Dell PowerEdge R720 storage system

Executive summary

After performing all tests, the Dell PowerEdge R720 has been officially certified according to the Open-E Hardware Certification Program Guide 2.0.

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 R720 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 R720 a great NAS filer solution:

- Sixteen high class SAS hard drives provide fast access to random data.
- 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 R720 great storage for a databases:

- The following features make the Dell PowerEdge R720 great storage for a databases:
- Four 1GbE interfaces for a fast MPIO network connection to a target.
- Two 10GbE interfaces for fast database connection.
- Hardware RAID10 for high performance, best I/Ops ratio and data safety.
- Twenty-two 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, RAID50, RAID6 or RAID60 for high performance and data safety.
- Two 10GbE interfaces for efficient network connections to virtualization systems.
- Four 1GbE interfaces for fast MPIO connection.
- Redundant power supply for system reliability.
- Sixteen fast, high class SAS hard drives for good virtual machine density.

Certification notes

For link aggregation, it is recommended to use balance-rr bonding mode with mode 6 hash policy on 10GbE switch and mode 5 hash policy on 1GbE switch (mode 5 - src/dst MAC/VLAN/EtherType source modID/port, mode 6 - src/dst ip/port).

Dell PowerEdge R720 hardware components

Technical specifications about the certified system are listed below:

Model	Dell PowerEdge R720
Operating system	Open-E DSS V7 build 7356
Enclosure/chassis	Dell PowerEdge R720
CPU	2x Intel Xeon E5-2640 2.50 GHz
Motherboard	Dell Power Edge R720 (based on Intel C600)
Memory	4x 8GB DDR3 ECC-REG Hynix HMT31GR7BFR4A-H9
Network	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE
Network	Broadcom 5720 Quad-Port 1GbE
HW RAID	Dell PERC H710 Integrated
Hard disk drives	16x 146GB Seagate Savvio 15K.2 ST9146852SS

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

Dell PowerEdge R720 photos

FIGURE 1: Front photo

FIGURE 2: Rear photo

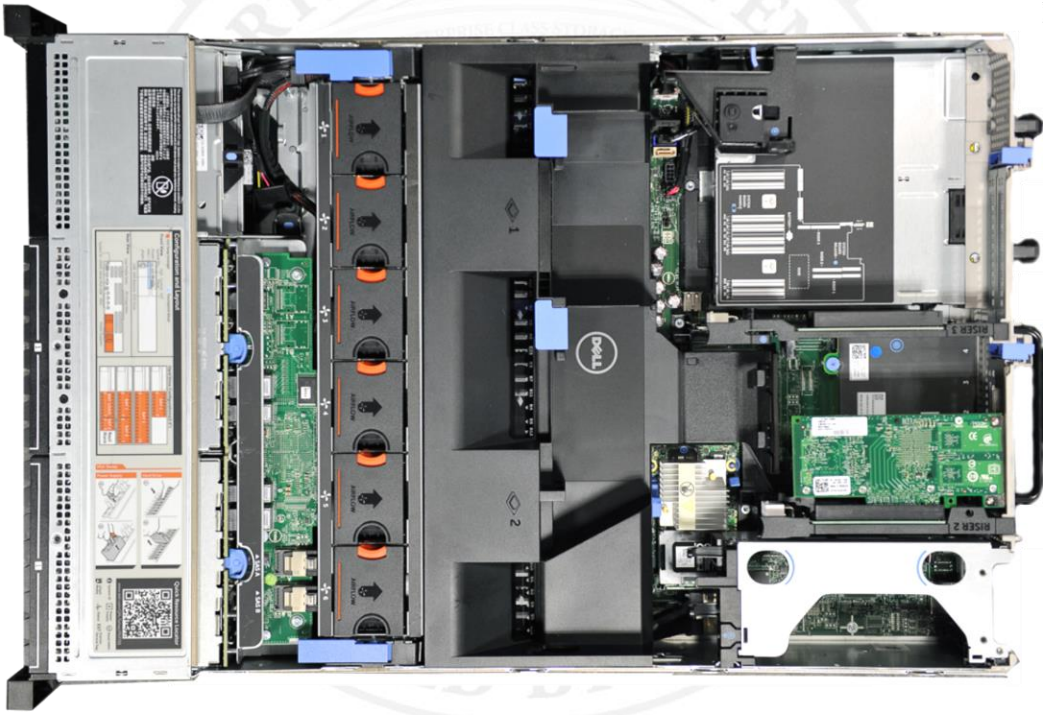

FIGURE 3: Top photo

Auxiliary systems hardware components

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

Model	Dell PowerEdge R720
Operating system	MS Windows Server 2008 R2
Enclosure/chassis	Dell PowerEdge R720
Motherboard	Dell Power Edge R720 (based on Intel C600)
CPU	Intel Xeon E5-2640 2.50 GHz
Memory	4x 8GB DDR3 ECC-REG Hynix HMT31GR7BFR4A-H9
Network	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE
Network	Broadcom 5720 Quad-Port 1GbE
HW RAID	PERC H710 Integrated
Hard disk drives	2x 146GB Seagate Savvio 15K.2 ST9146852SS

TABLE 2: Hardware components of first Workstation with MS Windows

Model	Dell PowerEdge R720
Operating system	MS Windows Server 2008 R2
Enclosure/chassis	Dell PowerEdge R720
Motherboard	Dell Power Edge R720 (based on Intel C600)
CPU	Intel Xeon E5-2640 2.50 GHz
Memory	4x 8GB DDR3 ECC-REG Hynix HMT31GR7BFR4A-H9
Network	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE
Network	Broadcom 5720 Quad-Port 1GbE
HW RAID	PERC H710 Integrated
Hard disk drives	2x 146GB Seagate Savvio 15K.2 ST9146852SS

