Digital Storage digiStor™Network system

Executive summary

After performing all tests, the Digital Storage digiStor™Network 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 Digital Storage digiStor™Network is stable and performs well.

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

- ✓ **Fibre Channel storage**

  The following features make Digital Storage digiStor™Network a great Fibre Channel Storage solution:

  - **Fibre Channel HBA for stable, low latency and high throughput connection.**
  - **Twenty-four high class enterprise drives combined with Fibre Channel HBA ensure fast random data access and reliability.**
  - **Redundant power supply for system reliability.**

- ✓ **iSCSI storage**

  The following features make Digital Storage digiStor™Network good iSCSI storage:

  - **Hardware RAID5, RAID6, RAID10, RAID50 or RAID60 for high performance and data safety.**
  - **Twenty-four high capacity, enterprise class drives ensure a lot of fast storage space.**
  - **Two 1GbE and two 10GbE interfaces for fast MPIO connection and flexible network topology.**
  - **Redundant power supply for system reliability.**

- ✓ **Storage for virtualization**

  For this application the following can be used:

  - **Hardware RAID5, RAID6, RAID50 and RAID60 for fault tolerance and the most efficient use of available disk space or RAID10 for greater virtual machines density.**
  - **Two 10GbE and two 1GbE interfaces which may be aggregated, for efficient network connections to virtualization systems.**
  - **Redundant power supply for system reliability.**
  - **Fast, low latency Fibre Channel connection.**

Certification notes

We recommend using Balance-alb or 802.3ad bonding modes for link aggregation.

Digital Storage digiStor™Network hardware components

Technical specifications about the certified system are listed below:

Model	Digital Storage digiStor™Network
Operating system	Open-E DSS V7 build 7637
Enclosure/chassis	SuperChassis 846E16-R1200B
CPU	Intel Xeon E5606 2.13GHz
Motherboard	Supermicro X8DT6-F
Memory	3x 8GB Hynix ECC-REG HMT31GR7AFR4C-H9
Network	Myricom 10G-PCIE2-8B2-2S
Network	2x Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)
Fibre Channel HBA	QLogic QLE2560-CK Fibre Channel Host Bus Adapter
HW RAID	Areca ARC-1882IX-16
Hard disk drives	24x 2TB Toshiba MK2001TRKB HDD3A01
Hard disk drives	2x 120GB SanDisk SDSSD-X120G-G25

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

Digital Storage digiStor™Network photos

FIGURE 1: Front photo

FIGURE 2: Rear photo

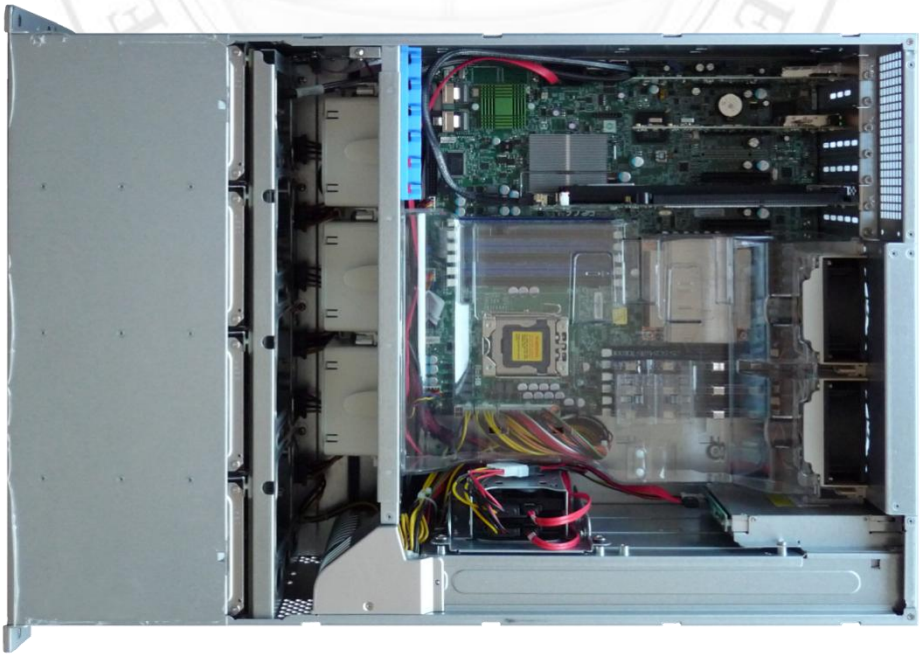

FIGURE 3: Top photo

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	Broadcom NetXtreme II BCM57712 10Gigabit Ethernet
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	Broadcom NetXtreme II BCM57712 10Gigabit Ethernet
Hard disk drives	500GB Hitachi Deskstar 7K1000.C HDS721050CLA362

TABLE 3: *Hardware components of second Workstation with MS Windows*

Model	Digital Storage digiStor™Network
Operating system	Open-E DSS V7 build 7637
Enclosure/chassis	SuperChassis 846E16-R1200B
CPU	Intel Xeon E5606 2.13GHz
Motherboard	Supermicro X8DT6-F
Memory	3x 8GB Hynix ECC-REG HMT31GR7AFR4C-H9
Network	Myricom 10G-PCIE2-8B2-2S
Network	2x Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)
Fibre Channel HBA	QLogic QLE2560-CK Fibre Channel Host Bus Adapter
HW RAID	Areca ARC-1882IX-16
Hard disk drives	24x 2TB Toshiba MK2001TRKB HDD3A01
Hard disk drives	2x 120GB SanDisk SDSSD-X120G-G25

TABLE4: *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.

