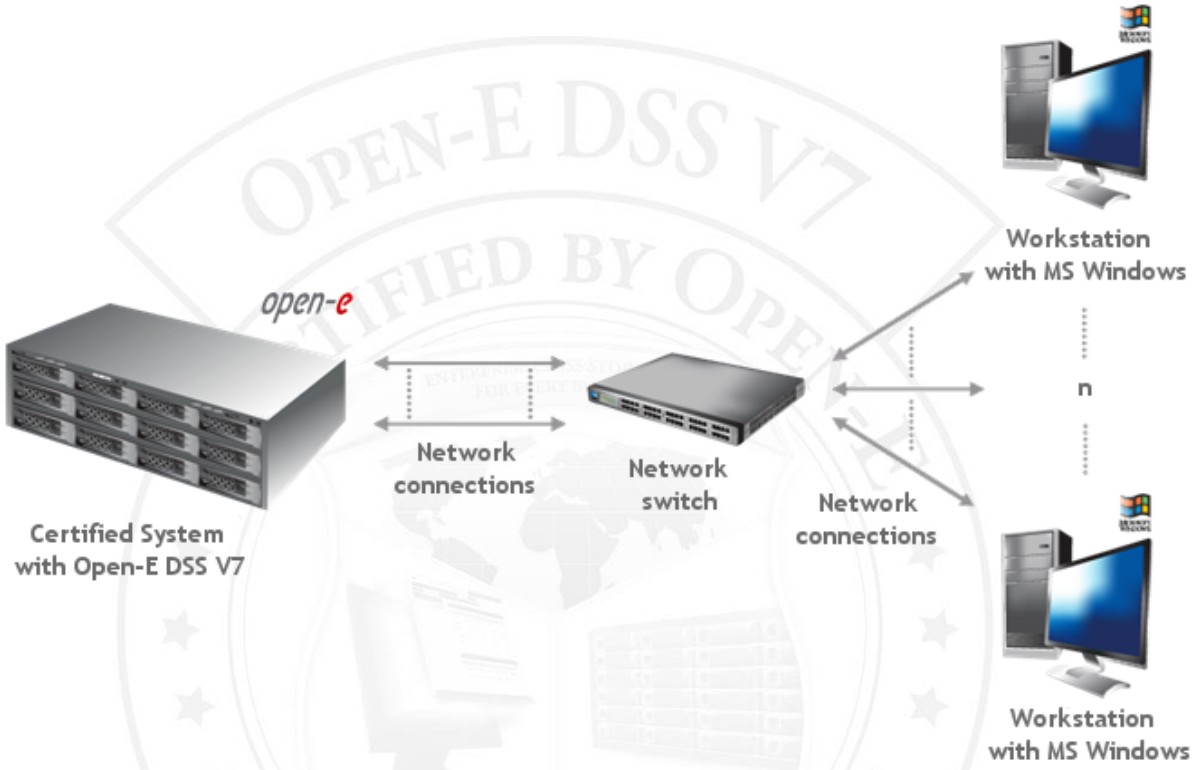

FIGURE 4: Network topology for Network testing

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 Ethernet I350 1GbE BT DP Network Controller

802.3ad bonding mode performance test results			
NIC model	Intel Ethernet I350 1GbE BT DP Network Controller		
Workstations with MS Windows	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
1st Workstation	106.97	50.78	passed
2nd Workstation	108.53	63.38	passed

TABLE 8: 802.3ad bonding mode performance test results table for Intel Ethernet I350 1GbE BT DP Network Controller

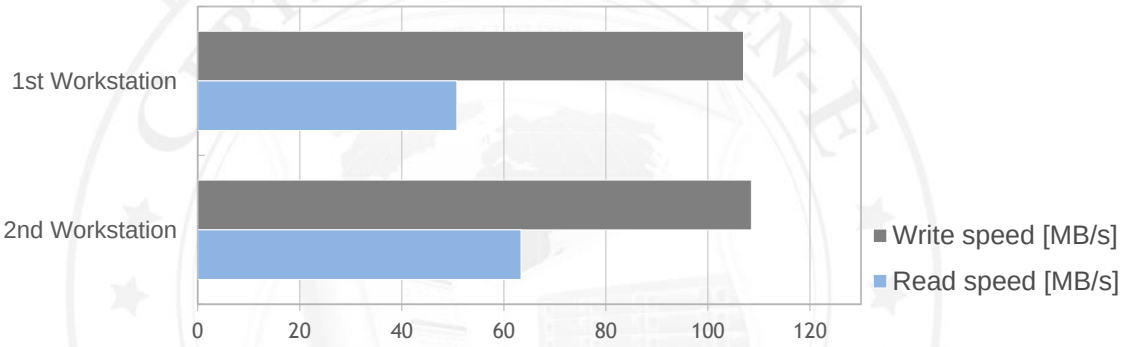

FIGURE 5: 802.3ad bonding mode performance test results chart for Intel Ethernet I350 1GbE BT DP Network Controller

