

# CORETO AG RECT ST-3762R16-N Storage system



## Executive summary

After performing all tests, the CORETO AG RECT ST-3762R16-N 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 CORETO AG RECT ST-3762R16-N 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 CORETO AG RECT ST-3762R16-N good iSCSI storage:

- Various hardware RAID levels with SSD cache for high performance and data safety.
- Two 1GbE and two 10GbE interfaces for fast MPIO connection and flexible network topology.
- Redundant power supply for system reliability.

### ✓ NAS filer

The following features make CORETO AG RECT ST-3762R16-N a good NAS filer solution:

- Sixteen high capacity SAS hard drives with SSD cache provide a lot of space for user files and ensure fast random access.
- Hardware RAID5, RAID6, RAID10, RAID50 and RAID60 for fault tolerance and the most efficient use of available disk space.
- Two 10GbE and two 1GbE interfaces for independent connection to different networks or link aggregation for improved throughput.

### ✓ Storage for CCTV

For this application the following can be used:

- Sixteen high capacity SAS drives with high level RAID5 provide lots of redundant storage for CCTV records.
- Two 1GbE and two 10GbE interfaces for independent connection to different networks or link aggregation for improved throughput.
- Redundant power supply for system reliability.

## Certification notes

For link aggregation, it is recommended to use balance-alb mode.

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## CORETO AG RECT ST-3762R16-N hardware components

Technical specifications about the certified system are listed below:

Model	CORETO AG RECT ST-3762R16-N
Operating system	Open-E DSS V7 build 10529
Enclosure/chassis	Chenbro RM31616E2
CPU	Intel® Xeon® Processor E3-1220 v3
Motherboard	Supermicro X10SLM+-F
Memory	2x 4GB Kingston KVR16E11S8/4 ECC DDR3-1600
Network	2x Intel® Ethernet Controller I210-AT
Network	Intel® Ethernet Converged Network Adapter X540-T2
HW RAID	Adaptec RAID 7805Q
Hard disk drives	2x Intel® SSD DC S3500 Series 240GB SSDSC2BB240G401
Hard disk drives	16x 2TB HGST UltraStar SAS HUS724020ALS640/0B26887

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



## CORETO AG RECT ST-3762R16-N photos



FIGURE 1: Front photo



FIGURE 2: Rear photo

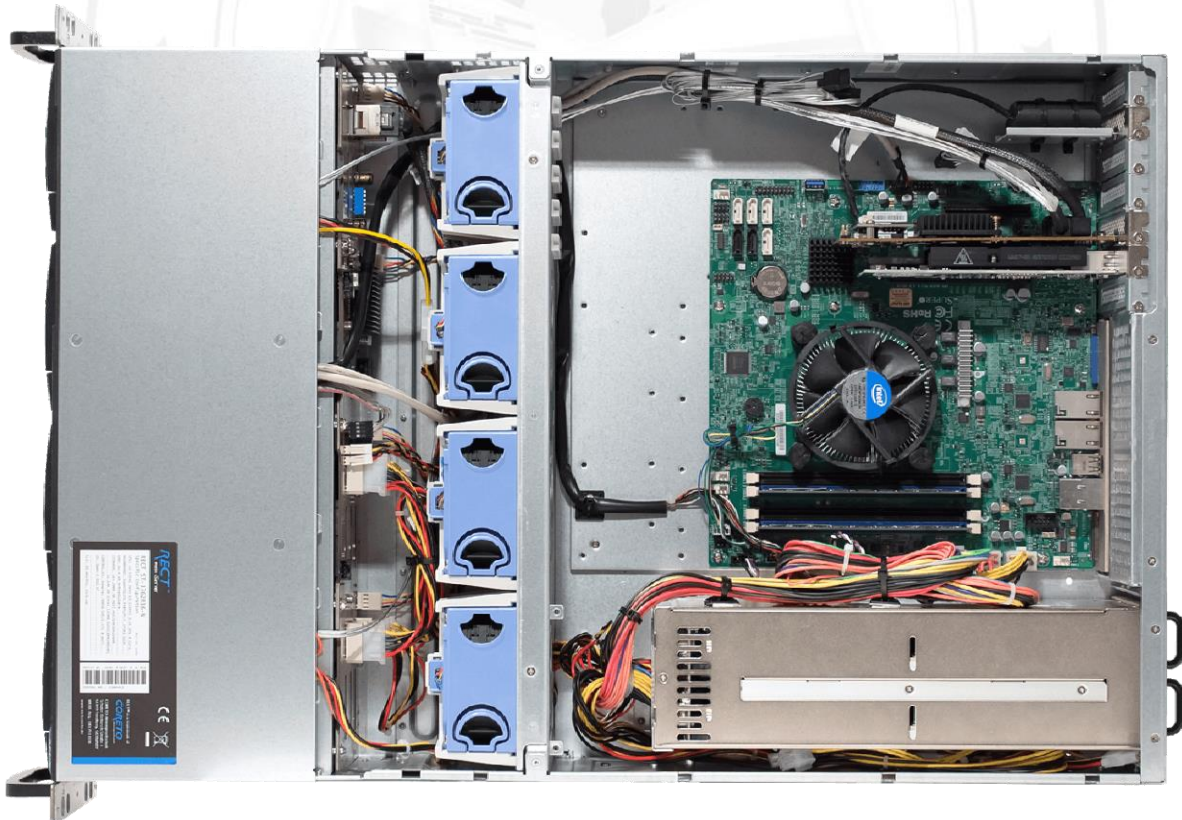


FIGURE 3: Top photo

## 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 2012 R2
Enclosure/chassis	Custom
Motherboard	Supermicro X10SLL-F
CPU	Intel® Xeon® Processor E3-1230 v3
Memory	2x 4GB Kingston KVR16E11S8/4 ECC DDR3-1600
Network	Intel® Ethernet Controller I210-AT
Network	Intel® Ethernet Connection I217-LM
Network	Intel® Ethernet Converged Network Adapter X540-T2
Hard disk controller	Intel® C222 Chipset
Hard disk drives	500 GB Western Digital RE WD5003ABYZ

TABLE 2: Hardware components of first Workstation with MS Windows

Model	Custom
Operating system	MS Windows Server 2012 R2
Enclosure/chassis	Custom
Motherboard	Supermicro X10SLL-F
CPU	Intel® Xeon® Processor E3-1230 v3
Memory	2x 4GB Kingston KVR16E11S8/4 ECC DDR3-1600
Network	Intel® Ethernet Controller I210-AT
Network	Intel® Ethernet Connection I217-LM
Network	Intel® Ethernet Converged Network Adapter X540-T2
Hard disk controller	Intel® C222 Chipset
Hard disk drives	500 GB Western Digital RE WD5003ABYZ