TABLE 3: Hardware components of second Workstation with MS Windows

Model	Custom
Operating system	Open-E DSS V7 build 7356
Enclosure/chassis	Dell PowerEdge R620
CPU	Intel Xeon E5-2640 2.50 GHz
Motherboard	Dell PowerEdge R620 (based on Intel C600)
Memory	4x 8GB DDR3 ECC-REG Samsung M393B1K70CH0-CH9
Network	Broadcom 5720 Quad-Port 1GbE
HW RAID	PERC H710 Integrated
Hard disk drives	4x 300GB Hitachi Ultrastar C10K600 HUC106030CSS600

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

Model	Dell PowerConnect 6224
Description	24-ports 1GbE managed network switch
Model	Dell PowerConnect 8024F
Description	24-ports 10GbE managed network switch

TABLE 5: *Network switches details*

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.

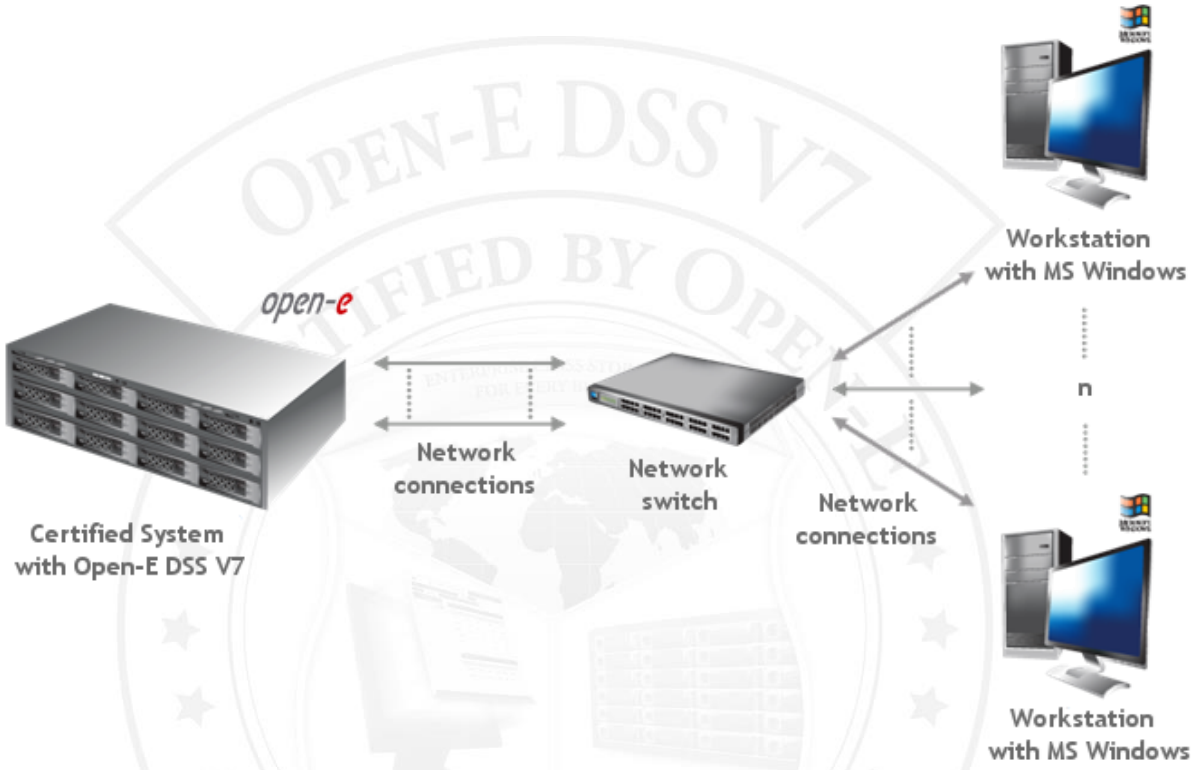

FIGURE 4: Network topology for Network testing

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

802.3ad bonding mode performance test results			
NIC model	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	691.95	402.67	passed
2nd Workstation	422.66	468.48	passed

TABLE 7: 802.3ad bonding mode performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

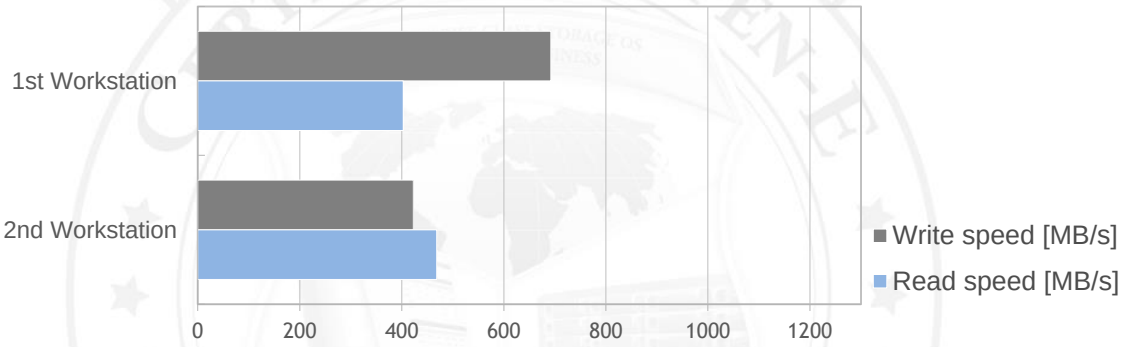

FIGURE 5: 802.3ad bonding mode performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

