Monitoring EMC CLARiiON SAN

eG Innovations Product Documentation

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Total Performance Visibility

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Chapter 1: Introduction

EMC CLARiiON leads the midrange storage market in providing customers with cost-effective storage solutions that deliver the highest levels of performance, functionality, and reliability.

CLARiion is ideal for today's mid-sized enterprises as it can scale system capacity and performance, simplify management, and can protect critical applications and data.

This implies that even the slightest of deficiencies in the performance of the server if not detected promptly and resolved quickly, can result in irredeemable loss of critical data. To avoid such an adversity, the EMC CLARiiON storage solution should be monitored 24 x 7. proactively alerts administrators to issues in its overall performance and its critical operations, so that the holes are plugged before any data loss occurs. eG Enterprise helps administrators in this regard.

Chapter 2: How to Monitor EMC CLARiiON Using eG Enterprise?

eG Enterprise uses an external agent to collect the required metrics from the device. The eG agent uses the following mechanisms:

- By default, eG uses the command line utility (**NaviSecCLI.exe**) available as part of the **NaviSphere Management Suite** of EMC CLARiion for monitoring it. The **NaviSphere Management Suite** is the central console using which the CLARiion environment can be controlled and monitored. The **NaviSphere CLI** (i.e., the **NaviSecCLI.exe**) is used for issuing commands to an array, writing scripts, requesting array status, and as a tool for problem determination.
- Optionally, you can also configure the eG agent to use the SMI-S provider of EMC CLARiiON to collect additional performance metrics from the storage device.

To enable the eG agent to use the aforesaid mechanisms, a set of pre-requisites should be fulfilled. These requirements have been discussed in the following section.

2.1 General Pre-requisites

To enable the eG agent to use both the **NaviSphere CLI** and the SMI-S provider for collecting metrics from EMC CLARiiON, you need to make sure that both the CLI and the provider are installed on the same host.

2.2 Pre-requisites for Monitoring EMC CLARiiON

To enable the eG agent to communicate with the EMC CLARiiON SAN storage device, a set of pre-requisites should be fulfilled. These requirements have been discussed below.

2.2.1 Pre-requisites for Monitoring Using the NaviSphere Management Suite

To enable the eG agent to use the **NaviSphere Management Suite** to collect metrics from CLARiiON, the following pre-requisites should be fulfilled:

1. If the storage device is SSL-enabled, then, when installing the **NaviSphere CLI**, make sure that the **Verification Level** is set to **Low** (see Figure 2.1). This ensures that the SSL certificate sent by the storage array is not verified by the CLI.

