



CATE Storage and Backup Engineering  
Citigroup Architecture & Technology Engineering

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# EMC XtremIO Certification

**CSBE-14008-RN**

**Release Notes**

**Version 1.1**

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## 1 Version Control

| Version | Date        | Author         | Reviewed            | Comments                                     |
|---------|-------------|----------------|---------------------|----------------------------------------------|
| 0.1     | 28-Jul-2014 | Jeff Hernandez |                     | Release for Comment                          |
| 1.0     | 12-Sep-2014 | Jeff Hernandez | -                   | Release for Production                       |
| 1.1     | 15-Jan-2015 | Jeff Hernandez | Global Stakeholders | Release for Production -<br>GNU BASH VTM Fix |
|         |             |                |                     |                                              |
|         |             |                |                     |                                              |

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## 3 Contact

Please address any comments or questions regarding the information contained in this document via email to [\\*CATE Storage and Backup Engineering](#).

## 4 Latest Versions

It is recommended that the latest version of the document be used from the [CATE Storage and Backup Engineering website](#). Newer versions may include certification on additional platforms, or comments on issues discovered after deployment.

## 5 Regional Reviewers

The purpose of this section is to list all the stakeholders who reviewed this document during the Request for Comment process.

| Region                 | Reviewed by |
|------------------------|-------------|
| Asia Pacific           | No feedback |
| EMEA                   | No feedback |
| Japan                  | No feedback |
| Latin America / Mexico | No feedback |
| North America          | No feedback |

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## 7 Introduction

The XtremIO Storage Array is EMC's first generation all flash storage platform based on scale-out architecture utilizing commodity hardware components.

XtremIO OS (XIOS) is the operating system developed by EMC XtremIO to run on its storage controllers. XtremIO OS 3.0.1 build 11 is the latest version available for the XtremIO platform which offers enhancements to the previous version.

The focus of this project is to test functionality and to provide guidelines for the use of XtremIO GA hardware and software at Citi. Version 3.0.1 build 11 enables a fix for the GNU Bash vulnerability and updated X-brick scalability numbers.

## 8 Scope

### 8.1 Items in scope for this project

The following items are deemed in scope for this project and were assessed due to their potential impact on the XtremIO for block standard build and operational best practices:

- Non-disruptive upgrade
- XMS management and CLI
- Thin provisioning
- Inline de-duplication
- iSCSI connectivity
- Local monitoring
- Remote monitoring and access
- Performance management and reporting
- LDAPS integration
- GNU BASH Remote Code Execution Vulnerability Fix
- Audit logging

### 8.2 Out of scope

CATE Storage Engineering will be leveraging vendor testing to validate the fixes for all other bugs addressed with this release of software.

Other components / features considered out of scope for this particular project include:

- Snapshots
- Remote replication
- Application protection
- VSI Support

### 8.3 Features requiring testing

The purpose of this section is to communicate the level of testing planned to be conducted by CATE on new feature functionality in the product, compared to where vendor testing is being leveraged.

| Feature                                | Testing            |                     |                    |                     |                           | Notes                              |
|----------------------------------------|--------------------|---------------------|--------------------|---------------------|---------------------------|------------------------------------|
|                                        | Light <sup>1</sup> | Medium <sup>2</sup> | Heavy <sup>3</sup> | Vendor <sup>4</sup> | Out of Scope <sup>5</sup> |                                    |
| NDU to 3.0.1-11                        |                    |                     |                    | ✓                   |                           |                                    |
| Thin Provisioning                      |                    | ✓                   |                    |                     |                           | Native                             |
| De-Duplication                         |                    | ✓                   |                    |                     |                           | In-line De-Duplication             |
| Local Protection Snapshots             |                    |                     |                    |                     | ✓                         | Redirect on Write Snapshots        |
| Remote Protection                      |                    |                     |                    |                     | ✓                         |                                    |
| Local Management                       |                    | ✓                   |                    |                     |                           | Domain Management RBAC             |
| Audit Logging and Review               |                    | ✓                   |                    |                     |                           | Central Event Monitoring, SEMS     |
| Reporting                              | ✓                  |                     |                    |                     |                           | SRM                                |
| Local Monitoring                       |                    | ✓                   |                    |                     |                           | SNMP Alerting<br>Capacity alerting |
| Remote Monitoring and Access           |                    | ✓                   |                    |                     |                           | SMTP<br>ESRS Gateway               |
| Performance Management                 | ✓                  |                     |                    |                     |                           | XMS, XMCLI                         |
| Management and CLI                     |                    |                     | ✓                  |                     |                           | XMS, XMCLI                         |
| Host Connectivity FC Current Platforms |                    |                     |                    |                     | ✓                         | SAN Stacks for Current Platforms   |
| Host Connectivity iSCSI, FCoE          |                    | ✓                   |                    |                     |                           | 10GbE Connectivity iSCSI           |

## 9 Conclusion

The below table summarizes the results of the items tested with code release 3.0.1-11.

| Item                  | Testing with 3.0.1-11                                                   |
|-----------------------|-------------------------------------------------------------------------|
| HA Testing            | Full HA testing completed. <a href="#">13.2</a>                         |
| LDAPS management      | LDAPS with AD integration.<br>Please refer to <a href="#">14.2</a>      |
| Audit Log Integration | Audit Log integration with SEMS<br>Please refer to <a href="#">14.1</a> |

For a full list of certified hardware, software and features certified for use in Citi please refer to the [EMC XtremIO Solutions Guide](#).

<sup>1</sup> Less than 4 hours of testing – validate functionality / proof of concept testing

<sup>2</sup> Between 4 and 8 hours of testing – validate functionality and devise best practices

<sup>3</sup> More than 8 hours of testing – validate functionality, determine use cases, identify operational issues and devise best practices

<sup>4</sup> Vendor to provide test plans executed in QA or to test on behalf of Citi

<sup>5</sup> Functionality will not be tested or recommended for production use as a result of this project.

## 10 Known Issues

### 10.1 EMC Known problems and limitations

For a full list of EMC known problems and limitations please refer to the *EMC XtremIO Storage Array Software Version 3.0.1-11 Release Notes* document available from [EMC Powerlink](#).

### 10.2 Issues identified during testing

The following issues were identified during testing

- Multiple SSD failures that occur simultaneously are not supported. A single SSD failure must completely rebuild before a second failure can occur.
- Upgrading an existing X-brick cluster with additional X-bricks is not supported.

## 11 Fixed problems

For a full list of issues fixed in 3.0.1-11 please refer to the *EMC XtremIO Storage Array Software Version 3.0.1-11 Release Notes* document available from [EMC Powerlink](#).

## 12 References

| Item                                     | Location / Value                                                                                                                                                                                            |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CATE Storage and Backup Engineering site | <a href="https://catecollaboration.citigroup.net/domains/platstor/gdse/products/default.aspx">https://catecollaboration.citigroup.net/domains/platstor/gdse/products/default.aspx</a>                       |
| CATE Storage ESRS standards              | <a href="https://catecollaboration.citigroup.net/domains/platstor/gdse/products/techstdshmpgs/esrs.aspx">https://catecollaboration.citigroup.net/domains/platstor/gdse/products/techstdshmpgs/esrs.aspx</a> |

## 13 Storage Configuration Test Plan/Results

### 13.1 Test Environment

This test plan will test basic functionality of the XtremIO running 3.0.1-11 . Since the XtremIO is a scale-out architecture, both x-Bricks will be tested for the certification of the XtremIO Next Gen storage arrays.