3. Test results for 802.3ad bonding mode test performed on Broadcom 5720 Quad-Port 1GbE

802.3ad bonding mode performance test results			
NIC model	Broadcom 5720 Quad-Port 1GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	110.13	38.58	passed
2nd Workstation	110.48	112.04	passed
3rd Workstation	56.23	33.65	passed
4th Workstation	56.44	41.37	passed

TABLE 8: 802.3ad bonding mode performance test results table for Broadcom 5720 Quad-Port 1GbE

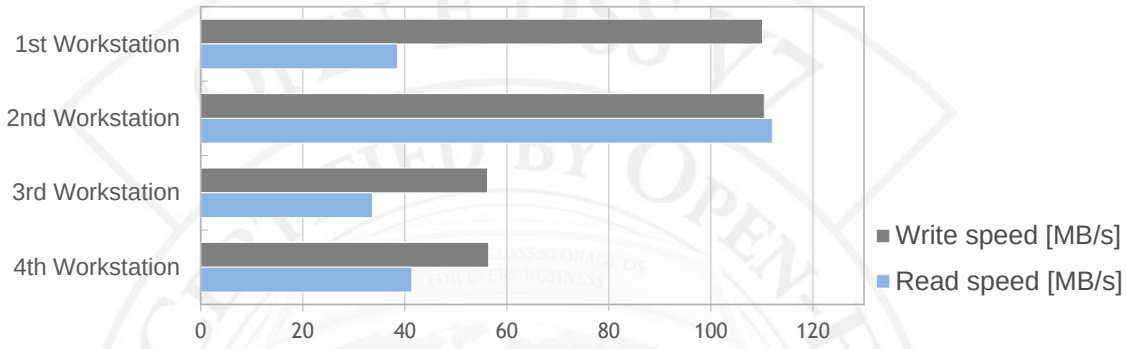

FIGURE 6: 802.3ad bonding mode performance test results chart for Broadcom 5720 Quad-Port 1GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

Balance-alb bonding mode performance test results			
NIC model	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	697.12	464.68	passed
2nd Workstation	420.35	378.96	passed

TABLE 9: Balance-alb bonding mode performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

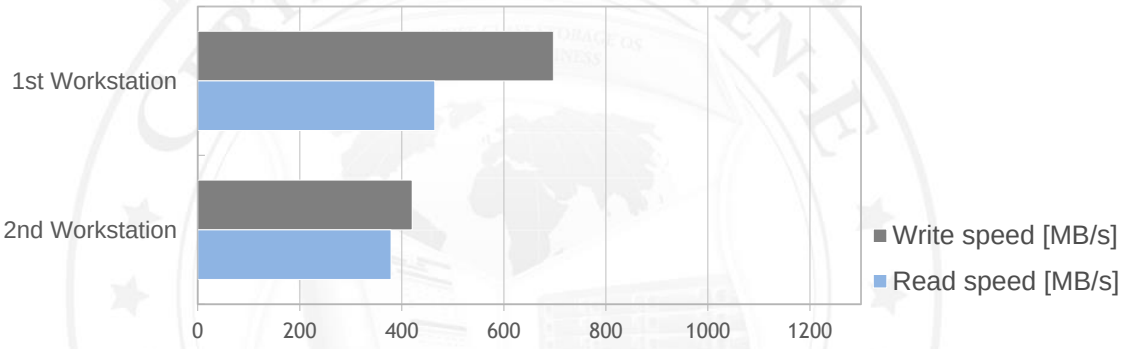

FIGURE 7: Balance-alb bonding mode performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

3. Test results for Balance-alb bonding mode test performed Broadcom 5720 Quad-Port 1GbE

Balance-alb bonding mode performance test results			
NIC model	Broadcom 5720 Quad-Port 1GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	109.96	112.14	passed
2nd Workstation	56.69	112.21	passed
3rd Workstation	110.58	112.25	passed
4th Workstation	56.25	112.26	passed

TABLE 10: Balance-alb bonding mode performance test results table forBroadcom 5720 Quad-Port 1GbE

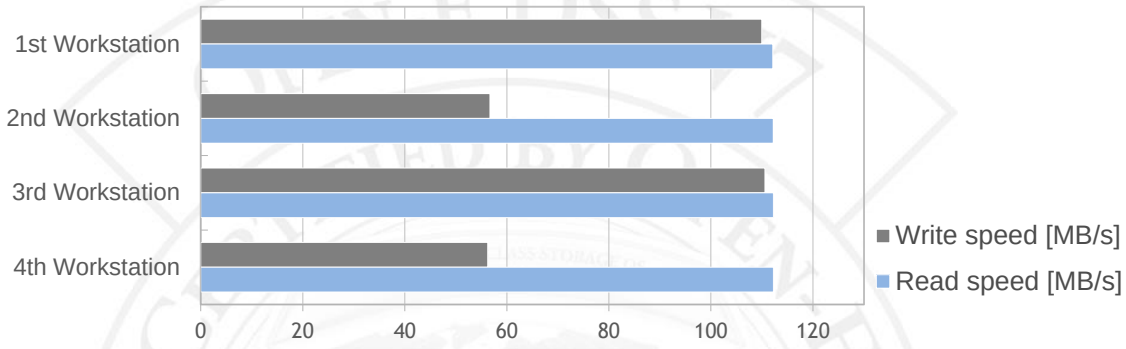

FIGURE 8: Balance-alb bonding mode performance test results chart for Broadcom 5720 Quad-Port 1GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