3. Test results for 802.3ad bonding mode test performed on Intel Ethernet X540 DP 10GbE BT Network Controller

802.3ad bonding mode performance test results			
NIC model	Intel Ethernet X540 DP 10GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	673.43	234.73	passed
2nd Workstation	651.85	267.34	passed

TABLE 9: 802.3ad bonding mode performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

FIGURE 6: 802.3ad bonding mode performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 Ethernet I350 1GbE BT DP Network Controller

Balance-alb bonding mode performance test results			
NIC model	Intel Ethernet I350 1GbE BT DP Network Controller		
Workstations with MS Windows	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
1st Workstation	108.17	111.64	passed
2nd Workstation	108.05	111.62	passed

TABLE 10: *Balance-alb bonding mode performance test results table for Intel Ethernet I350 1GbE BT DP Network Controller*

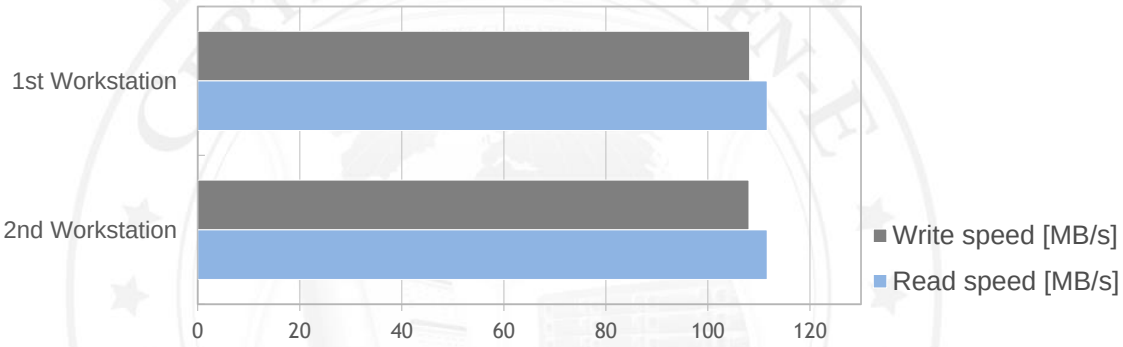

FIGURE 7: *Balance-alb bonding mode performance test results chart for Intel Ethernet I350 1GbE BT DP Network Controller*

3. Test results for Balance-alb bonding mode test performed Intel Ethernet X540 DP 10GbE BT Network Controller

Balance-alb bonding mode performance test results			
NIC model	Intel Ethernet X540 DP 10GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	810.34	463.48	passed
2nd Workstation	829.74	454.61	passed

TABLE 11: Balance-alb bonding mode performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

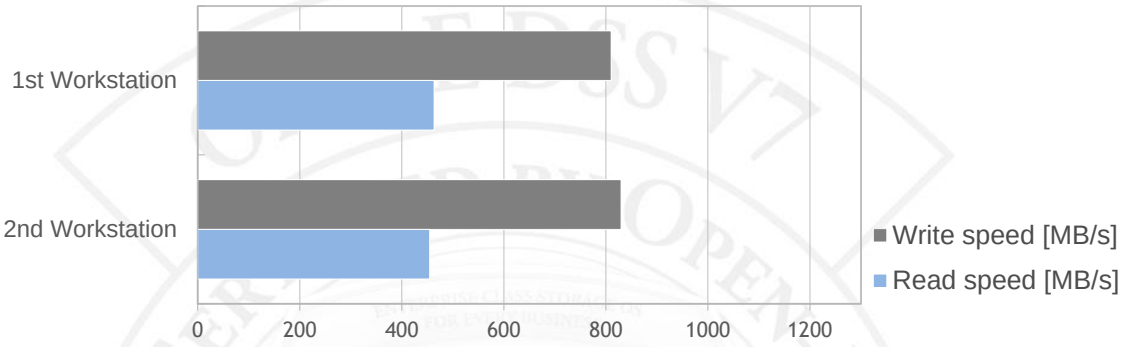

FIGURE 8: Balance-alb bonding mode performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 Ethernet I350 1GbE BT DP Network Controller

Balance-rr bonding mode performance test results			
NIC model	Intel Ethernet I350 1GbE BT DP Network Controller		
Workstations with MS Windows	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
1st Workstation	108.57	66.54	passed
2nd Workstation	108.42	66.83	passed

