Monitoring EMC XtremIO

eG Innovations Product Documentation

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Total Performance Visibility

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Chapter 1: Introduction

The XtremIO Storage Array is an all-flash system, based on a scale-out architecture. The system uses building blocks, called X-Bricks, which can be clustered together, as shown in Figure 2.

The system operation is controlled via a stand-alone dedicated Linux-based server, called the XtremIO Management Server (XMS). Each XtremIO cluster requires its own XMS host, which can be either a physical or a virtual server. The array continues operating if it is disconnected from the XMS, but cannot be configured or monitored.

XtremIO's array architecture is specifically designed to deliver the full performance potential of flash, while linearly scaling all resources such as CPU, RAM, SSDs, and host ports in a balanced manner. This allows the array to achieve any desired performance level, while maintaining consistency of performance that is critical to predictable application behavior.

The XtremIO Storage Array provides a very high level of performance that is consistent over time, system conditions and access patterns. It is designed for high granularity true random I/O.

The cluster's performance level is not affected by its capacity utilization level, number of volumes, or aging effects. Moreover, performance is not based on a "shared cache" architecture and therefore it is not affected by the dataset size or data access pattern.

Due to its content-aware storage architecture, XtremIO provides:

- Even distribution of data blocks, inherently leading to maximum performance and
- minimal flash wear
- Even distribution of metadata
- No data or metadata hotspots
- Easy setup and no tuning
- Advanced storage functionality, including Inline Data Deduplication and Compression, thin provisioning, advanced data protection (XDP), snapshots, and more

Chapter 2: How does eG Enterprise Monitor the EMC XtremIO Storage Array?

eG Enterprise employs an *agentless* approach to monitor the EMC XtremIO storage array. This approach requires that the eG agent be deployed on a remote Windows host in the environment. To collect the metrics of interest from the EMC XtremIO storage array, this agent uses the *RESTful APIs*.

The pre-requisites that need to be fulfilled to use these command line interfaces have been detailed in the next section.

2.1 Pre-requisites for Monitoring EMC XtremIO Storage Array

To enable the eG agent to monitor the EMC XtremIO storage array, the following pre-requisites should be fulfilled:

- The user who is authorized to access the EMC XtremIO should be vested with read-only privileges i.e., the user should be capable of executing the *HTTP GET* commands of the Restful APIs. The eG agent communicates with this user to collect the necessary metrics.

Once the aforesaid requirement is fulfilled, the eG agent will report a plethora of useful metrics revealing the health of the EMC XtremIO storage array and present these performance statistics in the eG monitoring model using the hierarchical layer model representation.

The chapters that follow will discuss on how to manage and monitor the target
EMC XtremIO Storage Array.

2.2 Managing the EMC XtremIO Storage Array

eG Enterprise can automatically discover the EMC XtremIO 4.x storage array in the environment. The discovered EMC XtremIO storage array can be managed using the following steps:

1. Log into the eG administrative interface.
2. To manage the EMC XtremIO 4.x that is already discovered, directly proceed towards managing it using the **COMPONENTS – MANAGE/UNMANAGE** page (Infrastructure -> Components -> Manage/Unmanage).
3. However, if it is yet to be discovered, then run discovery (Infrastructure -> Components ->

Discover) to discover or add the component manually using the **COMPONENTS** page (Infrastructure -> Components -> Add/Modify). Remember that components manually added are managed automatically. Discovered components, however, are managed using the **COMPONENTS – MANAGE / UNMANAGE** page.Figure 2.1 and Figure 2.2 clearly illustrate the process of managing the *EMC XtremIO 4.x* storage array.

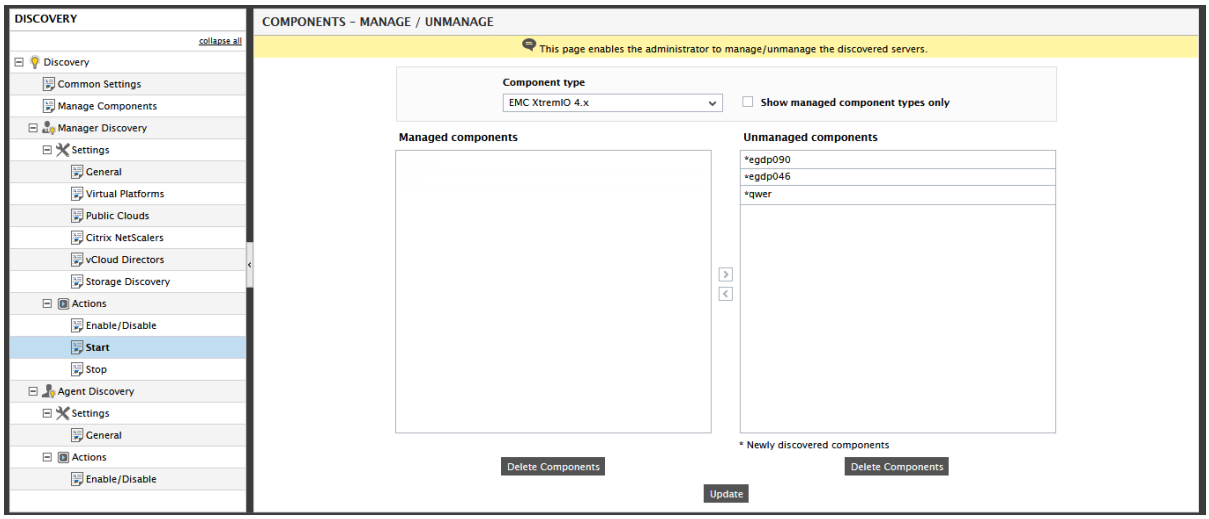


Figure 2.1: Viewing unmanaged EMC XtremIO 4.x

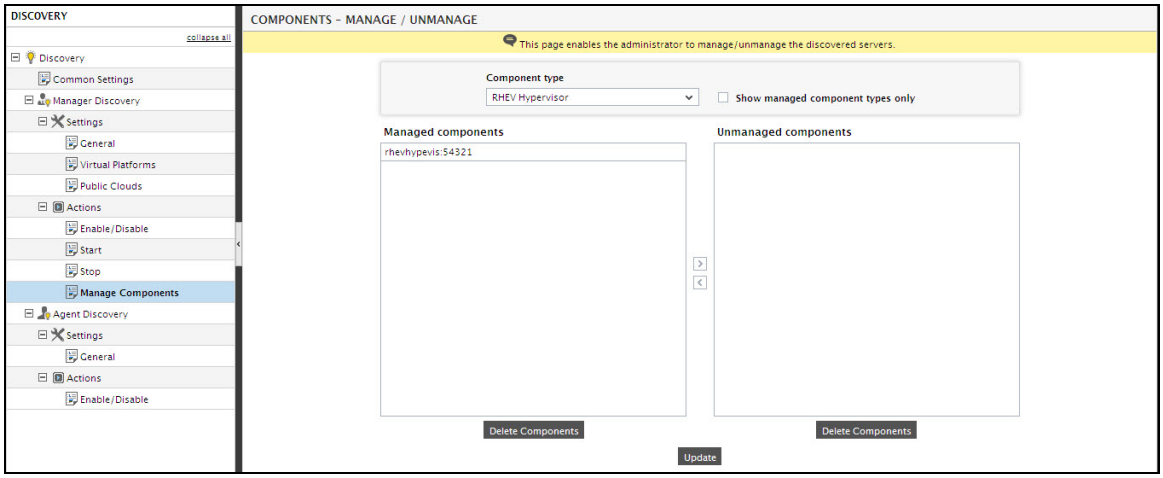


Figure 2.2: Managing EMC XtremIO 4.x storage arrays

4. Finally, signout of the administrative interface.

The eG Enterprise cannot automatically discover the EMC XtremIO version 1/2/3 storage arrays. Therefore, you need to manually add the component for monitoring. Remember that the eG

Enterprise automatically manages the components that are added manually. To manage a EMC XtremIO 1/2/3 component, do the following:

1. Log into the eG administrative interface.
2. Follow the Components -> Add/Modify menu sequence in the **Infrastructure** tile of the **Admin** menu.
3. In the **COMPONENT** page that appears next, select *EMC XtremIO*1/2/3 as the **Component type**. Then, click the **Add New Component** button. This will invoke Figure 2.3.

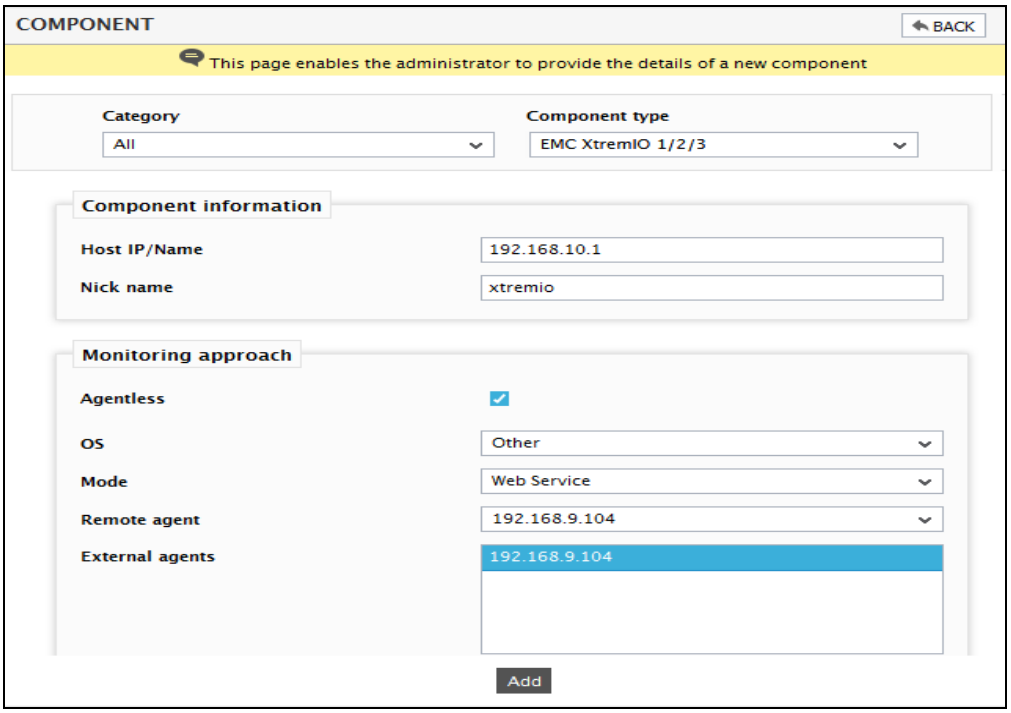
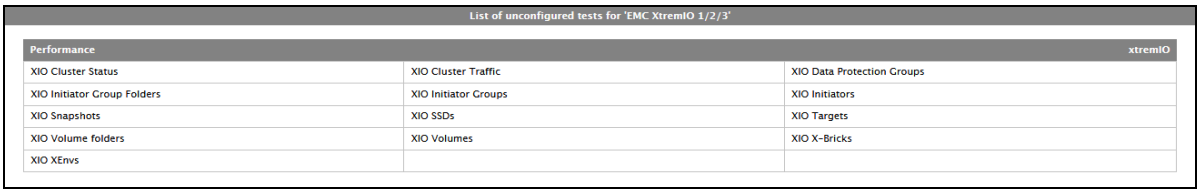


Figure 2.3: Adding a new component type of EMC XtremIO 1/2/3 storage array

4. Specify the **Host IP/Name** and the **Nick name** of the EMC XtremIO storage array. This EMC XtremIO component can only be monitored in an agentless manner. Therefore, set the **Agentless** flag to **Yes**, select the **OS** as **Other** and **Web Service** as the **Mode**. Then, click the **Add** button to register the changes (see Figure 2.3).

5. The EMC XtremIO component so added will be managed automatically by eG Enterprise. Now, try to sign out of the user interface. Doing so, will bring up the following page as shown in Figure 2.4, which prompts you to configure a list of unconfigured tests for the new EMC XtremIO 1/2/3 component.


List of unconfigured tests for 'EMC XtremIO 1/2/3'

Performance		xtremIO
XIO Cluster Status	XIO Cluster Traffic	XIO Data Protection Groups
XIO Initiator Group Folders	XIO Initiator Groups	XIO Initiators
XIO Snapshots	XIO SSDs	XIO Targets
XIO Volume folders	XIO Volumes	XIO X-Bricks
XIO XEnvs		

Figure 2.4: A page displaying the tests that need to be configured for the EMC XtremIO 1/2/3 storage array

6. Click on any test in the list of unconfigured tests. To know how to configure the tests, refer to **The EMC XTREMIO 4.x Monitoring Model**.
7. Finally, signout of the eG administrative interface.

Chapter 3: The EMC XTREMIO 4.x Monitoring Model

eG Enterprise offers a specialized EMC XtremIO 4.x monitoring model that monitors each of the key indicators of the performance of EMC XtremIO storage array - such as the SSDs, X-Bricks, volumes, target ports, initiators, etc. - and proactively alerts administrators to potential performance bottlenecks, so that administrators can resolve the issues well before end-users complain.