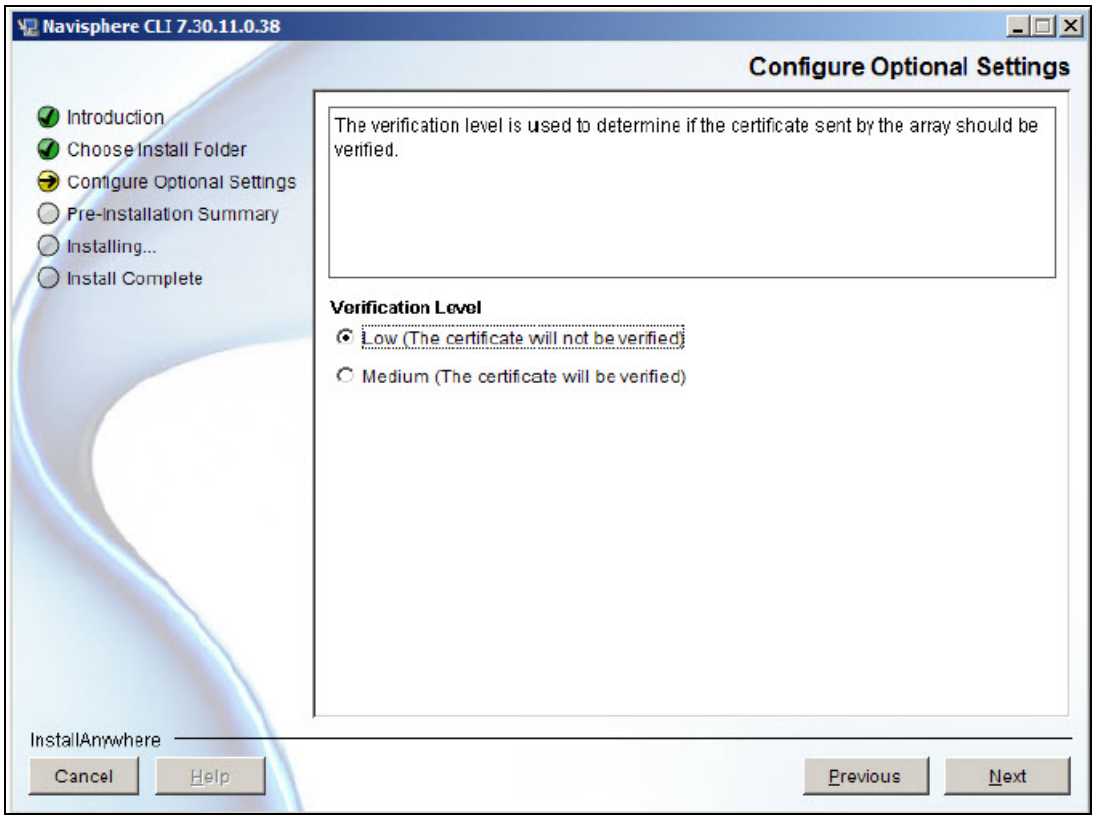

Figure 2.1: Setting verification level

2. The eG agent should be deployed on the same host on which the **NaviSphere CLI** (i.e., the **NaviSecCLI.exe**) operates;
3. The **NaviSphere CLI** should run on a host that communicates with the storage system;
4. The tests that use the NaviSphere CLI should be configured with the full path to the **NaviSecCLI.exe** and the credentials of a user who has access to the storage system.
5. Performance logging should be enabled on the storage system; the steps to be followed to achieve this have been detailed in Enabling Performance Logging on the Storage System .

2.2.2 Pre-requisites for Monitoring Using EMC's SMI-S Provider

By default, the tests that use the SMI-S provider of EMC to collect metrics, are disabled for the EMC Clariion SAN component. If one/more of these tests are enabled, you need to do the following to make sure that those tests run and report metrics:

- If you want the eG agent to use the SMI-S provider too for metrics collection, then, you need to make sure that you manage the target EMC CLARiiON device in the eG admin interface using

the **Host IP/Name** of that host on which the provider has been installed.

- The tests that use the SMI-S Provider for collecting metrics should be configured with the following:
  - The **SERIAL NUMBER** of the storage device to be monitored.

    This is because, the proxy implementation of the provider can manage multiple devices at the same time. The **SERIAL NUMBER** is the unique identifier that will enable the eG agent to collect metrics from the right storage device.

  - Credentials of an SMI-S provider CIM user who has the right to access the storage device, execute API commands on it and pull out the desired metrics

    For monitoring EMC CLARiiON, you will have to provide the credentials of a user who has been assigned the **Monitor** role.

  - The namespace that uniquely identifies the profiles specific to the SMI-S provider in use.

2.3 Managing the EMC Clariion SAN

The eG Enterprise cannot automatically discover the EMC Clariion SAN storage device. 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 Clariion SAN 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 Clariion SAN as the **Component type**. Then, click the **Add New Component** button. This will invoke 2.3.

