ICO Open-E Rack 2121 storage system

Executive summary

After performing all tests, the ICO Open-E Rack 2121 system has been officially certified according to the Open-E Hardware Certification Program Guide.

During the tests, it was found that the system is functional and efficient. With the Open-E DSS V7 operating system installed, the ICO Open-E Rack 2121 is stable and performs well.

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

✓ **iSCSI storage**

The following features make the ICO Open-E Rack 2121 good iSCSI storage:

- Hardware RAID5, RAID6, RAID10, RAID50 or RAID60 for high performance and data safety.
- Four 1GbE and four 10GbE interfaces for fast MPIO connection and flexible network topology.
- Redundant power supply for system reliability

✓ **Storage for database**

The following features make ICO Open-E Rack 2121 a great storage for database:

- Twelve fast and reliable SAS drives.
- Four 10GbE NICs, which can be aggregated for improved fault tolerance and increased performance.
- Server platform with fast CPUs for high transaction rate.
- Hardware RAID5, RAID6, RAID10, RAID50, RAID60 for high performance and data safety.
- Redundant power supply for system reliability.

✓ **Storage for virtualization**

Following features make ICO Open-E Rack 2121 great storage for virtualization:

- Four 10GbE interfaces, provides enough throughput even for demanding servers with many virtual machines running on.
- Four 1GbE interfaces for fast MPIO connection.
- Twelve SAS drives ensures fast data access and reliability.
- Hardware RAID5, RAID6, RAID10, RAID50, RAID60 for high performance and data safety.

Certification notes

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

Where to buy ?

ICO Open-E Rack 2121 Certified Open-E system can be found at
http://www.ico.de/details.php/category_path/0_11_675_994/p_id/yst2/p_name/ICO_Open_E_Rack_2121_GVO3

ICO Open-E Rack 2121 hardware components

Technical specifications about the certified system are listed below:

Model	ICO Open-E Rack 2121
Operating system	Open-E DSS V7 build 6806
Enclosure/chassis	Chenbro RM23500-LE
Motherboard	Intel® Freemont Pass S1400FP4
CPU	Intel® Xeon® E5-2420 1,9 6/12 1333
Memory	3x 8GB Samsung DDR3 FSB1600 240-pin REG x4 2R
Network	4x Intel® Ethernet I350-T2 Server Adapter (on board)
Network	2x Intel® Ethernet Converged Network Adapter X540-T2
HW RAID	LSI 9271-4i 4Port 6Gb/s PCI-E3.0 x8 LP
Hard disk drives	12x HGST Ultrastar 15K600 300GB SAS 6Gb/s

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

ICO Open-E Rack 2121 photos

FIGURE 1: Front photo

FIGURE 2: Rear photo

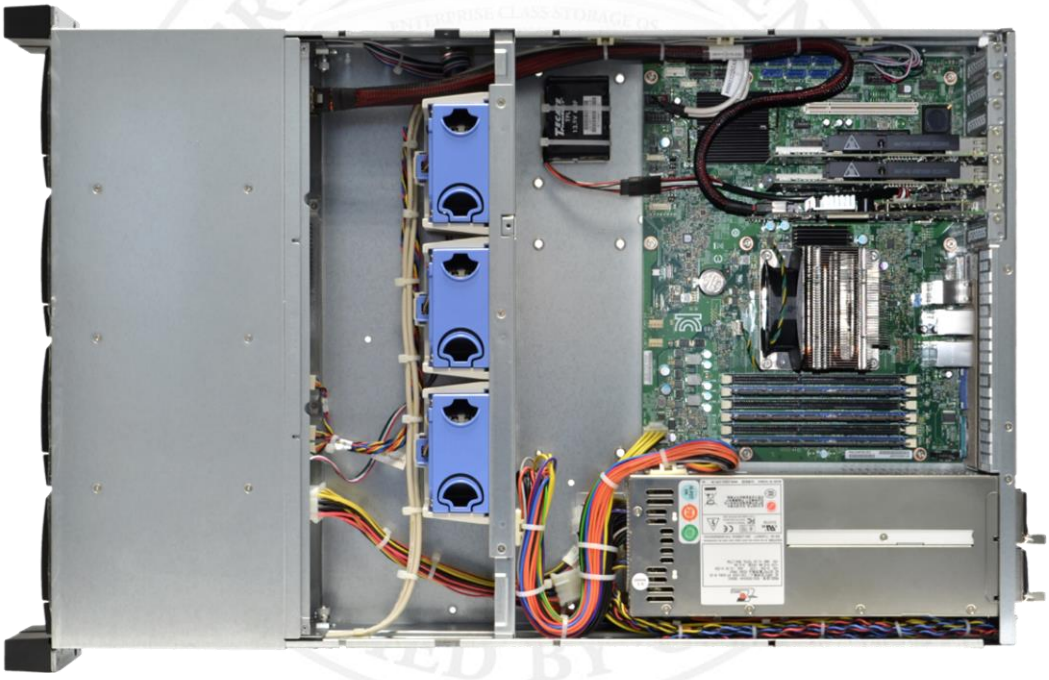

FIGURE 3: Top photo

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	Chenbro SR10769H-021
Motherboard	Intel® Beartooth Pass S1200BTL
CPU	Intel® Xeon® E3-1230v2 3,30GHz
Memory	8GB DDR3 FSB1600 240-pin ECC x8 2R
Network	Intel® Ethernet I350-T2 Server Adapter 1GbE
Network	Intel® Ethernet Converged Network Adapter X540-T2
HW RAID	ICH10R onboard Sata AHCI
Hard disk drives	HGST 1TB Ultrastar A7K2000 SATA2 24/7