TABLE 3: Hardware components of second Workstation with MS Windows

Model	Custom
Operating system	Open-E DSS V7 build 10529
Enclosure/chassis	Custom
Motherboard	Asus P8B WS
CPU	Intel® Core™ i3-3210 Processor
Memory	2x 4GB Kingston KVR1333D3N9/4G
Network	2x Intel® 82574L Gigabit Ethernet Controller
Network	Intel® Ethernet Converged Network Adapter X540-T1
Hard disk controller	Intel® C206 Chipset
Hard disk drives	500 GB Western Digital RE WD5003ABYZ

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

Model	Netgear ProSafe XS712T-100NES
Description	12 ports 10GbE and 2 ports SFP+ 10GbE

TABLE 5: Network switch details for connection with 10GbE

## 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.

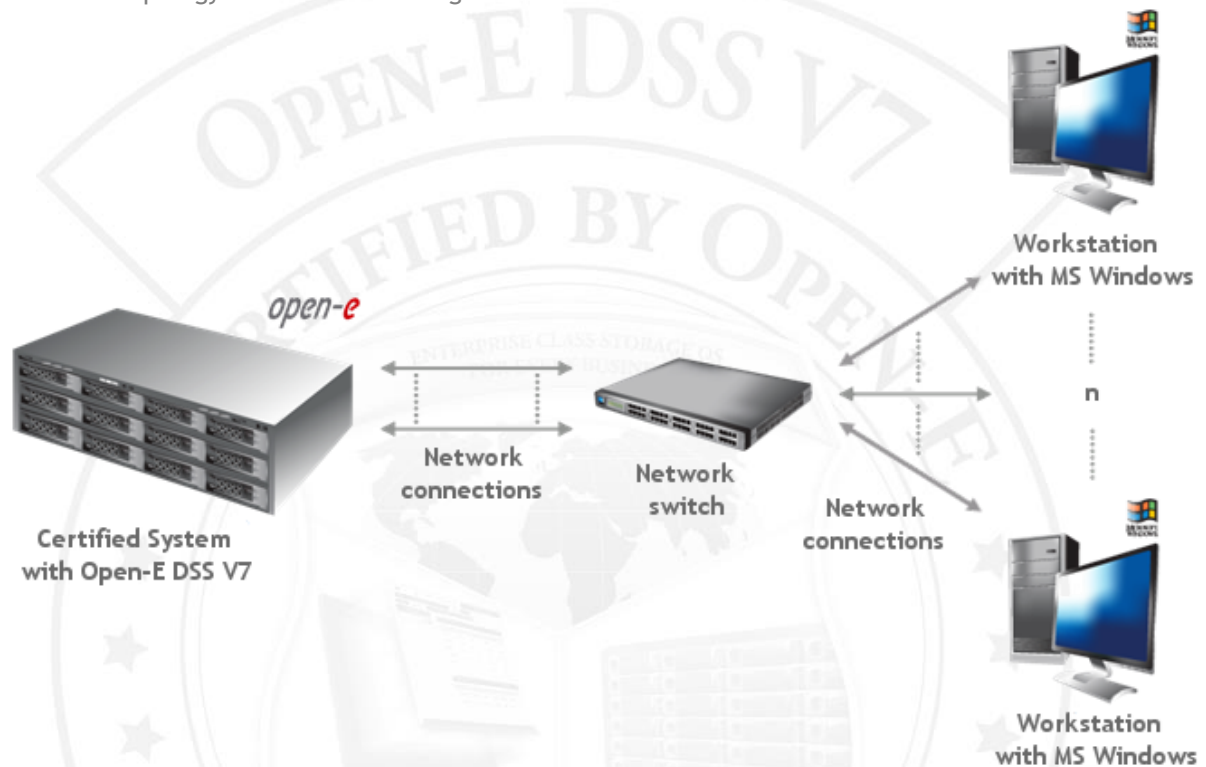


FIGURE 4: Network topology for Network testing



## 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 Controller I210-AT

802.3ad bonding mode performance test results			
NIC model	Intel® Ethernet Controller I210-AT		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1 <sup>st</sup> Workstation	104	104	passed
2 <sup>nd</sup> Workstation	112	108	passed

TABLE 7: 802.3ad bonding mode performance test results table for Intel® Ethernet Controller I210-AT

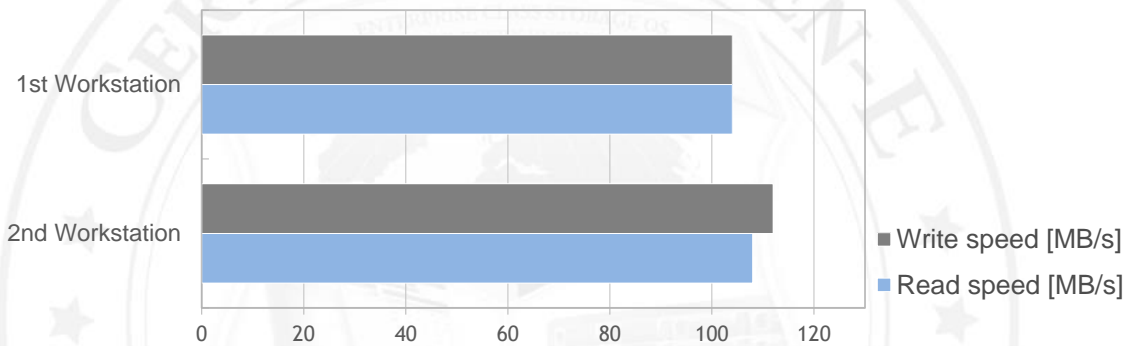


FIGURE 5: 802.3ad bonding mode performance test results chart for Intel® Ethernet Controller I210-AT

### 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 Converged Network Adapter X540		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1 <sup>st</sup> Workstation	1122	1098	passed
2 <sup>nd</sup> Workstation	1120	1093	passed

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

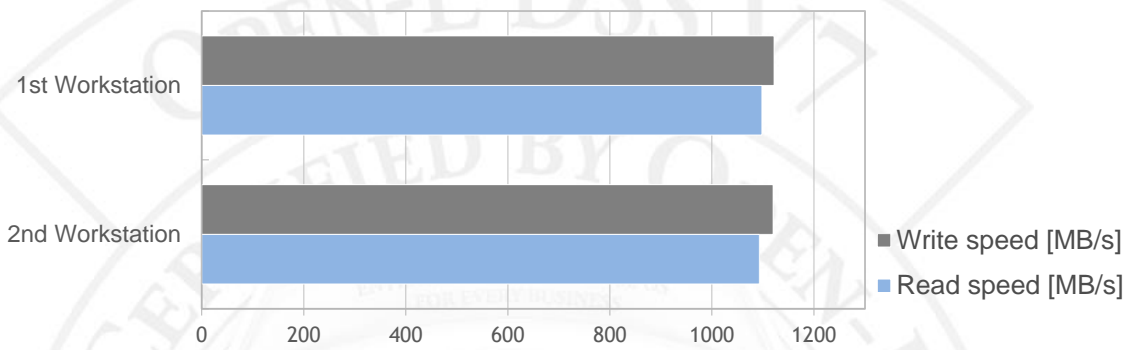


FIGURE 6: 802.3ad bonding mode performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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 Controller I210-AT