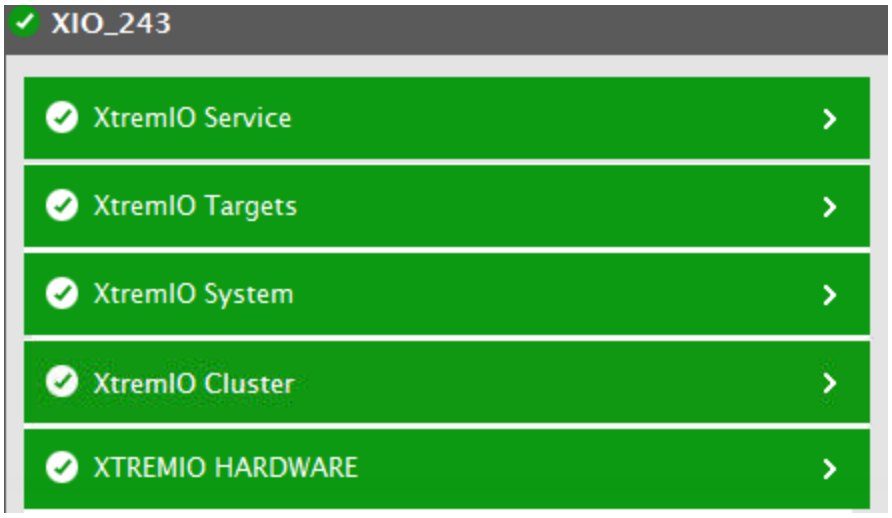


Figure 3.1: The layer model of EMC XtremIO

Each layer of Figure 3.1 above is mapped to a variety of tests, each of which report a wealth of performance information related to the EMC XtremIO storage array. Using these metrics, administrators can find quick and accurate answers to the following performance queries:

- How well the bandwidth is utilized in each Data Protection Group?
- How well read/write operations were performed on each Data Protection Group?
- How much of space is utilized in the SSDs of each Data Protection Group?
- How well read/write operations were performed on each SSD?
- What is the current state and CPU utilization of each X-Env?
- What is the current health of each cluster? Which cluster is too slow in processing I/O requests? What type of I/O requests are processed very slowly - read or write requests?
- How well each data block in a cluster is processed? Which data block size is the slowest to be processed causing bottlenecks?

- What is the current port state and health of each target port? How well read/write operations are performed through each target port? Which target port is the slowest in performing read/write and I/O operations?
- What is the current state of each X-Brick? How many SSDs and Battery Backup Units are present in each X-Brick?
- How well read/write operations were performed on each volume? Which volume is handling the maximum amount of I/O?
- How well the space of each volume is utilized?
- How well read/write operations were performed on each volume folder? Which volume folder is handling the maximum amount of data?
- How well read/write operations were performed through each initiator? Which initiator is taking too long to perform the I/O operations?
- How well read/write operations were performed on each initiator group? Which initiator group is handling the maximum I/O operations?
- How well read/write operations were performed on each initiator group folder? Which folder is handling the maximum I/O operations?
- How well read/write operations were performed on each snapshot? Which snapshot is experiencing a processing bottleneck?
- What is the health of each BBU?
- Are the BBUs enabled?
- What is the charge that is remaining in each BBU?
- What is the current load on each BBU?
- Are the storage controllers enabled ?
- What is the health of each storage controller?
- What is the journalling health state of each storage controller?
- What is the current state of each slot?
- What is the current health state of each DAE Controller?
- Are the DAE Controllers enabled?
- What is the state of the SAS ports of each DAE Controller?
- Are the power supply units of each DAE Controller enabled?

- Are the infiniband switches enabled?
- What is the current health of each infiniband switch?
- What is the health of each storage controller?
- What is the front panel temperature of each storage controller?
- What is the current health of the power supply units of each storage controller?
- What is the state of the SAS ports of each storage controller?
- What is the state of each local disk added to the EMC XtremIO Storage array?

This chapter deep dives into every layer of the EMC XtremIO monitoring model, the tests mapped to each layer, and the measures every test reports.

3.1 The XtremIO Hardware Layer

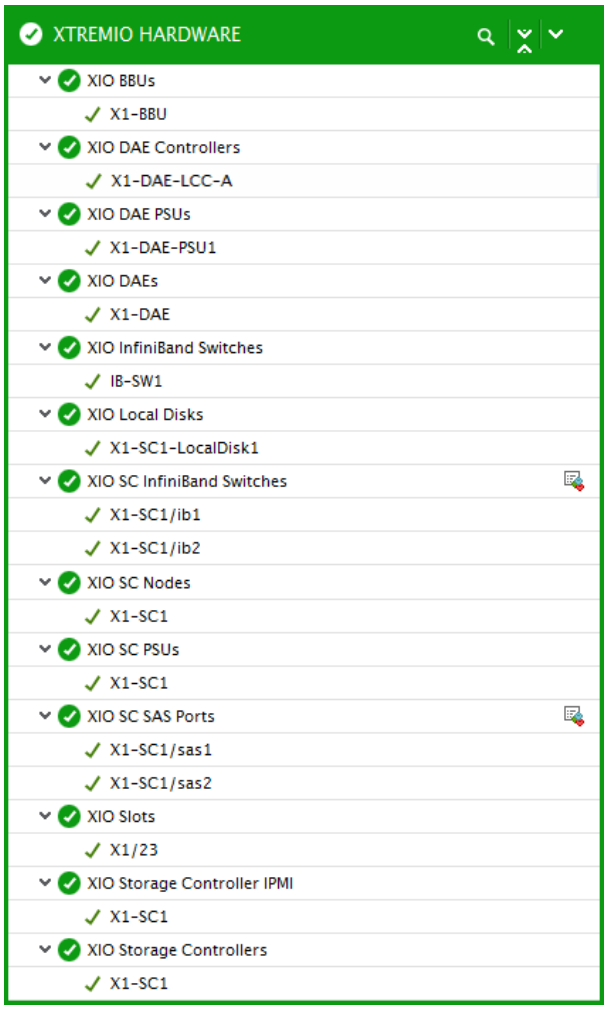


Figure 3.2: The tests mapped to the XtremIO Hardware layer

3.1.1 XIO BBUs Test

Each X-Brick of the EMC XtremIO contains atleast one Battery Backup Unit (BBU). From the hardware perspective, no component is a single point of failure. Each Storage Controller, DAE and InfiniBand Switch in the cluster is equipped with dual power supplies. The cluster also has dual Battery Backup Units and dual network and data ports (in each of the Storage Controllers). Two InfiniBand Switches are cross connected and create a dual data fabric. Both the power input and the different data paths are constantly monitored, and any failure triggers a recovery attempt or failover.

The software architecture is built in a similar way. Every piece of information that is not committed to the SSD is kept in multiple locations, called Journals. Each software module has its own Journal, which is not kept on the same Storage Controller, and can be used to restore data in case of unexpected failure. Journals are regarded as highly important and always kept on Storage

Controllers with battery backed up power supplies. In case of a problem with the Battery Backup Unit, the Journal fails over to another Storage Controller.

In case of global power failure, the Battery Backup Units ensure that all Journals are written to vault drives in the Storage Controllers and the cluster is turned off.

Administrators of large environments may not entertain frequent failure of the Battery Backup Units and may wish to be alerted proactively about the overall status of the Battery backup Unit and its functioning in detail. The **XIO BBUs** test helps administrators in this regard!

This test auto-discovers the Battery Backup Units of the target EMC XtremIO and for each BBU, reports the health, status and overload condition. This test also reports the input and output power supply to the BBUs, the battery charge etc. This way, this test helps the administrators proactively detect defective batteries and help them in removing and replacing such batteries, so as to ensure service continuity.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Battery Backup Unit of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Parameter	Description
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every fourth time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Is enabled ?	Indicates whether/not this BBU is enabled.		The values reported by this measure and its numeric equivalents are mentioned in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Yes</td><td>0</td></tr>
<tr><td>No</td><td>1</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not this BBU is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
</td></tr>
<tr><td>Health status</td><td>Indicates the current health of this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
<tr><td>Initializing</td><td>1</td></tr>
<tr><td>Uninitialized</td><td>2</td></tr>
<tr><td>Failed</td><td>3</td></tr>
<tr><td>Disconnected</td><td>4</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this BBU. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.
</td></tr>
<tr><td>InfiniBand switch bypass active</td><td>Indicates whether/not the infiniband switch bypass is active on this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Yes</td><td>0</td></tr>
<tr><td>No</td><td>1</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not the infiniband switch bypass is active. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
</td></tr>
<tr><td>Running under low battery?</td><td>Indicates whether/not low battery runtime has been detected on this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Yes</td><td>0</td></tr>
<tr><td>No</td><td>1</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not low battery runtime has been detected on this BBU. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
</td></tr>
<tr><td>Is BBU overloaded?</td><td>Indicates whether/not this BBU is overloaded.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Yes</td><td>0</td></tr>
<tr><td>No</td><td>1</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not this BBU is overloaded. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>Power output in outlet1</td><td>Indicates the current state of power output from outlet 1 of this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>On</td><td>0</td></tr><tr><td>Off</td><td>1</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state of power output from outlet 1. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>Power output in outlet2</td><td>Indicates the current state of power output from outlet 2 of this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>On</td><td>0</td></tr><tr><td>Off</td><td>1</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state of power output from outlet 2. The graph of</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>Output current</td><td>Indicates the output current of this BBU.</td><td>Amps</td><td></td></tr>
<tr><td>Output frequency</td><td>Indicates the output frequency of this BBU.</td><td>Hz</td><td></td></tr>
<tr><td>Output voltage</td><td>Indicates the output voltage of this BBU.</td><td>Volts</td><td></td></tr>
<tr><td>Power utilized</td><td>Indicates the amount of power utilized by this BBU.</td><td>Watts</td><td></td></tr>
<tr><td>BBU battery charge</td><td>Indicates the remaining battery charge of this BBU.</td><td>Percentage</td><td></td></tr>
<tr><td>Connection between storage controller and BBU</td><td>Indicates the current status of the control connection between the Storage Controller and this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Connected</td><td>0</td></tr><tr><td>Disconnected</td><td>1</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current status of the control connection between the storage controller and the BBU. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>BBU input</td><td>Indicates the current state of the external power feed of this BBU.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>On</td><td>0</td></tr>
<tr><td>Off</td><td>1</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state of the external power feed of this BBU. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
</td></tr>
<tr><td>Current BBU load</td><td>Indicates the current load on this BBU.</td><td>Percentage</td><td></td></tr>
<tr><td>BBU load</td><td>Indicates the current change in the load level of this BBU.</td><td></td><td>The value reported by this measure and its numeric equivalent is mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>OK</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current change in the load level of this BBU. The graph of this measure however is represented using the numeric equivalents only i.e., 0.
</td></tr>
<tr><td>BBU needs battery replacement?</td><td>Indicates whether/not the battery of this BBU needs replacement.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Yes</td><td>0</td></tr>
<tr><td>No</td><td>1</td></tr>
</table>
</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			Note: By default, this measure reports the Measure Values listed in the table above to indicate whether/not the battery of this BBU needis replacement. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.