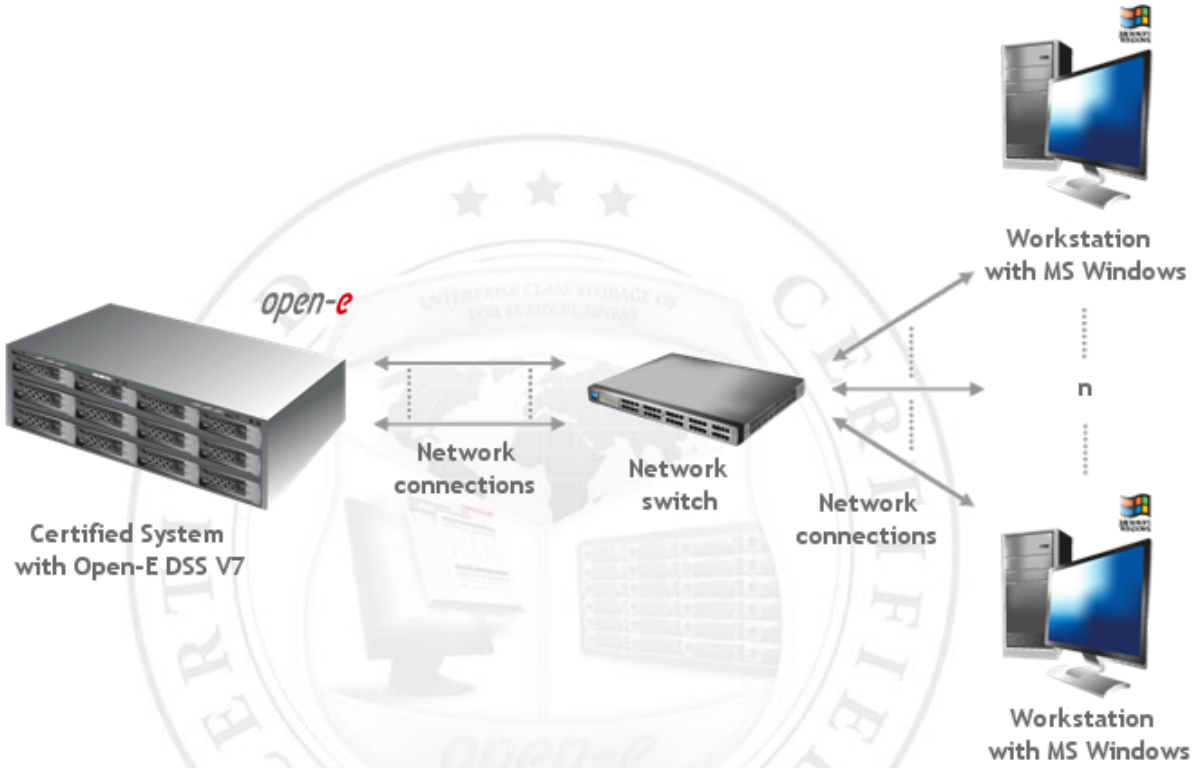

FIGURE 4: Network topology for Network testing

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 PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

802.3ad bonding mode performance test results			
NIC model	Intel PRO/1000 PT Dual Port Adapter (i82574L)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	110.90	106.14	passed
2nd Workstation	109.61	106.03	passed

TABLE 7: 802.3ad bonding mode performance test results table for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

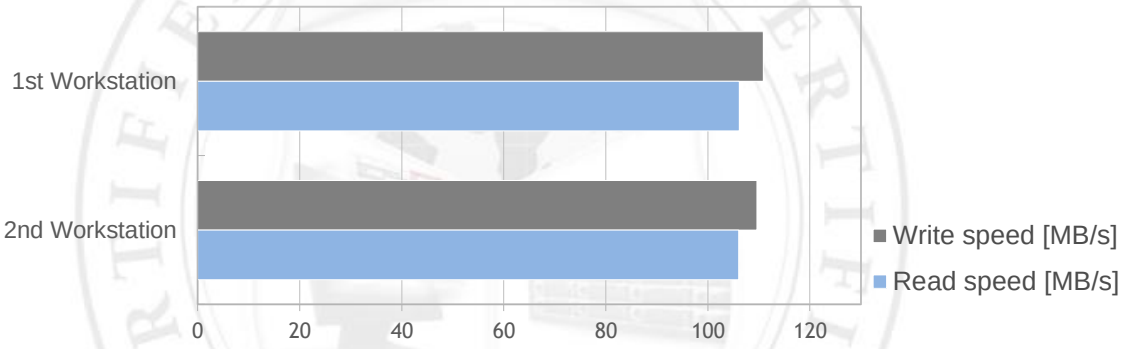

FIGURE 5: 802.3ad bonding mode performance test results chart for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

3. Test results for 802.3ad bonding mode test performed on Myricom 10G-PCIE2-8B2-2S

802.3ad bonding mode performance test results			
NIC model	Myricom 10G-PCIE2-8B2-2S		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	560.01	685.35	passed
2nd Workstation	659.08	665.40	passed

TABLE 8: 802.3ad bonding mode performance test results table for Myricom 10G-PCIE2-8B2-2S

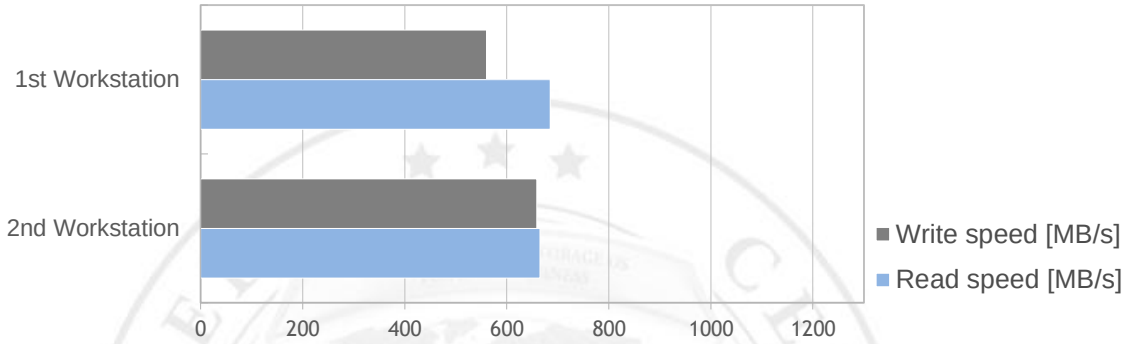

FIGURE 6: 802.3ad bonding mode performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

Balance-alb bonding mode performance test results			
NIC model	Intel PRO/1000 PT Dual Port Adapter (i82574L)		
Workstations with MS Windows	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
1st Workstation	109.08	107.78	passed
2nd Workstation	107.93	107.91	passed

TABLE 9: Balance-alb bonding mode performance test results table for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

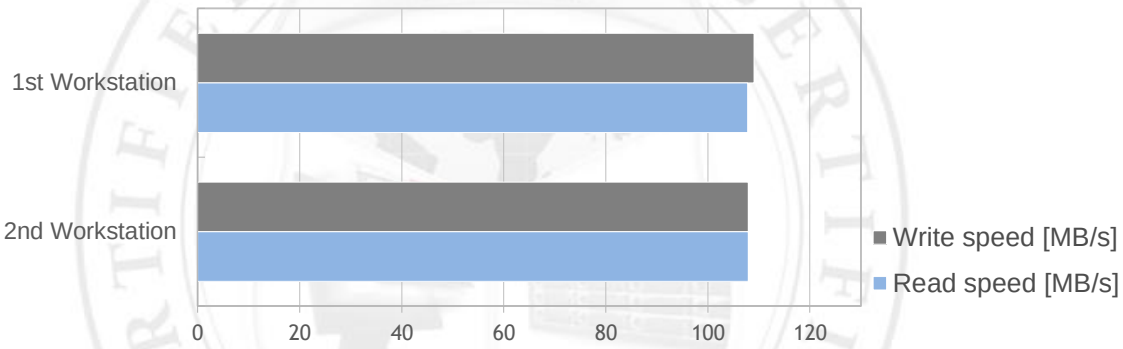

FIGURE 7: Balance-alb bonding mode performance test results chart for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