TABLE 2: Hardware components of first Workstation with MS Windows

Model	Custom
Operating system	MS Windows Server 2008 R2
Enclosure/chassis	Chenbro SR10769H-021
Motherboard	Intel® Beartooth Pass S1200BTL
CPU	Intel® Xeon® E3-1230v2 3,30GHz
Memory	8GB DDR3 FSB1600 240-pin ECC x8 2R
Network	Intel® Ethernet I350-T2 Server Adapter 1GbE
Network	Intel® Ethernet Converged Network Adapter X540-T2
HW RAID	ICH10R onboard Sata AHCI
Hard disk drives	HGST 1TB Ultrastar A7K2000 SATA2 24/7

TABLE 3: Hardware components of second Workstation with MS Windows

Model	ICO Open-E Rack 2121
Operating system	Open-E DSS V7 build 6806
Enclosure/chassis	Chenbro RM23500-LE
CPU	Intel® Freemont Pass S1400FP4
Motherboard	Intel® Xeon® E5-2420 1,9 6/12 1333
Memory	3x 8GB Samsung DDR3 FSB1600 240-pin REG x4 2R
Network	4x Intel® Ethernet I350-T2 Server Adapter (on board)
Network	2x Intel® Ethernet Converged Network Adapter X540-T2
HW RAID	LSI 9271-4i 4Port 6Gb/s PCI-E3.0 x8 LP
Hard disk drives	12x HGST Ultrastar 15K600 300GB SAS 6Gb/s

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

Model	HP E5406 zl Switch
Description	24-ports 1GbE and 8-ports 10GbE managed network switch

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

Administration functionality

The following functionality has been tested.

Drive identifier	OK
Power button	OK
Front and rear LEDs	OK

TABLE 6: Administration functionality test results

Network functionality

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

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

Network test topology

Network topology for Network testing is shown below.

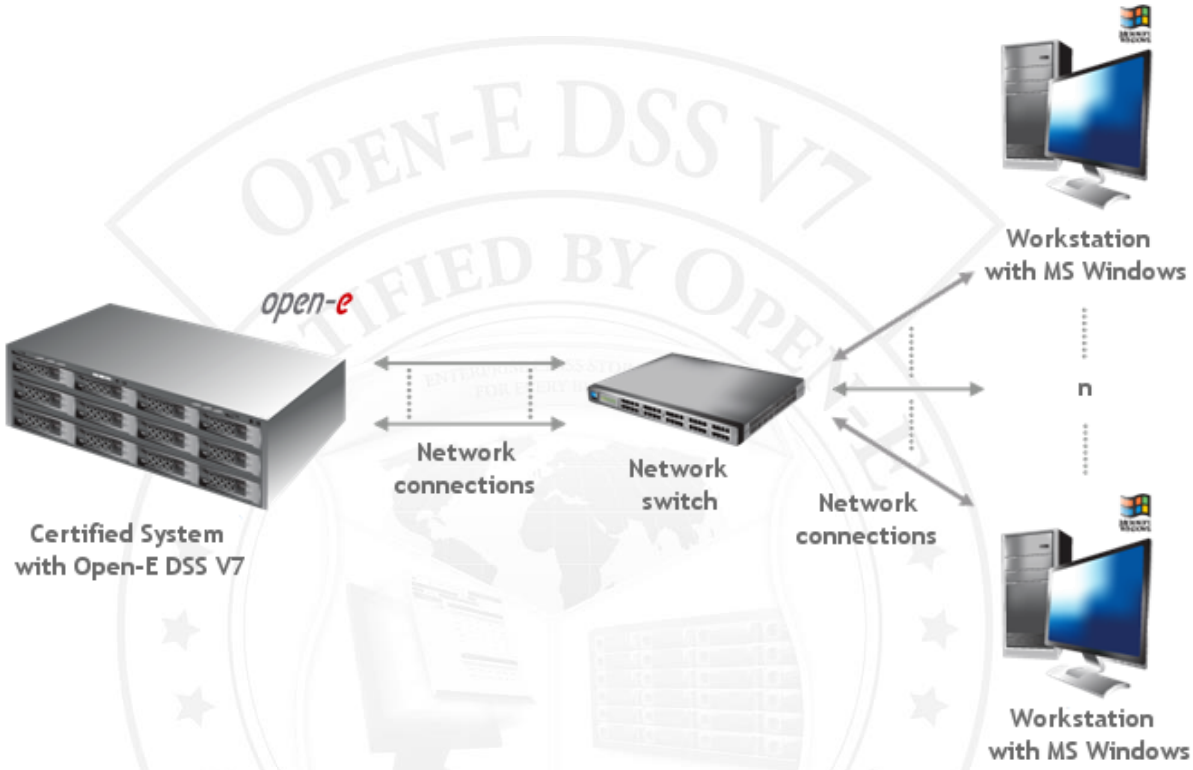

FIGURE 4: Network topology for Network testing

802.3ad bonding mode test

1. Test description

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

2. Test results for 802.3ad bonding mode test performed on Intel® Ethernet I350-T2 Server Adapter (on board)

802.3ad bonding mode performance test results			
NIC model	Intel® Ethernet I350-T2 Server Adapter (on board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	112	47	passed
2nd Workstation	112	105	passed
3rd Workstation	111	40	passed
4th Workstation	110	39	passed