3.1.1.1 Adding a new XMS

To add a new XMS Managament Server, specify the following in Figure 2 that appears when Other option is chosen from the XMS IP list of Figure 1:

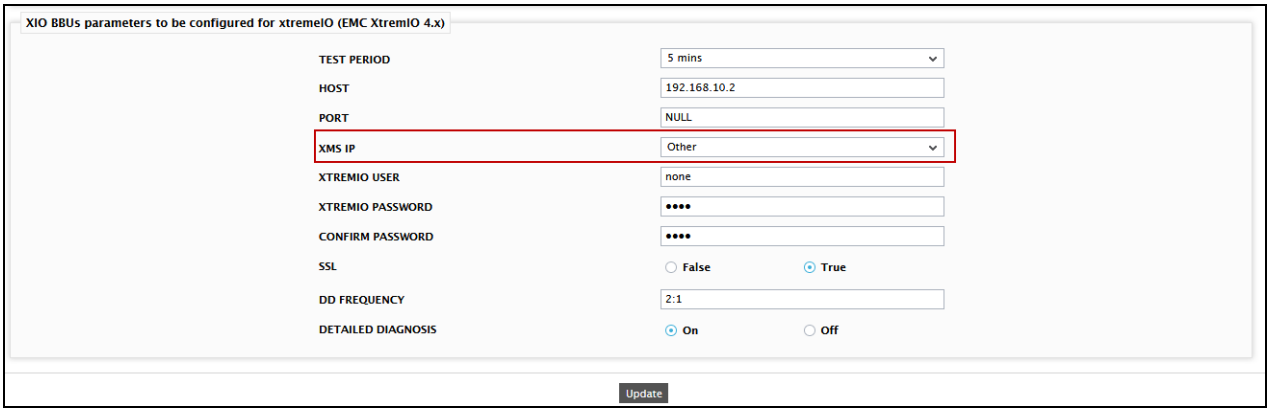


Figure 3.3: Choosing the Other option from the XMS IP list

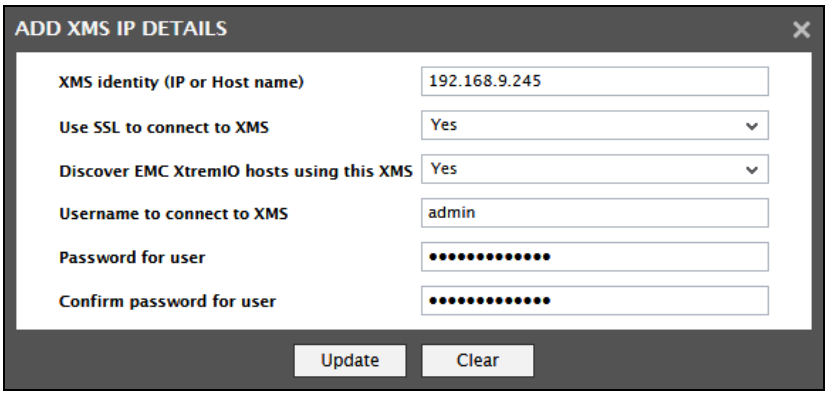


Figure 3.4: Adding a new XMS Management Server

- Specify the IP or host name of the XMS Management Server in the **XMS Identity (IP or Host name)** text box. By default, *None* will be displayed in this text box.
- Then, indicate whether the eG manager is to connect to the XMS Management Server using SSL or not by selecting the *Yes* or *No* option from the **Use SSL to connect to XMS** list. By default, this list is set to *Yes*.
- An IT environment may consist of multiple XMS Management Servers, each managing a different set of EMC XtremIO Clusters. To enable the eG manager to automatically discover those EMC XtremIO Clusters that are managed using the XMS Management Server being added, set the **Discover EMC XtremIO hosts using this XMS** flag to *Yes*. If not, set this flag to *No*.
- To collect metrics from the target EMC XtremIO Storage array within the XMS Management Server, the eG manager needs to connect to the XMS Management Server using the credentials of a valid user to the XMS Management Server. Provide the user name and password of such a user in the **Username to connect to XMS** and **Password for the user** text boxes.
- Confirm the password of the user by retyping it in the **Confirm password for the user** text box.
- To clear all the configuration details, click on the **Clear** button. To add the new XMS Management Server instead, click on the **Update** button.

3.1.2 XIO DAE Controllers Test

The DAE Controller or Link Control Card module is a horizontal card in the middle of the DAE. There are two LCC modules that support the backend SAS connections to the controllers. This test auto-discovers the DAE Controllers of the target EMC XtremIO and reports whether/not each DAE Controller is enabled. Besides, this test reports the current health, life cycle state of each DAE Controller and the current state of the Serial Attached SCSI ports on each DEA Controller. By closely monitoring the health of the DAE Controllers, abnormalities of the DAE Controllers can be identified and rectified at ease!

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each DAE Controller of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMSIP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option.

Parameter	Description
	The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Is enabled?	Indicates whether/not this LCC is enabled.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value**: Yes = 0; No = 1 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate whether/not this LCC is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
Health status	Indicates the current life cycle state of this LCC i.e., the current health state of the DAEController which is mentioned using generic FRUtransition states.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value**: Healthy = 0; Initializing = 1; Uninitialized = 2; Failed = 3; Disconnected = 4

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current life cycle state of this LCC. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.</td></tr>
<tr><td>Connectivity of the DAE Controller</td><td>Indicates the current connectivity state of this LCC.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Initializing</td><td>1</td></tr><tr><td>Uninitialized</td><td>2</td></tr><tr><td>Failed</td><td>3</td></tr><tr><td>Disconnected</td><td>4</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current connectivity state of this LCC. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.</td></tr>
<tr><td>DAE Controller health</td><td>Indicates the current health of this LCC.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Level_1_clear</td><td>0</td></tr><tr><td>Level_ 2_ unknown</td><td>1</td></tr></table></td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Level_3_warn-ing</td><td>2</td></tr>
<tr><td>Level_4_minor</td><td>3</td></tr>
<tr><td>Level_5_major</td><td>4</td></tr>
<tr><td>Level_ 6_ crit-ical</td><td>5</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this LCCon the DAE. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.
</td></tr>
<tr><td>SAS1 port state</td><td>Indicates the current state of the Serial Attached SCSI port 1 of this LCC.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Up</td><td>0</td></tr>
<tr><td>Down</td><td>1</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state Serial Attached SCSI port 1 of this DAEController. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
</td></tr>
<tr><td>SAS1 port state</td><td>Indicates the current state of the Serial Attached SCSI port 2 of this LCC.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Up</td><td>0</td></tr><tr><td>Down</td><td>1</td></tr></table> **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current state Serial Attached SCSI port 2 of this DAEController. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.

3.1.3 XIO DAE PSUs Test

This test auto-discovers the power supply units of the Disk Array Enclosure and for each PSU, this test reports whether the PSU is enabled and the current health status. Using this test, administrators can be proactively alerted to PSUs that have failed and are disconnected.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Power Supply Unit of the DAE Controller of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.

Parameter	Description
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>Is enabled?</td><td>Indicates whether/not this power supply unit of the DAE Controller is enabled.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Yes</td><td>0</td></tr><tr><td>No</td><td>1</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not this power supply unit of the DAE Controller is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>Health status</td><td>Indicates the current health of the Field Replaceable Unit available in this power supply unit of the DAE Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Initializing</td><td>1</td></tr><tr><td>Uninitialized</td><td>2</td></tr><tr><td>Failed</td><td>3</td></tr><tr><td>Disconnected</td><td>4</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of the Field Replaceable Unit available in</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			this power supply unit of the DAE Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.

3.1.4 XIO DAEs Test

This test reports the current health of each Disk Array Enclosure in the X-Bricks of the target EMC XtremIO. By closely monitoring the health of the Disk Array Enclosures, disconnected and failed Disk Array Enclosures can be identified easily.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Disk Array Enclosure of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a

Parameter	Description
	XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health status	Indicates the current health of this Disk Array Enclosure.		The values reported by this measure and its numeric equivalents are mentioned in the table below:

Measurement	Description	Measurement Unit	Interpretation
			<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Initializing</td><td>1</td></tr><tr><td>Uninitialized</td><td>2</td></tr><tr><td>Failed</td><td>3</td></tr><tr><td>Disconnected</td><td>4</td></tr></table> **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this Disk Array Enclosure. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.

3.1.5 XIO InfiniBand Switches Test

Multiple X-Brick clusters may consist of:

- Two, four, six or eight X -Bricks
- Two InfiniBand Switches

From the hardware perspective of the X-Brick cluster, no component is a single point of failure. Each Storage Controller, DAE and InfiniBand Switch in the system is equipped with dual power supplies. The system also has dual Battery Backup Units and dual network and data ports (in each of the Storage Controllers). The two InfiniBand Switches are cross connected and create a dual data fabric. Failure of any component may trigger a recovery attempt or a failover. For the failover process to be smooth enough, it is necessary that all the components are functioning well. Failure of the Infiniband switch may lead to connection loss to the storage controller and in due course may lead to data loss during failover. Therefore, it is necessary to monitor the Infiniband Switchess round the clock! The XIO Infiniband Switches test helps administrators in this regard!

This test reports whether/not each Infiniband Switch is enabled. This test also helps administrators to determine the availability of each Infiniband Switch, the current health of the switches and the state of the ports on the Infiniband Switches. Using this test, administrators can easily identify the Infiniband Switch that is wrongly connected to the storage controllers.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the InfiniBand Switches of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against

Parameter	Description
	DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Is enabled?	Indicates whether/not this InfiniBand Switch is enabled.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Yes / 0 No / 1 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate whether/not this InfiniBand Switch is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
Health status	Indicates the current health of this InfiniBand Switch.		The values reported by this measure and its numeric equivalents are mentioned in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
<tr><td>Initializing</td><td>1</td></tr>
<tr><td>Uninitialized</td><td>2</td></tr>
<tr><td>Failed</td><td>3</td></tr>
<tr><td>Disconnected</td><td>4</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this InfiniBand Switch. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.
</td></tr>
<tr><td>Fan drawer status</td><td>Indicates the current state of the fan drawer in this InfiniBand Switch.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
<tr><td>One_fan_failed</td><td>1</td></tr>
<tr><td>Failed</td><td>2</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state of the fan drawer in this InfiniBand Switch. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.
</td></tr>
<tr><td>Inter-switch port 1 state</td><td>Indicates the current state of the Inter-switch port 1 of this InfiniBand Switch.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Active</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state of the Inter-switch port 1 of this InfiniBand Switch. The graph of this measure however is represented using the numeric equivalents only i.e., 0.
</td></tr>
<tr><td>Inter-switch port 2 state</td><td>Indicates the current state of the Inter-switch port 2 of this InfiniBand Switch.</td><td></td><td>
The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Active</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current state of the Inter-switch port 2 of this InfiniBand Switch. The graph of this measure however is represented using the numeric equivalents only i.e., 0.
</td></tr>
<tr><td>Is infiniband switch available?</td><td>Indicates whether/not this InfiniBand Switch is available.</td><td></td><td>
The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Available</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not this
</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>InfiniBand Switch is available. The graph of this measure however is represented using the numeric equivalents only i.e., 0.</td></tr>
<tr><td>Is wrong storage controller connection detected?</td><td>Indicates whether any storage controller was not connected to the corresponding InfiniBand Switch.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>None</td><td>0</td></tr><tr><td>Wrong connection detected</td><td>1</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether any storage controller was not connected to the corresponding InfiniBand Switch. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
</table>

3.1.6 XIO Local Disks Test

This test auto-discovers the local disks on the EMC XtremIO and reports whether/not each local disk is enabled. This test also reports the health of the local disk and throws light on whether/not failure or disconnection was detected on each local disk. Besides, this test also helps administrators figure out the number of bad sectors on each disk. This way, administrators are proactively notified about the consistency of the disk on which data is stored.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each disk of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option.

Parameter	Description
	The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Is enabled?	Indicates whether/not this local disk is enabled.		The values reported by this measure and its numeric equivalents are mentioned in the table below: Measure value: Yes — Numeric Value: 0 Measure value: No — Numeric Value: 1 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate whether/not this local disk is enabled.The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
Number of bad sectors	Indicates the number of bad sectors in this local disk.	Number	
FRU failure or disconnection detected?	Indicates whether/not failure or disconnection was detected on this local disk.		The values reported by this measure and its numeric equivalents are mentioned in the table below: Measure value: No — Numeric Value: 0 **Note:**

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>By default, this measure reports the Measure Values listed in the table above to indicate whether/not failure or disconnection was detected on this local disk. The graph of this measure however is represented using the numeric equivalents only i.e., 0.</td></tr>
<tr><td>Health status</td><td>Indicates the current health of this local disk.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Initializing</td><td>1</td></tr><tr><td>Uninitialized</td><td>2</td></tr><tr><td>Failed</td><td>3</td></tr><tr><td>Disconnected</td><td>4</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the health of this local disk. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.</td></tr>
</table>

3.1.7 XIO SC InfiniBand Switches Test

This test reports whether/not each Infiniband Switch is enabled. This test also helps administrators to determine the availability of each Infiniband Switch, the current health of the switches and the state of the ports on the Infiniband Switches. Using this test, administrators can easily identify the infiniband switch that is prone to errors.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Controller:InfiniBand Switch* of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>InfiniBand link health level</td><td>Indicates the health of this InfiniBand Switch when linked to this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Level_1_clear</td><td>0</td></tr><tr><td>Level_ 2_ unknown</td><td>1</td></tr><tr><td>Level_3_warn-ing</td><td>2</td></tr><tr><td>Level_4_minor</td><td>3</td></tr><tr><td>Level_5_major</td><td>4</td></tr><tr><td>Level_ 6_ crit-ical</td><td>5</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the health of this InfiniBand Switch in the Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.</td></tr>
<tr><td>InfiniBand port state</td><td>Indicates the state of the port available on this Storage Controller that is linked to this InfiniBand Switch.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Up</td><td>0</td></tr><tr><td>Down</td><td>1</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the state of the port</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>available in this InfiniBand Switch of the Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>Connection between Storage Controllers</td><td>Indicates the health of this InfiniBand Switch connection between the Storage Controllers.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Not_node</td><td>1</td></tr><tr><td>Wrong_port</td><td>2</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the health of this InfiniBand Switch connection between the Storage Controllers. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.</td></tr>
<tr><td>Number of times InfiniBand port was down</td><td>Indicates the number of times the port to which this Infiniband Switch was connected was down.</td><td>Number</td><td>Ideally, the value of this measure should be zero.</td></tr>
<tr><td>InfiniBand link error recoveries</td><td>Indicates the number of times the port to which this InfiniBand Switch was connected successfully completed a link error recovery procedure.</td><td>Number</td><td></td></tr>
<tr><td>InfiniBand local link integrity errors</td><td>Indicates the number of times logical link integrity errors were encountered by the port to which this</td><td>Number</td><td>Ideally, the value of this measure should be zero.</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
	InfiniBand Switch was connected.		
InfiniBand port received errors	Indicates the number of packets that were received by the port of this InfiniBand Switch of the Storage Controller with errors.	Number	Ideally, the value of this measure should be zero.
Remote physical errors	Indicates the number of remote physical errors encountered by the port to which this InfiniBand Switch was connected.	Number	Ideally, the value of this measure should be zero.
InfiniBand symbol errors	Indicates the number of symbol errors encountered by the port of this InfiniBand Switch of the Storage Controller.	Number	Ideally, the value of this measure should be zero.