TABLE 12: Balance-rr bonding mode performance test results table for Intel Ethernet I350 1GbE BT DP Network Controller

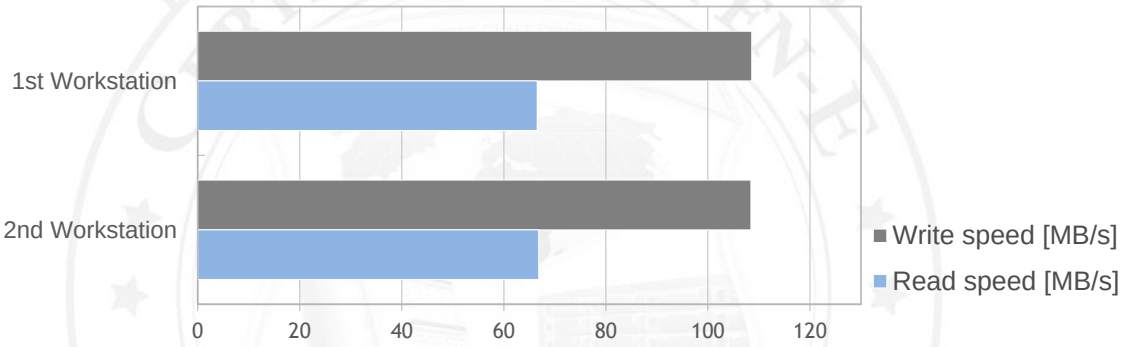

FIGURE 9: Balance-rr bonding mode performance test results chart for Intel Ethernet I350 1GbE BT DP Network Controller

3. Test results for Balance-rr bonding mode test performed on Intel Ethernet X540 DP 10GbE BT Network Controller

Balance-rr bonding mode performance test results			
NIC model	Intel Ethernet X540 DP 10GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	557.88	224.49	passed
2nd Workstation	558.31	223.21	passed

TABLE 13: Balance-rr bonding mode performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

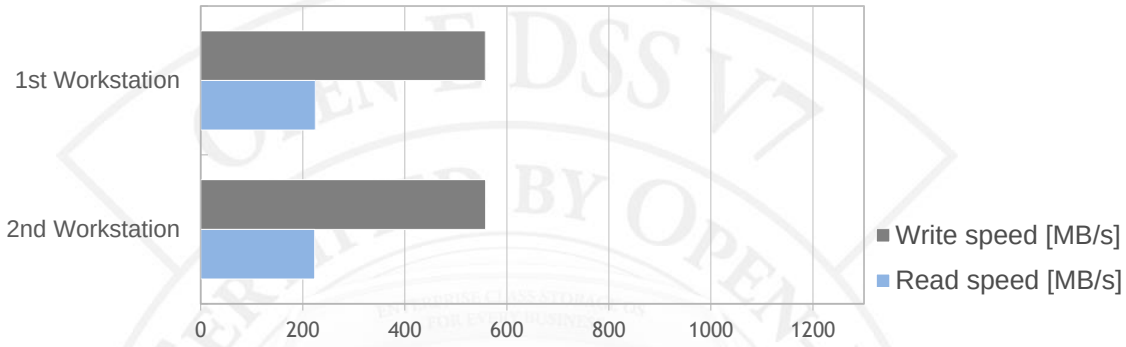

FIGURE 10: Balance-rr bonding mode performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 Ethernet I350 1GbE BT DP Network Controller

Single NIC performance test results			
NIC model	Intel Ethernet I350 1GbE BT DP Network Controller		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	108.06	112.04	passed

TABLE 14: Single NIC performance test results table for Intel Ethernet I350 1GbE BT DP Network Controller

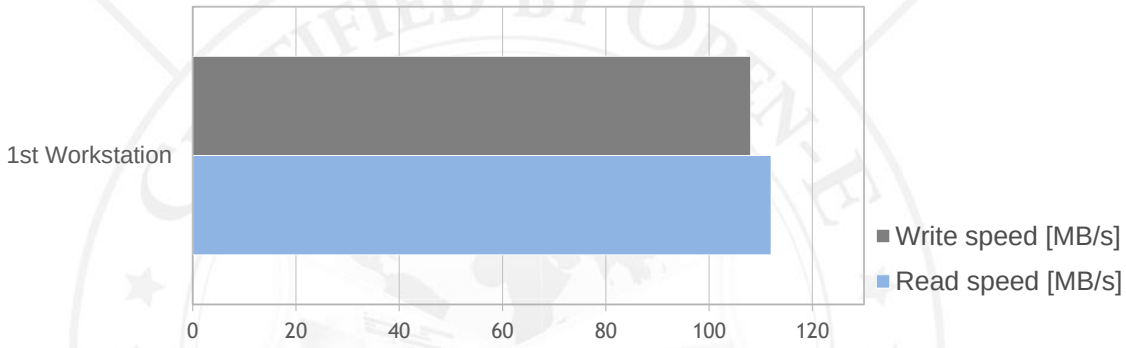

FIGURE 11: Single NIC performance test results chart for Intel Ethernet I350 1GbE BT DP Network Controller