TABLE 7: 802.3ad bonding mode performance test results table for Intel® Ethernet I350-T2 Server Adapter (on board)

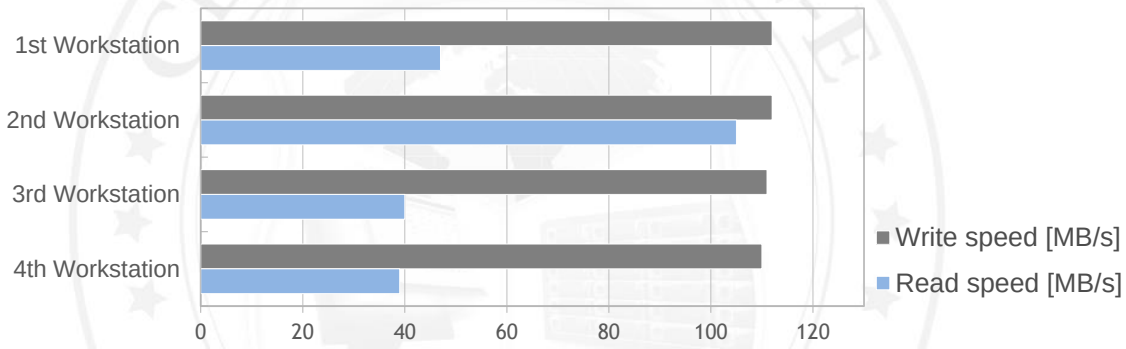

FIGURE 5: 802.3ad bonding mode performance test results chart for Intel® Ethernet I350-T2 Server Adapter (on board)

3. Test results for 802.3ad bonding mode test performed on Intel® Ethernet Converged Network Adapter X540-T2

802.3ad bonding mode performance test results			
NIC model	Intel® Ethernet CNA X540-T2		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	425	346	passed
2nd Workstation	580	444	passed
3rd Workstation	456	387	passed
4th Workstation	320	305	passed

TABLE 8: 802.3ad bonding mode performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

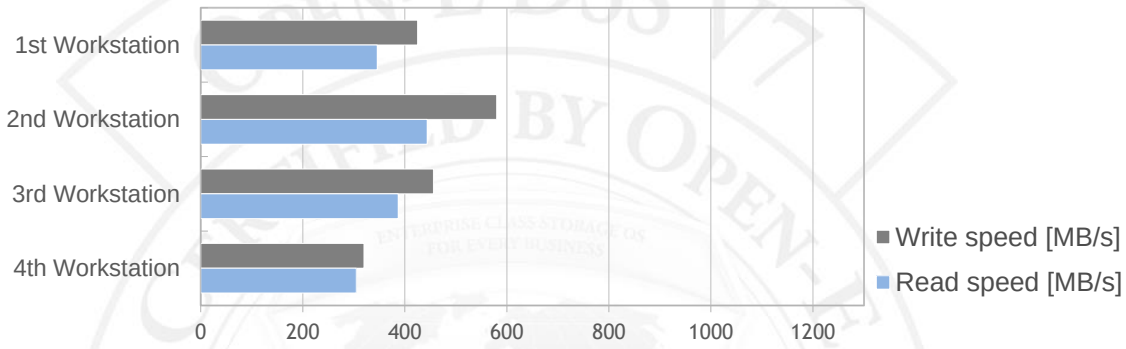

FIGURE 6: 802.3ad bonding mode performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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-T2 Server Adapter (on board)

Balance-alb bonding mode performance test results			
NIC model	Intel® Ethernet I350-T2 Server Adapter (on board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	112	112	passed
2nd Workstation	112	112	passed
3rd Workstation	112	112	passed
4th Workstation	112	112	passed

TABLE 9: Balance-alb bonding mode performance test results table for Intel® Ethernet I350-T2 Server Adapter (on board)

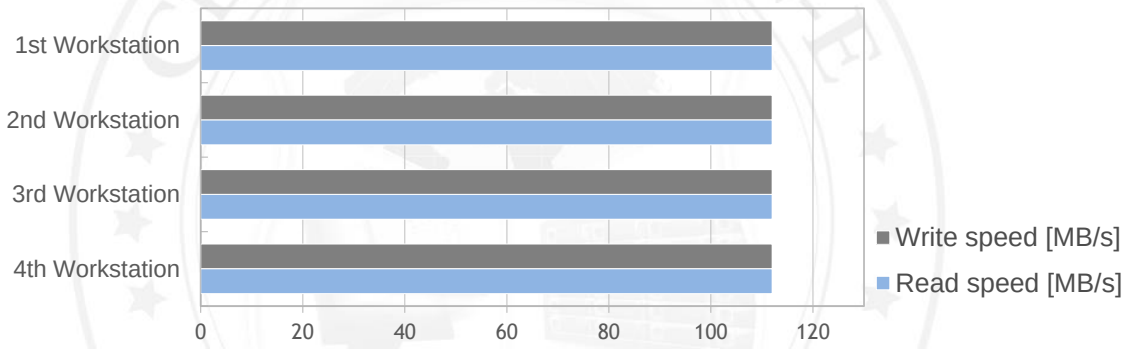

FIGURE 7: Balance-alb bonding mode performance test results chart for Intel® Ethernet I350-T2 Server Adapter (on board)