3.1.8 XIO SC Nodes Test

This test monitors each storage controller of the target EMC XtremIO storage array and reports the overall health of the storage controller along with its contained components. This test also reports the current temperature of the front panel of each storage controller, the journaling state and the connection state between the XMS and each storage controller. Using this test, administrators can figure out the storage controllers that were disconnected from the XMS and the reason behind why the storage controller stopped working.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Storage Controller node on the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option.

Parameter	Description
	The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Storage controller front panel temperature state	Indicates the current temperature state of the front panel of this storage controller node.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Warning: 1 High: 2 Invalid: 3 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this InfiniBand Switch. The graph of this measure however is represented using the numeric equivalents only - 0 to 3.
Storage controller health state	Indicates the overall health of this storage controller and the components contained in it.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Healthy: 0

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Partial_fault</td><td>1</td></tr>
<tr><td>Degraded</td><td>2</td></tr>
<tr><td>Failed</td><td>3</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this storage controller node. The graph of this measure however is represented using the numeric equivalents only - 0 to 3.
</td></tr>
<tr><td>Storage controller journaling health state</td><td>Indicates the current health of the journaling components of this storage controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
<tr><td>Dumping</td><td>1</td></tr>
<tr><td>Ready</td><td>2</td></tr>
<tr><td>Fault</td><td>3</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of the journaling components of this storage controller node. The graph of this measure however is represented using the numeric equivalents only - 0 to 3.
</td></tr>
<tr><td>Storage controller manager connection state</td><td>Indicates the connection state between the XMS and this Storage Controller manager.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Connected</td><td>0</td></tr>
<tr><td>Controlled_ dis-connect</td><td>1</td></tr>
<tr><td>Disconnected</td><td>2</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current connection state of the storage controller node manager. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.
</td></tr>
<tr><td>Storage controller stop type</td><td>Indicates the reason behind why this storage controller stopped.</td><td></td><td>
The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>None</td><td>0</td></tr>
<tr><td>Replaced</td><td>1</td></tr>
<tr><td>DAE_stopping</td><td>2</td></tr>
<tr><td>DAE_stopped</td><td>3</td></tr>
<tr><td>Stopping</td><td>4</td></tr>
<tr><td>Stopped</td><td>5</td></tr>
<tr><td>Failed_stop</td><td>6</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the reason behind why this storage controller stopped. The graph of this measure however is represented using the numeric equivalents only - 0 to 6.
</td></tr>
</table>

3.1.9 XIO SC PSUs Test

This test auto-discovers the power supply units (PSUs) of the Storage Controller and for each PSU, this test reports whether the PSU is enabled and the current health status. Using this test, administrators can be proactively alerted to PSUs that have failed and are disconnected.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each power supply unit of the Storage Controller available in the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section

Parameter	Description
	3.1.1.1.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Is enabled?	Indicates whether/not this power supply unit of the Storage Controller is enabled.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Yes / 0 No / 1 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate whether/not this power supply unit of the Storage

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>Controller is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.</td></tr>
<tr><td>Health status</td><td>Indicates the current health of this power supply unit of the Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Initializing</td><td>1</td></tr><tr><td>Uninitialized</td><td>2</td></tr><tr><td>Failed</td><td>3</td></tr><tr><td>Disconnected</td><td>4</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate current health of this power supply unit of the Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.</td></tr>
</table>

3.1.10 XIO SC SAS Ports Test

This test auto-discovers the SAS ports of the Storage Controller and reports the current state of the Storage Controller. This test also reports the current health of each SAS port.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Controller:SAS Port* of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option.

Parameter	Description
	The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Storage controller's SAS port health level	Indicates the health of this SAS port available in the Storage Controller.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value**: Level_1_clear = 0; Level_ 2_ unknown = 1; Level_3_warn-ing = 2; Level_4_minor = 3; Level_5_major = 4; Level_ 6_ crit-ical = 5 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the health of this SAS port available in the Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.
SAS port state	Indicates the current state of this SAS port available in the Storage Controller.		The values reported by this measure and its numeric equivalents are mentioned in the table below:

Measurement	Description	Measurement Unit	Interpretation
			<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Up</td><td>0</td></tr><tr><td>Down</td><td>1</td></tr></table> **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current state of this SAS port available in the Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.

3.1.11 XIO Slots Test

This test reports the current state of each slot on the target EMC XtremIO. Using this test, erroneous slots can be identified and rectified so that additional disks are inserted into the slots well before administrators are informed about storage space crunch!

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each slot on the target EMC XtremIO Storage array

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target

Parameter	Description
	Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Slot state	Indicates the current state of this slot.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Resident_ssd: 0 Ok: 1 Empty: 2 Unanticipated_disk: 3 Error: 4 Unsupported_disk: 5 Uninitialized_disk: 6 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate whether/not the Storage Controller is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 to 6.

3.1.12 XIO Storage Controller IPMI Test

This test reports the current state of the IPMI port i.e., the management port on each storage controller of the target EMC XtremIO and the current state of the link connecting the port and the storage controller.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Storage Controller on the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option.

Parameter	Description
	The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Dedicated IPMI link connection state	Indicates the state of the link between the dedicated IPMI port and this Storage Controller.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value**: Ok = 0; Invalid wiring = 1; Disconnected = 2 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the state of the link between the dedicated IPMI port and the other Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.
Dedicated IPMI port state	Indicates the current state of the IPMI port on this Storage Controller.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value**: Up = 0; Down = 1

Measurement	Description	Measurement Unit	Interpretation
			Note: By default, this measure reports the Measure Values listed in the table above to indicate the current state of the IPMI port on this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.

3.1.13 XIO Storage Controllers Test

This test auto-discovers the storage controllers in the target EMC XtremIO Storage array and reports where/not each storage controller is enabled. Using this test, administrators can figure out the current health of the storage controller and the components with the storage controller such as fan, Field Replaceable unit, internal sensor, management port etc. This test also helps administrators determine the journaling state and the RAM usage level of each storage controller. The temperature and voltage deviation of each storage controller can also be easily detected and rectified.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Storage Controller on the target EMC XtremIO being monitored

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.

Parameter	Description
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every second time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>Storage Controller's current health state</td><td>Indicates the current health of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Level_ 1_ clear</td><td>0</td></tr><tr><td>Level_ 2_ unknown</td><td>1</td></tr><tr><td>Level_ 3_ warning</td><td>2</td></tr><tr><td>Level_ 4_ minor</td><td>3</td></tr><tr><td>Level_ 5_ major</td><td>4</td></tr><tr><td>Level_ 6_ critical</td><td>5</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.</td></tr>
<tr><td>Is enabled?</td><td>Indicates whether/not this Storage Controller is enabled.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Yes</td><td>0</td></tr>
<tr><td>User_ disabled</td><td>1</td></tr>
<tr><td>System_disabled</td><td>2</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether/not the Storage Controller is enabled. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.
</td></tr>
<tr><td>Fan health state</td><td>Indicates the current health of the fan sensor types (both analog and discrete sensors) of this Storage Controller.</td><td></td><td>
The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Level_ 1_ clear</td><td>0</td></tr>
<tr><td>Level_ 2_ unknown</td><td>1</td></tr>
<tr><td>Level_ 3_ warning</td><td>2</td></tr>
<tr><td>Level_ 4_ minor</td><td>3</td></tr>
<tr><td>Level_ 5_ major</td><td>4</td></tr>
<tr><td>Level_ 6_ critical</td><td>5</td></tr>
</table>
Note:
</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>By default, this measure reports the Measure Values listed in the table above to indicate the current health of the fan sensor types of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.</td></tr>
<tr><td>Health status</td><td>Indicates the current health of the Field Replaceable Units of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Initializing</td><td>1</td></tr><tr><td>Uninitialized</td><td>2</td></tr><tr><td>Failed</td><td>3</td></tr><tr><td>Disconnected</td><td>4</td></tr></table>Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of the Field Replaceable Units of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 4.</td></tr>
<tr><td>Internal sensor health state</td><td>Indicates the current health state of the temperature/fan/voltage/current/internal sensor types(both analog and discrete sensors) of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Level_ 1_ clear</td><td>0</td></tr>
<tr><td>Level_ 2_ unknown</td><td>1</td></tr>
<tr><td>Level_ 3_ warning</td><td>2</td></tr>
<tr><td>Level_ 4_ minor</td><td>3</td></tr>
<tr><td>Level_ 5_ major</td><td>4</td></tr>
<tr><td>Level_ 6_ critical</td><td>5</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of all the sensor types of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.
</td></tr>
<tr><td>iSCSI daemon state</td><td>Indicates the state of the iSCSI deamon of this Storage Controller.</td><td></td><td>
The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
<tr><td>Failed</td><td>1</td></tr>
</table>
Note:
By default, this measure reports the Measure Values
</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			listed in the table above to indicate the state of the iSCSI deamon of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.
Journal state	Indicates the health of the journals during failover and failback on this Storage Controller.		Every piece of information that is not committed to the SSD is kept in multiple locations, called Journals. Each software module has its own Journal, which is not kept on the same Storage Controller, and can be used to restore data in case of unexpected failure. Journals are regarded as highly important and are always kept on Storage Controllers with battery backed up power supplies. In case of a problem with the Battery Backup Unit, the Journal fails over to another Storage Controller. In case of global power failure, the Battery Backup Units ensure that all Journals are written to vault drives in the Storage Controllers and the system is turned off. The values reported by this measure and its numeric equivalents are mentioned in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the journal health state regarding failover and failback of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only i.e., 0.
</td></tr>
<tr><td>RAM usage level</td><td>Indicates the health of the RAM low level indicator of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the health of the RAM low level indicator of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only i.e., 0.
</td></tr>
<tr><td>Management link health state</td><td>Indicates the current health of the management port of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Level_ 1_ clear</td><td>0</td></tr>
<tr><td>Level_ 2_ unknown</td><td>1</td></tr>
<tr><td>Level_ 3_ warning</td><td>2</td></tr>
<tr><td>Level_ 4_ minor</td><td>3</td></tr>
<tr><td>Level_ 5_ major</td><td>4</td></tr>
<tr><td>Level_ 6_ critical</td><td>5</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of the management port of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.
</td></tr>
<tr><td>Remote journaling health state</td><td>Indicates the health of the remote journal of this Storage Controller.</td><td></td><td>
The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to
</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>indicate the health of the remote journal of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only i.e., 0.</td></tr>
<tr><td>Temperature health state</td><td>Indicates the health of the temperature sensor types (both analog and discrete sensors) of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Level_ 1_ clear</td><td>0</td></tr><tr><td>Level_ 2_ unknown</td><td>1</td></tr><tr><td>Level_ 3_ warning</td><td>2</td></tr><tr><td>Level_ 4_ minor</td><td>3</td></tr><tr><td>Level_ 5_ major</td><td>4</td></tr><tr><td>Level_ 6_ critical</td><td>5</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the health of the temperature sensor types of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.</td></tr>
<tr><td>Voltage health</td><td>Indicates the health of the voltage</td><td></td><td>The values reported by this</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>state</td><td>sensor types (both analog and discrete sensors) of this Storage Controller.</td><td></td><td>measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Level_ 1_ clear</td><td>0</td></tr><tr><td>Level_ 2_ unknown</td><td>1</td></tr><tr><td>Level_ 3_ warning</td><td>2</td></tr><tr><td>Level_ 4_ minor</td><td>3</td></tr><tr><td>Level_ 5_ major</td><td>4</td></tr><tr><td>Level_ 6_ critical</td><td>5</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the health of the voltage sensor types of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 5.</td></tr>
<tr><td>Management port state</td><td>Indicates the current state of the management port of this Storage Controller.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Up</td><td>0</td></tr><tr><td>Down</td><td>1</td></tr></table></td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			Note: By default, this measure reports the Measure Values listed in the table above to indicate the current state of the management port of this Storage Controller. The graph of this measure however is represented using the numeric equivalents only - 0 or 1.

3.2 The XtremIO System Layer

The tests mapped to this layer report the health state of each SSD, space utilization of each SSD, CPU utilization and state of each X-Env, bandwidth utilization for read/write operations in each Data Protection Group etc.

Figure 3.5: The tests mapped to the XtremIO System layer

3.2.1 XIO Data Protection Groups Test

The XtremIO Storage Array is an all-flash system, based on a scale-out architecture. The system uses building blocks, called X-Bricks, which can be clustered together to grow performance and capacity as required. An X-Brick is the basic building block of an XtremIO array. An X-Brick comprises of 25 SSDs. A data protection group is a set of SSDs that form a redundancy group. Each data protection group has a name, health state, and defined usable SSD space. Each X-Brick contains one data protection group, which is created during the initial configuration. The data protection group cannot be removed. Whenever multiple SSDs fail, administrators are required to assign a new SSD in the data protection group so that the space within the data protection group is maintained and the data loss is kept to a minimum. To achieve superior data protection, enhanced performance of the XtremIO storage array along with a minimal data loss due to SSD failure, it is

necessary to continuously monitor the bandwidth utilization and IOPS of the data protection group. The **XIO Data Protection Group** test helps administrators in this regard!