3. Test results for single NIC test performed on Intel Ethernet X540 DP 10GbE BT Network Controller

Single NIC performance test results			
NIC model	Intel Ethernet X540 DP 10GbE BT Network Controller		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	653.44	509.58	passed

TABLE 15: Single NIC performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

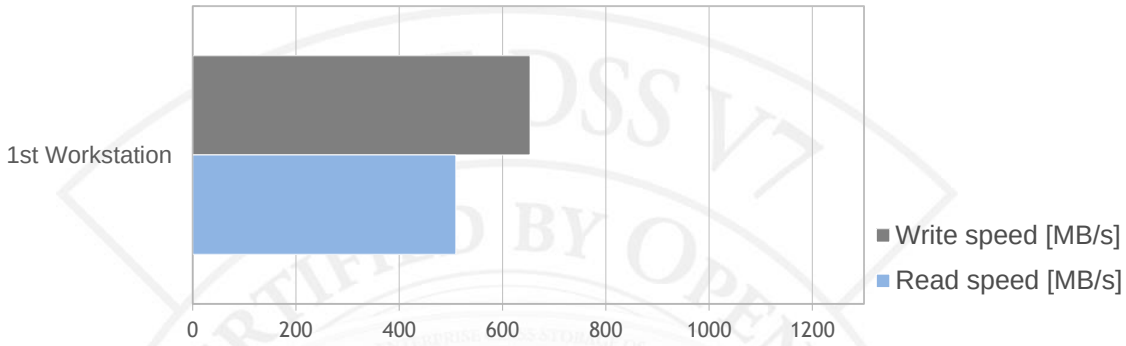

FIGURE 12: Single NIC performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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

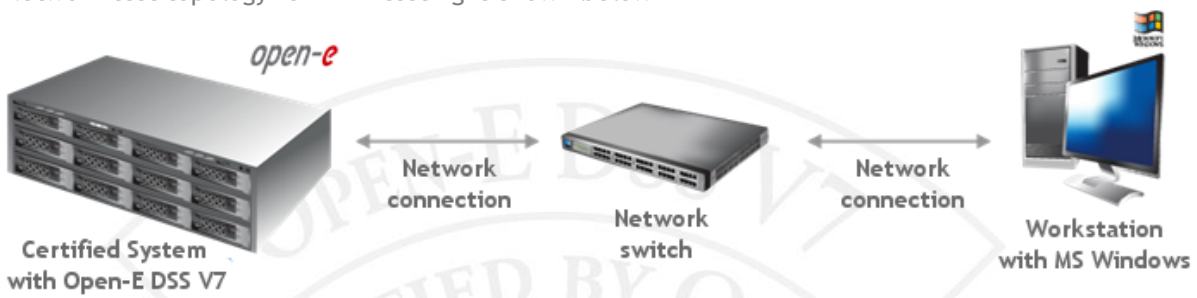

FIGURE 13: Network test topology for RAID testing

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 X540 DP 10GbE BT Network Controller

RAID0 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	20.40	39.84	passed
32	108.48	277.87	passed
64	217.98	383.03	passed
128	341.53	440.38	passed
256	446.25	583.09	passed
512	494.77	608.00	passed
1024	500.56	507.45	passed
4096	506.48	504.79	passed

TABLE 16: RAID0 performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

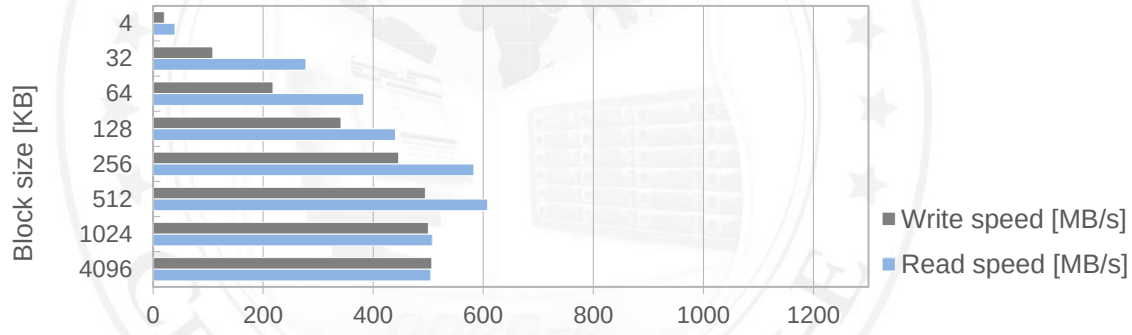

FIGURE 14: RAID0 performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 X540 DP 10GbE BT Network Controller