3. Test results for Balance-alb bonding mode test performed Intel® Ethernet Converged Network Adapter X540-T2

Balance-alb bonding mode performance test results			
NIC model	Intel® Ethernet CNA X540-T2		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	530	386	passed
2nd Workstation	724	385	passed
3rd Workstation	365	382	passed
4th Workstation	304	393	passed

TABLE 10: Balance-alb bonding mode performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

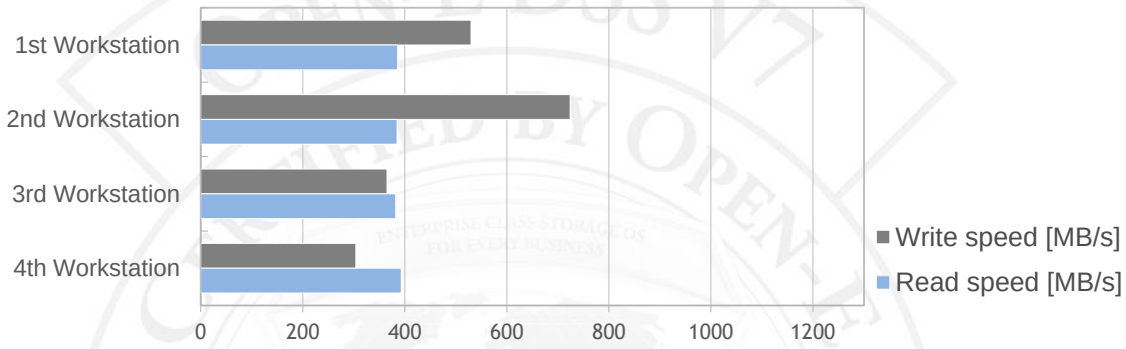

FIGURE 8: Balance-alb bonding mode performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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-T2 Server Adapter (on board)

Balance-rr bonding mode performance test results			
NIC model	Intel® Ethernet I350-T2 Server Adapter (on board)		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	112	64	passed
2nd Workstation	112	67	passed
3rd Workstation	112	64	passed
4th Workstation	112	66	passed

TABLE 11: Balance-rr bonding mode performance test results table for Intel® Ethernet I350-T2 Server Adapter (on board)

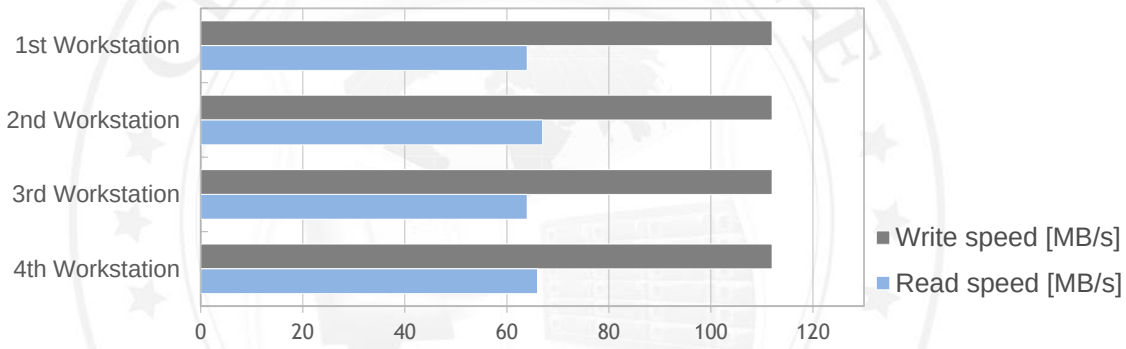

FIGURE 9: Balance-rr bonding mode performance test results chart for Intel® Ethernet I350-T2 Server Adapter (on board)

3. Test results for Balance-rr bonding mode test performed on Intel® Ethernet Converged Network Adapter X540-T2

Balance-rr bonding mode performance test results			
NIC model	Intel® Ethernet CNA X540-T2		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1st Workstation	428	177	passed
2nd Workstation	528	173	passed
3rd Workstation	461	181	passed
4th Workstation	459	183	passed

TABLE 12: Balance-rr bonding mode performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

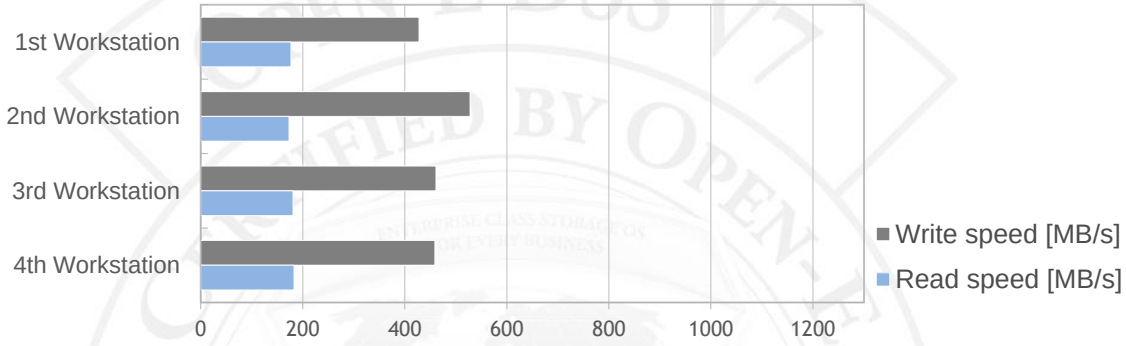

FIGURE 10: Balance-rr bonding mode performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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, 1, 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