This test auto-discovers the Data Protection Group of an X-Brick and reports the bandwidth utilization for read/write operations, the rate at which read/write operations are performed and the percentage of free space within the SSDs of the Data Protection Group.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Data Protection Group on the EMC XtremIO Storage array that is to be monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto-discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode

Parameter	Description
	only. In this case, set the SSL flag to **No**.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the rate at which data is read from this data protection group.	MB/Sec	Comparing the value of these measures across the data protection groups will clearly indicate which data protection group is the slowest in I/O processing, and when exactly the slowdown occurred – when reading data? or when writing data?
Write bandwidth	Indicates the rate at which data is written to this data protection group.	MB/Sec	
Bandwidth	Indicates the amount of data handled while performing I/O operations per second on this data protection group.	MB/Sec	Compare the value of this measure across the data protection groups to identify the group that is consuming the maximum bandwidth.
Read IOPS	Indicates the rate at which read operations were performed on this data protection group.	IOPS	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential reading bottleneck.
Write IOPS	Indicates the rate at which write operations were performed on this data protection group.	IOPS	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential writing bottleneck.

Measurement	Description	Measurement Unit	Interpretation
IOPS	Indicates the rate at which I/O operations were performed on this data protection group.	IOPS	A high value is desired for this measure. Compare the value of this measure across the data protection groups to identify the group that is handling the maximum number of I/O operations.
User data SSD free space	Indicates the percentage of free space available for use in the SSDs of this data protection group.	Percent	A high value is desired for this measure. When an SSD in a data protection group fails, the cluster rebuilds it to restore redundancy. A rebuild reconstructs the data from the failed SSD onto the remaining SSDs in the data protection group, thus restoring redundancy and protection level. A rebuild requires sufficient available space in the remaining SSDs to handle the data protection group's demands. If sufficient free space is not available, a rebuild cannot be performed and the data protection group's performance and resiliency may be degraded.

3.2.2 XIO SSDs Test

This test reports the current health and enabled state of each SSD in an EMC XtremIO, monitors the space utilization of each SSD, and enables administrators to accurately identify which SSD is experiencing space crunch currently. In addition, this test monitors the level of traffic on each SSD, and helps isolate irregularities in load balancing across the SSDs. In the process, the test also helps identify which SSD is experiencing processing bottlenecks (if any).

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Data Protection Group:SSD* in the target EMC XtremIO Storage array that is being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>SSD health state</td><td>Indicates the current health of this SSD.</td><td></td><td>The values reported by this measure and their numeric equivalents are available in the table below:
<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Unknown</td><td>1</td></tr></table>
Note:
This measure reports the Measure Values listed in the table above to indicate the current health of this SSD. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.</td></tr>
<tr><td>SSD enabled state</td><td>Indicates whether/not this SSD is enabled.</td><td></td><td>The values reported by this measure and their numeric equivalents are available in the table below:
<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>Enabled</td><td>0</td></tr><tr><td>Disabled</td><td>1</td></tr><tr><td>Unknown</td><td>2</td></tr></table>
Note:
This measure reports the Measure Values listed in the table above to indicate whether/not this SSD is enabled. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.</td></tr>
<tr><td>SSD RG state</td><td>Indicates whether/not this SSD is within a Raid</td><td></td><td>The values reported by this measure and their numeric equivalents are</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td>Group.</td><td></td><td>available in the table below:
<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>In RG</td><td>0</td></tr><tr><td>Unknown</td><td>1</td></tr></table>
Note:
This measure reports the Measure Values listed in the table above to indicate whether/not this SSD is within a Raid Group. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.</td></tr>
<tr><td>SSD size</td><td>Indicates the total size of this SSD.</td><td>GB</td><td></td></tr>
<tr><td>SSD space in use</td><td>Indicates the amount of space that is currently utilized by this SSD.</td><td>GB</td><td>If the value of this measure is close to that of the SSD size measure, it indicates potential space crunch in the SSD. Administrators are therefore required to increase the size of the SSD.</td></tr>
<tr><td>SSD free space</td><td>Indicates the percentage of space that is available for use in this SSD.</td><td>Percent</td><td>A high value is desired for this measure.</td></tr>
<tr><td>SSD space used</td><td>Indicates the percentage of space that is currently in use in this SSD.</td><td>Percent</td><td>A low value is desired for this measure. A consistent increase in this value could indicate a gradual, but steady erosion of space in this SSD. A value close to 100% indicates that this SSD is rapidly running out of space.</td></tr>
<tr><td>Endurance remaining</td><td>Indicates the tolerance i.e., withstanding capability of this SSD, expressed in terms of percentage.</td><td>Percent</td><td>A high value is desired for this measure. A sudden/gradual decrease in the value indicates an impending SSD failure.</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the rate at which data is read from this SSD.	MB/Sec	Comparing the value of these measures across the SSDs will clearly indicate which SSD is the slowest in I/O processing, and when exactly the slowdown occurred – when reading data? or when writing data?
Write bandwidth	Indicates the rate at which data is written to this SSD.	MB/Sec	
Bandwidth	Indicates the amount of data handled while performing I/O operations per second on this SSD.	MB/Sec	Compare the value of this measure across the SSDs to identify the SSD that is consuming the maximum bandwidth.
Read IOPS	Indicates the rate at which read operations were performed on this SSD.	IOPS	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential reading bottleneck.
Write IOPS	Indicates the rate at which write operations were performed on this SSD.	IOPS	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential writing bottleneck.
IOPS	Indicates the rate at which I/O operations were performed on this SSD.	IOPS	A high value is desired for this measure. Compare the value of this measure across the SSDs to identify the SSD that is handling the maximum number of I/O operations.

3.2.3 XIO XEnvs Test

By default, each X-Brick comprises of two storage controller nodes and each storage controller consists of two CPU sockets. An XIOS instance called the X-ENV runs on each CPU socket. There are 6 software modules that are responsible for various functions such as I/O flow, I/O processing etc in the XTREMIO storage array. The first 3 (R,C,D) are data plane modules and the last 3 (P,M,L) are control plane modules. Each of these modules are explained in detail as follows:

P – Platform Module. This module is responsible for monitoring the hardware of the system. Each node runs a P-module.

M – Management Module. This module is responsible for system wide configurations. It communicates with the XMS management server to perform actions such as volume creation, host

LUN masking, etc from the GUI and CLI. There is one active M-module running on a single node, and the other nodes run a stand-by M-module for HA purposes.

L – Clustering Module. This clustering module is responsible for managing the cluster membership state, joining the cluster, and typical cluster functions. Each node runs an L-module.

R - Routing Module. This module is the SCSI Command parser and translates all host SCSI commands into internal XtremIO commands/addresses. It is responsible for the 2 FC and 2 iSCSI ports on the node and functions as the ingress/egress point for all I/O of the node. It is also responsible for breaking all I/O into 4K chunks and calculating the data hash values via SHA-1. Each node runs an R-Module.

C - Control Module. This module contains the address to hash mapping table (A2H) which is the first layer of indirection that allows much of the "magic" to happen. Many of the advanced data services such as snapshots, de-duplication, thin provisioning, etc are all handled in this module.

D - Data Module. The data module contains the hash to physical (H2P) SSD address mapping. It is also responsible for doing all of the I/O to the SSDs themselves as well as managing the data protection scheme, called XDP (XtremIO Data Protection).

Each storage controller node is configured specifically to run R and C modules on one CPU socket and the D module is run on the other CPU socket. When communication between the RC and D modules happens evenly, then the I/O processing will be smooth and uniform. If for any reason the XIOS instance aka X-ENV is inactive, the corresponding storage controller node may fail leading to performance degradation of the XTREMIO storage array. Also, if the CPU utilization of the X-Env is not maintained optimally, then the I/O processing may not be uniform. In order to maintain uniform I/O processing, it becomes important to continuously monitor the state and CPU utilization of each X-Env. The **XIO XEnvs** test exactly helps you in this regard. This test auto-discovers the X-Envs of the target storage array and reports the current state and CPU utilization of each X-Env.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each **`X-Env`** of the EMC XtremIO Storage array that is being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.

Parameter	Description
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
CPU usage	Indicates the CPU utilization of this X-Env.	Percent	A high value for this measure indicates continuous I/O processing by the storage array. If the value of this measure is increasing gradually or is high for a prolonged period, then administrators should check if adequate LUNs/Volumes are available for storage purposes, if the disk drive capacity is adequate or if the storage capacity of the snapshots is adequate. To optimize the CPU utilization,

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>administrators may either increase the storage capacity or clear unwanted storage space for a smoother I/O processing.</td></tr>
<tr><td>XEnv state</td><td>Indicates the current state of this X-Env.</td><td></td><td>The values reported by this measure and their numeric equivalents are available in the table below:
<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>Active</td><td>0</td></tr><tr><td>Unknown</td><td>1</td></tr></table>
Note:
This measure reports the Measure Values listed in the table above to indicate the state of this X-Env. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.</td></tr>
</table>

3.3 The XtremIO Cluster Layer

This layer monitors the level of I/O activity of each cluster and space usage of each SSD in a cluster of the EMC XtremIO. In addition, this layer helps administrator to keep a check on the I/O processing capability of the cluster based on the data block size so that lag in read/write operations can be detected and precautionary measures can be initiated before any serious damage occurs.

Figure 3.6: The tests mapped to the XtremIO Cluster layer

3.3.1 XIO Cluster Status Test

An XtremIO Storage Array can include a single X-Brick or a cluster of multiple X-Bricks. A cluster of multiple X-Bricks consists of:

- Two or four X-Bricks
- Two InfiniBand Switches

This test auto-discovers the clusters of the target storage array and reports the current health, connection state and uptime. In addition, this test monitors the SSD space utilization of the cluster and helps administrators identify potential space crunch, if any. Also, this test helps administrators to figure out the cluster that is busy processing I/O requests along clusters, detect irregularities in the distribution of I/O load across clusters and thus enables administrators to initiate pre-emptive measures.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each cluster on the EMC XtremIO Storage array being monitored

Configurable parameters for the test

Parameters	Description
Test period	How often should the test be executed .
Host	The IP address of the storage array
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto-discovered XMS Management Server or a brand new

Parameters	Description
	EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the Restful APIs using the HTTPS mode. This is why, the **SSL** flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the **SSL** flag to **No**.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Cluster uptime since last restart	Indicates the time duration for which this cluster had been up since the last restart.	Hours	
Cluster health state	Indicates the current health of this cluster.		The values reported by this measure and their numeric equivalents are available in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>Healthy</td><td>0</td></tr>
<tr><td>Unknown</td><td>1</td></tr>
</table>
Note:
This measure reports the Measure Values listed in the table above to indicate the health of this cluster. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.
</td></tr>
<tr><td>Cluster manager connection state</td><td>Indicates the current connection state between the XtremIO Management Server (XMS) and this cluster.</td><td>MB/Sec</td><td>The values reported by this measure and their numeric equivalents are available in the table below:
<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>Connected</td><td>0</td></tr>
<tr><td>Unknown</td><td>1</td></tr>
</table>
Note:
This measure reports the Measure Values listed in the table above to indicate the connection state of this cluster. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.
</td></tr>
<tr><td>Consistency state</td><td>Indicates the detection of data consistency error in this cluster.</td><td></td><td>This measure will report a value Healthy if the data consistency error is determined as non-existant and Unknown otherwise.</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>The values reported by this measure and their numeric equivalents are available in the table below:
<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>Healthy</td><td>0</td></tr><tr><td>Unknown</td><td>1</td></tr></table>
Note:
This measure reports the Measure Values listed in the table above to indicate the detection of data consistency error in this cluster. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.</td></tr>
<tr><td>Used user data SSD space</td><td>Indicates the percentage of SSD space utilized by this cluster.</td><td>Percent</td><td>A value close to 100 indicates that the SSDs in the cluster are running out of space.</td></tr>
<tr><td>Free user data SSD space</td><td>Indicates the percentage of SSD space that is currently available for use in this cluster.</td><td>Percent</td><td>A high value is desired for this measure. A sudden/gradual decrease in the value of this measure is an indication for the administrators to either free up space in the SSDs or add additional resources to the cluster.</td></tr>
<tr><td>Reads</td><td>Indicates the number of reads made on this cluster per second during the last measurement period.</td><td>Reads/sec</td><td rowspan="2">Comparing the value of these measures across clusters will clearly indicate which cluster is overloaded - it could also shed light on irregularities in load balancing across the clusters.</td></tr>
<tr><td>Writes</td><td>Indicates the number of writes to this cluster during the last measurement period.</td><td>Writes/Sec</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
Data reads	Indicates the rate at which data is read from this cluster during the last measurement period.	MB/Sec	Compare the values of these measures across the clusters to identify the slowest cluster in terms of servicing read and write requests (respectively).
Data written	Indicates the rate at which data is written to this cluster during the last measurement period.	MB/Sec	
Average read size	Indicates the average amount of data read from this cluster per I/O operation during the last measurement period.	MB/Op	Compare the values of these measures across the clusters to identify the slowest cluster in terms of servicing read and write requests (respectively).
Average write size	Indicates the average amount of data written to this cluster per I/O operation during the last measurement period.	MB/Op	

3.3.2 XIO Cluster Traffic Test

To external applications, XtremIO appears and behaves like a standard block storage array. However, due to its unique architecture, it takes a fundamentally different approach to internal data organization. Instead of using logical addresses, XtremIO uses data blocks internally to store data. According to the block content, XtremIO decides where exactly to place the data blocks.