The following components were used for these tests:

- XtremIO installed and configured as a block-level system.
- XtremIO was connected to the corporate IP network for management.
- XtremIO management server(XMS) for managing XtremIO cluster
- Dual non routed VLANs for 10GbE iSCSI attachment
- Dual SAN fabrics with 8GB connectivity
- Each host NIC & HBA is accessible to both storage controllers

The following software was used for the functionality tests:

- XMS
- XMCLI

For a description of the environment used for performance testing, please refer to [XtremIO Performance Tests](#) section.

## 13.2 XtremIO Storage Platform Hardware Tests

Citi and EMC collectively provided a standard hardware test plan that was used for certification of XtremIO storage platform. The final test plan is provided below:

| Item | Citi Requested Test                                          | Expected Result                                                                                             | Pass         | Notes                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Power-off PSU #1 for SC1                                     | Fault on XMS, No effect on hosts, recharge of power supply should occur.                                    | Pass         | Powered off X1-SC1 PSU1. Command show-storage-controllers-psus displayed PSU1 off. Power was restored and PSU displayed on.                                                                                                                                                                                                                                                                                                         |
| 2    | Power off Battery Backup Unit #1                             | Fault on XMS, No effect on hosts, battery begins drain.                                                     | Pass         | Powered off BBU1. Command show-bbus displayed failed then disconnected. Power was restored and BBU displayed connected then started recharge.                                                                                                                                                                                                                                                                                       |
| 3    | Storage controller failure – disconnect all power            | Fault on XMS, host should not be affected.                                                                  |              | Powered off X1-SC1. Command show-xenvs displayed state for X1-SC1 as inactive, show-storage-controllers displayed X1-SC1 as disconnected. Host was not impacted. Restored power and X1-SC1 shows active and healthy again.                                                                                                                                                                                                          |
| 4    | Pull SC1 IB port 1 and replace                               | Faults on SC1 and enclosures connected to IB 1                                                              | Pass         | Pulled X1-SC1-IB1 cable, show-storage-controllers-infiniband-ports displayed state as down. No impact to host or X-brick cluster. Reconnected and port shows up.                                                                                                                                                                                                                                                                    |
| 5    | Pull both IB ports for X1-SC2 and replace                    | X1-SC2 will fail and display error                                                                          | Pass         | Pulled X1-SC2-IB1/IB2 cable, show-storage-controllers-infiniband-ports displayed Rate-In-Gbps as 0. Show-storage-controllers displays state for X1-SC2 as disconnected. No impact to host or X-brick cluster. Reconnected and port shows 40GB/s and X1-SC2 as healthy.                                                                                                                                                              |
| 6    | Pull DAE LCC A and replace                                   | A fault should be appear but connectivity to disks should not be lost due to redundant loop                 | Pass         | Pulled X1-DAE-LCC A, show-daes-controllers displayed State as disconnected. Show-xenvs displays X1-SC1 as inactive. No impact to host or X-brick cluster. Reconnected and port shows active and X1-SC1 as healthy.                                                                                                                                                                                                                  |
| 7    | Pull single SSD                                              | A fault should appear on the drive but no data loss should occur. Rebuild of parity and no capacity change. | Pass         | Pulled SSD from X1 slot 0, show-slots displays empty and none for drive info. Show-ssds displays slot 0 as failed_in_rg and disconnected. Show-data-protection-groups has degraded state for X1-DPG 1. Show-data-protection-groups-performance shows high utilization due to rebuild. Rebuild took about 1hr and 45mins. Once rebuild completed DPG has normal state and performance is zero. No impact to host or X-brick cluster. |
| 8    | Pull 2 x SSDs                                                | Rebuild of parity should occur.                                                                             | Partial Pass | Per EMC, dual SSD failure must happen in sequential fashion, one SSD must fail and rebuild before the second SSD can fail and rebuild. Simultaneous failure is not supported. This scenario was tested successfully show-ssds displays both SSDs as revoked_from_rg. Once rebuild completes for 2 <sup>nd</sup> SSD the DPG displays state of normal. No impact to host or X-brick cluster.                                         |
| 9    | Replace SSDs                                                 | Install both SSDs that were removed previously and add to DPG.                                              | Pass         | Installed SSD in X1 -slot 0 and slot1. Added the first SSD via GUI back to DPG. Took 5 mins to complete, then added the second SSD. Show-ssds displays drive as in_rg.                                                                                                                                                                                                                                                              |
| 10   | Pull out network connections from storage system and replace | Connectivity to SC's through the management server should be lost                                           | Pass         | Pulled mgmt. network connections from both storage controllers. Show-clusters displays state as active but Conn-State is unknown. No impact to host or X-brick cluster.                                                                                                                                                                                                                                                             |
| 11   | Add a new DAE to an existing array                           | This upgrade is not possible with the current release.                                                      | Fail         | Currently the ability to upgrade an existing XtremIO cluster is not available. Adding another X-brick to the cluster will be available in 3.0 release                                                                                                                                                                                                                                                                               |

|    |                                                                                                                                                                                                   |                                                                                                                                                                                                  |      |                                                                                                                                                                                                                                                                                                                           |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | Unplug power to Infiniband switch – one PSU at a time                                                                                                                                             | Fault should appear but connectivity to disks should not be lost due to redundant switch                                                                                                         | Pass | Removed power from IB-SW1. Show-infiniband-switches displays state as disconnected. Restored power and state displays healthy. No impact to host or X-brick cluster.                                                                                                                                                      |
| 13 | Remove power cable from one of the DAE's PSU. Replug power cable once the results have been recorded.                                                                                             | The other PSU module should increase its fan speed and the DAE should remain operational. LED on PSU should turn amber. When power cable gets replugged, the PSU should resume normal operation. | Pass | Pulled power to X1-DAE-PSU 2, show-daes-psus displayed State as off. No impact to host or X-brick cluster. Reconnected and state shows on.                                                                                                                                                                                |
| 14 | Shutdown XMS                                                                                                                                                                                      | Cluster should continue to function, XMS/XMCLI inaccessible.                                                                                                                                     | Pass | XMS was powered off and host access to luns was validated successfully.                                                                                                                                                                                                                                                   |
| 15 | Shutdown power to the entire storage array forcing a shutdown. Verify that no data loss occurs as a result of the power loss and the system fully recovers after power is restored to the system. | The storage array should switch to the standby power supplies for power and should remain powered up until all cache is flushed to the journal drives. No data loss should occur.                | Pass | All power removed from X-brick, show-storage-controllers displays Powered-State as disconnected and show-clusters displays unknown and disconnected. All control data is written to journal before BBUs drain to 0% and orderly shutdown is initiated. Power was restored and cluster re-initialized then BBUs recharged. |
| 16 | Dual SC failure                                                                                                                                                                                   | Take down 1 SC from each X-brick in multiple X-bricks setup.                                                                                                                                     | Pass | Removed power to X1-SC1 and X2-SC2, show-xenvs displays each SC as inactive in the cluster and show-storage-controllers displays each SC as disconnected. Restored power to both SCs and state displays active and connected. No impact to host or X-brick cluster.                                                       |