3. Test results for Balance-alb bonding mode test performed on Myricom 10G-PCIE2-8B2-2S

Balance-alb bonding mode performance test results			
NIC model	Myricom 10G-PCIE2-8B2-2S		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	537.19	666.04	passed
2nd Workstation	628.66	662.19	passed

TABLE 10: Balance-alb bonding mode performance test *results table for Myricom 10G-PCIE2-8B2-2S*

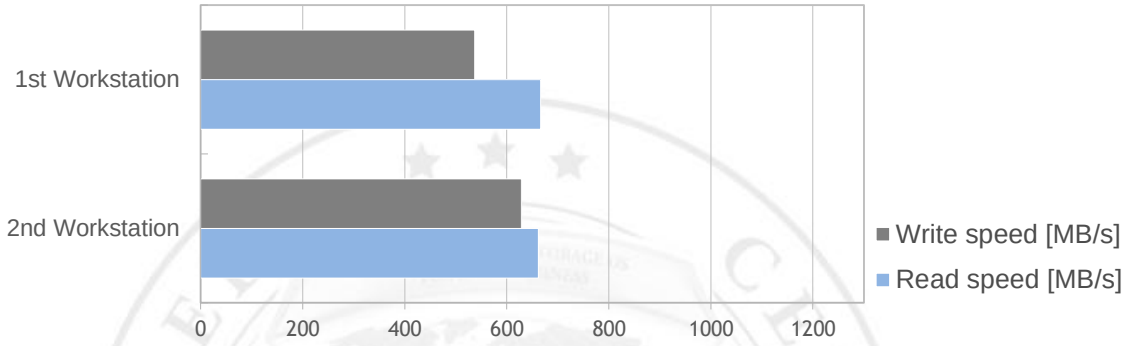

FIGURE 8: Balance-alb bonding mode performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

Balance-rr bonding mode performance test results			
NIC model	Intel PRO/1000 PT Dual Port Adapter (i82574L)		
Workstations with MS Windows	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
1st Workstation	110.19	70.93	passed
2nd Workstation	108.90	105.02	passed

TABLE 11: Balance-rr bonding mode performance test results table for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

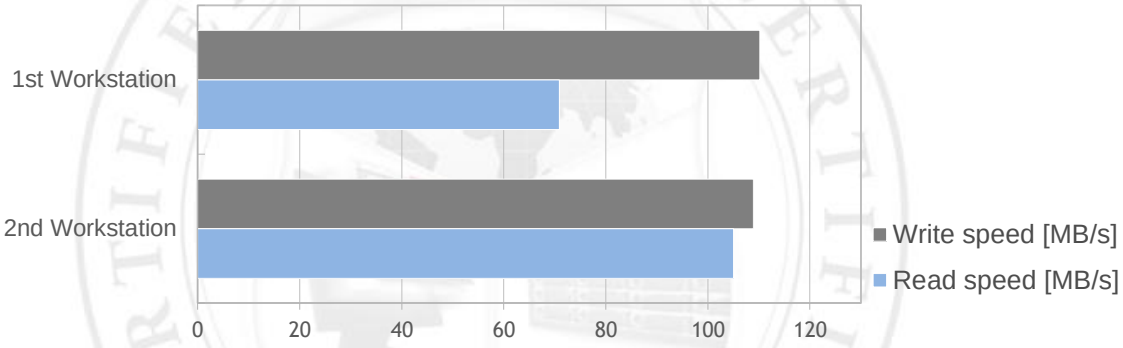

FIGURE 9: Balance-rr bonding mode performance test results chart for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

3. Test results for Balance-rr bonding mode test performed on Myricom 10G-PCIE2-8B2-2S

Balance-rr bonding mode performance test results			
NIC model	Myricom 10G-PCIE2-8B2-2S		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	580.61	193.52	passed
2nd Workstation	579.80	252.23	passed

TABLE 12: Balance-rr bonding mode performance test results table for Myricom 10G-PCIE2-8B2-2S

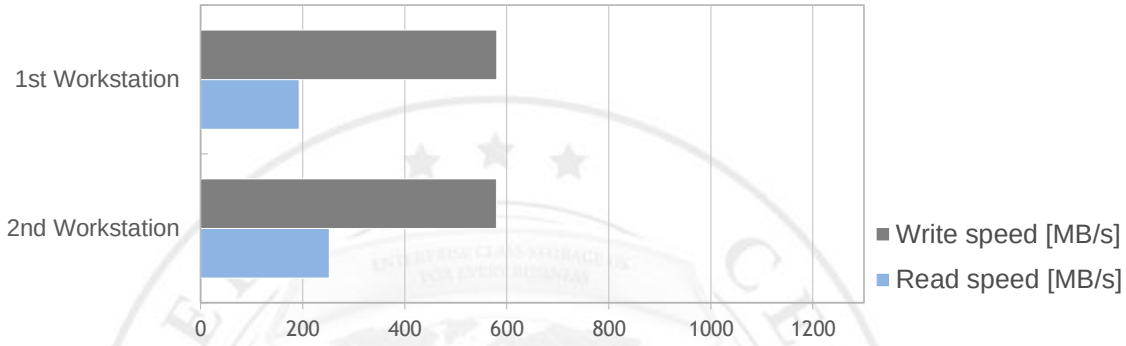

FIGURE 10: Balance-rr bonding mode performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

Single NIC performance test results			
NIC model	Intel PRO/1000 PT Dual Port Adapter (i82574L)		
Workstations with MS Windows	**Write speed [MB/s]**	**Read speed [MB/s]**	**Performance test results**
1st Workstation	110.29	106.42	passed

TABLE 13: Single NIC performance test results table for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