In a write operation, any data chunks that are larger than the native block size are broken down into standard blocks when they first enter the storage array. The system calculates a unique fingerprint for each of the incoming data blocks, using a special mathematical algorithm. This unique fingerprint is used for two primary purposes:

- To determine where the data block is placed within the array
- Inline Data Reduction

Because of the way the fingerprinting algorithm works, the ID numbers appear completely random and are evenly distributed over the possible range of fingerprint values. This results in an even distribution of data blocks across the entire cluster and all SSDs within the array. In other words, with

XtremIO it is neither necessary to check the space utilization levels on different SSDs, nor to actively manage equal data writes to every SSD. XtremIO inherently provides even distribution of data by placing the blocks based on their unique IDs. To achieve peak performance of any storage array, administrators should constantly keep a check on the read/write operations on the clusters, disks, SSDs of the storage array. The shorter the time taken to perform the read/write operations, the better is the performance of the storage array. In order to improve the performance of the storage array and figure out any processing bottlenecks in the storage array, it is necessary for the administrator to carefully monitor the processing capability of each cluster in the EMC XtremIO with respect to the size of the data blocks. The **XIO Cluster Traffic** test helps administrators in this regard!

This test reports the I/O processing capability of each cluster with respect to the data block size. For each data block size, this test reports how well the data block is processed, the time taken to process each data block size etc. Using this test, administrators can identify processing bottlenecks and initiate pre-emptive actions.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *cluster:data block* on the EMC XtremIO Storage array.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered

Parameter	Description
	XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the rate at which data blocks of this size were read from this cluster.	MB/Sec	
Write bandwidth	Indicates the rate at which data blocks of this size were written to this cluster.	MB/Sec	
Read latency	Indicates the time taken to read data blocks of this size.	msecs	Ideally, this value should be low. A high value could indicate that read/write operations are slowing down for some reason.
Write latency	Indicates the time taken to write data blocks of this size.	msecs	
Average latency	Indicates the average time taken to read/write data blocks of this size.	msecs	A value close to 100 indicates that the SSDs in the cluster are running out of space.
Read IOPS	Indicates the rate of read I/.O operations measured for the data blocks of this size during the last measurement period.	IOPS	
Write IOPS	Indicates the rate of write	IOPS	

Measurement	Description	Measurement Unit	Interpretation
	I/O operations measured for the data blocks of this size during the last measurement period.		

3.4 The XtremIO Targets Layer

Using the tests mapped to this layer, administrators can focus on the overall operational state and operational efficiency of their storage ports i.e., target ports. This way, they can proactively detect a potential overload condition and/or an I/O processing bottleneck with the target ports, and initiate measures to resolve these issues. In addition, the layer also throws light on the current state of each X-Brick and the number of SSDs and BBUs in each X-Brick.

Figure 3.7: The tests mapped to the XtremIO Target layer

3.4.1 XIO Targets Test

A target is a physical port located on the storage controller of the XtremIO Storage Array.

The XtremIO Storage Array supports the following target types:

- iSCSI - a 10GbE NIC port for connecting to iSCSI networks. There are two iSCSI targets per Storage Controller.
- FC - an FC HBA port for connecting to fiber optic cable networks. There are two FC targets per Storage Controller.

The cluster targets form the XtremIO Storage Array's front-end to which application servers connect for receiving storage services. The I/O requests from the host/server are primarily received through these targets, and the responses from the storage array are communicated to the host/server through these targets. The targets are the primary handlers of the I/O request processing in the storage array. By periodically checking the target port status and measuring the I/O load on the ports, you can identify overloaded ports, and thus proactively detect potential/existing load-balancing irregularities and/or processing bottlenecks with the storage controller. The **XIO Targets** test

facilitates this port check. For every target port configured on the storage controller, this test reports the port state, the I/O load on the ports, the processing ability of the ports, and the errors encountered by each target port. In the process, the test not only points administrators to overloaded ports, but also puts a finger on ports that are slow when processing I/O requests and the ports that are erroneous.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *X-Brick:Storage Controller:target port* of the target EMC XtremIO being monitored .

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Parameter	Description
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Port state	Indicates the current state of this target port.		The values reported by this measure and their numeric equivalents are available in the table below: **Measure Value** / **Numeric Value** Up / 0 Down / 1 **Note:** This measure reports the **Measure Value**s listed in the table above to indicate the current state of this target. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.
Target health	Indicates the current health of this target port.		The values reported by this measure and their numeric equivalents are available in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>Level 1 clear</td><td>0</td></tr>
<tr><td>Unknown</td><td>1</td></tr>
</table>
Note:
This measure reports the Measure Values listed in the table above to indicate the health of this target. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.
</td></tr>
<tr><td>Bandwidth</td><td>Indicates the amount of data utilized for performing I/O operations per second through this target port.</td><td>MB/sec</td><td></td></tr>
<tr><td>Read bandwidth</td><td>Indicates the amount of data utilized for performing read I/O operations per second through this target port.</td><td>MB/Sec</td><td rowspan="2">By comparing the values of these measures across the target ports, you can isolate those target ports that consume bandwidth excessively, and also understand where exactly was too much of bandwidth consumed - while reading? or writing?</td></tr>
<tr><td>Write bandwidth</td><td>Indicates the amount of data utilized for performing write I/O operations were performed per second through this target port.</td><td>MB/Sec</td></tr>
<tr><td>IOPS</td><td>Indicates the total number of reads and writes through this target port per second.</td><td>IOPS</td><td>Compare the value of this measure across the target ports to know the target port that handled the maximum number of I/O operations and the port that handled the least. By constantly analyzing these values, administrators can keep a check on the load balancing issues across the target ports.</td></tr>
<tr><td>Read IOPS</td><td>Indicates the number of read I/O operations</td><td>IOPS</td><td></td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
	performed through this target port per second.		
Write IOPS	Indicates the number of write I/O operations performed through this target port per second.	IOPS	
Reads	Indicates the number of reads per second through this target port during the last measurement period.	Reads/sec	Compare the value of this measure across target ports to identify the port that is handling the maximum number of read requests and the port that is handling the least.
Writes	Indicates the number of writes handled by this target port per second during the last measurement period.	Writes/sec	Compare the value of this measure across target ports to identify the port that is handling the maximum number of write requests and the port that is handling the least.
Data reads	Indicates the rate at which data was read through this target port during the last measurement period.	MB/Sec	Compare the value of these measures across the target ports to identify the slowest target port in terms of servicing read and write requests respectively.
Data written	Indicates the rate at which data was written through this target port during the last measurement period.	MB/Sec	
Average read size	Indicates the average amount of data read through this target port per I/O operation during the last measurement period.	MB/Op	
Average write size	Indicates the average amount of data written through this target port per I/O operation during the last measurement period.	MB/Op	
Loss of signals	Indicates the number of times the signal was lost	Number	Ideally, the value of this measure should be zero. A non-zero value for

Measurement	Description	Measurement Unit	Interpretation
	on this target port during the last measurement period.		this measure indicates that the port detected a loss of the electrical or optical signal used to transfer data on the port. This is likely an indicator for a faulty connector or cable. These are also caused when the device connected to the port is restarted, replaced or being serviced when the Fiber Channel cable connected to the port is temporarily disconnected. If the port is in the “loss of signal” state for longer than a specific period, the port will get into the link failure state which could degrade the performance of the Fiber Channel link. This measure is applicable only when the target port is a FC port.
Rate of Signal loss	Indicates number of signals lost on this target port per second during the last measurement period.	Signals/sec	A low value is desired for this measure. This measure is applicable only when the target port is a FC port.
Loss of Syncs	Indicates the number of times this target port failed to synchronize during the last measurement period.	Number	Ideally, the value of this measure should be zero. A non-zero value for this measure indicates that port went into the “loss of synchronization” state, where it encountered continuous Disparity errors. This is likely an indicator for a faulty connector or cable. These are also caused when the device connected to the port is restarted, replaced or being serviced when the Fiber Channel cable connected to the port is temporarily disconnected. If the port is in the “loss of

Measurement	Description	Measurement Unit	Interpretation
			synchronization" state for longer than a specific period, the port will get into the link failure state which could degrade the performance of the Fiber Channel link. This measure is applicable only when the target port is a FC port.
Loss syncs rate	Indicates the number of times this target port failed to synchronize per second during the last measurement period.	Sync/sec	Ideally, the value of this measure should be zero. This measure is applicable only when the target port is a FC port.
Invalid CRCs	Indicates the number of invalid CRCs that occurred on this target port during the last measurement period.	Number	This refers to the number of frames handled by this target that contains checksum errors. Ideally, the value of this measure should be zero. These are usually recoverable errors and will not degrade system performance unless their occurrence is sustained when the data cannot be relayed after retransmissions. This measure is applicable only when the target port is a FC port.
Rate of invalid CRCs	Indicates the rate at which invalid CRCs occurred on this target port during the last measurement period.	CRC/sec	Ideally, the value of this measure should be low. A high value for this measure indicates poor health of the target port. This measure is applicable only when the target port is a FC port.
Primitive sequence protocol errors	Indicates the number of Primitive Sequence protocol errors that occurred on this target port during the last measurement period.	Number	Ideally, the value of this measure should be zero. This measure is applicable only when the target port is a FC port.

Measurement	Description	Measurement Unit	Interpretation
Rate of PSP errors	Indicates the number of Primitive Sequence protocol errors occurred per second on this target port during the last measurement period.	Errors/sec	Ideally, the value of this measure should be zero. This measure is applicable only when the target port is a FC port.
Link failures	Indicates the number of link failures experienced by this target during the last measurement period.	Number	Ideally, the value of this measure should be zero. A non-zero value indicates that Fiber Channel connectivity with this target was "broken" that many times. This is likely an indicator for a faulty connector or cable. These are also caused when the device connected to this target is restarted, replaced or being serviced when the Fiber Channel cable connected to this target is temporarily disconnected. These measures are applicable only when the target port is a FC port.
Rate of link failures	Indicates the number of link failures experienced per second by this target during the last measurement period.	Failures/sec	
Dumped frames	Indicates the number of frames dumped by this target port due to lack of buffer credit during the last measurement period.	Percent	Buffer credits, also called buffer-to-buffer credits (BBC) are used as a flow control method by Fiber Channel technology and represent the number of frames a port can store. Each time a port transmits a frame that port's BB Credit is decremented by one; for each R_RDY received, that port's BB Credit is incremented by one. Transmission of an R_RDY indicates that the port has processed a frame, freed a receive buffer, and is ready for one more. If the BB Credit is zero, the corresponding node cannot transmit until an R_RDY is received back. A high value for this measure therefore indicates that an R_RDY was not received by the FC port for a long time.

Measurement	Description	Measurement Unit	Interpretation
			This is a cause for concern, as until the R_RDY is received, the FC port will not resume communication. The solution for this problem is to allocate optimal buffer credits to the FC port. The optimal number of buffer credits is determined by the distance (frame delivery time), the processing time at the receiving port, the link signaling rate, and the size of the frames being transmitted. As the link speed increases, the frame delivery time is reduced and the number of buffer credits must be increased to obtain full link utilization, even in a short-distance environment. Smaller frame sizes need more buffer credits. This measure is applicable only when the target port is a FC port.

3.4.2 XIO X-Bricks Test

An X-Brick is the basic building block of an XtremIO array. Each X-Brick is comprised of:

- One 2U Disk Array Enclosure (DAE), containing:
  - 25 eMLC SSDs (standard X-Brick) or 13 eMLC SSDs (10TB Starter X-Brick [5TB])
  - Two redundant power supply units (PSUs)
  - Two redundant SAS interconnect modules
- One Battery Backup Unit
- Two 1U Storage Controllers (redundant storage processors) which includes,
  - Two redundant power supply units (PSUs)
  - Two 8Gb/s Fiber Channel (FC) ports
  - Two 10GbE iSCSI ports

- Two 40Gb/s InfiniBand ports
- One 1Gb/s management/IPMI port

This test monitors the current state of each X-Brick and also reports the number of SSDs and BBUs available in each X-Brick.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each X-Brick of the target EMC XtremIO being monitored

Configurable parameters for the test

Parameters	Description
Test period	How often should the test be executed
Host	The IP address of the storage array
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto-discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the Restful APIs using the HTTPS mode. This is why, the **SSL** flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the **SSL** flag to **No**.