### 13.3 Volume (LUN) Provisioning

| Item | Test                                      | Results                                                          | Pass / Fail | Notes |
|------|-------------------------------------------|------------------------------------------------------------------|-------------|-------|
| 1    | Discover host connected to the array.     | iSCSI and FC connectivity host discovery of array was successful | Pass        |       |
| 2    | Create Volumes (LUN)                      | Volumes (Luns) created successfully                              | Pass        |       |
| 3    | Create Initiator Groups                   | Initiator groups created successfully                            | Pass        |       |
| 4    | Apply volume (LUN) mapping                | Volume (LUN) mapping applied successfully                        | Pass        |       |
| 5    | Host volume (LUN) access                  | Host can access the volumes (LUN) successfully                   | Pass        |       |
| 6    | Unmap volumes (LUN) from initiator group. | Volumes (LUN) unmapped from IG successfully.                     | Pass        |       |
| 7    | Delete Volumes (LUN)                      | Volumes (LUN) deleted successfully                               | Pass        |       |
|      |                                           |                                                                  |             |       |

## 13.4 Thin Provisioning

| Item | Test                                                                              | Results                                                                                                                      | Pass / Fail | Notes                                                                                    |
|------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------|
| 1    | Create thin LUN                                                                   | 2.34TB Thin LUN created successfully.                                                                                        | Pass        | LUN details in XMS:<br>User Capacity: 2.34 TB<br>Used Capacity: 0 bytes                  |
| 2    | Map thin LUN to initiator group.                                                  | Thin LUN mapped to IG and host was able to discover the LUN.                                                                 | Pass        |                                                                                          |
| 3    | Verify that thin friendly file systems do not take up all the allocated capacity. | Performed format of a 2.34TB VMFS5 LUN on ESX 5.0 server. The consumed capacity of the thin LUN after the format was 19.3MB. | Pass        |                                                                                          |
| 4    | Verify XMS can gather performance statistics on thin LUNs                         | Performance statistics were gathered and reported by XMS in real time.                                                       | Pass        |                                                                                          |
| 5    | Unmap LUN from initiator.                                                         | LUN removed successfully.                                                                                                    | Pass        |                                                                                          |
| 6    | Delete LUN                                                                        | LUN deleted successfully.                                                                                                    | Pass        |                                                                                          |
| 7    | Verify logical volume capacity is updated and zero physical space is reclaimed.   | Logical LUN capacity was updated successfully and zero physical space was reclaimed from array.                              | Pass        | For detailed test results, see <a href="#">Zero-Space Reclaim with Thin Provisioning</a> |

### 13.4.1 De-duplication

| Item | Test                                                                         | Results                                                        | Pass / Fail | Notes |
|------|------------------------------------------------------------------------------|----------------------------------------------------------------|-------------|-------|
| 1    | In line de-duplication is enabled by default                                 | De-duplication occurred in-line at an array level.             | Pass        |       |
| 2    | Jurassic pilot environment with 290 VDIs consuming various physical capacity | Optimal de-dupe ratio obtained for active pilot VDIs was 5.5:1 | Pass        |       |

## 14 Security Configuration Test Plan/Results

### 14.1 Audit Logging (SEMS)

Verify that the XMS can use the existing SEMS solution.

| Item | Test                                                                                      | Results                                                              | Pass / Fail | Notes                                                                                                           |
|------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------|
| 1    | Ensure audit logs can be picked up by SEMS                                                | SEMS (Arcsight) is able to receive syslog from XMS for audit review. | Pass        | Refer to <a href="#">Appendix B: Central Event Monitoring</a> for sample audit report generated from audit logs |
| 2    | Ensure all user initiated changes are logged                                              | User initiated changes are logged                                    | Pass        |                                                                                                                 |
| 3    | Verify with SEMS team that the audit log entries are being captured and parsed correctly. | SEMS team is able to receive events from XMS syslog notifications    | Pass        | Refer to <a href="#">Appendix B: Central Event Monitoring</a> for sample audit report generated from audit logs |

## 14.2 XMS LDAPS Security Tests

The tests in this section are related to the configuration and management of LDAPS in the XtremIO environment.

| Item | Test                                                                                    | Results                                                                                                                                                           | Pass / Fail | Notes                                                                  |
|------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------|
| 1    | Initialize LDAPS configuration on XMS.                                                  | LDAPS security initialized on XMS.                                                                                                                                | Pass        |                                                                        |
| 2    | Connect XMS to Active Directory for user authentication.                                | XMS was successfully configured to connect to the test AD environment and users were successfully able to log in respective to the role assigned to the AD group. | Pass        | Refer to <a href="#">Appendix A: LDAPS Management</a> for more details |
| 3    | Verify that AD users can only perform actions respective to their defined roles in XMS. | AD users can only perform actions based on their roles                                                                                                            | Pass        | Available Roles: Administrator, Configuration, Read-only               |
| 4    | Test multi-domain management on XMS (Global Catalog Server)                             | Not tested                                                                                                                                                        | N/A         | Refer to <a href="#">Appendix A: LDAPS Management</a> for more details |

## 14.3 XMS & Storage Controller BASH Vulnerability Tests

As part of the 3.0.1-11 Service Pack the GNU Bash CVE-2014-6271 Remote Code Execution Vulnerability has been resolved. This fix is enabled after non-disruptive upgrade completes from 3.0.0-42 to 3.0.1-11 and resolves VTM 45102.

Validation of XIO 3.0.0-42 show vulnerability exists in red below.

```
[root@mwdcitasx8002x bin]# bash --version
GNU bash, version 4.1.2(1)-release (x86_64-redhat-linux-gnu)
Copyright (C) 2009 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
```

```
This is free software; you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
[root@mwdcitasx8002x bin]# env 'x=() { : }; echo vulnerable' 'BASH_FUNC_x()=() { : };
echo vulnerable' bash -c "echo test"
vulnerable
bash: BASH_FUNC_x(): line 0: syntax error near unexpected token `)'
bash: BASH_FUNC_x(): line 0: `BASH_FUNC_x() () { : }; echo vulnerable'
bash: error importing function definition for `BASH_FUNC_x'
test
```

<https://access.redhat.com/articles/1200223>

Validation of XIO 3.0.1-11 shows vulnerability does not exist below.

```
[root@b2-xtremio1-vxms ~]# /bin/bash --version
GNU bash, version 4.1.2(1)-release (x86_64-redhat-linux-gnu)
Copyright (C) 2009 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
```

```
This is free software; you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
```

---

```
[root@b2-xtremio1-vxms ~]# env 'x=() { :}; echo vulnerable' 'BASH_FUNC_x=() { :};  
echo vulnerable' bash -c "echo test"  
bash: warning: x: ignoring function definition attempt  
bash: error importing function definition for `BASH_FUNC_x'  
test
```

## 15 Array Management Test Plan/Results

### 15.1 Array Management

| Item | Test                                                | Results                                                                                                                                                                              | Pass / Fail | Notes                                                                                     |
|------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------|
| 1    | Verify that the XMS can manage the X-brick cluster. | XMS version 3.0.1-11 can manage X-brick cluster. XMS version must be the same as storage controllers. When cluster is installed or upgraded, XMS and SCs must have the same version. | Pass        | Refer to <a href="#">CSBE XtremIO Product Page</a> for the latest certified Service Pack. |