Balance-rr bonding mode performance test results			
NIC model	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	402.39	337.94	passed
2nd Workstation	715.25	675.07	passed

TABLE 11: Balance-rr bonding mode performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

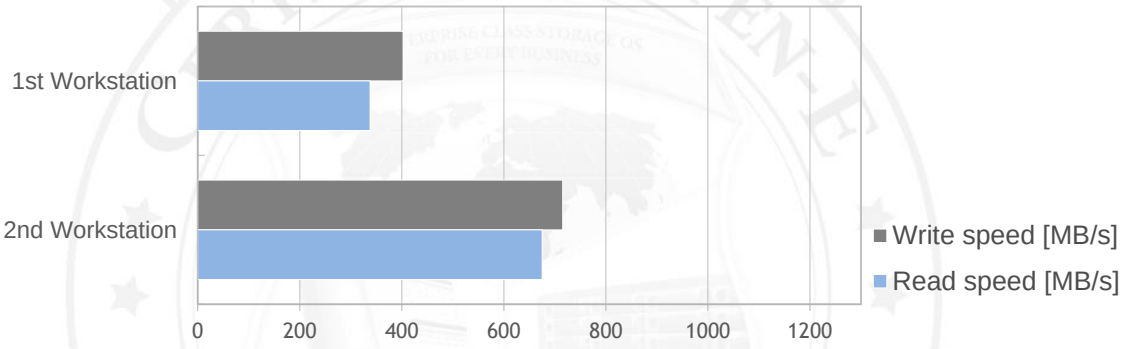

FIGURE 9: Balance-rr bonding mode performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

3. Test results for Balance-rr bonding mode test performed on Broadcom 5720 Quad-Port 1GbE

Balance-rr bonding mode performance test results			
NIC model	Broadcom 5720 Quad-Port 1GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	109.14	96.16	passed
2nd Workstation	110.02	93.72	passed
3rd Workstation	110.22	106.58	passed
4th Workstation	109.45	107.55	passed

TABLE 12: Balance-rr bonding mode performance test results table for Broadcom 5720 Quad-Port 1GbE

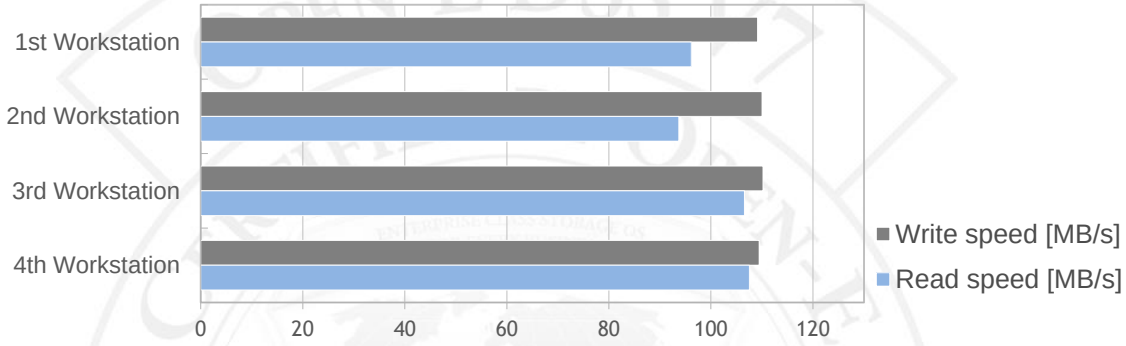

FIGURE 10: Balance-rr bonding mode performance test results chart for Broadcom 5720 Quad-Port 1GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

Single NIC performance test results			
NIC model	Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	974.52	507.31	passed

TABLE 13: Single NIC test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

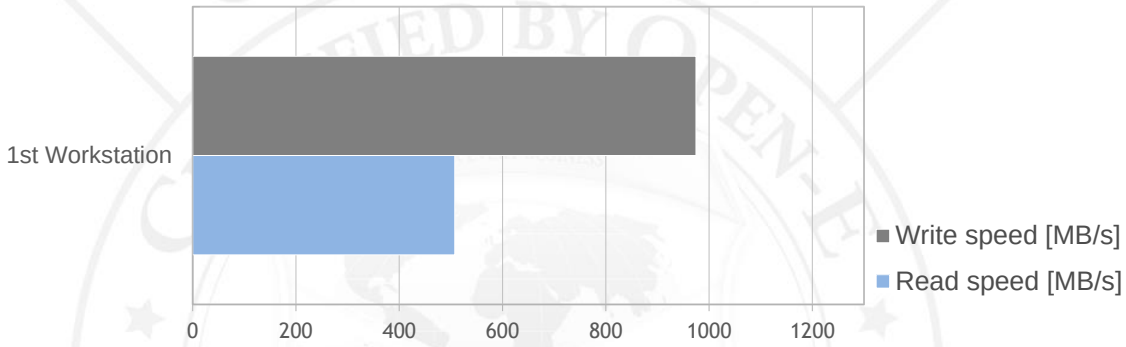

FIGURE 11: Single NIC performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

3. Test results for single NIC test performed on Broadcom 5720 Quad-Port 1GbE

Single NIC performance test results			
NIC model	Broadcom 5720 Quad-Port 1GbE		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	106.94	111.98	passed