Balance-alb bonding mode performance test results			
NIC model	Intel® Ethernet Controller I210-AT		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1 <sup>st</sup> Workstation	112	112	passed
2 <sup>nd</sup> Workstation	112	112	passed

TABLE 9: Balance-alb bonding mode performance test results table for Intel® Ethernet Controller I210-AT

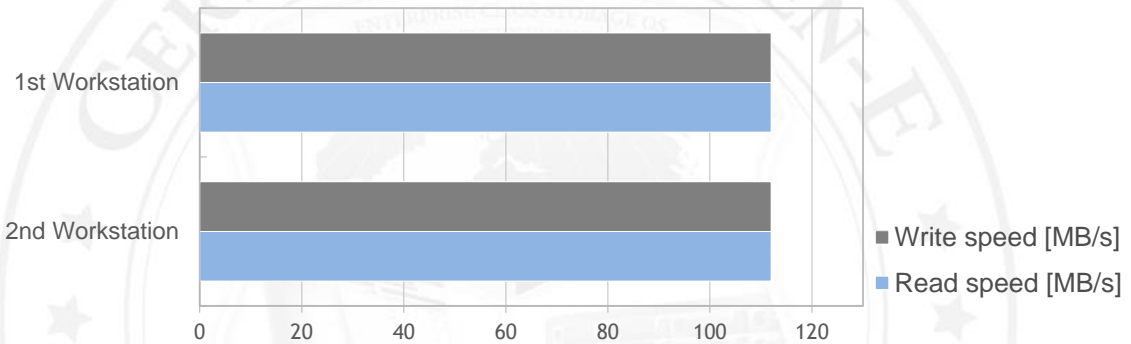


FIGURE 7: Balance-alb bonding mode performance test results chart for Intel® Ethernet Controller I210-AT

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

Balance-alb bonding mode performance test results			
NIC model	Intel® Ethernet Converged Network Adapter X540		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1 <sup>st</sup> Workstation	1102	1069	passed
2 <sup>nd</sup> Workstation	1120	1104	passed

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

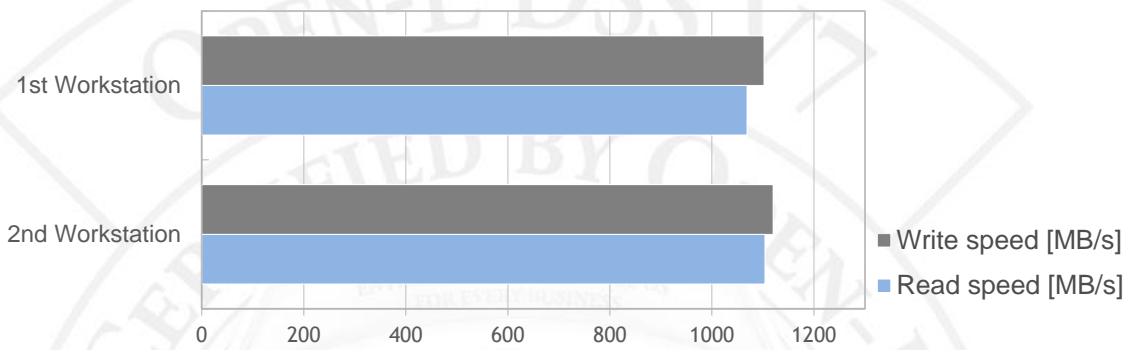


FIGURE 8: Balance-alb bonding mode performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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 Controller I210-AT

Balance-rr bonding mode performance test results			
NIC model	Intel® Ethernet Controller I210-AT		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1 <sup>st</sup> Workstation	112	84	passed
2 <sup>nd</sup> Workstation	108	120	passed

TABLE 11: Balance-rr bonding mode performance test results table for Intel® Ethernet Controller I210-AT

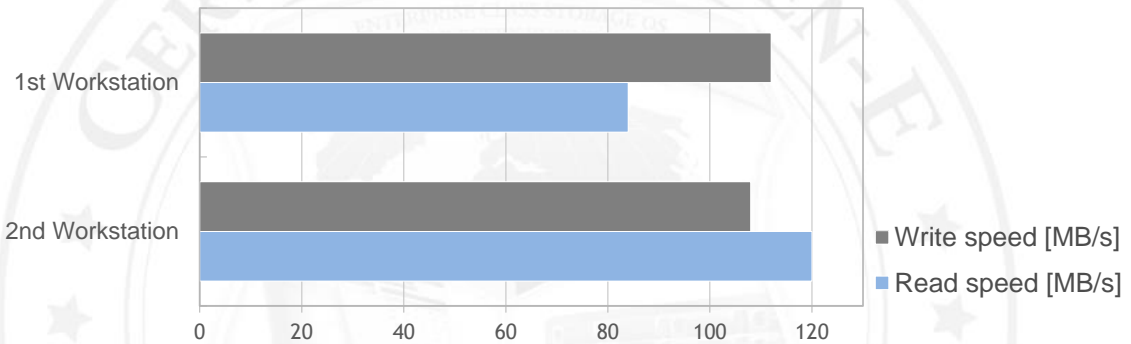


FIGURE 9: Balance-rr bonding mode performance test results chart for Intel® Ethernet Controller I210-AT

### 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 Converged Network Adapter X540		
Workstations with MS Windows	Write speed [MB/s]	Read speed [MB/s]	Performance test results
1 <sup>st</sup> Workstation	1112	353	passed
2 <sup>nd</sup> Workstation	1120	337	passed

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

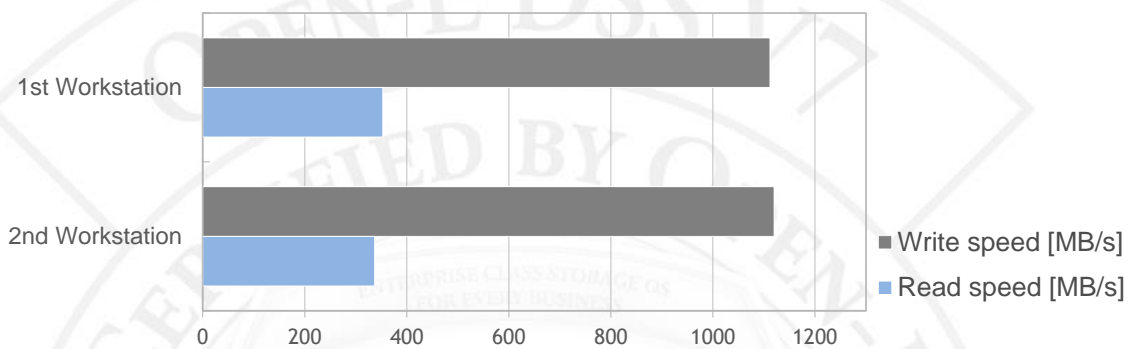


FIGURE 10: Balance-rr bonding mode performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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, 1E, 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 lometer testing tool.