### 15.2 XMS Test Plan/Results

All tests in this section were done on Windows 2008 R2 and Win7 Desktop .

| Item | Test                                                                                                | Results                                                                                                                     | Pass / Fail | Notes |
|------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------|-------|
| 1    | Install and launch XMS from management server                                                       | Entered XMS IP in browser and downloaded JNLP file. Full Java version required due to java webstart. Installed successfully | Pass        |       |
| 2    | Verify that upgrade installation of the X-brick cluster updates XMS and the cluster can be managed. | XMS upgraded successfully. Entered XMS IP in browser and downloaded new JNLP file.                                          | Pass        |       |

## 16 Alerting and Monitoring Test Plan/Results

### 16.1 Monitoring/Alerting

| Item | Test                                                    | Results                                                                         | Pass / Fail | Notes                                                                                                                      |
|------|---------------------------------------------------------|---------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------|
| 1    | Verify that email home is sending alerts to the vendor. | EMC successfully setup and tested email-home functionality                      | Pass        |                                                                                                                            |
| 2    | Verify Performance Monitoring functionality.            | XMS was able to gather statistics real-time as well as historical data.         | Pass        | GUI and XMCLI with export-performance-history command                                                                      |
| 3    | Verify SRM discovery                                    | SRM 3.5 is able to discover XtremIO arrays                                      | Pass        | XtremIO is discovered under Solution Pack for XtremIO. Refer to <a href="#">Appendix C: SRM Discovery</a> for more details |
| 4    | Verify that Tivoli Alerting works with XMS              | SNMP alerts were being sent out for errors on the system and received by Tivoli | Pass        | Worked with Tivoli team to create ruleset and filter traps.                                                                |

### 16.2 Vendor Remote Access

| Item | Test                                                                                | Results                                                      | Pass / Fail | Notes                                                                 |
|------|-------------------------------------------------------------------------------------|--------------------------------------------------------------|-------------|-----------------------------------------------------------------------|
| 1    | Verify that EMC can access the XtremIO via ESRS for troubleshooting.                | The vendor was able to access the XtremIO remotely via ESRS  | Pass        | Refer to <a href="#">Appendix E: ESRS Management</a> for more details |
| 2    | Implement ACL with IPTables for limiting leap frog from XMS and storage controllers | Implemented IPTables commands and enabled ACL on XMS and SCs | Pass        | Refer to <a href="#">Appendix E: ESRS Management</a> for more details |

## 17 Host Connectivity Test Plan/Results

Supported host connectivity configurations are iSCSI and fiber channel.

### 17.1 iSCSI Path Failover Test

| Item | Test                                                                                 | Results                                                     | Pass / Fail | Notes                                                                               |
|------|--------------------------------------------------------------------------------------|-------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------|
| 1    | Verify that iSCSI paths perform proper failover with ESX NMP accessing XtremIO LUNS. | Active paths to XIO LUNs failed and recovered successfully. | Pass        | Round Robin must be set on ESX host. Refer to <a href="#">19.4</a> for more details |

## 18 XtremIO Performance Tests

A mixture of I/O workloads was run against the configuration to gather relative performance metrics. The intent of this testing is to gauge any relative change in the performance metrics for the single server used in this testing. Because of the limited workload and server connectivity on the storage frame, **these results should not be considered applicable for determining production storage array performance** capabilities nor for determining the expected performance of any single server. Many additional factors could affect the actual performance of a single server attached to a storage array.

### 18.1 Test Environment

SOE Management Station Configuration:

- Server Model: VMware Guest
- OS: Windows 2008 R2

Load Generator Server

- Server Model: Oracle M5000
- OS: SunOS 5.10 Generic\_150400-02
- HBA: 2 x LPe11002-E-8Gb, 2 x LPe12002-8Gb, 4 x LP16002-8Gb
- Switch Ports : Cisco MDS 9500 8GB full duplex

XtremIO Configuration:

- 2 - X-bricks
- 2 - Storage Controllers (SC) per X-brick/256GB memory per SC
- 4 x 8-core 2.1GHz Xeon per X-brick
- Release 2.2.3-25 SP3
- 50 x 400Gb eMLC per X-brick - 14.9TB usable

Vdbench Configuration:

- Vdbench version 503rc11
- Raw volume access

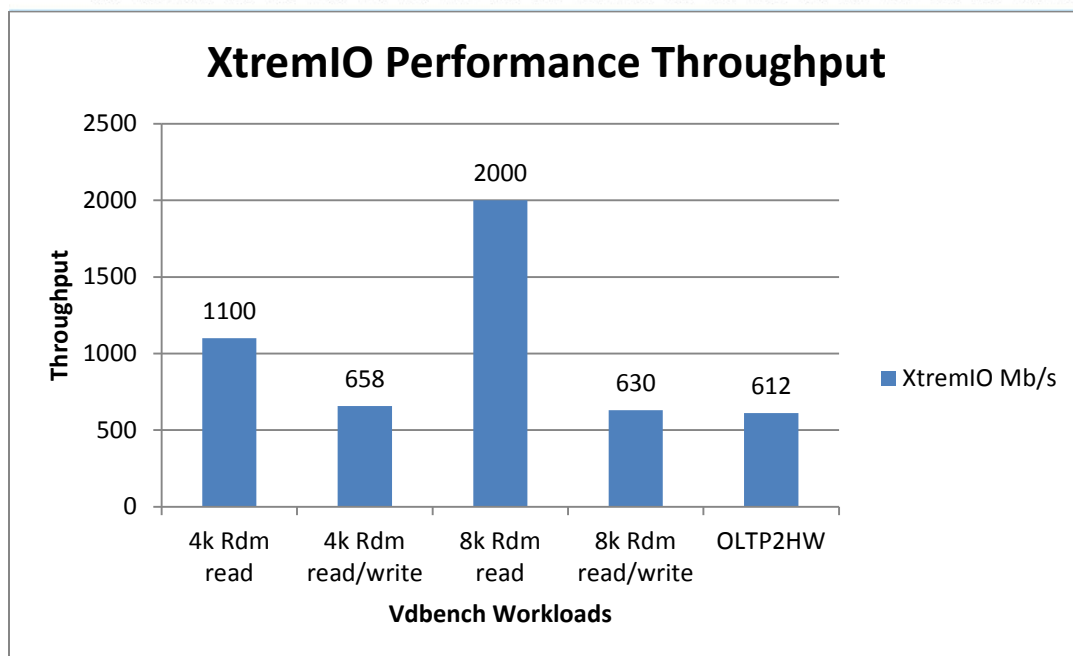
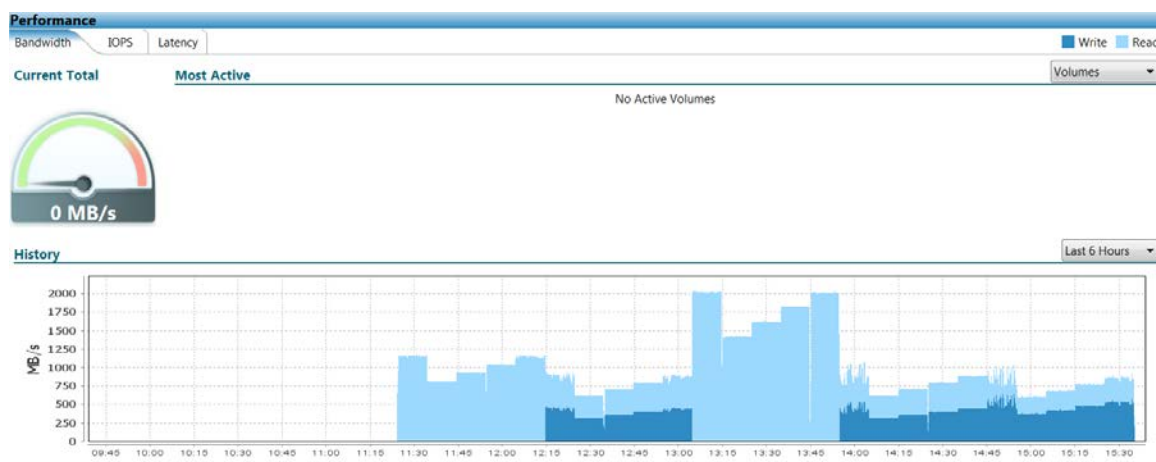
Vdbench was utilized for generating a variety of I/O workloads. For random workloads a parameter file was created on the M5000 to drive I/O against 15 x 873 GB raw volumes using 24 threads which seemed to be the optimal setting for these test scenarios. These tests lasted about 5 minutes per workload test. Also, before beginning the testing a sequential write workload was completed to fill capacity on all LDEVs. Below is a summary of the workloads that were tested for each configuration.