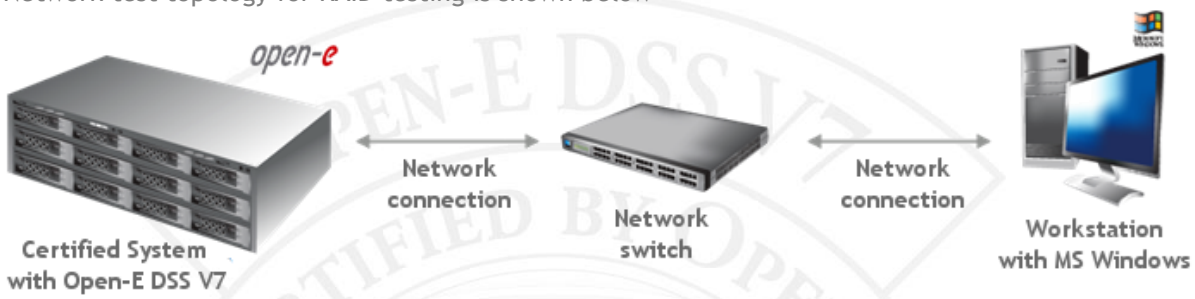

FIGURE 11: Network test topology for RAID testing

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 X540-T2

RAID0 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	11	69	passed
32	56	394	passed
64	231	451	passed
128	392	536	passed
256	516	646	passed
512	519	489	passed
1024	531	496	passed
4096	539	487	passed

TABLE 13: RAID0 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

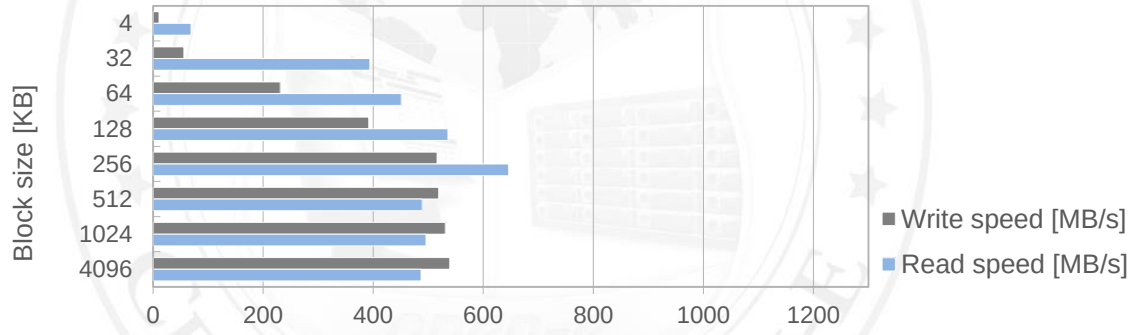

FIGURE 12: RAID0 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

Hardware RAID1 test

1. Test description

The test relies on creation of the RAID1 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 RAID1 and Intel® Ethernet Converged Network Adapter X540-T2

RAID1 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	12	69	passed
32	61	389	passed
64	243	448	passed
128	418	528	passed
256	535	628	passed
512	529	492	passed
1024	525	490	passed
4096	535	484	passed

TABLE 14: RAID1 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

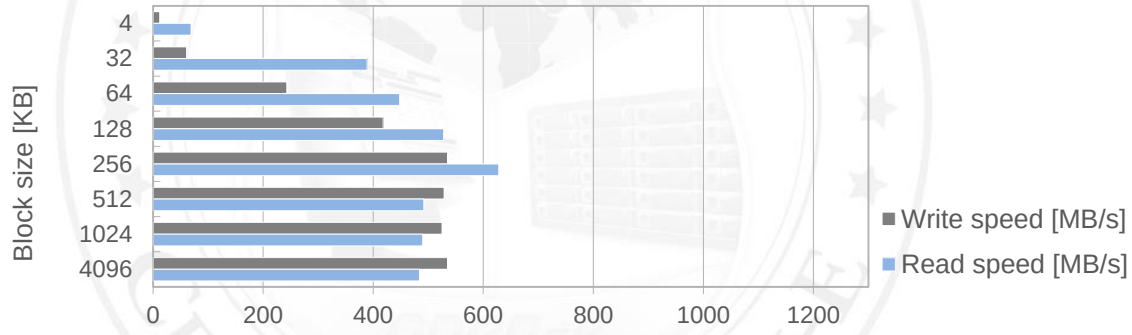

FIGURE 13: RAID1 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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 X540-T2

RAID5 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	11	70	passed
32	61	411	passed
64	237	465	passed
128	393	544	passed
256	522	638	passed
512	527	498	passed
1024	535	492	passed
4096	541	497	passed

TABLE 15: RAID5 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

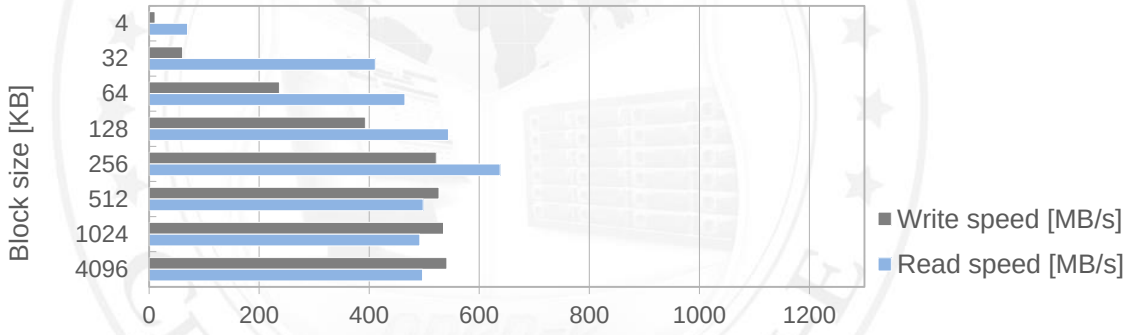

FIGURE 14: RAID5 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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 X540-T2