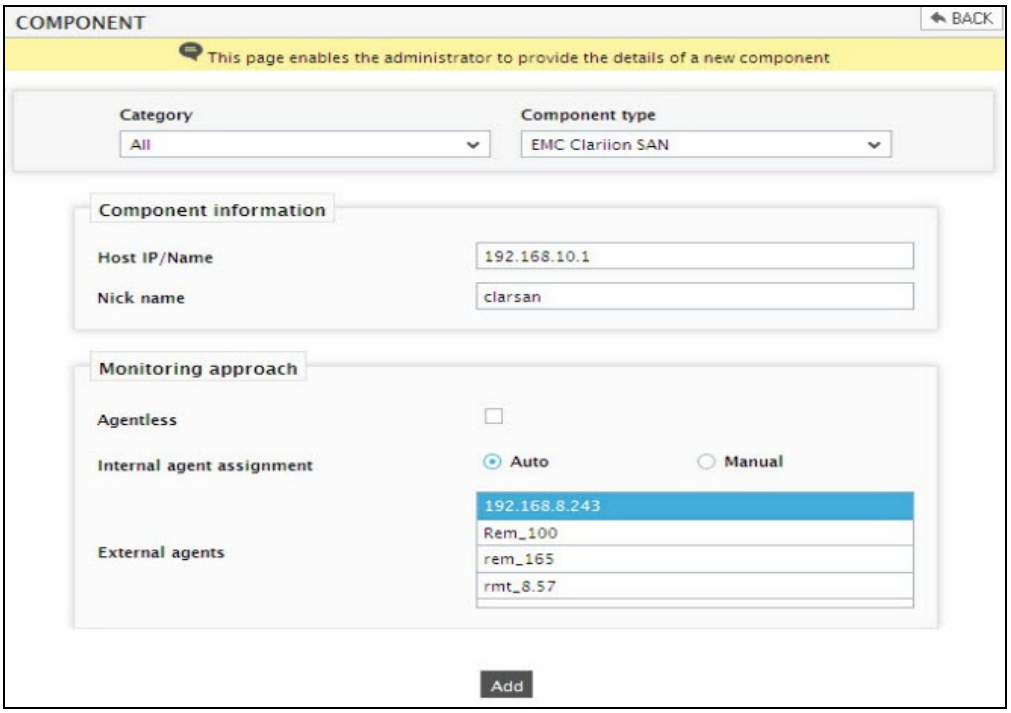

Figure 2.2: Adding the EMC Clariion SAN component

4. Specify the **Host IP/Name** and the **Nick name** of the EMC Clariion SAN storage system. This EMC Clariion SAN component can only be monitored in an agentless manner. Therefore, set the **Agentless** flag to **Yes**, select **Other** as the **OS** and **SNMP** as the **Mode**. Then, click the **Add** button to register the changes (see Figure 2.2).

   Note:

   Though the **Mode** is set to **SNMP** while adding a new component, the eG agent will be able to collect metrics from the target environment through the **NAVISSECCLI** path that will be specified by you during parameter configuration for the tests pertaining to the EMC Clariion SAN storage system.

5. The EMC Clariion SAN component type 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 2.3, which prompts you to configure a list of unconfigured tests for the new EMC Clariion SAN component type.

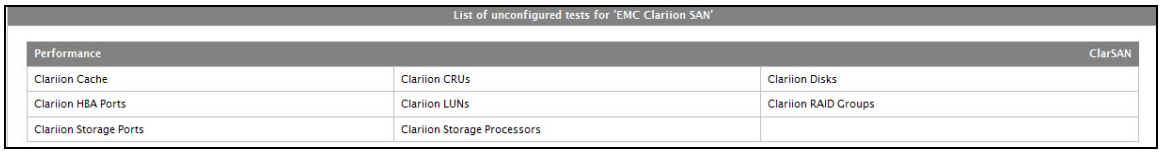

Figure 2.3: A page displaying the tests that need to be configured for the EMC Clariion SAN

6. Click on any test in the list of unconfigured tests. For instance, click on the **Clariion Cache** test to configure it. To know how to configure the tests, refer to **Monitoring the EMC CLARiiON** .
7. Finally, signout of the eG administrative interface.

Chapter 3: Monitoring the EMC CLARiiON

eG Enterprise offers a specialized EMC Clariion SAN monitoring model that monitors the core functions and components of the CLARiiON storage device, and proactively alerts administrators to issues in its overall performance and its critical operations, so that the holes are plugged before any data loss occurs.

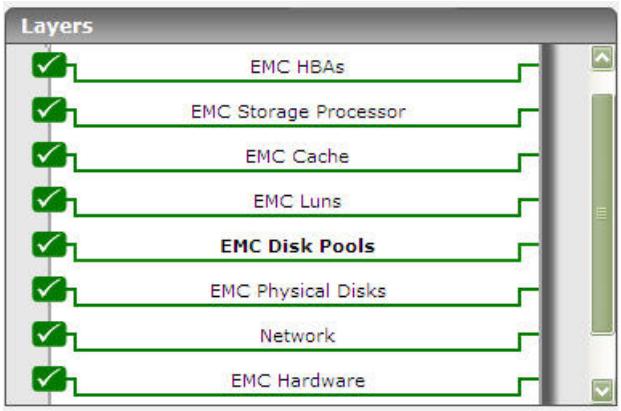

Figure 3.1: The layer model of the EMC CLARiion device

Each layer of this model is mapped to tests that monitor a critical component of the device such as the disks, the LUNs, the storage processors, etc

Once the pre-requisites discussed in Section **2.2** are fulfilled, the eG agent will extract useful statistics from the storage system and report it to the eG manager.