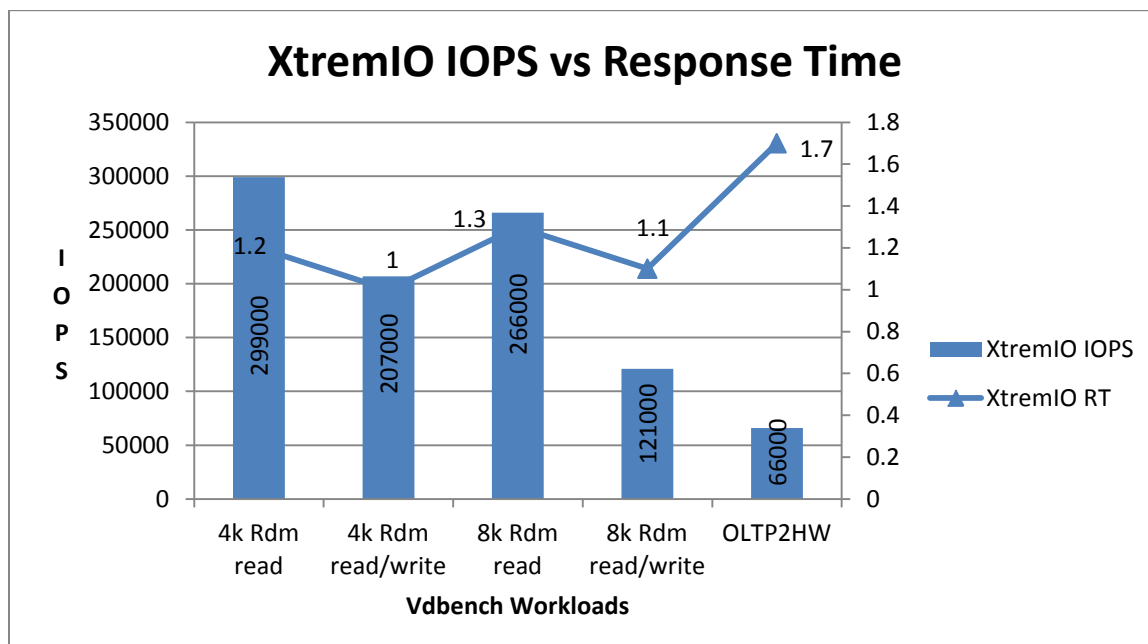
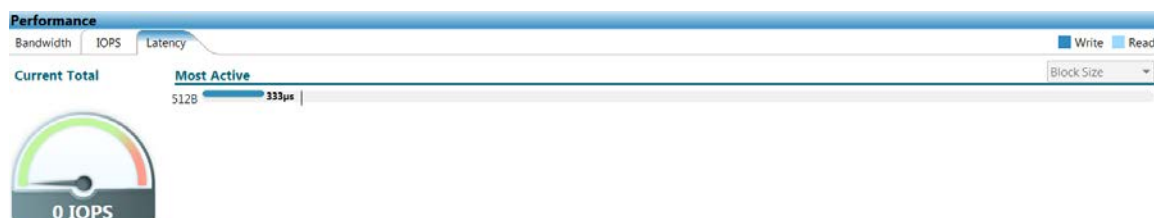
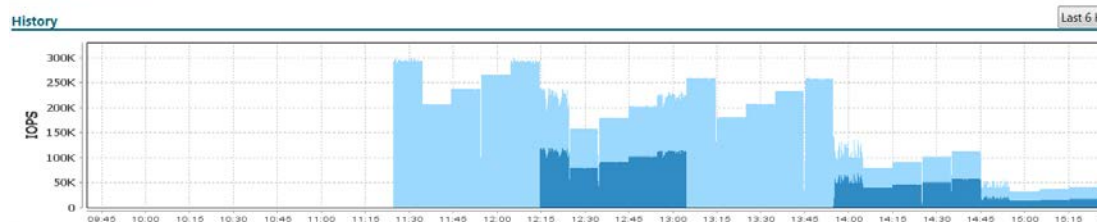
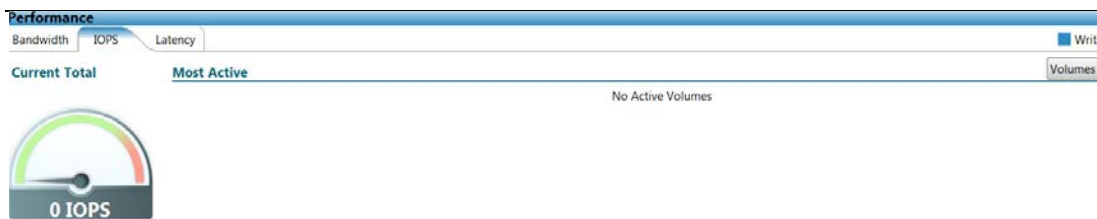
### 18.2 Test I/O Workloads

| Workload                                  | Block Size   | Type                                                                                           | Tested Configuration |
|-------------------------------------------|--------------|------------------------------------------------------------------------------------------------|----------------------|
| 100% Read                                 | 4 Kb         | Random, 0% cache hit                                                                           | XDP                  |
| 50% Read 50% Write                        | 4 Kb         | Random, 0% cache hit                                                                           | XDP                  |
| 100% Read                                 | 8 Kb         | Random, 0% cache hit                                                                           | XDP                  |
| 50% Read 50% Write                        | 8 Kb         | Random, 0% cache hit                                                                           | XDP                  |
| OLTP2HW –<br>Mixed: 80% WD 1,<br>20% WD 2 | 8 Kb<br>64Kb | WD1 Random = 66% read/34% write,<br>22% read cache hit<br>WD2 Sequential = 25 % read/75% write | XDP                  |

## 18.2.1 Results

The following are the results from Vdbench running the test workload defined in [18.2 Test I/O Workloads](#)





## 18.2.2 Performance Observations

- Vdbench response time varied due to host queuing and with a single host in this benchmarking test the risk was more prevalent.
- The 4kb random read, 4kb random read/write, and 8kb random read workloads performed well on the XtremIO array.
- The 8kb random read/write and the OLTP2HW mixed workload showed much lower IOPS, throughput, and response time.