RAID6 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	13	69	passed
32	60	405	passed
64	235	457	passed
128	414	585	passed
256	536	662	passed
512	530	499	passed
1024	538	503	passed
4096	536	505	passed

TABLE 16: RAID6 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

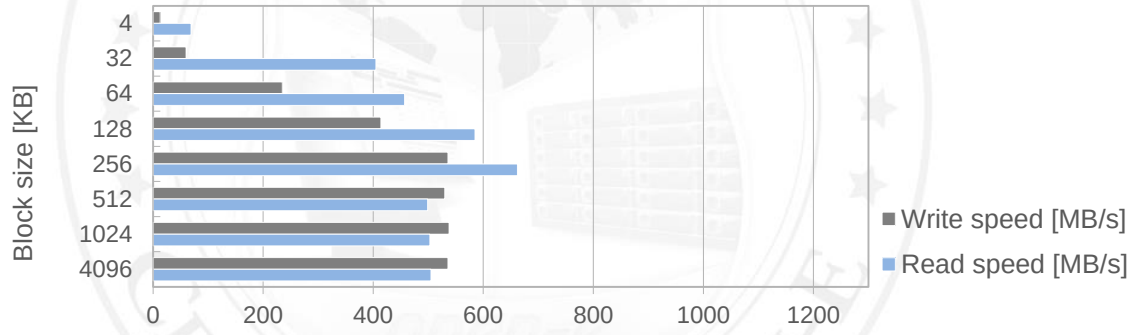

FIGURE 15: RAID6 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

Hardware RAID10 test

1. Test description

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

2. Test results for RAID10 and Intel® Ethernet Converged Network Adapter X540-T2

RAID10 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	11	70	passed
32	59	393	passed
64	227	452	passed
128	395	541	passed
256	512	642	passed
512	520	494	passed
1024	530	491	passed
4096	530	493	passed

TABLE 17: RAID10 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

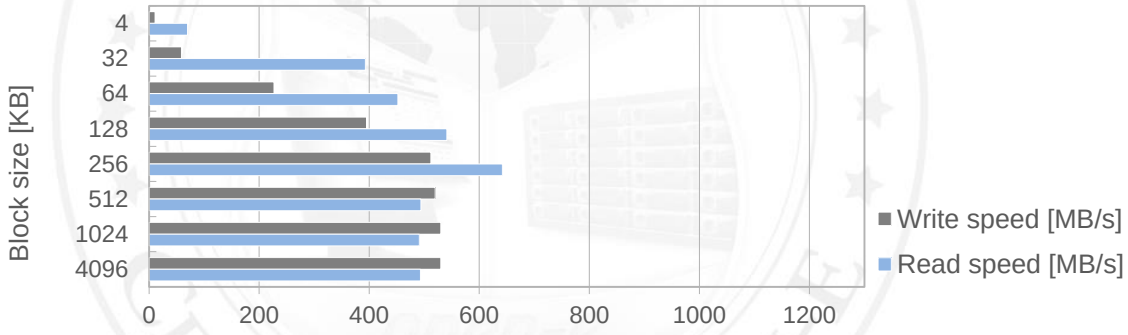

FIGURE 16: RAID10 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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 X540-T2

RAID50 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	12	69	passed
32	60	393	passed
64	244	453	passed
128	415	531	passed
256	536	630	passed
512	525	495	passed
1024	530	490	passed
4096	532	488	passed

TABLE 18: RAID50 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

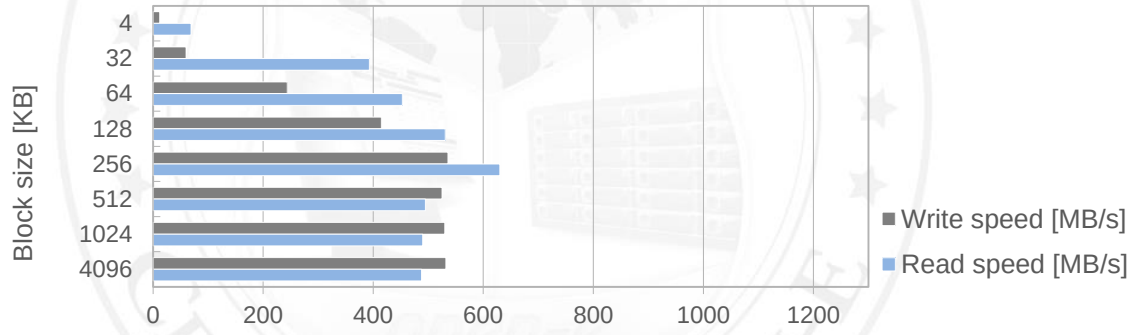

FIGURE 17: RAID50 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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 X540-T2

RAID60 performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	13	68	passed
32	64	412	passed
64	236	456	passed
128	420	577	passed
256	542	676	passed
512	533	503	passed
1024	539	499	passed
4096	538	499	passed