RAID5 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	14.40	28.04	passed
32	76.18	263.65	passed
64	163.52	393.29	passed
128	255.86	435.65	passed
256	367.51	598.72	passed
512	425.76	616.85	passed
1024	461.66	515.12	passed
4096	534.62	512.92	passed

TABLE 17: RAID5 performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

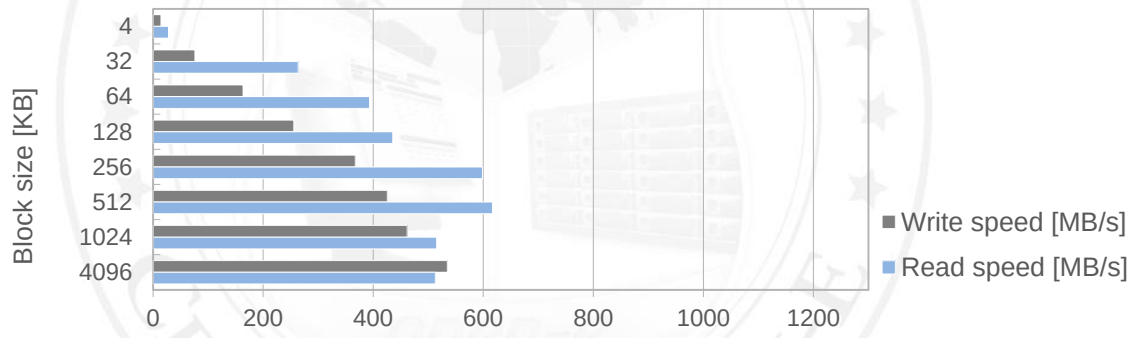

FIGURE 15: RAID5 performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 X540 DP 10GbE BT Network Controller

RAID6 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	5.78	18.60	passed
32	31.79	265.89	passed
64	73.10	384.41	passed
128	117.49	469.49	passed
256	183.74	554.32	passed
512	264.60	554.20	passed
1024	348.94	510.55	passed
4096	514.31	519.41	passed

TABLE 18: RAID6 performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

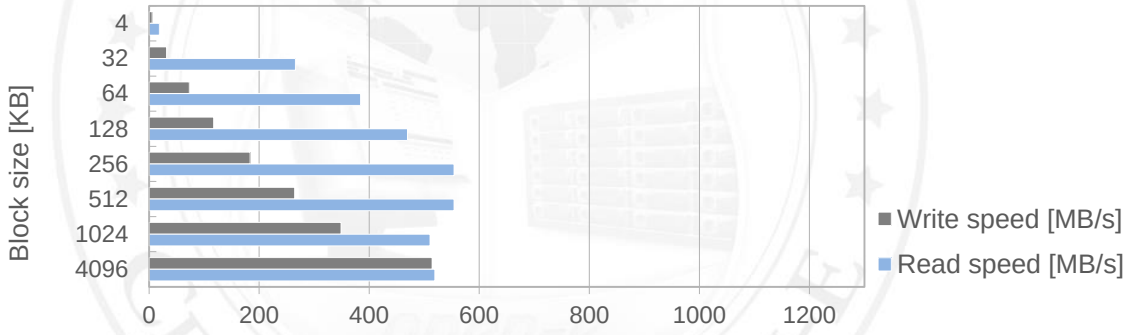

FIGURE 16: RAID6 performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 X540 DP 10GbE BT Network Controller

RAID10 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	11.72	32.80	passed
32	66.59	265.23	passed
64	138.96	387.22	passed
128	222.43	447.90	passed
256	306.77	584.26	passed
512	362.07	587.51	passed
1024	436.86	508.98	passed
4096	503.71	504.00	passed