## 18.2.3 Workload Recommendations

Based on the above results, the use case recommendation for XtremIO is small block workloads such as VDI. Larger block size mixed workloads such as database or ETL environments are not recommended on this platform at this time.

## 18.3 Zero-Space Reclaim with Thin Provisioning

The purpose of these tests is to determine that Zero-Space in thin LUNs gets reclaimed after ESX UNMAP command is run..

### 18.3.1 Test steps

1. Created multiple 2.34TB thin LUNs and allocated them to ESX 5.0 cluster.
2. Configured all LUNs as datastore and VMFS5 format
3. Loaded VDI VMs on the datastores
4. Deleted data from datastore
5. In ESX shell navigate to datastore (/vmfs/volumes/...
6. Run "vmkfstool -y 50" (unmaps 50% of free space)
7. View volume and array capacity utilization.

### 18.3.2 Results

The volume capacity and physical utilization from the XtremIO array decreased based on the unmap command being run. Large 1MB writes were encountered due to the UNMAP command, this triggered higher throughput and response time to the ESX hosts connected to the XtremIO array.

### 18.3.3 Observations

From the results above the reclaim process does provide the ability to reclaim space with 0's written to it; however, it is important to note that the performance impact experienced should be considered when scheduling these reclaim commands in a production environment.

## 19 Test Plan Additional Details

### 19.1 Appendix A: LDAPS Management

This section describes the test results of LDAPS management on XMS for single AD domain integration.

#### 19.1.1 AD Integration

XMS allows for setting up authentication with Citi's Active Directory environment. This allows the ability to assign XMS roles to AD groups instead of having to map roles to each user..

The test was carried out with the development AD environment and the following AD users for each role were verified:

1. xtrem\_adm
2. xtrem\_cfg
3. xtrem\_ro

Multiple domain authentication is supported by adding another LDAP configuration..

**Edit LDAP Configuration: [LDAP Config1]**

LDAP configuration

Bind DN : namdev\srvc\_emc\_xtrem

Bind password : .....

Search base : dc=namdev,dc=nsrootdev,dc=net

Search filter : sAMAccountName={username}

User to DN rule : NAMDEV\{username}

Timeout in msec: 1500

Cache expiration in hours: 1

Server URLs : ldaps://namdev.nsrootdev.net

Active directory group : admin:CN=per\_csbe\_emc\_xtrem\_admins\_uni,OU...

CA Certificate file name :

Load CA Certificate (optional) :

OK Cancel

## 19.2 Appendix B: Central Event Monitoring

### 19.2.1 SEMS Sample Report

XMS events were visible in the Alerts & Events section of the GUI or with show-events via XMCLI.

| Severity    | Event Code | Date and Time       | Category | Entity | Entity Details | Description                                                            |
|-------------|------------|---------------------|----------|--------|----------------|------------------------------------------------------------------------|
| Information | S0002      | Jul 29, 2014 5:3... | Audit    |        |                | External user 'xtrem_admin' authenticated with role 'admin'            |
| Information | S0002      | Jul 29, 2014 5:1... | Audit    |        |                | External user 'jhs3740' authenticated with role 'admin'                |
| Information | S0002      | Jul 29, 2014 3:2... | Activity |        |                | Removed 17253 old PerformanceHistoryMonitor monitoring data records... |
| Information | S0002      | Jul 29, 2014 3:2... | Activity |        |                | Removed 0 old events...                                                |

It was confirmed with the SEMS team that audit logs were being captured.

At the time of publishing, the SEMS team was in the review phase of validating the XMS syslog format. An include list of events will be developed once this initial review is complete. As such it was not possible to include a sample of the audit report that is generated by SEMS team for regular reporting on audit events.

The initial audit report generated from ArcSight will intentionally have some empty column fields. These fields are populated by the Log review team during log review process. For more info on these fields, please refer to the Log review team.

## 19.3 Appendix C: SRM Discovery

Below is a sample screenshot of how XtremIO is discovered in SRM 3.5.

Capacity, de-dupe ratio, and thin provision savings were displayed for multiple arrays.

**Report Library / EMC XtremIO**

July 2014, Tuesday 29 » Wednesday 30, 11:11 AM EDT | Last 1 Day: average on real-time

- De-Duplication Ratio:** This report displays the real-time inline data reduction ratio
- Thin Provisioning Savings:** This report displays the used disk space compared to allocated disk space
- Overall Efficiency:** This report displays the disk space saved by the XtremIO Storage Array, calculated as volume capacity / physical space used.
- Configured Usable Capacity:** This report displays the usable physical capacity not including the RAID, Meta overhead etc.
- Volume Capacity:** This report displays the logical capacity information of XtremIO Storage Array.

**XtremIO Systems**

3 elements found, displaying all elements.

| Cluster            | Model | Firmware | Management IP | No. of XBricks | No. of Target Groups | No. of Volumes | No. of Initiator Groups | No. of SSDs | Configured Usable | Raw Capacity (GB) | Fr Capa (GB) |
|--------------------|-------|----------|---------------|----------------|----------------------|----------------|-------------------------|-------------|-------------------|-------------------|--------------|
| lab12vdi-xtremio01 |       | 2.2.3-25 | 10.40.43.151  | 1              | 1                    | 16             | 1                       | 28          | 7.47 TB           |                   | 7,652        |
| rmwcdtinasx8002    |       | 2.2.3-25 | 159.17.118.54 | 1              | 1                    | 26             | 2                       | 28          | 7.47 TB           |                   | 4,796        |

At the time of this writing SRM 3.5 was still in the certification process and full reporting integration with XtremIO is under review.

## 19.4 Appendix D: iSCSI Path Failover

iSCSI failover was verified with ESX server accessing XtremIO LUNs.

Started copy of powered off vm files to XtremIO iSCSI volume - 8 paths show active

**XtremIO\_iSCSI\_100GB-ElitTEST**

Getting Started Summary Virtual Machines Hosts Performance Configuration Tasks & Events Alarms Permissions Storage Views

The following hosts are connected to this datastore (select a host from the list to view the details):

| Name                                          | Datastore | State     | Status  | % CPU | % Memory | Last Time Exited Standby | Alarm Actions |
|-----------------------------------------------|-----------|-----------|---------|-------|----------|--------------------------|---------------|
| gdsxmsvr01-vmkernel.nam.nsroot.net            | Mounted   | Connected | Warning | 36    | 89       | Never                    | Enabled       |
| gdsxmsvr02-vmkernel.nam.nsroot.net (inactive) | Mounted   | Connected | Normal  | 44    | 85       | Never                    | Enabled       |

**Datastore Details**

**XtremIO\_iSCSI\_100GB-ElitTEST** 99.75 GB Capacity

Location: /vmfs/volumes/52d855c5-4d9e0a5-3757-001a4be65948

Hardware Acceleration: Supported

75.53 GB Used

24.22 GB Free

Refresh Storage Capabilities

System Storage Capability: N/A

User-defined Storage Capability: N/A

**Path Selection**

Round Robin (VM...)