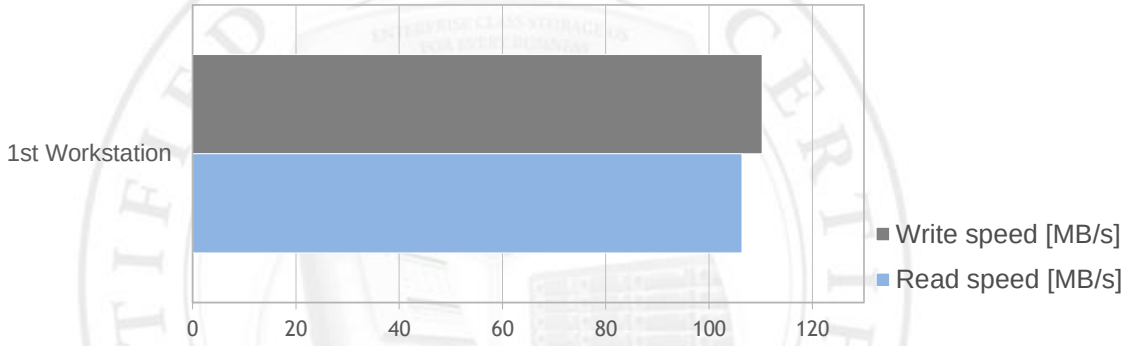

FIGURE 11: Single NIC performance test results chart for Intel PRO/1000 PT Dual Port Server Adapter (i82574L) (on-board)

3. Test results for single NIC test performed on Myricom 10G-PCIE2-8B2-2S

Single NIC performance test results			
NIC model	Myricom 10G-PCIE2-8B2-2S		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	769.01	667.84	passed

TABLE 14: Single NIC performance test results table for Myricom 10G-PCIE2-8B2-2S

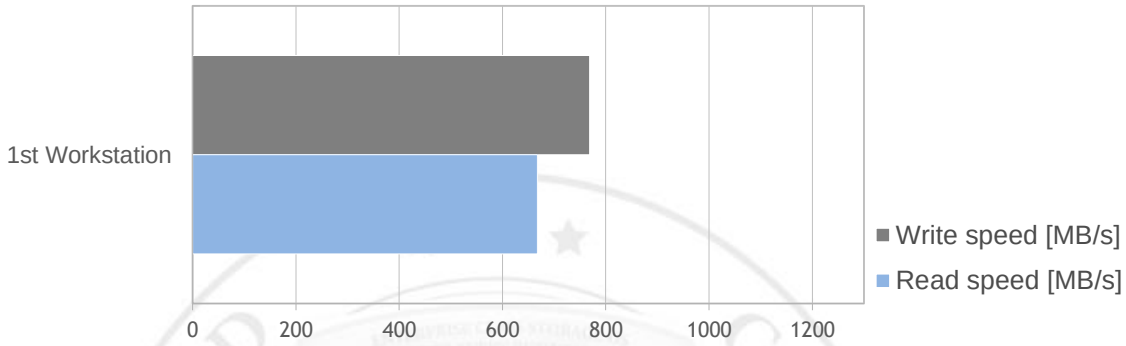

FIGURE 12: Single NIC performance test results chart for Myricom 10G-PCIE2-8B2-2S

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

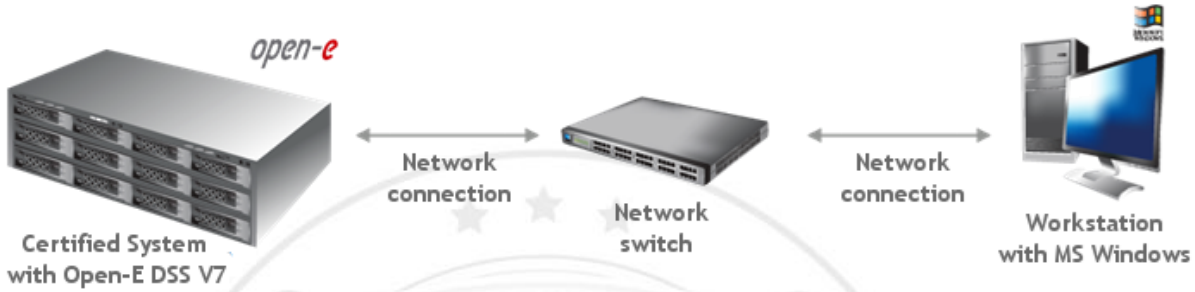

FIGURE 13: Network test topology for RAID testing

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 Myricom 10G-PCIE2-8B2-2S

RAID0 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	89.48	99.59	passed
32	453.60	504.16	passed
64	665.66	598.10	passed
128	873.35	697.60	passed
256	981.01	713.45	passed
512	1008.73	697.14	passed
1024	1005.18	740.49	passed
4096	1005.89	689.03	passed

TABLE 15: RAID0 performance test results table for Myricom 10G-PCIE2-8B2-2S

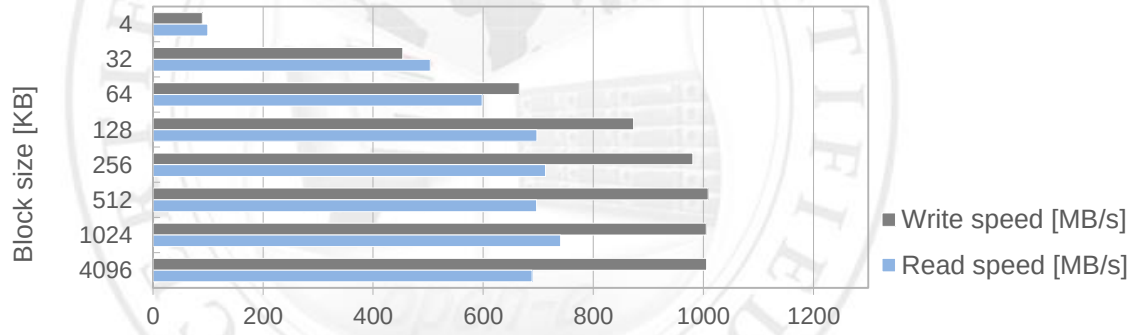

FIGURE 14: RAID0 performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 Myricom 10G-PCIE2-8B2-2S

RAID5 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	89.72	97.99	passed
32	448.43	514.46	passed
64	657.92	597.45	passed
128	871.67	699.73	passed
256	976.61	713.12	passed
512	917.52	703.90	passed
1024	987.72	700.68	passed
4096	1003.78	684.67	passed