TABLE 19: RAID10 performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

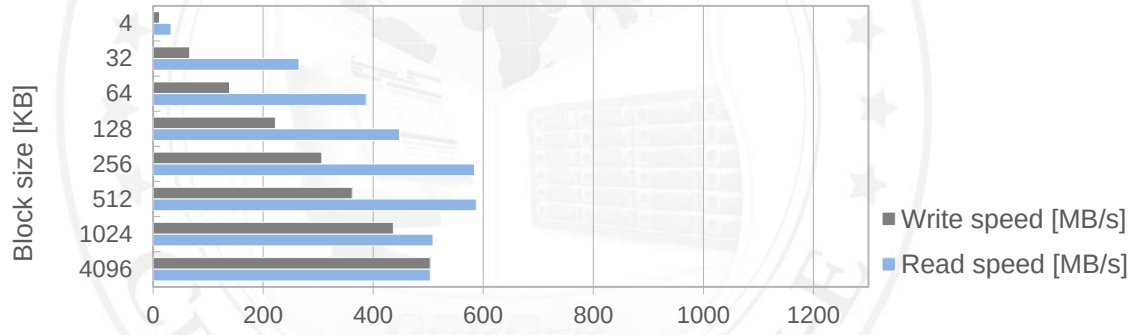

FIGURE 17: RAID10 performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 X540 DP 10GbE BT Network Controller

RAID50 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	15.68	33.38	passed
32	82.47	273.00	passed
64	163.68	405.00	passed
128	259.87	454.77	passed
256	382.59	602.13	passed
512	436.11	626.23	passed
1024	475.03	517.33	passed
4096	524.42	522.97	passed

TABLE 20: RAID50 performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

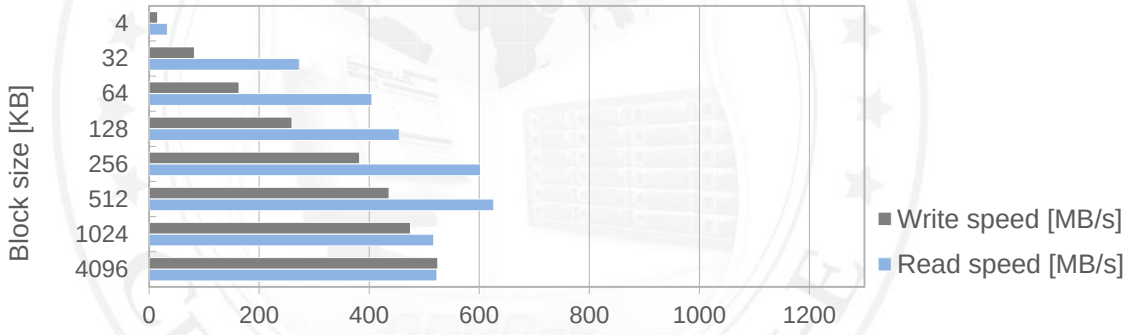

FIGURE 18: RAID50 performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 X540 DP 10GbE BT Network Controller

RAID60 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	12.22	32.69	passed
32	70.57	270.01	passed
64	159.03	390.62	passed
128	219.26	462.95	passed
256	269.87	552.14	passed
512	332.33	585.04	passed
1024	394.46	510.38	passed
4096	511.38	513.98	passed

TABLE 21: RAID60 performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

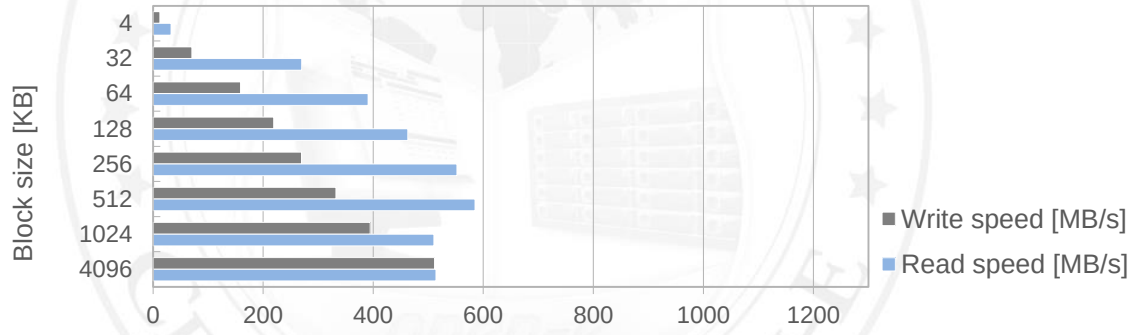

FIGURE 19: RAID60 performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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.

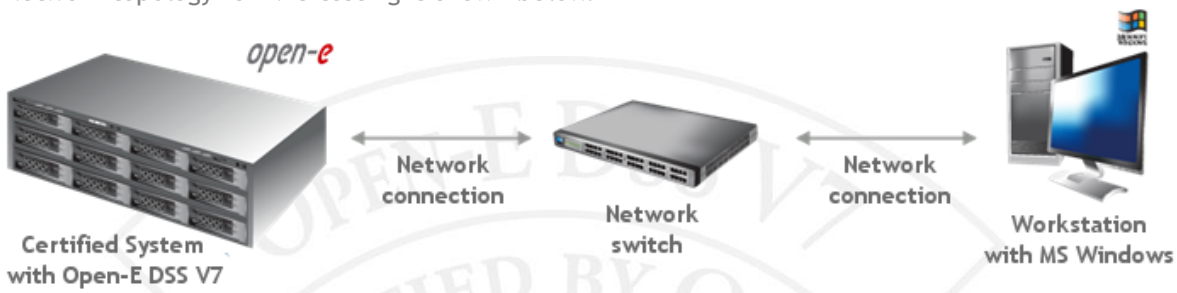

FIGURE 20: Network topology for NAS testing

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 X540 DP 10GbE BT Network Controller