Using these metrics, the following critical performance queries can be answered:

- Are there any faulty components on the storage system? If so, which components are these?
- Does the storage system support any invalid CRUs (Customer Replaceable Units)?
- Are any RAID groups invalid?
- Do all RAID groups have sufficient disk space? Is any RAID group experiencing a space crunch?
- Is any RAID group being defragmented or expanded?
- Is the defragmentation / expansion priority 'High' for any RAID group?
- Is I/O load balanced across all LUNS?
- Is any LUN being rebuilt?

- Is any LUN being bound? If so, what is the status of the binding process?
- Is there sufficient space in the disks?
- Are the disks processing requests quickly?
- Is any disk experiencing too many read/write retries?
- Is load uniformly distributed across disks?
- Is any disk in the disabled state?
- Is any disk running out of space currently?
- Are any disks experiencing too many hard read/write or soft read/write errors?
- Are there any error-prone LUNs?
- Are the read/write caches of Storage Processors A and B enabled?
- Are the read/write caches of Storage Processors A and B correctly sized? Have adequate memory pages not been allotted to any cache? If so, which cache is it (read/write), and which storage processor is that cache associated with?
- Is any cache been under-utilized?
- Is any storage port link down?
- Is any storage processor in a faulty state now?
- Is any storage processor overloaded?
- Is any HBA port not plugged into the fibre channel?
- Which HBA ports are not trusted?
- Which HBA ports are not defined?

The sections that will follow discuss each of the layers of Figure 3.1 in great detail.

3.1 The EMC Hardware Layer

Using the test mapped to this layer, you can proactively capture the potential failure of the core hardware components of the Clariion disk array enclosure.

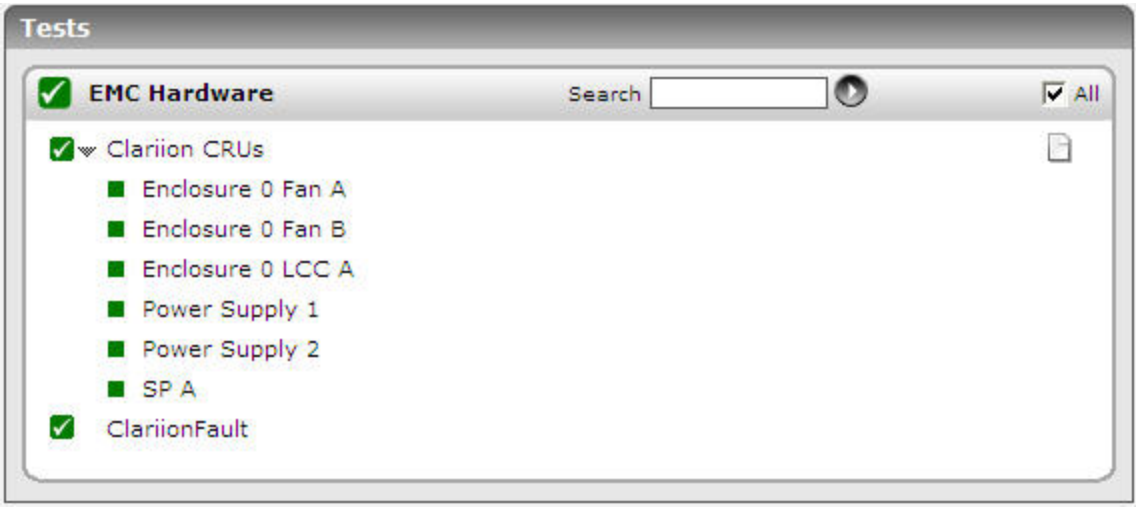

Figure 3.2: The test associated with the Hardware layer

3.1.1 Clariion CRUs Test

A Customer Replaceable Unit (CRU) is a part or subassembly designed so that an end-user or customer can easily replace a failing part or subassembly where it is located.