### RAID test topology

Network test topology for RAID testing is shown below

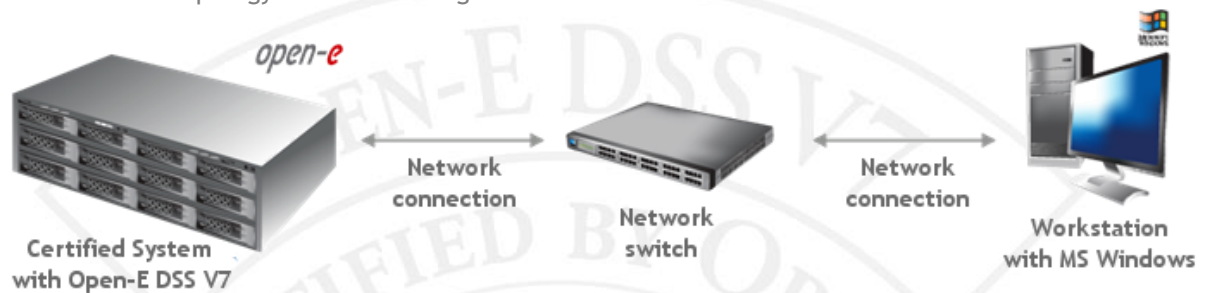


FIGURE 11: Network test topology for RAID testing

## 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	80	96	passed
32	504	544	passed
64	768	960	passed
128	984	1088	passed
256	1112	1104	passed
512	1120	1104	passed
1024	1120	1112	passed
4096	1120	1112	passed

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

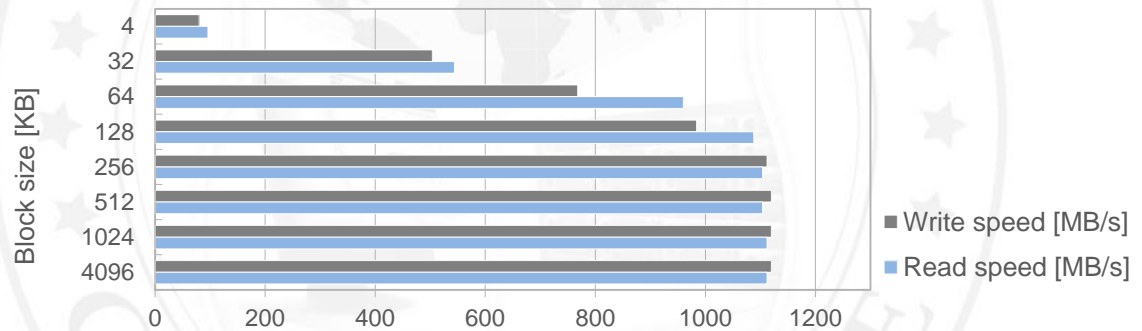


FIGURE 12: RAID0 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2



## 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	89	100	passed
32	510	621	passed
64	718	862	passed
128	909	991	passed
256	995	1075	passed
512	1025	1110	passed
1024	1025	1103	passed
4096	1030	824	passed

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

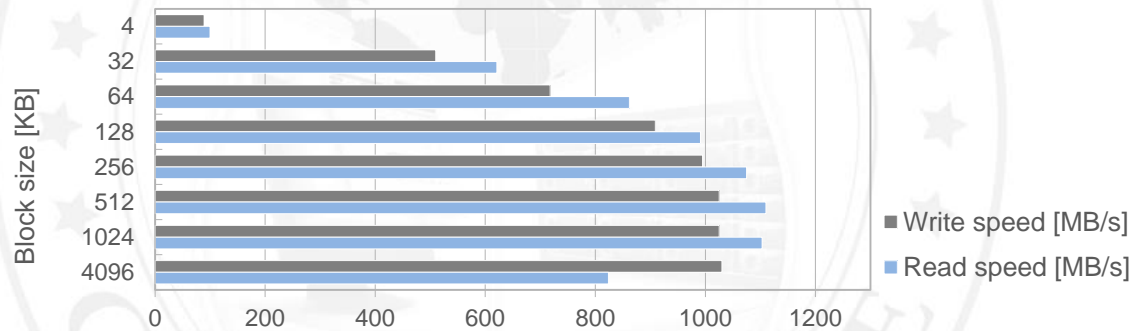


FIGURE 13: RAID1 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## Hardware RAID1E test

### 1. Test description

The test relies on creation of the RAID1E 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 lometer testing tool.

### 2. Test results for RAID1E and Intel® Ethernet Converged Network Adapter X540-T2

RAID1E performance test results			
Block size [KB]	Write speed [MB/s]	Read speed [MB/s]	Performance test results
4	87	112	passed
32	514	401	passed
64	727	425	passed
128	914	1005	passed
256	1015	1102	passed
512	1008	1074	passed
1024	1021	1085	passed
4096	1013	1109	passed

TABLE 15: RAID1E performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

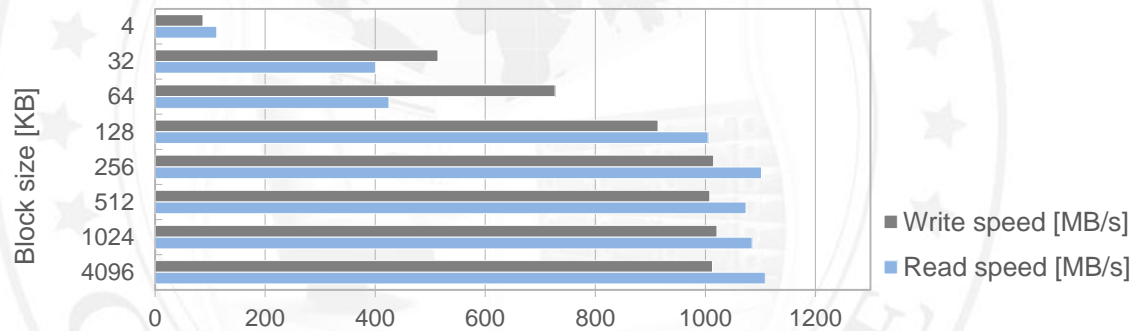


FIGURE 14: RAID1E performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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	87	113	passed
32	544	502	passed
64	768	687	passed
128	989	1018	passed
256	1120	1110	passed
512	1123	1115	passed
1024	1121	1085	passed
4096	1123	1102	passed