TABLE 14: Single NIC test results table for Broadcom 5720 Quad-Port 1GbE

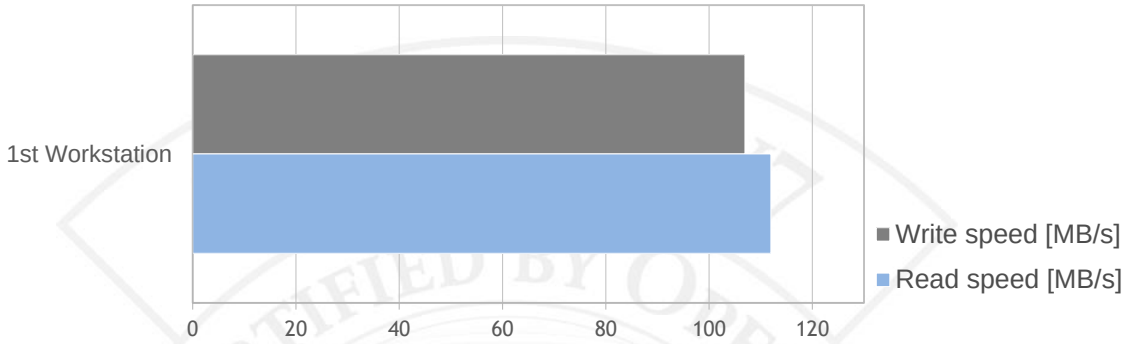

FIGURE 12: Single NIC performance test results chart for Broadcom 5720 Quad-Port 1GbE

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

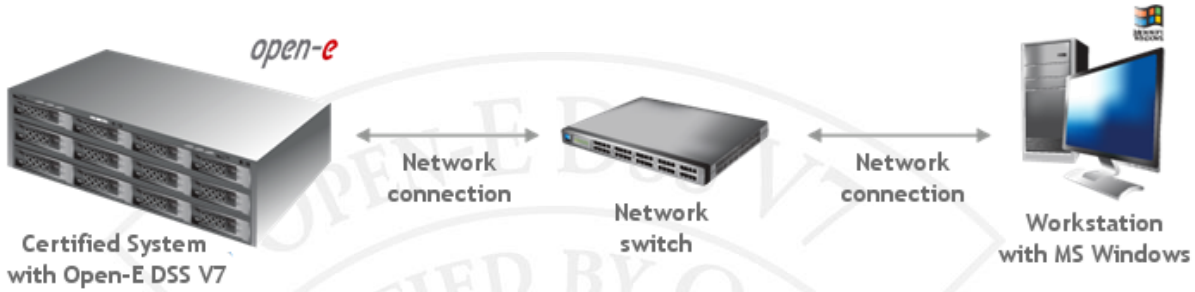

FIGURE 13: Network test topology for RAID testing

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

RAID0 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	5.00	127.25	passed
32	33.92	354.01	passed
64	143.79	325.56	passed
128	427.35	430.78	passed
256	547.46	429.11	passed
512	562.15	469.91	passed
1024	560.94	473.68	passed
4096	553.32	499.63	passed

TABLE 15: RAID0 performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

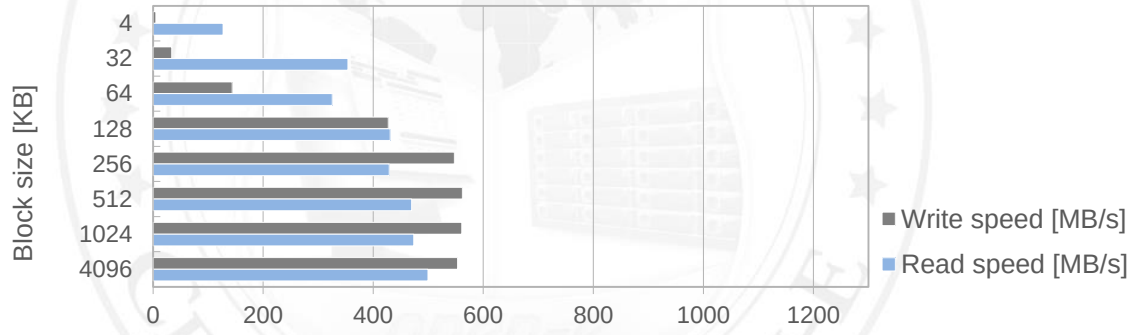

FIGURE 14: RAID0 performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

RAID5 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	4.38	123.51	passed
32	36.66	340.64	passed
64	196.22	343.96	passed
128	463.83	433.65	passed
256	570.58	455.81	passed
512	573.33	415.63	passed
1024	577.04	409.10	passed
4096	601.08	455.68	passed

TABLE 16: RAID5 performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

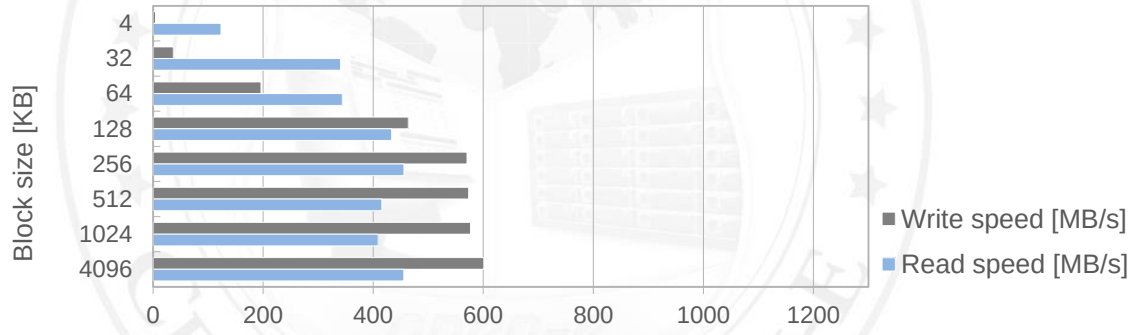

FIGURE 15: RAID5 performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

RAID6 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	4.85	134.85	passed
32	35.01	354.19	passed
64	146.64	351.22	passed
128	459.45	456.09	passed
256	599.79	470.92	passed
512	611.30	487.10	passed
1024	605.16	462.47	passed
4096	616.92	515.17	passed