This test auto-discovers the CRUs supported by a Clariion storage system, and reports the current state of each, so that potential failures are swiftly detected and the affected components replaced before any permananent damage occurs.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each CRU on the storage device.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC

Parameter	Description
	CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Status	Indicates the current status of this CRU.		This measure reports one of the following values as the status of the CRU: • Invalid • Present • N/A • Empty The numeric values that correspond to each of the states discussed above are as follows: State: Value Invalid: 0 Present: 1 N/A: 2 Empty: 3

Measurement	Description	Measurement Unit	Interpretation
			Note: By default, this measure reports the **State**s listed in the table above to indicate the status of a CRU. The graph of this measure however, represents the CRU state using the numeric equivalents - 0 to 3.

3.1.2 Clariion Fault Hardware Test

This test promptly alerts administrators to faulty components on the storage system. You can use the detailed diagnosis of this test to view which components are faulty.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the storage device 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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and	Provide the credentials of a user who is authorized to access the storage device in the

Parameter	Description
Password	User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.
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 abnormalfrequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Faulted	Indicates whether any component on the device is currently faulty or not.		This measure reports the value *Yes* if at least one component on the storage system has been found to be faulty. The value *No* is reported if no faulty components have been discovered on the storage system. The numeric values that correspond to each of the fault states discussed above are as follows: State: Yes — Numeric Value: 0 State: No — Numeric Value: 1 **Note:**

Measurement	Description	Measurement Unit	Interpretation
			By default, this measure reports the **State**s listed in the table above to indicate the fault status of a component. The graph of this measure however, represents the fault state using the numeric equivalents - 0 and 1. If this measure reports the value *Yes*, then, you can use the detailed diagnosis of the measure to know which components on the system are currently faulty.

3.1.3 Clariion Disk Array Enclosures Test

This test reveals the status of the hardware components of the disk array enclosure, such as, the fans, the power supply units, and the LCC. Potential hardware failures in the enclosure can be proactively determined with the help of this test.

This test is disabled by default. To enable the test, go to the **ENABLE / DISABLE TESTS** page using the menu sequence : Agents -> Tests -> Enable/Disable, pick the *EMC Clariion SAN* as the desired **Component type**, set *Performance* as the **Test type**, choose the test from the **DISABLED TESTS** list, and click on the **<** button to move the test to the **ENABLED TESTS** list. Finally, click the **Update** button.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each disk array enclosure on the storage device.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.

Parameter	Description
Host	The IP address of the storage device for which this test is to be configured.
Port	The port number at which the storage device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Fan A state	Indicates the current state of Fan A.	Status	If the fan A is unavailable, then this measure will return the value "Not Present". On the other hand, if fan A is available, then the value of this measure will be "Present". The numeric values that correspond to each of the states discussed above are as follows: State: Present – Value: 1 State: Not Present – Value: 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>Note:

By default, this measure reports the States listed in the table above to indicate the status of fan A. The graph of this measure however, represents the status of fan A using the numeric equivalents - 0 to 2.</td></tr>
<tr><td>Fan B state</td><td>Indicates the current state of Fan B.</td><td>Status</td><td>If fan B is unavailable, then this measure will return the value "Not Present". On the other hand, if fan B is available, then the value of this measure will be "Present".

The numeric values that correspond to each of the states discussed above are as follows:

<table><tr><th>State</th><th>Value</th></tr><tr><td>Present</td><td>1</td></tr><tr><td>Not Present</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Present or Not Present to indicate the status of fan B. The graph of this measure however, represents the status of fan A using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>Power A state</td><td>Indicates the current state of the power supply unit A.</td><td>Status</td><td>If power unit A is unavailable, then this measure will return the value "Not Present". On the other hand, if power unit A is available, then the value of this measure will be "Present".