TABLE 16: RAID5 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

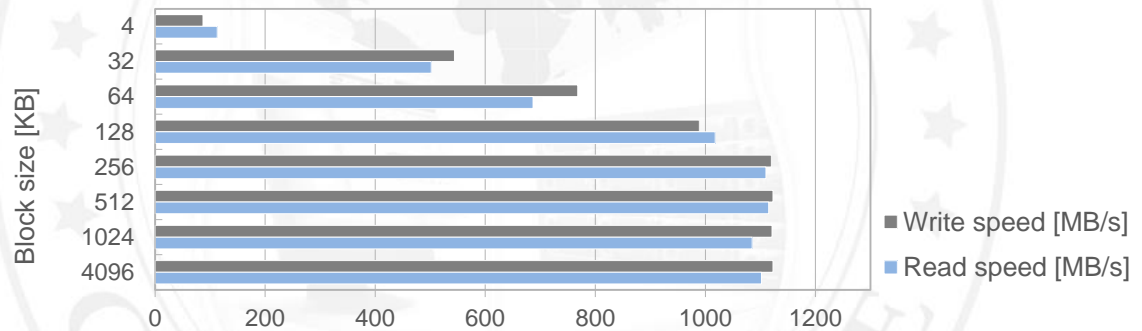


FIGURE 15: RAID5 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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 lometer 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	88	114	passed
32	512	510	passed
64	705	811	passed
128	917	1077	passed
256	1063	1107	passed
512	1029	992	passed
1024	1043	1064	passed
4096	1045	1084	passed

TABLE 17: RAID6 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

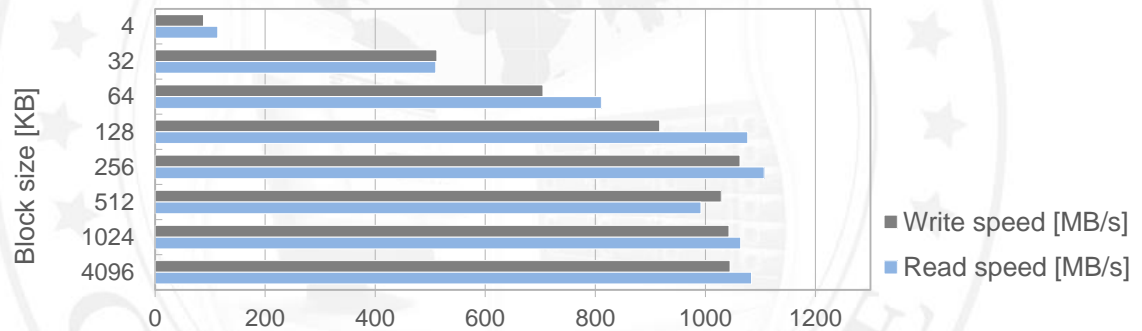


FIGURE 16: RAID6 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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 lometer 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	88	110	passed
32	554	630	passed
64	798	978	passed
128	1009	1105	passed
256	1122	1119	passed
512	1123	1120	passed
1024	1124	1122	passed
4096	1123	1123	passed

TABLE 18: RAID10 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

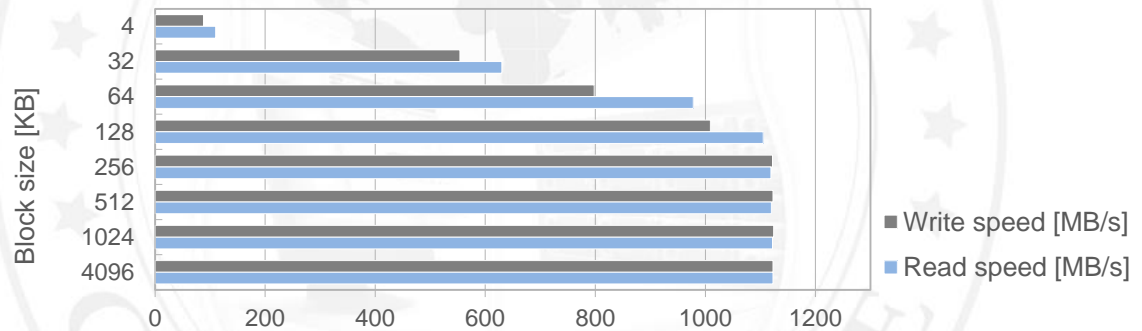


FIGURE 17: RAID10 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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 lometer 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	80	112	passed
32	512	848	passed
64	720	1024	passed
128	880	1080	passed
256	1040	1096	passed
512	1024	1109	passed
1024	1016	1104	passed
4096	1024	1079	passed

TABLE 19: RAID50 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

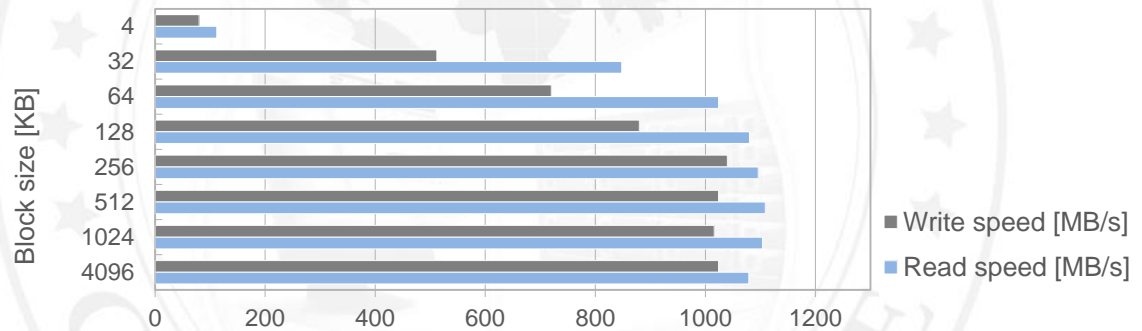


FIGURE 18: RAID50 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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 lometer 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	87	116	passed
32	530	782	passed
64	749	1025	passed
128	977	1062	passed
256	1120	1103	passed
512	1121	1074	passed
1024	1123	1047	passed
4096	1122	1046	passed