TABLE 16: RAID5 performance test results table for Myricom 10G-PCIE2-8B2-2S

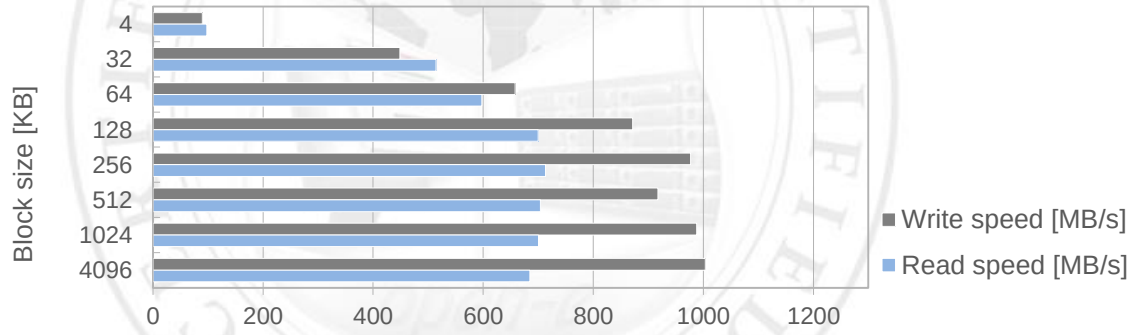

FIGURE 15: RAID5 performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 Myricom 10G-PCIE2-8B2-2S

RAID6 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	92.08	102.60	passed
32	423.57	510.67	passed
64	604.01	600.43	passed
128	776.25	690.00	passed
256	873.79	771.88	passed
512	939.35	700.37	passed
1024	935.40	731.66	passed
4096	998.42	735.67	passed

TABLE 17: RAID6 performance test results table for Myricom 10G-PCIE2-8B2-2S

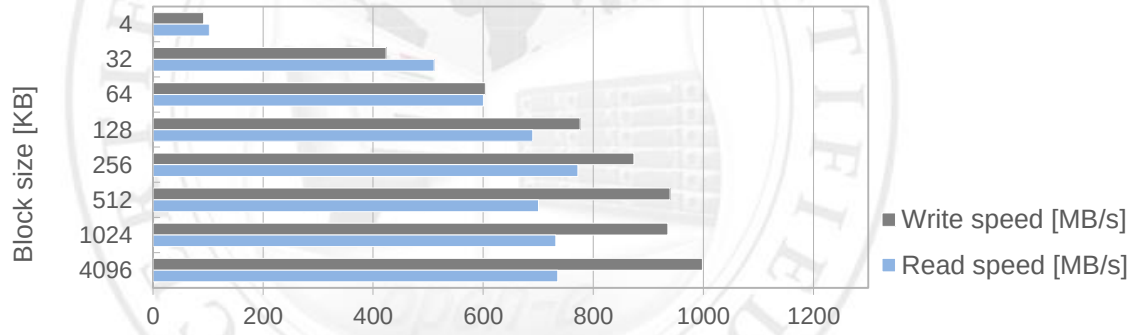

FIGURE 16: RAID6 performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 Myricom 10G-PCIE2-8B2-2S

RAID10 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	89.67	92.63	passed
32	450.63	507.96	passed
64	640.19	570.16	passed
128	873.82	690.68	passed
256	978.47	703.72	passed
512	928.94	711.94	passed
1024	960.97	684.89	passed
4096	1001.37	707.73	passed

TABLE 18: RAID10 performance test results table for Myricom 10G-PCIE2-8B2-2S

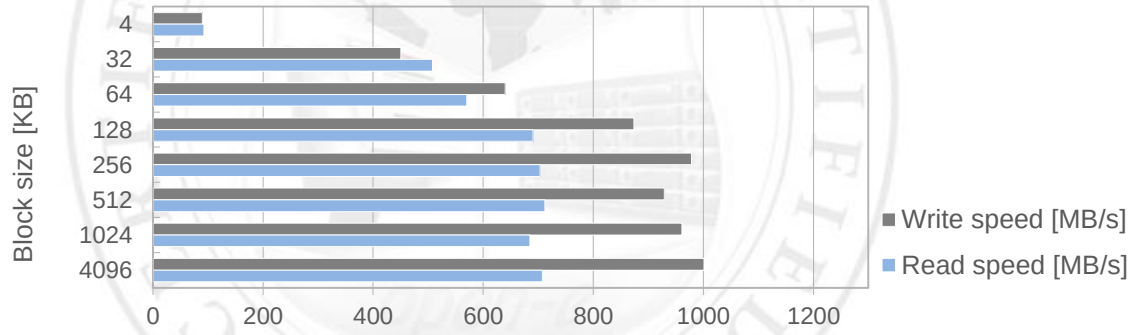

FIGURE 17: RAID10 performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 Myricom 10G-PCIE2-8B2-2S

RAID50 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	91.49	103.90	passed
32	428.82	515.08	passed
64	601.54	542.95	passed
128	795.86	680.58	passed
256	915.22	776.34	passed
512	933.16	717.41	passed
1024	973.18	733.58	passed
4096	997.33	737.47	passed

TABLE 19: RAID50 performance test results table for Myricom 10G-PCIE2-8B2-2S

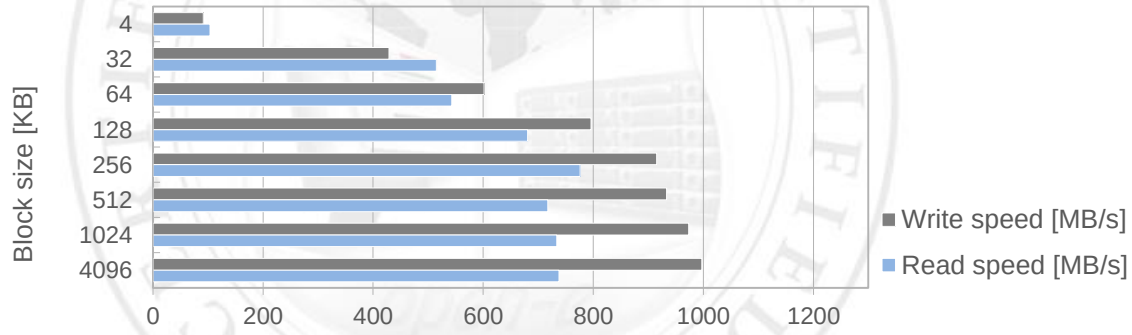

FIGURE 18: RAID50 performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 Myricom 10G-PCIE2-8B2-2S

RAID60 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	90.70	100.29	passed
32	455.72	510.76	passed
64	672.27	596.72	passed
128	871.12	695.85	passed
256	976.96	711.16	passed
512	993.47	732.38	passed
1024	939.40	681.13	passed
4096	1000.42	681.29	passed