The numeric values that correspond to each of the states discussed above are as follows:</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>State</th><th>Value</th></tr>
<tr><td>Present</td><td>1</td></tr>
<tr><td>Not Present</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the values Present or Not Present to indicate the status of power supply unit A. The graph of this measure however, represents the status of unit A using the numeric equivalents - 0 or 1.
</td></tr>
<tr><td>Power B state</td><td>Indicates the current state of the power supply unit B.</td><td>Status</td><td>If power unit B is unavailable, then this measure will return the value "Not Present". On the other hand, if power unit B is available, then the value of this measure will be "Present".
The numeric values that correspond to each of the states discussed above are as follows:
<table>
<tr><th>State</th><th>Value</th></tr>
<tr><td>Present</td><td>1</td></tr>
<tr><td>Not Present</td><td>0</td></tr>
</table>
Note:
By default, this measure reports the values Present or Not Present to indicate the status of power supply unit B. The graph of this measure however, represents the status of unit B using the numeric equivalents - 0 or 1.
</td></tr>
<tr><td>LCC A state</td><td>Indicates the current state of the LCC A.</td><td>Status</td><td>If LCC A is unavailable, then this measure will return the value "Not Present". On the other hand, if LCC A is available, then the value of this measure will be "Present".</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 numeric values that correspond to each of the states discussed above are as follows:
<table><tr><th>State</th><th>Value</th></tr><tr><td>Present</td><td>1</td></tr><tr><td>Not Present</td><td>0</td></tr></table>
Note:
By default, this measure reports the values Present or Not Present to indicate the status of LCC A. The graph of this measure however, represents the status of LCC A using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>LCC B state</td><td>Indicates the current state of the LCC B.</td><td>Status</td><td>If LCC B is unavailable, then this measure will return the value "Not Present". On the other hand, if LCC B is available, then the value of this measure will be "Present".
The numeric values that correspond to each of the states discussed above are as follows:
<table><tr><th>State</th><th>Value</th></tr><tr><td>Present</td><td>1</td></tr><tr><td>Not Present</td><td>0</td></tr></table>
Note:
By default, this measure reports the values Present or Not Present to indicate the status of LCC B. The graph of this measure however, represents the status of LCC B using the numeric equivalents - 0 or 1.</td></tr>
</table>

3.2 The Network Layer

Monitor the availability of the Clariion storage device over the network using the test mapped to this layer.

Figure 3.3: The test mapped to the EMC Network layer

The test mapped to this layer has been dealt with in the *Monitoring Unix and Windows Servers* document. Refer to the mentioned document for details on configuring the **Network** test.

3.3 The EMC Physical Disks Layer

Instantly identify abnormal/error-prone disks on the EMC CLARiiON storage device using the test mapped to this layer.

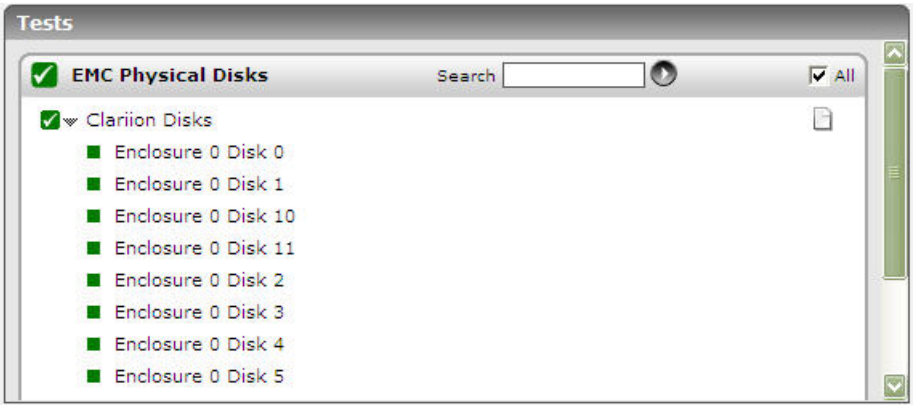

Figure 3.4: The test mapped to the EMC Physical Disks layer

3.3.1 Clariion Disks Test

This test reveals the state, I/O activity, and overall health of each disk supported by the storage system.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each disk within each disk supported by the storage device.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Ignore Disabled Disks	By default, this flag is set to **No**, indicating that the test monitors all disks by default. Set this flag to **Yes** if you want the test to consider only the 'enabled' disks for monitoring.
Exclude Disks	Provide a comma-separated list of disk IDs that you want to exclude from the monitoring scope of this test. By default, this is set to *none* indicating that no disks are excluded by default.