TABLE 19: RAID60 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

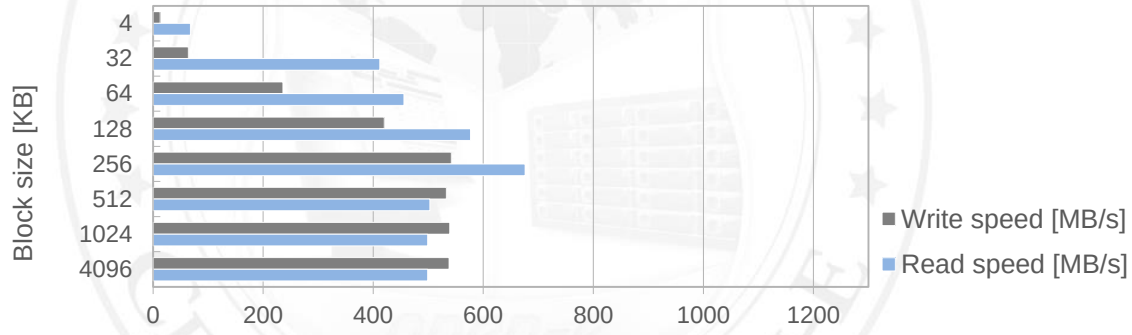

FIGURE 18: RAID60 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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.

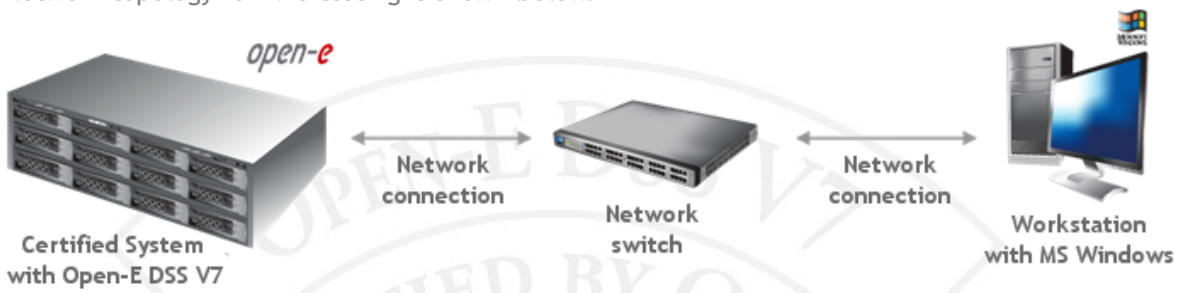

FIGURE 19: Network topology for NAS testing

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 X540-T2

SMB performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	96	140	passed
32	647	621	passed
64	1005	472	passed
128	1043	496	passed
256	999	498	passed
512	989	493	passed
1024	995	486	passed
4096	998	487	passed

TABLE 20: SMB performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

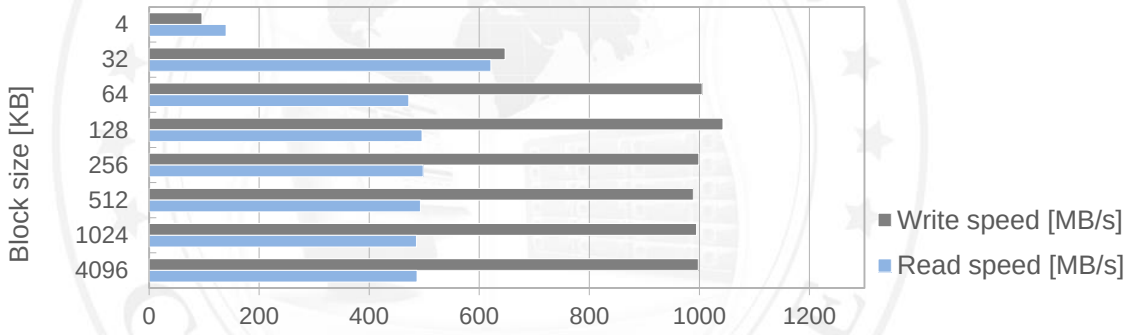

FIGURE 20: SMB performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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.