TABLE 20: RAID60 performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

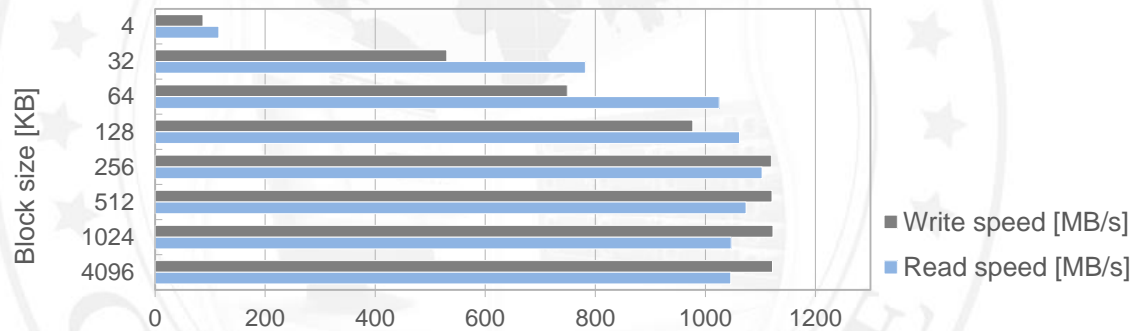


FIGURE 19: RAID60 performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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.

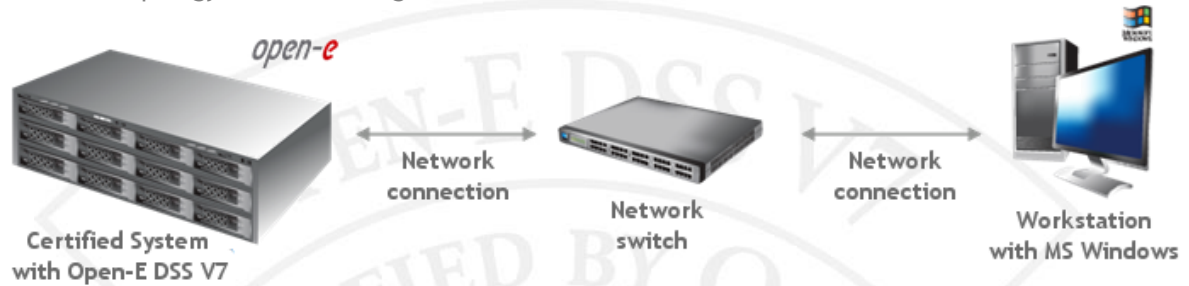


FIGURE 20: Network topology for NAS testing



## 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 lometer 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	56	55	passed
32	471	597	passed
64	999	498	passed
128	1037	883	passed
256	1017	1042	passed
512	1074	1108	passed
1024	1066	1097	passed
4096	1066	1118	passed

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

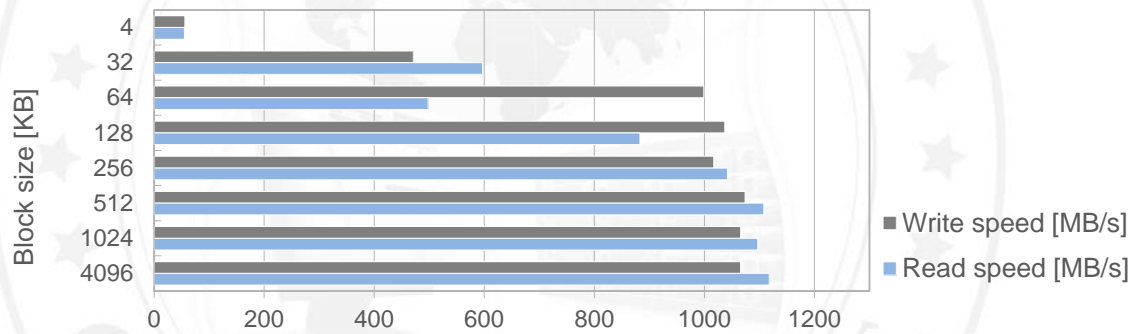


FIGURE 21: SMB performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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.

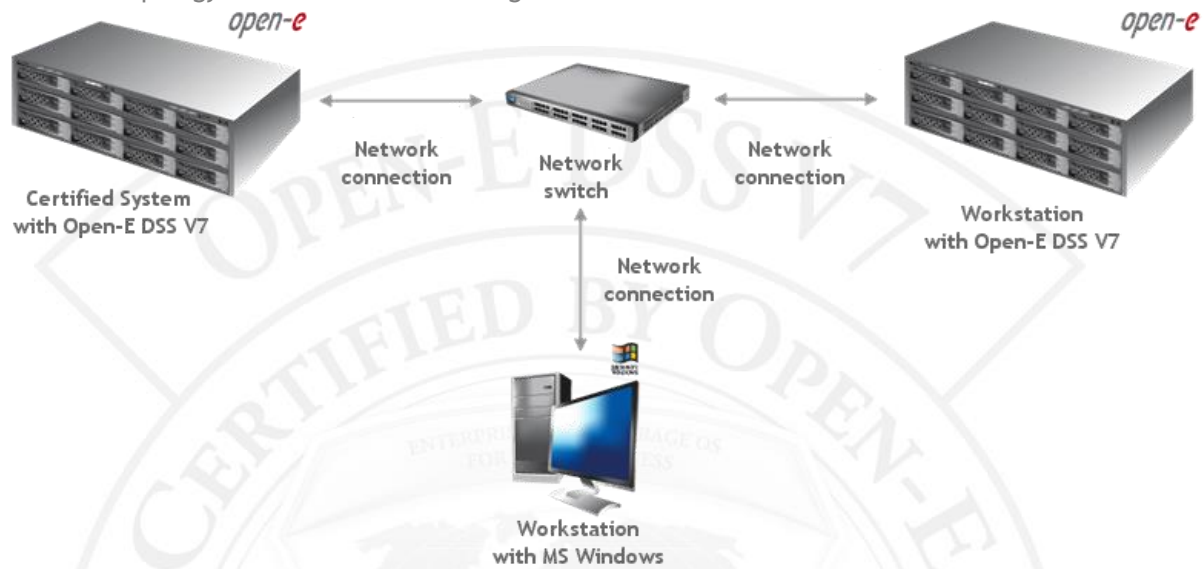


FIGURE 22: Network topology for iSCSI Initiator testing

### iSCSI Target test topology

Network topology for iSCSI Target testing is shown below.