TABLE 20: RAID60 performance test results table for Myricom 10G-PCIE2-8B2-2S

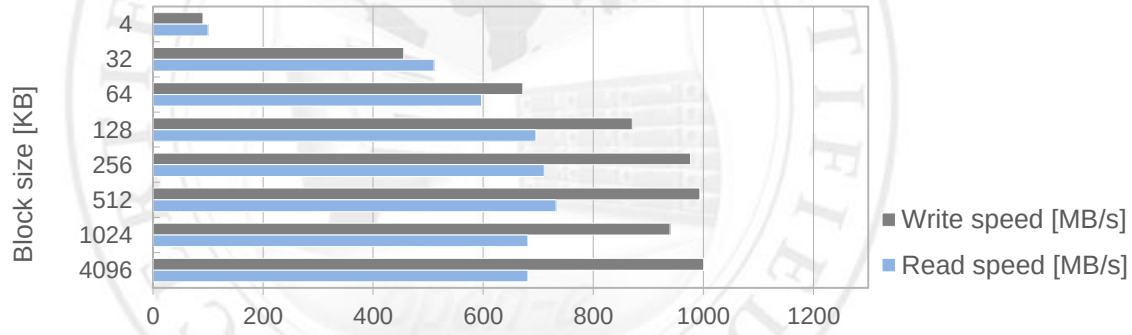

FIGURE 19: RAID60 performance test results chart for Myricom 10G-PCIE2-8B2-2S

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.

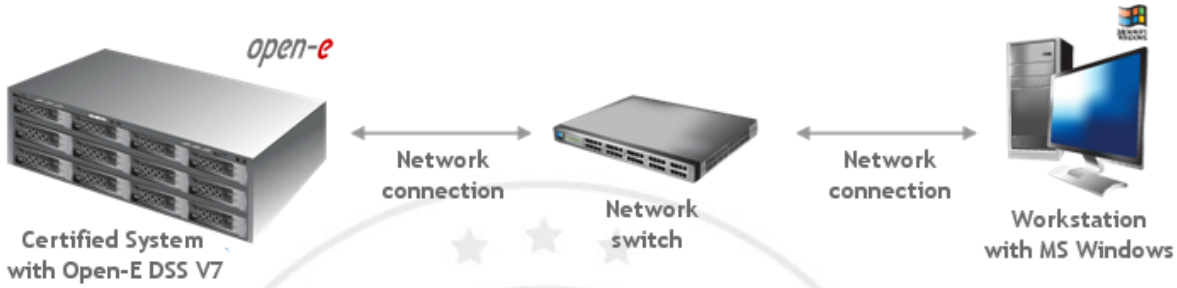

FIGURE 20: Network topology for NAS testing

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 Myricom 10G-PCIE2-8B2-2S

SMB performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	156.95	181.46	passed
32	621.84	771.59	passed
64	787.05	565.72	passed
128	780.86	612.27	passed
256	759.58	571.99	passed
512	742.73	548.74	passed
1024	720.14	536.50	passed
4096	713.72	539.11	passed

TABLE 21: SMB performance test results table for Myricom 10G-PCIE2-8B2-2S

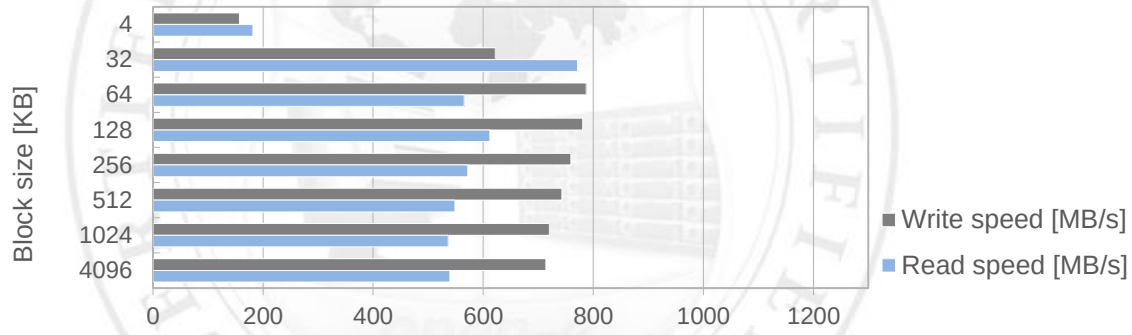

FIGURE 21: SMB performance test results chart for Myricom 10G-PCIE2-8B2-2S

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.

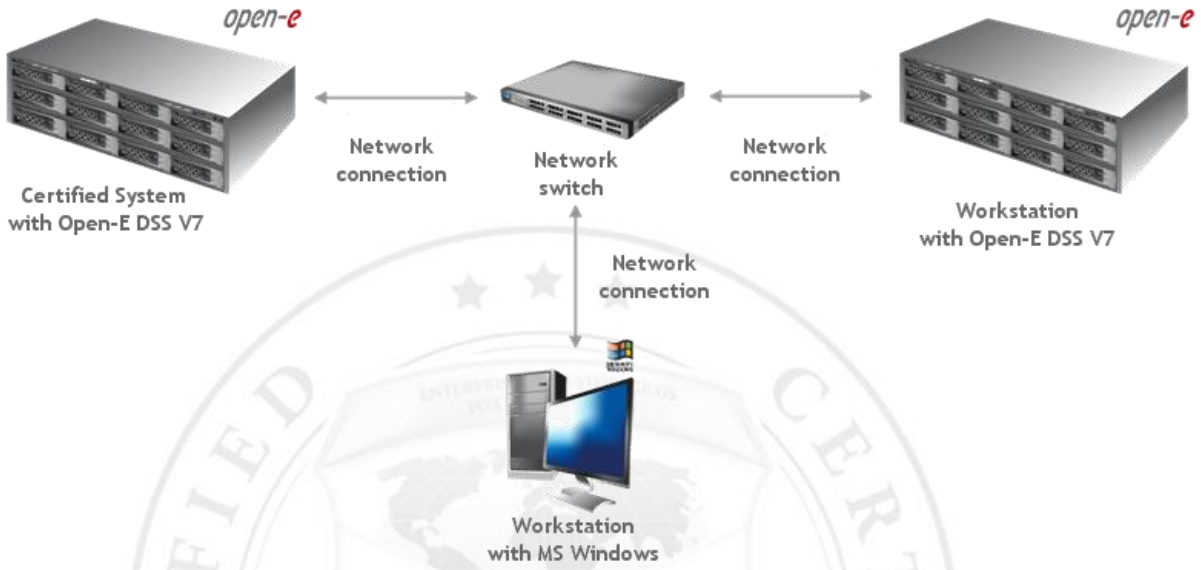

FIGURE 22: Network topology for iSCSI Initiator testing

iSCSI Target test topology

Network topology for iSCSI Target testing is shown below.