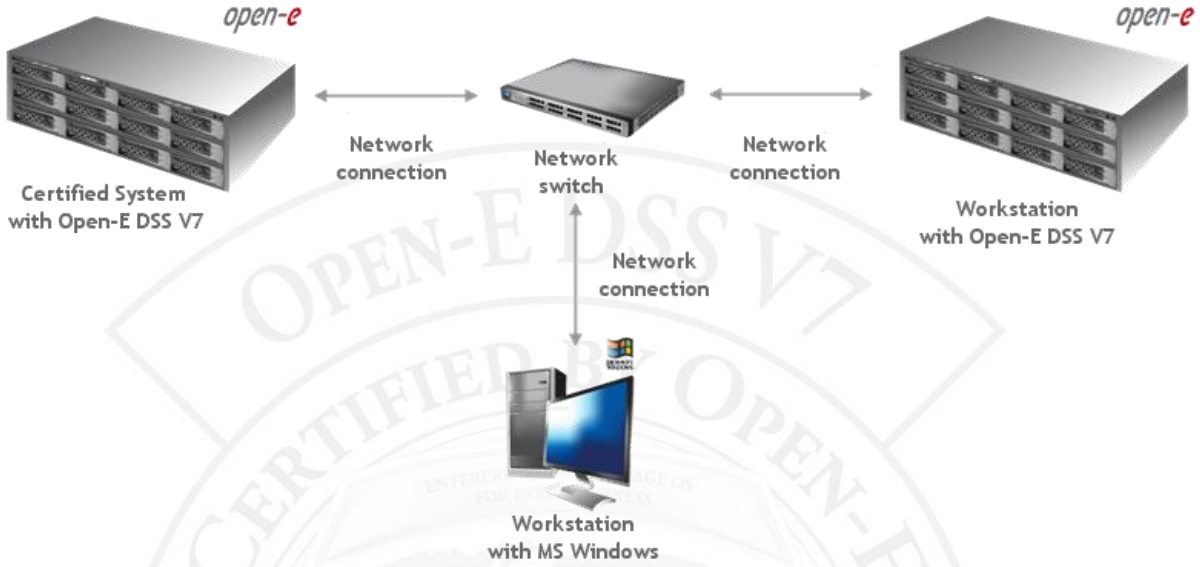

FIGURE 21: Network topology for iSCSI Initiator testing

iSCSI Target test topology

Network topology for iSCSI Target testing is shown below.

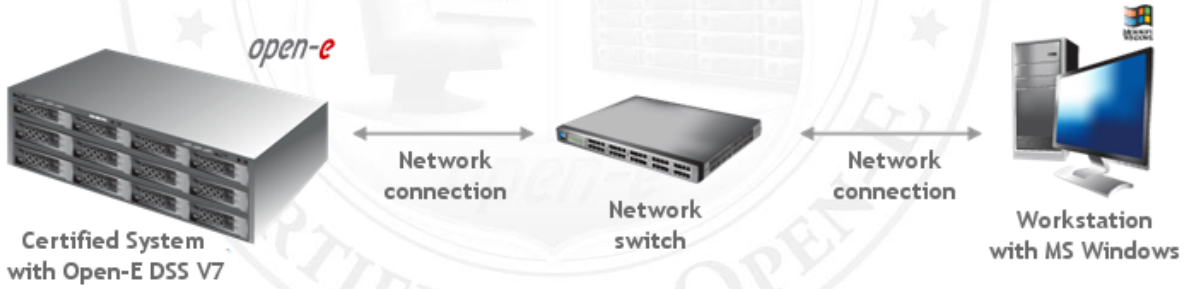

FIGURE 22: Network topology for iSCSI Target testing

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 X540-T2

iSCSI Initiator performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	122	110	passed
32	647	724	passed
64	739	676	passed
128	950	631	passed
256	730	576	passed
512	980	543	passed
1024	746	522	passed
4096	1055	537	passed

TABLE 21: iSCSI Initiator performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

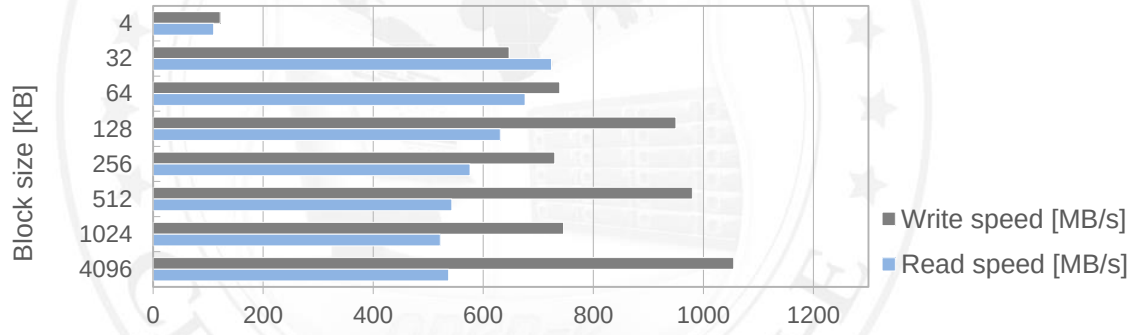

FIGURE 23: iSCSI Initiator performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

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 X540-T2

iSCSI Target performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	11	70	passed
32	57	399	passed
64	228	463	passed
128	401	534	passed
256	532	642	passed
512	530	505	passed
1024	539	499	passed
4096	540	498	passed

TABLE 22: iSCSI Target performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

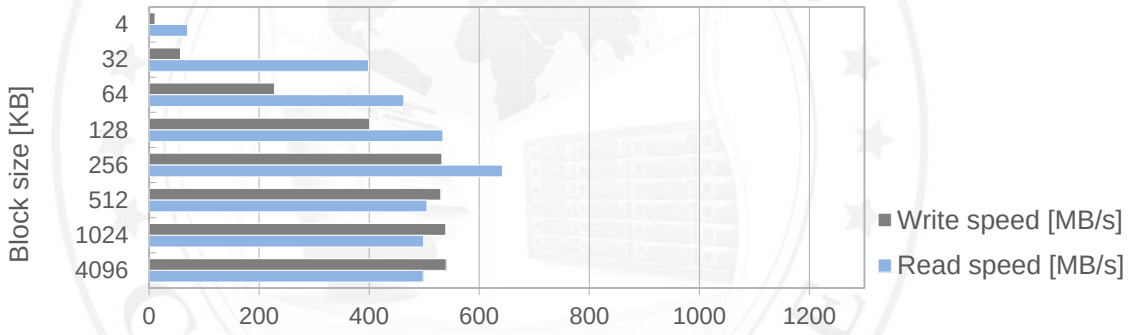

FIGURE 24: iSCSI Target performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2