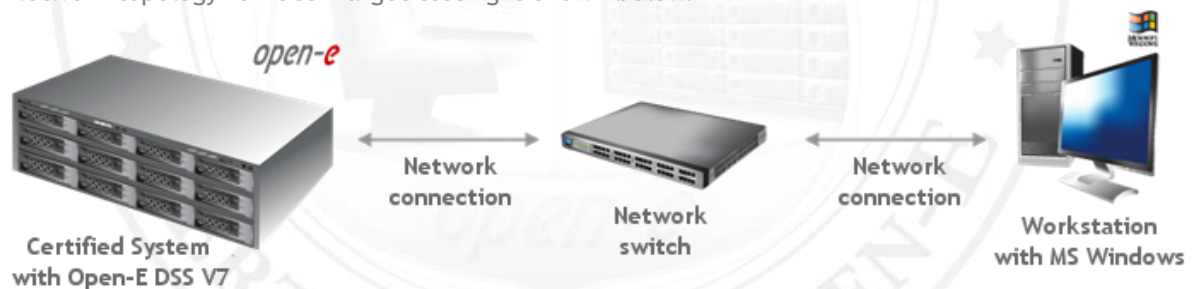


FIGURE 23: Network topology for iSCSI Target testing

## 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 lometer 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	57	56	passed
32	469	485	passed
64	935	479	passed
128	953	874	passed
256	978	972	passed
512	997	1011	passed
1024	1012	991	passed
4096	1000	1022	passed

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

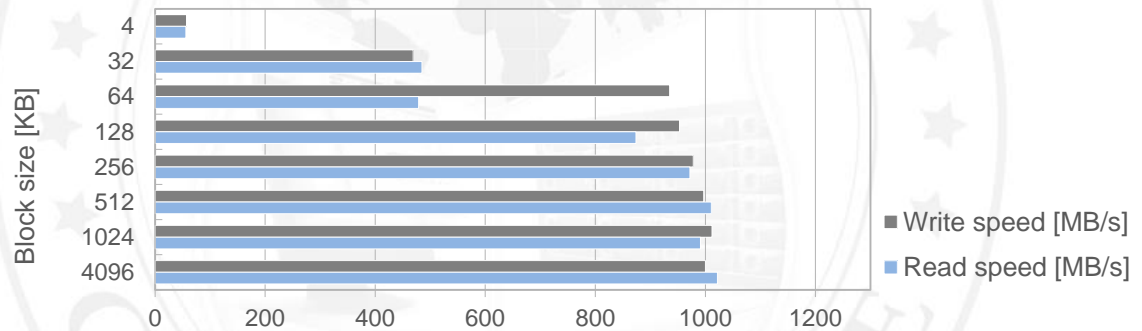


FIGURE 24: iSCSI Initiator performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## 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	80	96	passed
32	512	536	passed
64	720	904	passed
128	896	1064	passed
256	1016	1099	passed
512	1056	1104	passed
1024	1040	1104	passed
4096	1024	1101	passed

TABLE 23: iSCSI Target performance test results table for Intel® Ethernet Converged Network Adapter X540-T2

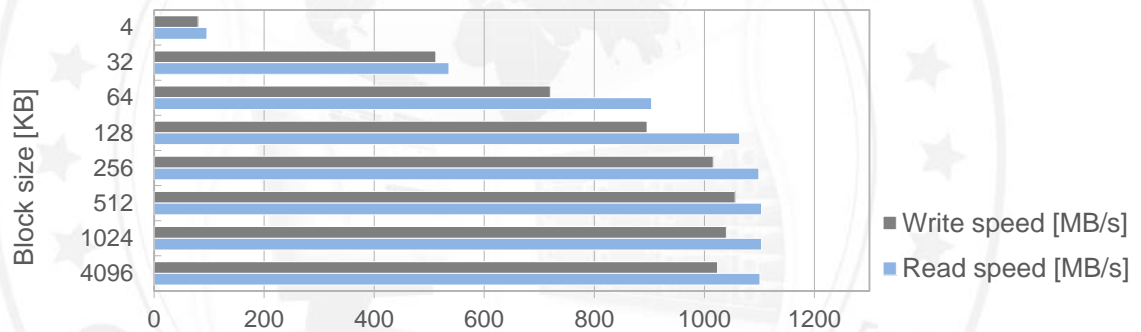


FIGURE 25: iSCSI Target performance test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## SSD Cache performance

Tests performed in this section check the performance of SSD cache in the Open-E DSS V7 product on the certified system.

### SSD Cache test topology

Network topology for SSD Cache testing is shown below.