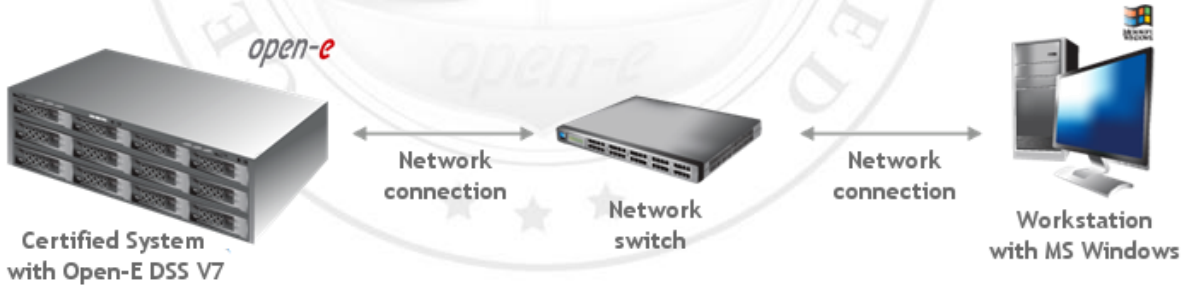

FIGURE 23: Network topology for iSCSI Target testing

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 Myricom 10G-PCIE2-8B2-2S

iSCSI Initiator performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	108.48	106.38	passed
32	562.19	669.66	passed
64	565.40	519.37	passed
128	629.11	589.10	passed
256	661.61	491.83	passed
512	587.58	471.05	passed
1024	607.90	453.95	passed
4096	648.79	456.31	passed

TABLE 22: iSCSI Initiator performance test results table for Myricom 10G-PCIE2-8B2-2S

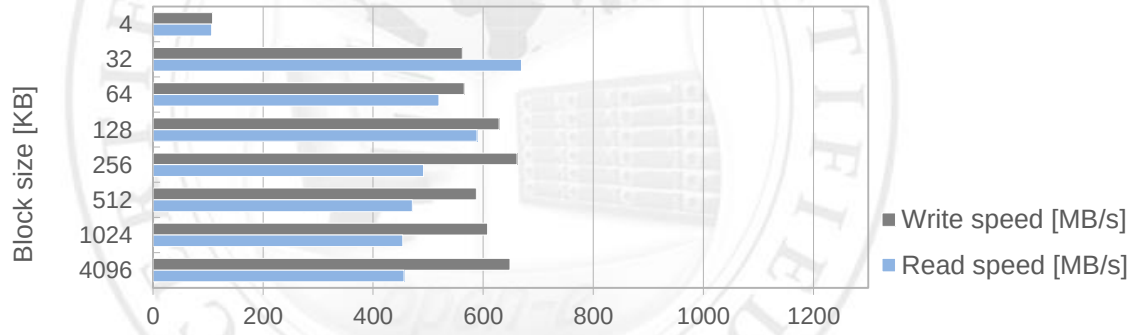

FIGURE 24: iSCSI Initiator performance test results chart for Myricom 10G-PCIE2-8B2-2S

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 Myricom 10G-PCIE2-8B2-2S

iSCSI Target performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	85.97	98.11	passed
32	435.25	415.54	passed
64	636.36	458.56	passed
128	802.33	479.08	passed
256	910.40	478.30	passed
512	944.37	478.99	passed
1024	936.43	478.83	passed
4096	944.83	464.16	passed

TABLE 23: iSCSI Target performance test results table for Myricom 10G-PCIE2-8B2-2S

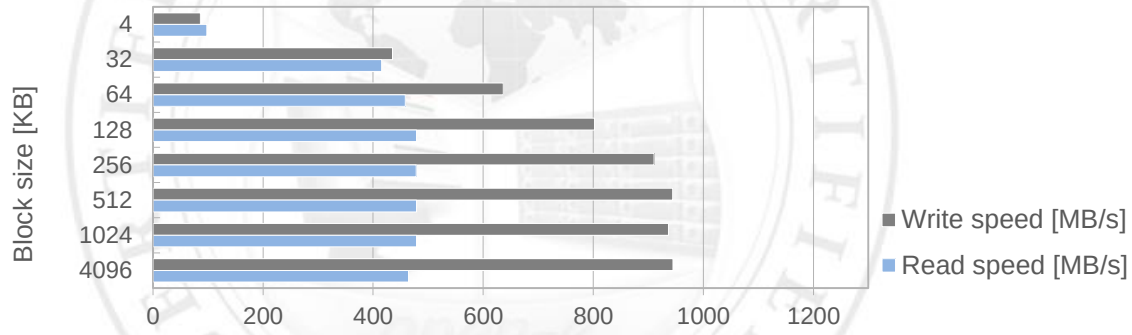

FIGURE 25: iSCSI Target performance test results chart for Myricom 10G-PCIE2-8B2-2S

Fibre Channel functionality

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

Fibre Channel Initiator test topology

Network topology for Fibre Channel Initiator testing is shown below.

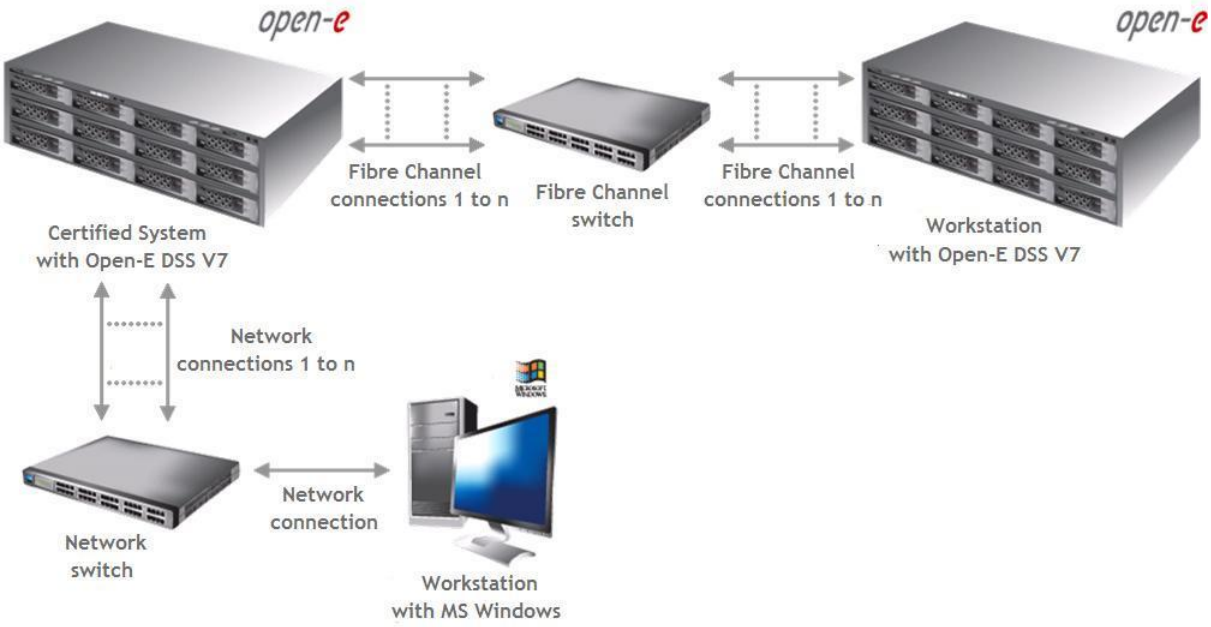

FIGURE 26: Network topology for Fibre Channel Initiator testing

Fibre Channel Target test topology

Network topology for Fibre Channel Target testing is shown below.