**Properties**

Volume Label: XtremIO\_iS...

Datastore Name: XtremIO\_iS...

**Extents**

XtremIO iSCSI Disk (nas.S1... 100.00 GB

Total Formatted Capacity 99.75 GB

**Storage I/O Control**

Doubled

**Paths**

Total: 8

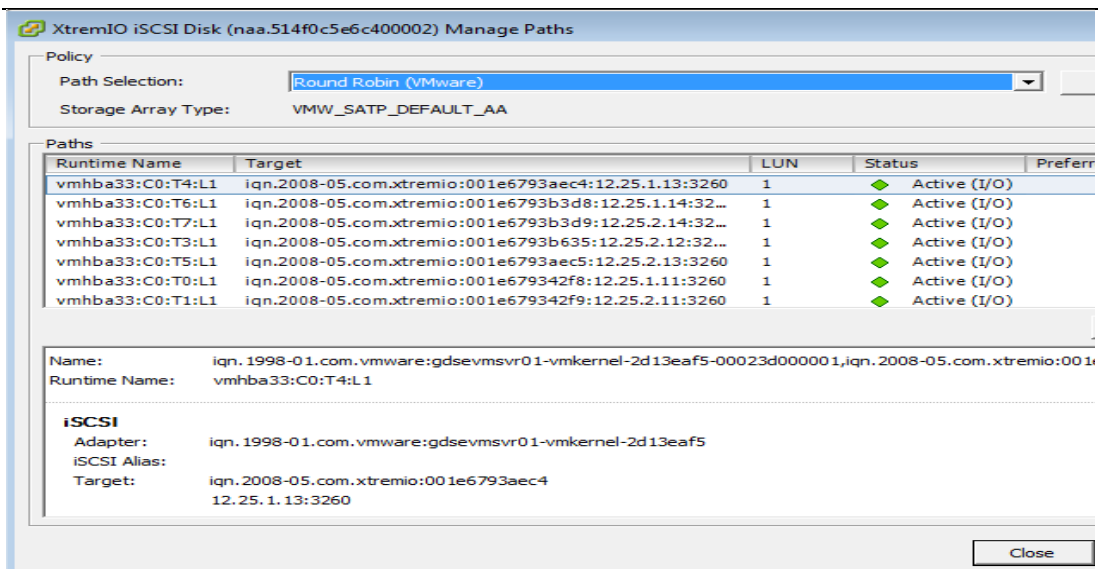
Broken: 0

Disabled: 0

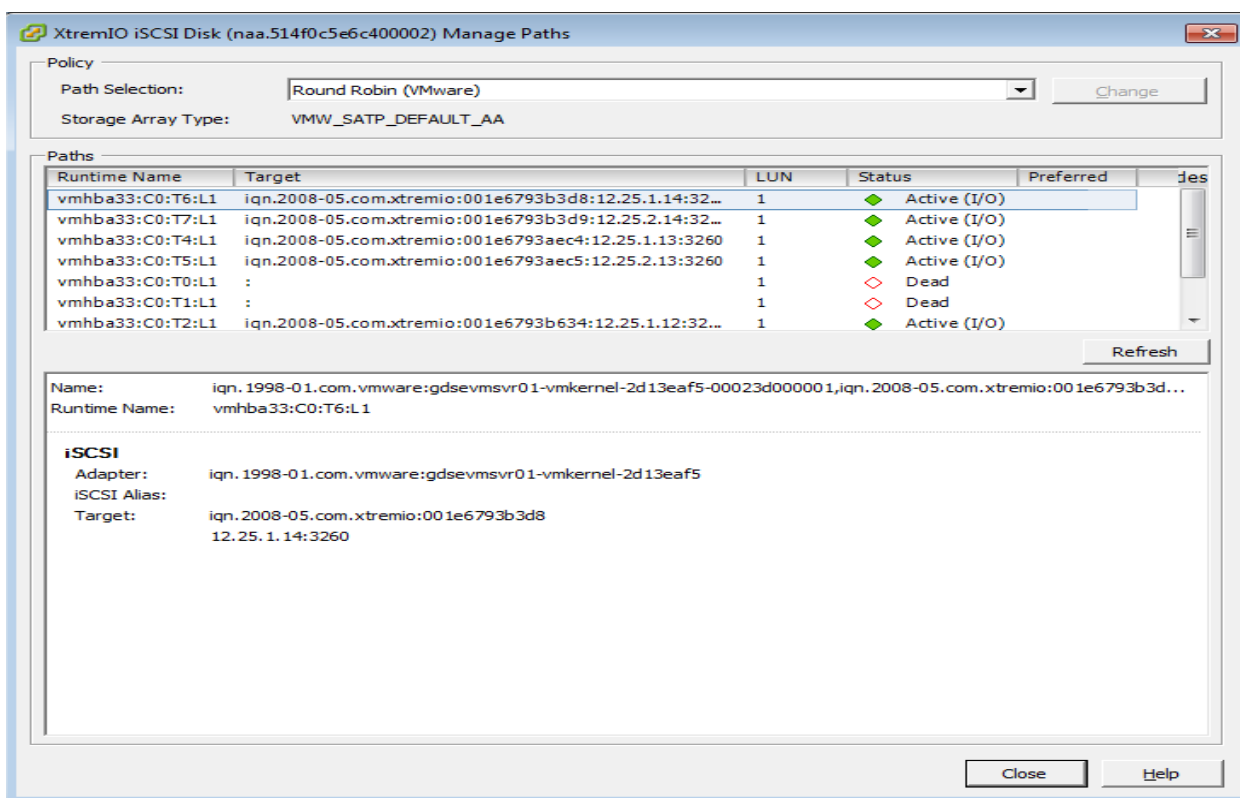
**Formatting**

File System: VMFS 5.5B

Block Size: 1 MB



After removing both iSCSI Portals from XMS (X1-SC1-iscsi1 – 12.25.1.11/24 & X1-SC1-iscsi2 – 12.25.2.11/24) 2 dead paths show broken





T10-GDSE2-VM01

- CSBE Lab #10 Data Center
- gdsevmvr01 Local
- gdsevmvr02 Local
- NFS-Celera-42.213-ess-labec (inactive)
- NFS-NETAPP-GDSE-DS01
- NFS-NETAPP-GDSE-DS02
- NFS-NETAPP-GDSE-VSWAP01
- NFS-VNX-42.209-vmks-csbe\_ess\_datastore1
- NFS-VNX-42.209-vswap-csbe\_ess\_datastore2
- VNX500-1868\_LUN184
- VNX500-1868\_LUN186
- VNX500-1868\_LUN187
- XIV-LUN\_XIV\_VM\_1
- XIV-LUN\_XIV\_VM\_2
- XIV-LUN\_2
- XIV-LUN\_3
- XIV-LUN\_4
- XtremIO\_FC\_EliotTest
- XtremIO\_iSCSI\_100GB-EliotTest**

### XtremIO\_iSCSI\_100GB-EliotTest

Getting Started | Summary | Virtual Machines | Hosts | Performance | Configuration | Tasks & Events | Alarms | Permissions | Storage Views