TABLE 17: RAID6 performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

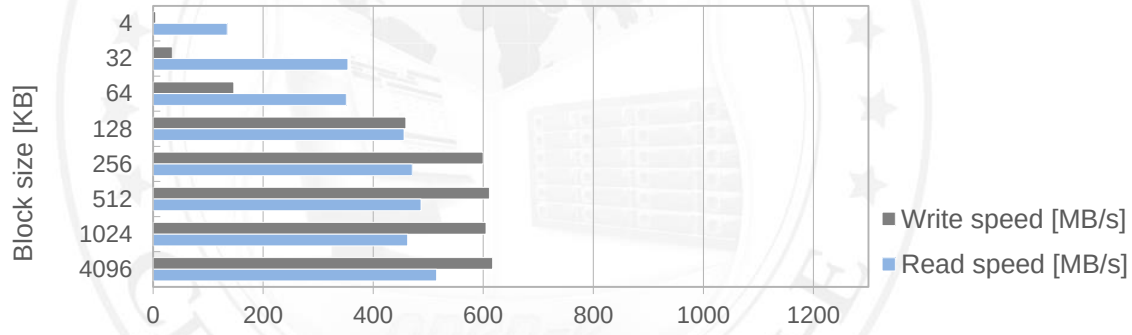

FIGURE 16: RAID6 performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

RAID10 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	4.82	127.71	passed
32	34.19	337.73	passed
64	166.50	404.26	passed
128	417.72	401.64	passed
256	543.03	490.99	passed
512	557.87	494.91	passed
1024	564.65	488.23	passed
4096	586.43	492.06	passed

TABLE 18: RAID10 performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

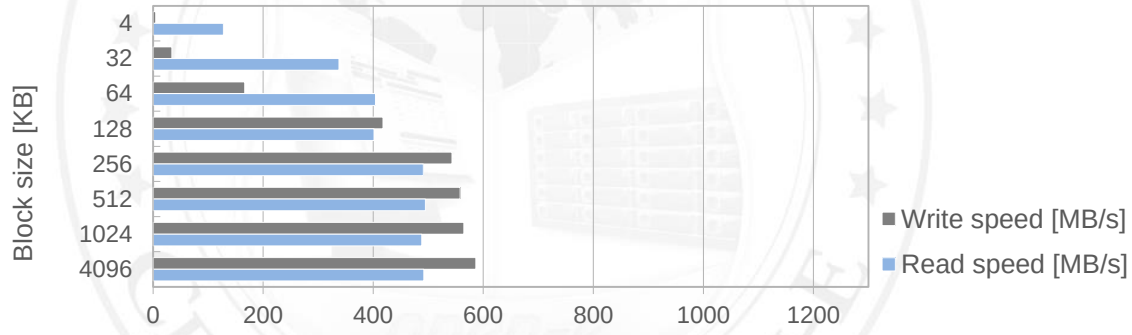

FIGURE 17: RAID10 performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

RAID50 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	4.72	131.41	passed
32	34.14	328.74	passed
64	157.23	328.32	passed
128	436.60	428.36	passed
256	573.16	429.39	passed
512	564.07	405.87	passed
1024	577.40	424.10	passed
4096	587.55	542.52	passed

TABLE 19: RAID50 performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

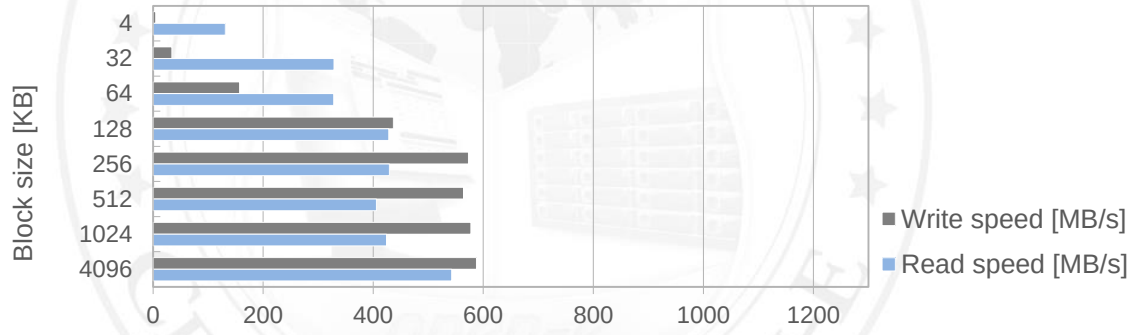

FIGURE 18: RAID50 performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

RAID60 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	5.05	123.62	passed
32	34.98	379.82	passed
64	111.27	385.14	passed
128	434.42	437.45	passed
256	583.72	468.57	passed
512	583.97	522.42	passed
1024	590.88	487.95	passed
4096	615.02	436.69	passed