SMB performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	62.01	61.79	passed
32	400.01	355.25	passed
64	684.86	372.66	passed
128	993.74	453.40	passed
256	1115.31	508.25	passed
512	1107.12	525.05	passed
1024	1105.30	518.57	passed
4096	1115.41	517.94	passed

TABLE 22: SMB performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

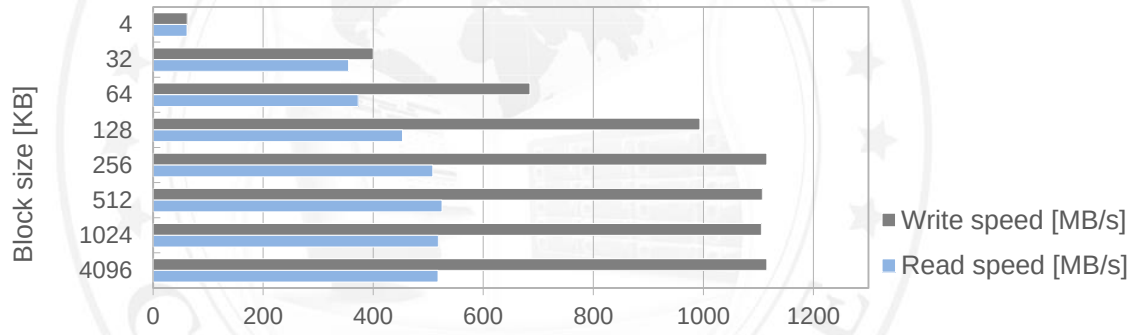

FIGURE 21: SMB performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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.

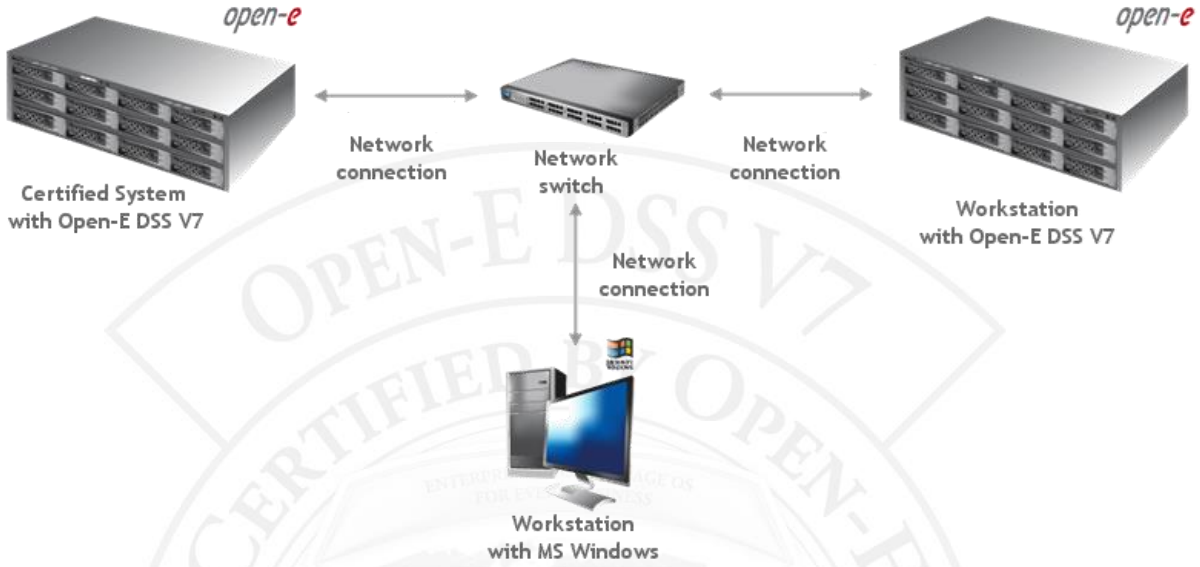

FIGURE 22: Network topology for iSCSI Initiator testing

iSCSI Target test topology

Network topology for iSCSI Target testing is shown below.