The following hosts are connected to this datastore (select a host from the list to view the details):

| Name                                          | Datastore | State     | Status  | % CPU | % Memory | Last Time Exited Standby |
|-----------------------------------------------|-----------|-----------|---------|-------|----------|--------------------------|
| gdsevmvr01-vmkernel.nam.nsroot.net            | Mounted   | Connected | Warning | 56    | 89       | Never                    |
| gdsevmvr02-vmkernel.nam.nsroot.net (inactive) | Mounted   | Connected | Normal  | 44    | 85       | Never                    |

#### Datastore Details

**XtremIO\_iSCSI\_100GB-EliotTest** 99.75 GB Capacity

Locations: /vmfs/volumes/52d855c5-ef0e0a5-3757-001a4be65848

Hardware Acceleration: Supported 75.53 GB Used

Refresh Storage Capabilities 24.22 GB Free

System Storage Capability: N/A

User-defined Storage Capability: N/A

| Path Selection       | Properties                                                   | Extents                                             | Storage I/O Control |
|----------------------|--------------------------------------------------------------|-----------------------------------------------------|---------------------|
| Round Robin (VMware) | Volume Label: XtremIO_iS...<br>Datastore Name: XtremIO_iS... | XtremIO iSCSI Disk (naa.514f0c5e6c400002) 100.00 GB | Disabled            |

| Paths       | Formatting             |
|-------------|------------------------|
| Total: 8    | File System: VMFS 5.58 |
| Broken: 2   | Block Size: 1 MB       |
| Disabled: 0 |                        |

After iSCSI Portals are recreated from XMS, all paths automatically become active

 XtremIO iSCSI Disk (naa.514f0c5e6c400002) Manage Paths

**Policy**

Path Selection: Round Robin (VMware) Change

Storage Array Type: VMW\_SATP\_DEFAULT\_AA

**Paths**

| Runtime Name     | Target                                                | LUN | Status       | Preferred |
|------------------|-------------------------------------------------------|-----|--------------|-----------|
| vmhba33:C0:T6:L1 | iqn.2008-05.com.xtremio:001e6793b3d8:12.25.1.14:32... | 1   | Active (I/O) |           |
| vmhba33:C0:T7:L1 | iqn.2008-05.com.xtremio:001e6793b3d9:12.25.2.14:32... | 1   | Active (I/O) |           |
| vmhba33:C0:T4:L1 | iqn.2008-05.com.xtremio:001e6793aec4:12.25.1.13:3260  | 1   | Active (I/O) |           |
| vmhba33:C0:T5:L1 | iqn.2008-05.com.xtremio:001e6793aec5:12.25.2.13:3260  | 1   | Active (I/O) |           |
| vmhba33:C0:T0:L1 | iqn.2008-05.com.xtremio:001e679342f8:12.25.1.11:3260  | 1   | Active (I/O) |           |
| vmhba33:C0:T1:L1 | iqn.2008-05.com.xtremio:001e679342f9:12.25.2.11:3260  | 1   | Active (I/O) |           |
| vmhba33:C0:T2:L1 | iqn.2008-05.com.xtremio:001e6793b634:12.25.1.12:32... | 1   | Active (I/O) |           |

Refresh

Name: iqn.1998-01.com.vmware:gdsevmvr01-vmkernel-2d13eaf5-00023d000001,iqn.2008-05.com.xtremio:001e6793b3d...

Runtime Name: vmhba33:C0:T6:L1

---

**iSCSI**

Adapter: iqn.1998-01.com.vmware:gdsevmvr01-vmkernel-2d13eaf5

iSCSI Alias:

Target: iqn.2008-05.com.xtremio:001e6793b3d8  
12.25.1.14:3260

Close Help

The following hosts are connected to this datastore (select a host from the list to view the details):

| Name                                       | Datastore | State     | Status  | % CPU | % Memory | Last Time Exited Standby |
|--------------------------------------------|-----------|-----------|---------|-------|----------|--------------------------|
| gdsevmv01-vmkernel.nam.root.net            | Mounted   | Connected | Warning | 64    | 88       | Never                    |
| gdsevmv02-vmkernel.nam.root.net (inactive) | Mounted   | Connected | Normal  | 42    | 85       | Never                    |

**Datastore Details**

**XtremIO\_9CST\_100GB-ElitTEST**

Location: /vmfs/volumes/52d855c5-ef09e0a5-3757-001a4b6e5848 99.75 GB Capacity

Hardware Acceleration: Supported 75.53 GB Used 24.22 GB Free

Refresh Storage Capabilities

System Storage Capability: N/A

User-defined Storage Capability: N/A

**Path Selection**

Round Robin (VM...)

**Properties**

Volume Label: XtremIO\_9CST\_100GB-ElitTEST

Datastore Name: XtremIO\_9CST\_100GB-ElitTEST

**Extents**

XtremIO iSCSI Disk (naa.51...) 100.00 GB

Total Formatted Capacity 99.75 GB

**Storage I/O Control**

Disabled

**Paths**

Total: 8

Broken: 0

Disabled: 0

**Formatting**

File System: VMFS 5.50

Block Size: 1 MB

## 19.5 Appendix E: ESRS Management

The XtremIO was integrated with version 2.24 of ESRS. The below lab frames have been deployed and remote connectivity tested successfully (APM00134910382, APM00141803339):

Browse for Devices

Page 1 of 2

Service and Advanced Search | Collapse

Search Clear

Device: APM00134910382 Product: XTREMO Organization: Citigroup - Warren Party Number: 410894 City: WARREN State/Province: NJ Country: US District: 53125 AM CS District

Device: APM00141803339 Product: XTREMO Organization: Citigroup - Warren Party Number: 410894 City: WARREN State/Province: NJ Country: US District: 53125 AM CS District

Page 1 of 2

### 19.5.1 Access Control List (ACL) with IPTables

With EMC support requiring access to XMS for ESRS capability ACL using IPTables was tested for limiting access from the XMS and storage controllers to any other devices on the Citi GRN. EMC has integrated ACL using IPTables in 3.0.1-11 without the need to make any manual entries. The following rules were validated once the Hotfix was applied.

| Source                  | Target             | Purpose                                                                                             | Ports    |
|-------------------------|--------------------|-----------------------------------------------------------------------------------------------------|----------|
| Storage management host | XMS                | SSH access to XMS for management                                                                    | SSH - 22 |
| ESRS gateway            | XMS                | SSH access to XMS for EMC troubleshooting                                                           | SSH - 22 |
| XMS                     | Storage Controller | SSH access from XMS to storage controllers for troubleshooting. No SSH access to any other targets. | SSH - 22 |
| Storage controllers     | None               | No SSH access to any other targets                                                                  | SSH - 22 |

## 20 Document Version Control

| Version | Changes                                                                                                                                                                 |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0.1     | <ul style="list-style-type: none"> <li>Initial Release For Comment</li> </ul>                                                                                           |
| 1.0     | <ul style="list-style-type: none"> <li>Release for Production</li> </ul>                                                                                                |
| 1.1     | <ul style="list-style-type: none"> <li>Release for Production</li> <li>14.3 - 3.0.1 GNU BASH Vulnerability Fix</li> <li>19.1.1 - LDAPS Configuration Updated</li> </ul> |