TABLE 20: RAID60 performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

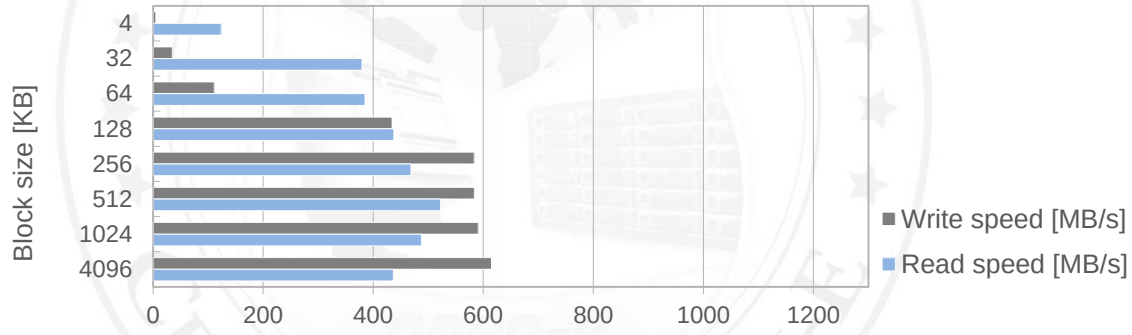

FIGURE 19: RAID60 performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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.

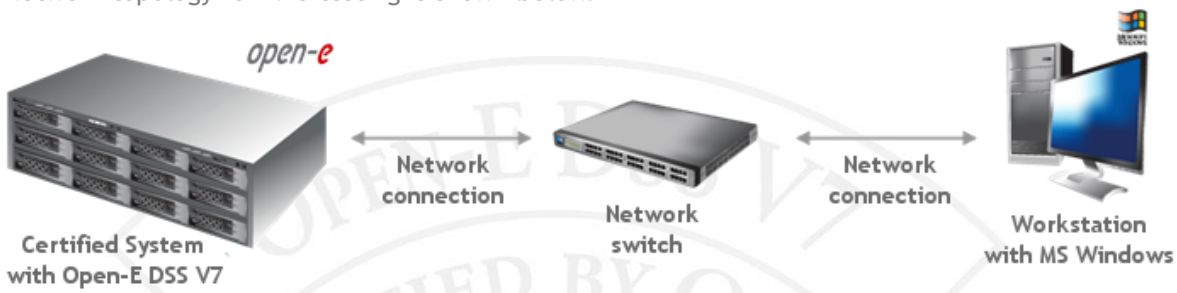

FIGURE 20: Network topology for NAS testing

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

SMB performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	133.73	121.10	passed
32	850.46	693.23	passed
64	1123.76	623.40	passed
128	1123.59	767.40	passed
256	1126.71	812.82	passed
512	1121.50	852.10	passed
1024	1124.89	840.42	passed
4096	1124.80	845.15	passed

TABLE 21: SMB performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

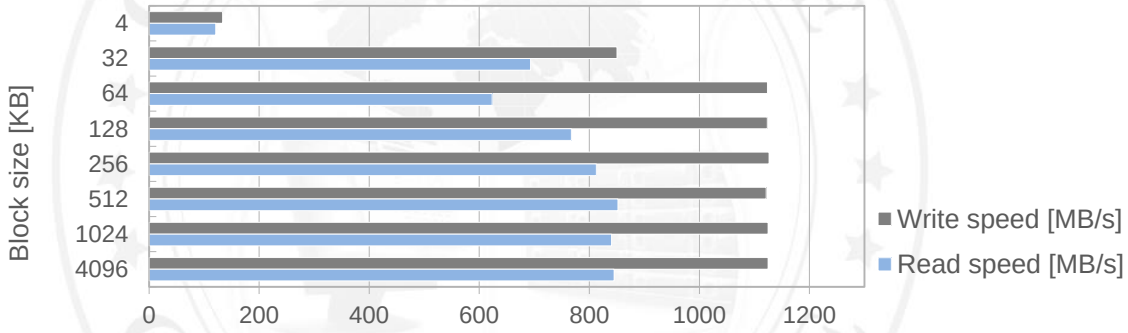

FIGURE 21: SMB performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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.