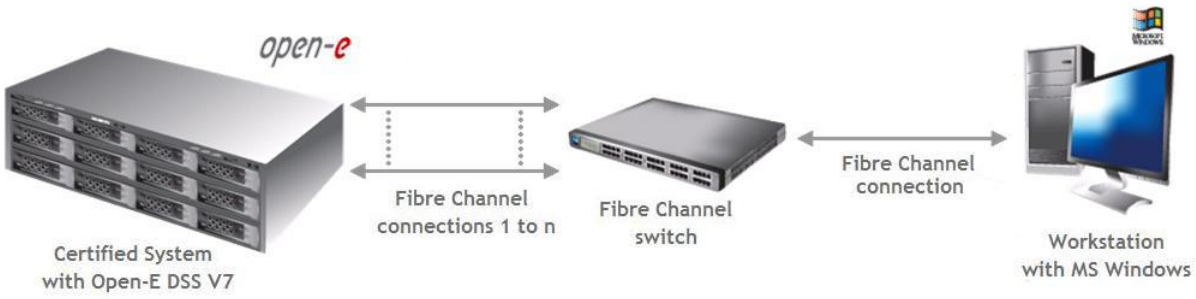

FIGURE 27: Network topology for Fibre Channel Target testing

Fibre Channel Initiator test

1. Test description

Test relies on creating the Fibre Channel Target on *Workstation with Open-E DSS V7*, connecting to the target using *Certified System with Open-E DSS V7* Fibre Channel Initiator and copying the data to the previously exported Fibre Channel LUNs using the Iometer through the SMB protocol using *Workstation with MS Windows* on the certified system.
All the tests were performed using 10GbE network connections and 8Gb Fibre Channel connection.

2. Test results for Fibre Channel Initiator and QLogic QLE2560-CK Fibre Channel Host Bus Adapter

Fibre Channel Initiator performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	110.67	108.96	passed
32	590.74	690.19	passed
64	804.89	527.27	passed
128	782.58	581.77	passed
256	779.68	500.88	passed
512	936.57	476.29	passed
1024	1042.07	465.79	passed
4096	1005.95	467.43	passed

TABLE 24: Fibre Channel Initiator performance test results table for QLogic QLE2560-CK Fibre Channel Host Bus Adapter

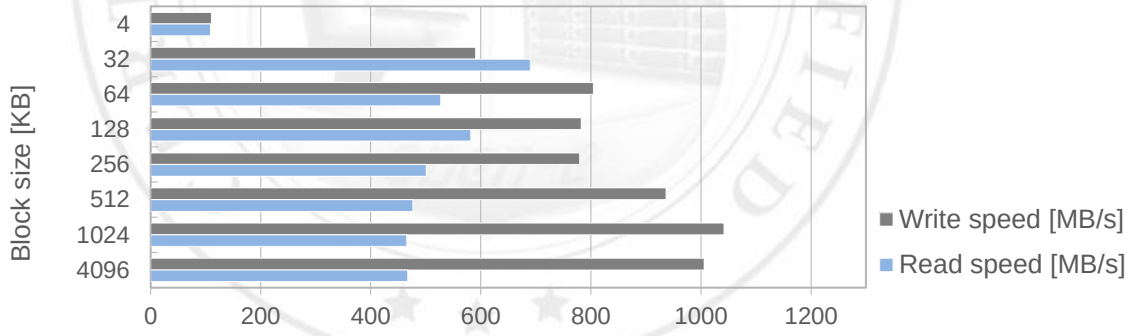

FIGURE 28: Fibre Channel Initiator performance test results chart for QLogic QLE2560-CK Fibre Channel Host Bus Adapter

Fibre Channel Target test

1. Test description

Test relies on creating the Fibre Channel Target on *Certified System with Open-E DSS V7*, connecting to the target using *Workstation with MS Windows* with a Fibre Channel Controller in the initiator mode and copying the data to connected LUN using Iometer.
All the tests were performed using 8GB Fibre Channel connection.

2. Test results for Fibre Channel Target and QLogic QLE2560-CK Fibre Channel Host Bus Adapter

Fibre Channel Target performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	143.07	190.68	passed
32	700.49	521.51	passed
64	744.06	556.90	passed
128	763.55	581.18	passed
256	711.28	601.08	passed
512	743.04	621.87	passed
1024	760.62	622.95	passed
4096	762.90	631.89	passed

TABLE 25: Fibre Channel Target performance test results table for QLogic QLE2560-CK Fibre Channel Host Bus Adapter

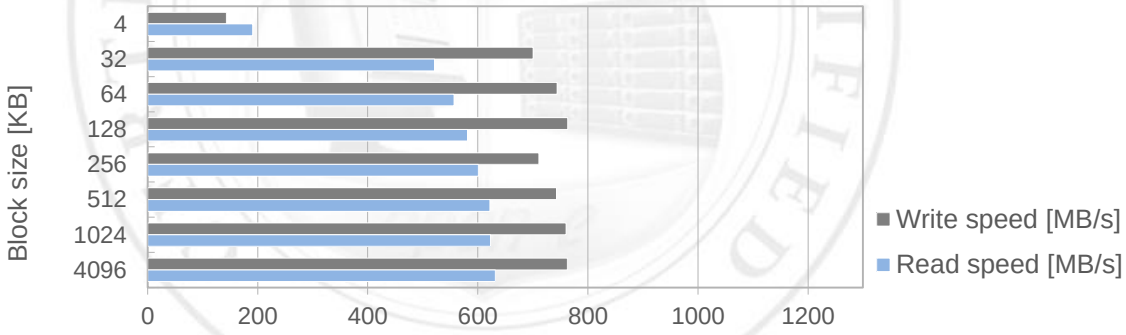

FIGURE 29: Fibre Channel Target performance test results chart for QLogic QLE2560-CK Fibre Channel Host Bus Adapter