Measurements made by the test

Measurement		Measurement Unit	Interpretation
X-Brick state	Indicates the current state of this X-Brick.		The values reported by this measure and their numeric equivalents are available in the table below: **Measure Value** / **Numeric Value** In sys / 0 Unknown / 1 **Note:** This measure reports the **Measure Value**s listed in the table above to indicate the state of this X-Brick. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.
Number of SSDs	Indicates the total number of SSDs in this X-Brick.	Number	
Number of BBUs	Indicates the number of Battery Backup units in this X-Brick.	Number	If the value of this measure is 1 then this X-Brick is a stand-alone X-Brick. If the value of this measure is 2 then this X-Brick is a single X-Brick cluster.

3.5 The XtremIO Service Layer

The tests mapped to this layer helps administrators to monitor the level of I/O activity on each initiator, initiator group, volume, snapshot volume folder etc. Using these tests, administrators can analyze the I/O activity on each of the volumes, volume folders, snapshots etc, and easily identify the volumes, volume folders and snapshots that are busy in I/O processing.

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each of the volumes, volume folders, snapshots etc, and easily identify the volumes, volume folders and snapshots that are busy in I/O processing.

Figure 3.8: The tests mapped to the XtremIO Service layer

3.5.1 XIO Volumes Test

One of the primary capabilities of the XtremIO Storage Array is to provision volumes (LUNs) to the connected servers. Each volume is a defined quantity of disk space which is provisioned to the servers so that you can enable the servers to treat the volume as a SCSI device. Once the volumes are provisioned, you can create instantaneous copy images of volume data called snapshots so as to ensure availability of the original copy of the volume data without interruption. In an EMC XtremIO cluster, you can define various quantities of disk space as volumes. For an administrator to efficiently utilize the volumes, it is essential to provision the volumes prudently and monitor the processing ability of the volumes round the clock. If a sudden decrease in the I/O processing is noticed, administrators need to analyze what exactly has brought down the I/O processing capability of the volumes. To address the needs of the administrators and keep an eye on the volumes, eG Enterprise suite provides you with the **XIO Volumes** test.

This test auto discovers the volumes of the target storage array and helps administrators to figure out the volume that is busy processing I/O requests, detect irregularities in the distribution of I/O load across the volumes, analyze the space utilization of each volume and thus enables administrators to initiate pre-emptive measures when I/O processing capability decreases gradually.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each volume of the target EMC XtremIO being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled:

Parameter	Description
	• The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Bandwidth	Indicates the amount of data handled while performing I/O operations per second on this volume.	MB/Sec	
Read bandwidth	Indicates the amount of data utilized for read I/O operations per second on this volume.	MB/Sec	
Write bandwidth	Indicates the amount of data utilized for write I/O operations per second on this volume.	MB/Sec	
IOPS	Indicates the rate at which I/O operations were performed on this volume during the last measurement period.	IOPS	Compare the value of this measure across the volumes to know which volume handles the maximum number of I/O operations
Read IOPS	Indicates the rate at which read operations were performed on this volume.	IOPS	
Write IOPS	Indicates the rate at which write operations were performed on this volume.	IOPS	
Read latency	Indicates the time taken to perform read operations on this volume.	msec	
Write latency	Indicates the time taken to perform write operations on	msec	

Measurement	Description	Measurement Unit	Interpretation
	this volume.		
Average latency	Indicates the average time taken to perform I/O operations on this volume.	msec	
Reads	Indicates the number of reads performed on this volume per second during the last measurement period.	Reads/sec	Compare the values of this measure across the volumes to know which volume handles the maximum number of read requests.
Data written	Indicates the amount of data written to this volume during the last measurement period.	MB/sec	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential writing bottleneck. By comparing the value of this measure across the volumes, you can quickly identify the volume that is the slowest to process write requests.
Number of LUN mappings	Indicates the number of LUN mappings defined on this volume.	Number	
Number of destination snaps	Indicates the number of snapshots that were snapshotted from this volume.	Number	By default, volumes are snapshotted at equal intervals and these snapshots are distributed to various clients whereas the original volume is maintained as the source copy. If the value of this measure is high, then administrators may be required to correlate this value with that of the Bandwidth measure. The higher the value of this measure, the greater is the bandwidth utilized. Therefore, for the bandwidth to be maintained in an optimal range, the value of this measure should be maintained within the permissible limits. If too many snapshots are created within a short period of time, then the optimization of

Measurement	Description	Measurement Unit	Interpretation
			the storage array may fail leading to severe processing bottlenecks.
Used volume size	Indicates the total amount of space utilized for writing data to this volume before deduplication process.	GB	
Free volume size	Indicates the amount of space that is available for use in this volume.	GB	A high value is desired for this measure. A gradual/sudden decrease in the value of this measure indicates that the volume is running out of space.
Used volume	Indicates the percentage of space that is already utilized in this volume.	Percent	A value close to 100% indicates that the volume is running out of space.
Free volume	Indicates the percentage of space that is available for use in this volume.	Percent	A high value is desired for this measure.

3.5.2 XIO Volume folders Test

In an EMC XtremIO cluster, you can define various quantities of disk space as volumes. In large environments, multiple EMC XtremIO clusters may be deployed with too many volumes. If too many volumes are available in the cluster, then, monitoring the I/O processing and the I/O load on each individual volume is difficult for the administrators. Therefore, it is necessary to group the volumes and place those volumes in a volume folder. By analyzing the I/O processing and I/O load of each volume folder, administrators can figure out the processing ability of the volumes within the volume folder. If a volume folder is experiencing minimum activity, then administrators can resize a volume and allocate the available disk space to a volume that is currently experiencing space crunch or a volume that is constantly handling high I/O rate, thereby evenly distributing the load across the volume folders. To achieve the above, administrators can use the **XIO Volume folders** test.

This test auto discovers the volume folders of the target storage array and helps administrators to figure out the volume folder that is busy processing I/O requests, detect irregularities in the distribution of I/O load across the volume folders and thus enables administrators to identify the volume folder whose I/O processing rate is the maximum and the minimum. Using this test, administrators can easily load balance the volumes and utilize the volumes more efficiently.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each volume folder of the target EMC XtremIO being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Bandwidth	Indicates the amount of data utilized for I/O operations per second on this volume folder.	MB/Sec	
Read bandwidth	Indicates the amount of data utilized for read I/O operations per second on this volume folder.	MB/Sec	
Write bandwidth	Indicates the amount of data utilized for write I/O operations per second on this volume folder.	MB/Sec	
IOPS	Indicates the rate at which I/O operations were performed on this volume folder during the last measurement period.	IOPS	Compare the value of this measure across the volumes to know which volume handles the maximum number of I/O operations
Read IOPS	Indicates the rate at which read operations were performed on this volume folder.	IOPS	
Write IOPS	Indicates the rate at which write operations were performed on this volume folder.	IOPS	
Reads	Indicates the number of reads performed on this volume folder per second during the last measurement period.	Reads/sec	Compare the values of this measure across the volumes to know which volume folder handles the maximum number of read requests.
Writes	Indicates the number of writes performed on this volume folder per second during the last measurement period.	Writes/sec	

Measurement	Description	Measurement Unit	Interpretation
Data reads	Indicates the rate at which data was read from this volume folder during the last measurement period.	MB/Sec	
Data written	Indicates the rate at which data was written to this volume folder during the last measurement period.	MB/Sec	
Average read size	Indicates the amount of data read from this volume folder per I/O operation during the last measurement period.	MB/Op	Compare the values of these measures across the volume folders to identify the volume folder that is the slowest in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this volume folder per I/O operation during the last measurement period.	MB/Op	

3.5.3 XIO Initiators Test

The XtremIO Storage Array uses the term “Initiators” to refer to ports which can access a volume. Initiators can be managed by assigning them to an Initiator Group. The Initiators within an Initiator Group share access to one or more of the cluster's volumes. This test auto discovers the initiators of the target storage array and reports the current connection state. In addition, this test helps administrators to figure out the initiator that is busy processing I/O requests along initiators, detect irregularities in the distribution of I/O load across the initiators and thus enables administrators to initiate pre-emptive measures.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each initiator of the target EMC XtremIO being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Initiator connection state	Indicates the connection state of this initiator to the XtremIO storage array via at least one target port.		The values reported by this measure and their numeric equivalents are available in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>Connected</td><td>0</td></tr>
<tr><td>Disconnected</td><td>1</td></tr>
<tr><td>Unknown</td><td>1</td></tr>
</table>
Note:
This measure reports the Measure Values listed in the table above to indicate the connection state of this initiator. However, in the graph, this measure is indicated using the Numeric Values listed in the above table.
</td></tr>
<tr><td>Bandwidth</td><td>Indicates the amount of data utilized for performing I/O operations per second through this initiator.</td><td>MB/Sec</td><td></td></tr>
<tr><td>Read bandwidth</td><td>Indicates the amount of data utilized for performing read I/O operations per second through this initiator.</td><td>MB/Sec</td><td></td></tr>
<tr><td>Write bandwidth</td><td>Indicates the amount of data utilized for performing write I/O operations per second through this initiator.</td><td>MB/Sec</td><td></td></tr>
<tr><td>IOPS</td><td>Indicates the rate at which I/O operations were performed through this initiator during the last measurement period.</td><td>IOPS</td><td>Compare the value of this measure across the initiators to know which initiator handled the maximum number of I/O operations and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in I/O operations across the initiators.</td></tr>
<tr><td>Read IOPS</td><td>Indicates the number of read operations performed</td><td>IOPS</td><td></td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
	through this initiator per second.		
Write IOPS	Indicates the number of the write operations performed through this initiator per second.	IOPS	
Read latency	Indicates the time taken to perform read operations through this initiator.	msec	A low value is desired for this measure. A high value indicates that the read and write operations take too long to execute which directly affects the performance of the XtremIO Storage Array.
Write latency	Indicates the time taken to perform write operations through this initiator.	msec	
Average latency	Indicates the average time taken to perform I/O operations through this initiator.	msec	
Reads	Indicates the rate at which the read operations were performed through this initiator during the last measurement period.	Reads/sec	Compare the value of this measure across initiators to know which initiator handled the maximum number of read requests and which handled the least.
Writes	Indicates the rate at which the write operations were performed through this initiator during the last measurement period.	Writes/sec	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential writing bottleneck. By comparing the value of this measure across the initiators, you can quickly identify the initiator which is the slowest in processing write requests.
Data reads	Indicates the rate at which data was read through this initiator during the last measurement period.	MB/Sec	Compare the values of these measures across the initiators to identify the slowest initiator in terms of servicing read and write requests (respectively).
Data written	Indicates the rate at which data was written through this initiator during the last	MB/Sec	

Measurement	Description	Measurement Unit	Interpretation
	measurement period.		
Average read size	Indicates the amount of data read through this initiator per I/O operation during the last measurement period.	MB/Op	Compare the values of these measures across the initiators to identify the slowest initiator in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written through this initiator per I/O operation during the last measurement period.	MB/Op	

3.5.4 XIO Initiator Groups Test

Initiators can be managed by assigning them to an Initiator Group. If too many initiators are available in an EMC XtremIO cluster, then individual monitoring of each initiator becomes difficult for the administrators. To avoid such inconvenience but at the same time monitor the I/O processing of the initiators without any lag, administrators can use the **XIO Initiator Groups** test. This test auto discovers the initiator groups of the target storage array and helps administrators to figure out the initiator group that is busy processing I/O requests, detect irregularities in the distribution of I/O load across the initiator groups and thus enables administrators to initiate pre-emptive measures.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each initiator group of the target EMC XtremIO being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and	Provide the credentials of a user who has read only privileges to access the XtremIO

Parameter	Description
XtremIO Password	storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Bandwidth	Indicates the total amount of data utilized for performing I/O operations per second on this initiator group.	MB/Sec	
Read bandwidth	Indicates the amount of data utilized for performing read I/O operations per second on this initiator group.	MB/Sec	High values for these measures indicate high bandwidth usage by this initiator group folder. By comparing the values of these measures across the initiator group, you can isolate those initiator group that consume bandwidth excessively, and also understand which operation consumed too much of bandwidth – is it reading? or writing?
Write bandwidth	Indicates the amount of data utilized for performing write I/O operations per	MB/Sec	

Measurement	Description	Measurement Unit	Interpretation
	second on this initiator group.		
IOPS	Indicates the rate at which I/O operations were performed on this initiator group.	IOPS	Compare the value of this measure across the initiator group to know which initiator group is handling the maximum number of I/O operations.
Read IOPS	Indicates the rate at which read operations were performed on this initiator group.	IOPS	
Write IOPS	Indicates the rate at which write operations were performed on this initiator group.	IOPS	A high value is desired for this measure. A low value for this measure may indicate a poor throughput thus resulting in a decrease in the free space of the initiator group and the overall performance.
Reads	Indicates the number of read operations performed on this initiator group per second during the last measurement period.	Reads/Sec	Compare the value of this measure across initiator groups to know which initiator group is handling the maximum number of read requests.
Writes	Indicates the number of write operations performed on this initiator group per second during the last measurement period.	Writes/Sec	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential writing bottleneck. By comparing the value of this measure across the initiator group folders, you can quickly identify the initiator group folder which is the slowest in processing write requests.
Data reads	Indicates the rate at which data was read from this initiator group during the last measurement period.	MB/Sec	Compare the values of these measures across the initiator groups to identify the slowest initiator group in terms of servicing read and write requests (respectively).
Data written	Indicates the rate at which data was written to this initiator group during the	MB/Sec	

Measurement	Description	Measurement Unit	Interpretation
	last measurement period.		
Average read size	Indicates the amount of data read from this initiator group per I/O operation during the last measurement period.	MB/Op	Compare the values of these measures across the initiator groups to identify the slowest initiator group in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this initiator group per I/O operation during the last measurement period.	MB/Op	

3.5.5 XIO Initiator Group Folders Test

An initiator group folder comprises of multiple initiator groups. This test auto-discovers the initiator group folders of the target storage array and helps administrators to figure out the initiator group folder that is busy processing I/O requests, detect irregularities in the distribution of I/O load across the initiator group folders and thus enables administrators to initiate pre-emptive measures.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each initiator group folder of the EMC XtremeIO being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.