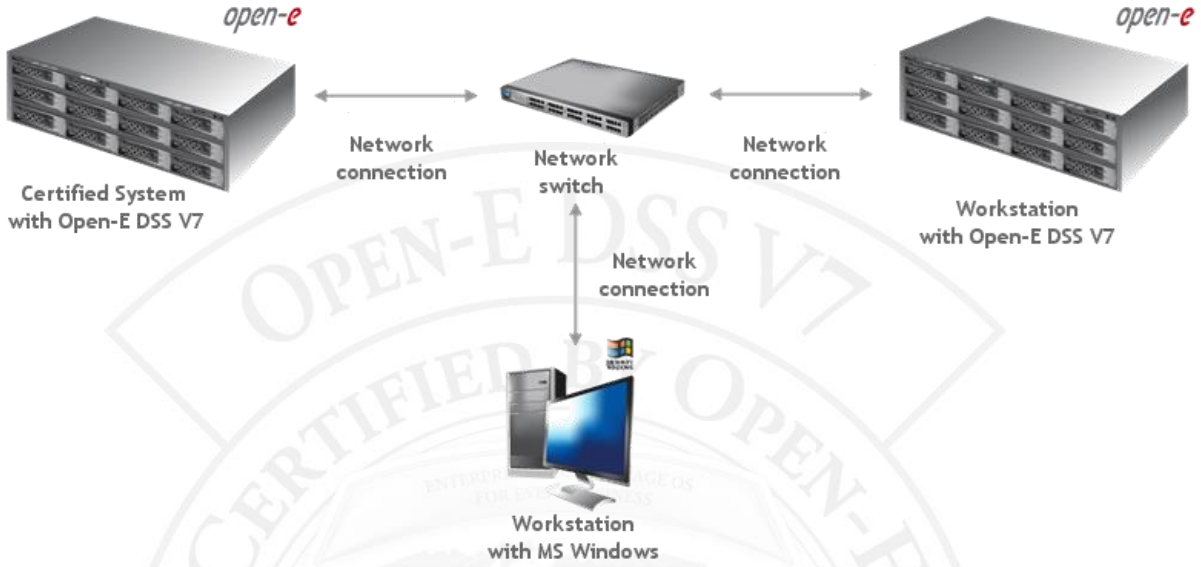

FIGURE 22: Network topology for iSCSI Initiator testing

iSCSI Target test topology

Network topology for iSCSI Target testing is shown below.

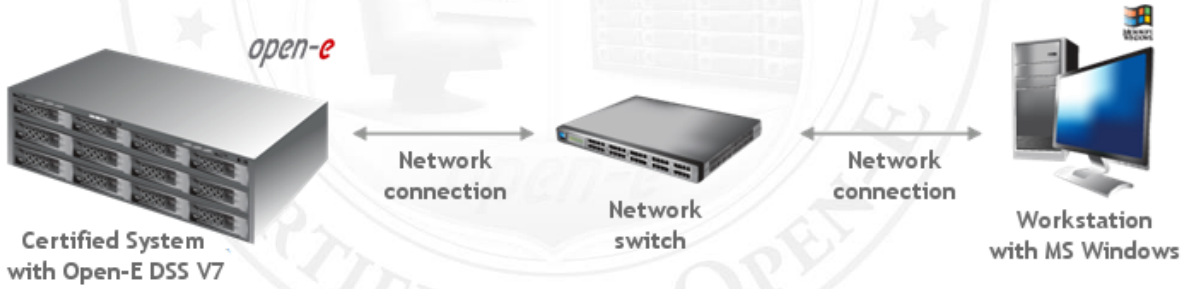

FIGURE 23: Network topology for iSCSI Target testing

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

iSCSI Initiator performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	108.26	101.09	passed
32	708.33	324.94	passed
64	1119.05	517.17	passed
128	1123.69	283.52	passed
256	1107.84	289.61	passed
512	1109.66	349.47	passed
1024	1119.36	298.83	passed
4096	1098.17	342.90	passed

TABLE 22: iSCSI Initiator performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

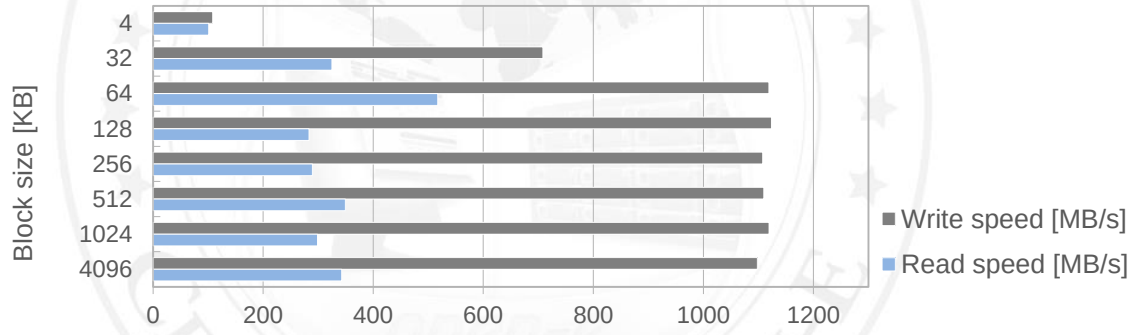

FIGURE 24: iSCSI Initiator performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

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 Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

iSCSI Target performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	4.85	121.47	passed
32	34.97	317.81	passed
64	119.20	408.69	passed
128	386.02	426.42	passed
256	532.37	441.55	passed
512	557.05	476.41	passed
1024	578.36	438.01	passed
4096	586.65	436.62	passed

TABLE 23: iSCSI Target performance test results table for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE

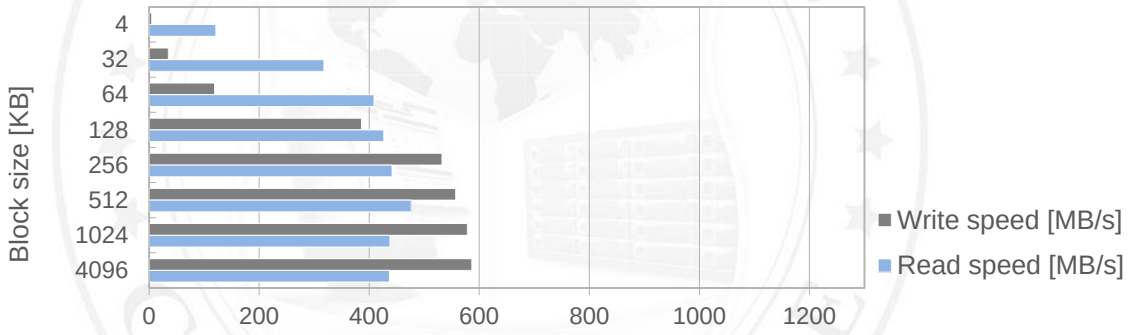

FIGURE 25: iSCSI Target performance test results chart for Broadcom NetXtreme II BCM57711 Dual-Port 10 GbE