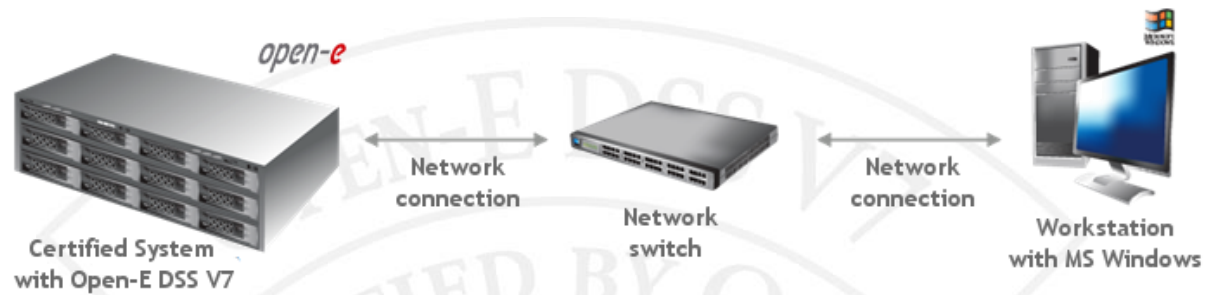
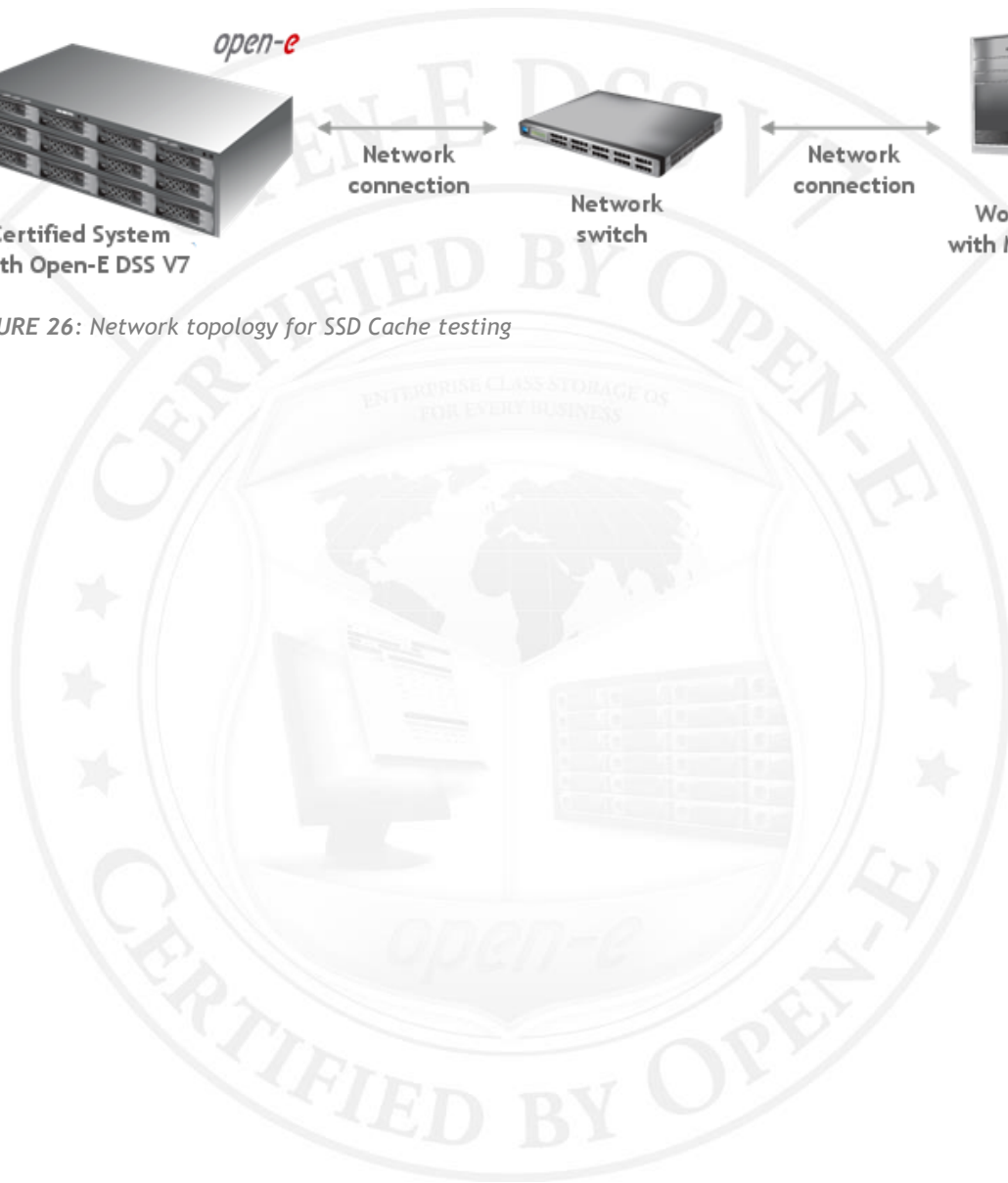


FIGURE 26: Network topology for SSD Cache testing



## SSD Cache with real life pattern test

### 1. Test description

The test relies on creating the iSCSI target on the certified system, writing (35%) and reading (65%) random data from a *Workstation with MS Windows* to it with various block sizes using the lometer tool.

### 2. Test results for SSD Cache with real life pattern and Intel® Ethernet Converged Network Adapter X540-T2

SSD Cache with real life pattern test results		
Block size [KB]	Performance [IOPS]	Performance test results
1	18427	passed
2	18802	passed
4	14063	passed

TABLE 24: SSD Cache with real life pattern test results table for Intel® Ethernet Converged Network Adapter X540-T2

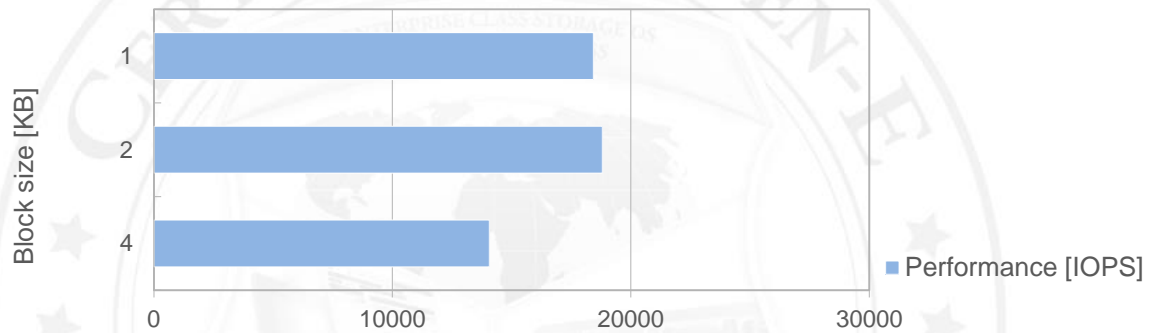


FIGURE 27: SSD Cache with real life pattern test results chart for Intel® Ethernet Converged Network Adapter X540-T2

## SSD Cache with random read/write pattern test

### 1. Test description

The test relies on creating the iSCSI target on the certified system and copying random data from a *Workstation with MS Windows* to it with various block sizes using the *Iometer* tool.

### 2. Test results for SSD cache with random read/write pattern Intel® Ethernet Converged Network Adapter X540-T2

SSD cache with random read/write pattern test results			
Block size [KB]	Write speed [IOPS]	Read speed [IOPS]	Performance test results
1	7592	9163	passed
2	8152	10656	passed
4	7604	10506	passed

TABLE 25: SSD cache with random read/write pattern test results table for Intel® Ethernet Converged Network Adapter X540-T2

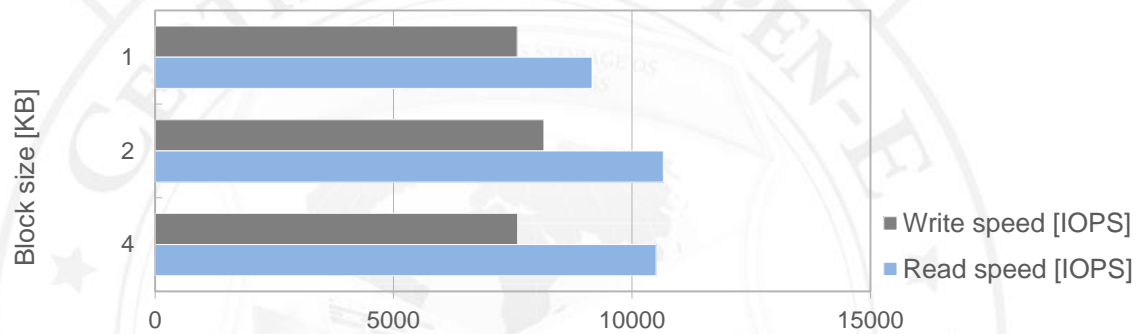


FIGURE 28: SSD cache with random read/write pattern test results chart for Intel® Ethernet Converged Network Adapter X540-T2