Parameter	Description
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Number of sub folders	Indicates the number for sub-folders that were created from this initiator group folder.	Number	
Bandwidth	Indicates the amount of data utilized for performing I/O operations per second on this initiator group folder.	MB/Sec	
Read bandwidth	Indicates the amount of data utilized for performing read I/O operations per second on this initiator group folder.	MB/Sec	High values for these measures indicate high bandwidth usage by this initiator group folder. By comparing the values of these measures across the initiator group folders, you can isolate those initiator group folders that consume bandwidth excessively, and

Measurement	Description	Measurement Unit	Interpretation
Write bandwidth	Indicates the amount of data utilized for performing write I/O operations per second on this initiator group folder.	MB/Sec	also understand which operation consumed too much of bandwidth – is it reading? or writing?
IOPS	Indicates the rate at which I/O operations were performed on this initiator group folder.	IOPS	Compare the value of this measure across the initiator group folders to know which initiator group folder id handling the maximum number of I/O operations.
Read IOPS	Indicates the rate at which read operations were performed on this initiator group folder.	IOPS	
Write IOPS	Indicates the rate at which write operations were performed on this initiator group folder.	IOPS	A high value is desired for this measure. A low value for this measure may indicate a poor throughput thus resulting in a decrease in the free space of the initiator group folder and the overall performance.
Reads	Indicates the number of read operations performed on this initiator group folder per second during the last measurement period.	Reads/Sec	Compare the value of this measure across initiator group folders to know which initiator group folder is handling the maximum number of read requests.
Writes	Indicates the number of write operations performed on this initiator group folder per second during the last measurement period.	Writes/Sec	Ideally, the value of this measure should be high. A steady dip in this measure value could indicate a potential writing bottleneck. By comparing the value of this measure across the initiator group folders, you can quickly identify the initiator group folder which is the slowest in processing write requests.
Data reads	Indicates the rate at which data was read from this initiator group folder during	MB/Sec	Compare the values of these measures across the initiator group folders to identify the slowest initiator

Measurement	Description	Measurement Unit	Interpretation
	the last measurement period.		group folder in terms of servicing read and write requests (respectively).
Data written	Indicates the rate at which data was written to this initiator group folder during the last measurement period.	MB/Sec	
Average read size	Indicates the amount of data read from this initiator group folder per I/O operation during the last measurement period.	MB/Op	Compare the values of these measures across the initiator group folders to identify the slowest initiator group folder in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this initiator group folder per I/O operation during the last measurement period.	MB/Op	

3.5.6 XIO Snapshots Test

Snapshots are instantaneous copy images of volume data with the state of the data captured exactly as it appeared at the specific point in time that the snapshot was created, enabling users to save the volume data state and then access the specific volume data whenever needed, including after the source volume has changed.

Creating snapshots, which can be done at any time, does not affect system performance, and a snapshot can be taken either directly from a source volume or from other snapshots within a source volume's group (Volume Snapshot Group).

The original copy of the data remains available without interruption, while the snapshot can be used to perform other functions on the data. Changes made to the snapshot's source do not change or impact on the snapshot data.

XtremIO snapshots are read-write. Users can choose to mount the snapshot in read-only (host side or from the host) in order to maintain its immutability.

XtremIO's snapshot technology is implemented by leveraging the content-aware capabilities of the system (Inline Data Reduction), optimized for SSD media, with a unique metadata tree structure

that directs I/O to the right timestamp of the data. This allows efficient snapshotting that can sustain high performance, while maximizing the media endurance, both in terms of the ability to create multiple snapshots and the amount of I/O that a snapshot can support. To analyze the performance of snapshots, administrators can use the **XIO Snapshots** test.

This test auto-discovers the snapshots of the target storage array and helps administrators to figure out the snapshot that is busy processing I/O requests, detect irregularities in the distribution of I/O load across the snapshots. In addition, using this test, administrators can analyze the space utilization of each snapshot and thus figure out remedial measures to keep a check on the irregularities detected.

Target of the test : An EMC XtremIO Storage array

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each snapshot available in the target EMC XtremIO being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage array listens. The default is NULL.
XtremIO User and XtremIO Password	Provide the credentials of a user who has read only privileges to access the XtremIO storage array in the XtremIO User and XtremIO Password text boxes.
Confirm Password	Confirm the password by retyping it here.
XMS IP	**This parameter is applicable only for EMC XtremIO 4.x**. By default, *None* will be chosen from this list. If the target EMC XtremIO storage array is within a XMS Management Server that is auto-discovered, then the IP or host name of that XMS Management Server will be displayed in this list. Select that particular XMS IP to configure this test. If you wish to monitor an EMC XtremIO Storage Array that is either not an integral part of the auto- discovered XMS Management Server or a brand new EMC XtremIO Storage Array, choose the **Other** option. This will enable you to add a new XMS Managament Server. To know how to add a new XMS Management Server, refer to Section **3.1.1.1**.

Parameter	Description
SSL	The eG agent collects performance metrics by invoking Restful APIs on the target Storage array. Typically, the Restful APIs can be invoked through the HTTP or the HTTPS mode. By default, the eG agent invokes the **Restful APIs** using the HTTPS mode. This is why, the SSL flag is set to **Yes** by default. If the target storage array is not SSL-enabled, then the Restful APIs can be accessed through the HTTP mode only. In this case, set the SSL flag to **No**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Bandwidth	Indicates the amount of data utilized for performing I/O operations per second on this snapshot.	MB/Sec	
Read bandwidth	Indicates the amount of data utilized for performing read I/O operations per second on this snapshot.	MB/Sec	
Write bandwidth	Indicates the amount of data utilized for performing write I/O operations per second on this snapshot.	MB/Sec	
IOPS	Indicates the rate at which I/O operations were performed on this snapshot during the last measurement period.	IOPS	Compare the value of this measure across the snapshots to know which snapshot handles the maximum number of I/O operations
Read IOPS	Indicates the rate at which read operations were performed on this snapshot.	IOPS	
Write IOPS	Indicates the rate at which write operations were performed on this snapshot.	IOPS	
Reads	Indicates the number of	Reads/sec	Compare the value of this measure

Measurement	Description	Measurement Unit	Interpretation
	reads performed on this snapshot per second during the last measurement period.		across the snapshots to know which snapshot handles the maximum number of read requests.
Writes	Indicates the number of writes performed on this snapshot per second during the last measurement period.	Writes/sec	
Data reads	Indicates the rate at which data was read from this snapshot during the last measurement period.	MB/Sec	
Data written	Indicates the rate at which data was written to this snapshot during the last measurement period.	MB/Sec	
Average read size	Indicates the amount of data read from this snapshot per I/O operation during the last measurement period.	MB/Op	Compare the values of these measures across the snapshots to identify the snapshot that is the slowest in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this snapshot per I/O operation during the last measurement period.	MB/Op	
Read latency	Indicates the time taken to perform read operations on this snapshot.	msecs	
Write latency	Indicates the time taken to perform write operations on this snapshot.	msecs	
Average latency	Indicates the average time taken to perform I/O operations on this	msecs	

Measurement	Description	Measurement Unit	Interpretation
	snapshot.		
Number of destination snaps	Indicates the number of volumes that were generated from this snapshot.	Number	By default, volumes are snapshotted at equal intervals and these snapshots are distributed to various clients whereas the original volume is maintained as the source copy. If the value of this measure is high, then administrators may be required to correlate this value with that of the Bandwidth measure. The higher the value of this measure, the greater is the bandwidth utilized. Therefore, for the bandwidth to be maintained in an optimal range, the value of this measure should be maintained within the permissible limits. If too many snapshots are created within a short period of time, then the optimization of the storage array may fail leading to severe processing bottlenecks.
Free snap size	Indicates the amount of space allocated for this snapshot.	GB	
Used snap size	Indicates the amount of space utilized by this snapshot.	GB	
Free snap size Percent	Indicates the percentage of space allocated for this snapshot.	Percent	
Used snap size Percent	Indicates the percentage of space utilized by this snapshot.	Percent	A value close to 100 indicates that the snapshot is running out of space.

Chapter 4: The EMC XTREMIO 1/2/3 Monitoring Model

eG Enterprise offers a specialized EMC XtremIO 1/2/3 monitoring model that monitors each of the key indicators of the performance of EMC XtremIO - such as the SSDs, X-Bricks, volumes, target ports, initiators, etc. - and proactively alerts administrators to potential performance bottlenecks, so that administrators can resolve the issues well before end-users complain.

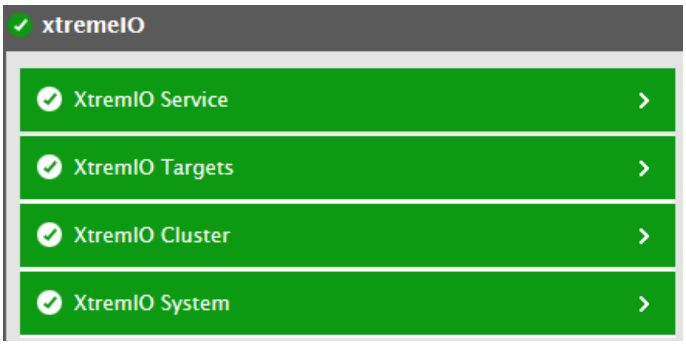

Figure 4.1: The layer model of EMC XtremIO 1/2/3 storage array

Each layer of Figure 4.1 above is mapped to a variety of tests, each of which report a wealth of performance information related to the EMC XtremIO storage array. Using these metrics, administrators can find quick and accurate answers to the following performance queries:

- How well the bandwidth is utilized in each Data Protection Group?
- How well read/write operations were performed on each Data Protection Group?
- How much of space is utilized in the SSDs of each Data Protection Group?
- How well read/write operations were performed on each SSD?
- What is the current state and CPU utilization of each X-Env?
- What is the current health of each cluster? Which cluster is too slow in processing I/O requests? What type of I/O requests are processed very slowly - read or write requests?
- How well each data block in a cluster is processed? Which data block size is the slowest to be processed causing bottlenecks?
- What is the current port state and health of each target port? How well read/write operations are performed through each target port? Which target port is the slowest in performing read/write and I/O operations?

- What is the current state of each X-Brick? How many SSDs and Battery Backup Units are present in each X-Brick?
- How well read/write operations were performed on each volume? Which volume is handling the maximum amount of I/O?
- How well the space of each volume is utilized?
- How well read/write operations were performed on each volume folder? Which volume folder is handling the maximum amount of data?
- How well read/write operations were performed through each initiator? Which initiator is taking too long to perform the I/O operations?
- How well read/write operations were performed on each initiator group? Which initiator group is handling the maximum I/O operations?
- How well read/write operations were performed on each initiator group folder? Which folder is handling the maximum I/O operations?
- How well read/write operations were performed on each snapshot? Which snapshot is experiencing a processing bottleneck?

The tests pertaining to this monitoring model have already been discussed in detail in **The EMC XTREMIO 4.x Monitoring Model**.

About eG Innovations

eG Innovations provides intelligent performance management solutions that automate and dramatically accelerate the discovery, diagnosis, and resolution of IT performance issues in on-premises, cloud and hybrid environments. Where traditional monitoring tools often fail to provide insight into the performance drivers of business services and user experience, eG Innovations provides total performance visibility across every layer and every tier of the IT infrastructure that supports the business service chain. From desktops to applications, from servers to network and storage, from virtualization to cloud, eG Innovations helps companies proactively discover, instantly diagnose, and rapidly resolve even the most challenging performance and user experience issues.

eG Innovations is dedicated to helping businesses across the globe transform IT service delivery into a competitive advantage and a center for productivity, growth and profit. Many of the world's largest businesses use eG Enterprise to enhance IT service performance, increase operational efficiency, ensure IT effectiveness and deliver on the ROI promise of transformational IT investments across physical, virtual and cloud environments.

To learn more visit www.eginnovations.com.

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