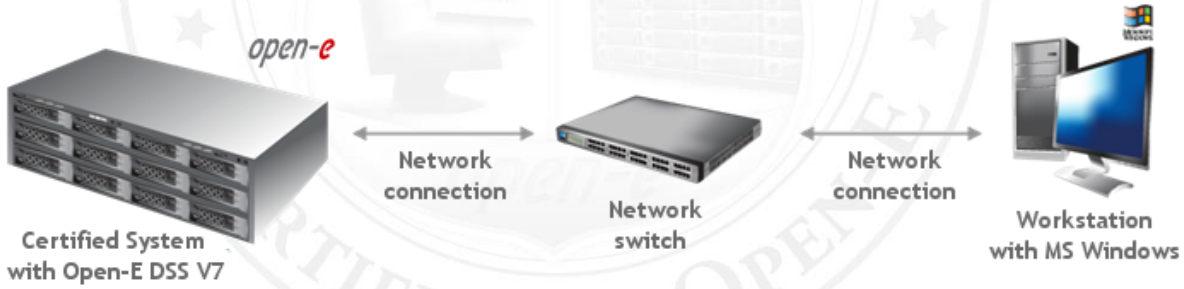

FIGURE 23: Network topology for iSCSI Target testing

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 X540 DP 10GbE BT Network Controller

iSCSI Initiator performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	61.12	59.78	passed
32	372.59	354.07	passed
64	594.78	360.30	passed
128	702.74	441.80	passed
256	780.92	499.26	passed
512	706.45	523.40	passed
1024	870.34	517.56	passed
4096	883.10	515.62	passed

TABLE 23: iSCSI Initiator performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

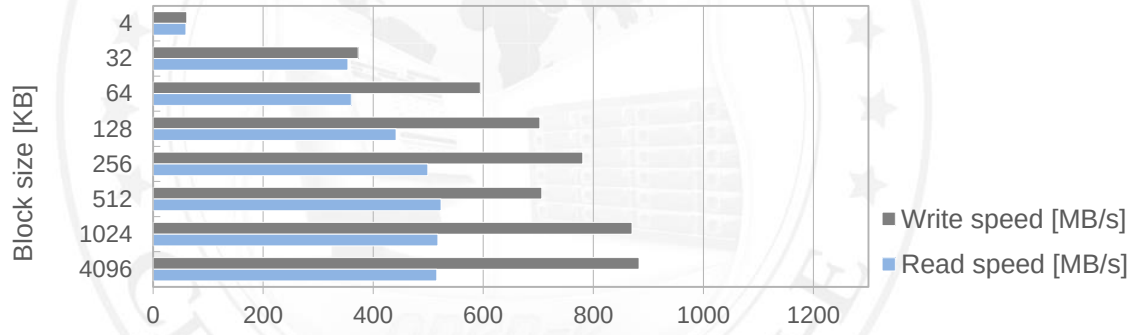

FIGURE 24: iSCSI Initiator performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller

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 X540 DP 10GbE BT Network Controller

iSCSI Target performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	19.28	39.75	passed
32	112.84	275.15	passed
64	219.24	387.21	passed
128	347.59	449.75	passed
256	471.67	551.35	passed
512	517.05	619.13	passed
1024	533.90	518.44	passed
4096	529.62	517.86	passed

TABLE 24: iSCSI Target performance test results table for Intel Ethernet X540 DP 10GbE BT Network Controller

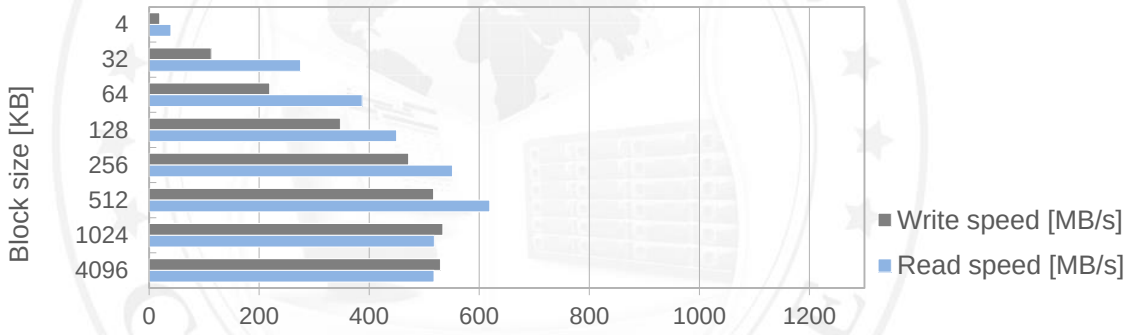

FIGURE 25: iSCSI Target performance test results chart for Intel Ethernet X540 DP 10GbE BT Network Controller