Parameter	Description
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *1:1*. This indicates that, by default, detailed measures will be generated every 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
State	Indicates the current state of this disk.		The states this measure reports and the numeric values that correspond to each of the states are as follows: State: Numeric Value Failed: 0 Off: 1 Removed: 2 Binding: 3

<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>State</th><th>Numeric Value</th></tr>
<tr><td>Empty</td><td>4</td></tr>
<tr><td>Enabled</td><td>5</td></tr>
<tr><td>Expanding</td><td>6</td></tr>
<tr><td>Unbound</td><td>7</td></tr>
<tr><td>Powering up</td><td>8</td></tr>
<tr><td>Ready</td><td>9</td></tr>
<tr><td>Reduced power, Trans-itioning</td><td>10</td></tr>
<tr><td>Hot spare ready</td><td>11</td></tr>
<tr><td>Unknown</td><td>12</td></tr>
<tr><td>Formatting</td><td>13</td></tr>
<tr><td>Equilizing</td><td>14</td></tr>
<tr><td>Rebuilding</td><td>15</td></tr>
<tr><td>Full power</td><td>16</td></tr>
<tr><td>Low power</td><td>17</td></tr>
<tr><td>Unformatted</td><td>18</td></tr>
<tr><td>Unsupported</td><td>19</td></tr>
</table>
Note:
By default, this measure reports the States listed in the table above to indicate the state of a disk. The graph of this measure however, represents disk state using the numeric equivalents - 0 to 19.
</td></tr>
<tr><td>LUNs</td><td>Indicates the number of LUNs that are sharing this disk.</td><td>Number</td><td>Use the detailed diagnosis of this measure to know which LUNs are sharing this disk.</td></tr>
<tr><td>Busy ticks</td><td>Indicates the percent utilization of this disk.</td><td>Percent</td><td>The values in percent and their respective states are listed below:
90%-Critical(Disk Full)</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			• 80%-Major • 60%-Minor
Hard read errors	Indicates the number of hard read errors in this disk.	Number	The values and their respective states are listed below: • 10 - critical • 5 - major • 2 - minor Increase in the value of this measure indicates that the disk life is going to end or fail.
Hard write errors	Indicates the number of hard write errors in this disk.	Number	The values and their respective states are listed below: • 10 - critical • 5 - major • 2 - minor Increase in the value of this measure indicates disk life is going to end or fail.
Soft read errors	Indicates the number of uncorrected read errors in this disk.	Number	The values and their respective states are listed below: • 10 - critical • 5 - major • 2 - minor Increase in value of this measure indicates disk life is going to end or fail.
Soft write errors	Indicates the number of uncorrected write errors in this disk.	Number	The values and their respective states are listed below: • 10 - critical • 5 - major

Measurement	Description	Measurement Unit	Interpretation
			• 2 - minor Increase in value of this measure indicates disk life is going to end or fail.
Read requests	Indicates the number of read requests made per second to this disk.	Reqs/Sec	Compare the value of these measures across disks to isolate overloaded disks. This will also reveal irregularities in load balancing across disks.
Write requests	Indicates the number of write requests made per second to this disk.	Reqs/Sec	
Data reads	Indicates the rate at which data is read from this disk.	MB/Sec	
Data writes	Indicates the rate at which data is written to this disk.	MB/Sec	
Total bandwidth	Indicates the sum of data reads and data writes to this disk.	MB/Sec	
Total capacity	Indicates the total size of this disk.	GB	
User capacity	Indicates the amount of space on this disk that is assigned to bound LUNs.	GB	
Usage	Indicates the percentage of space in this disk that is currently in use.	Percent	Ideally, the value of this measure should be low. A consistent increase in this value could indicate a gradual, but steady erosion of space in the disk.
Read retries	Indicates the number of times read requests to this disk were retried.	Number	A low value is desired for this measure.
Write retries	Indicates the number of times write requests to this disk were retried.	Number	A low value is desired for this measure.
Remapped sectors	Indicates the number of sectors on this disk that were remapped to new	Number	A low value is desired for this measure.

Measurement	Description	Measurement Unit	Interpretation
	locations on the disk due to read/write errors.		
Request service time	Indicates the time taken by this disk to service requests.	Secs	A high value is typically indicative of a request processing bottleneck in the disk. Compare the value of this measure across disks to know which disks are experiencing significant latencies.

The detailed diagnosis of the *LUNs* measure, if enabled, reveals the the IDs of the LUNs that are sharing a particular disk, and the Raid type of each LUN.

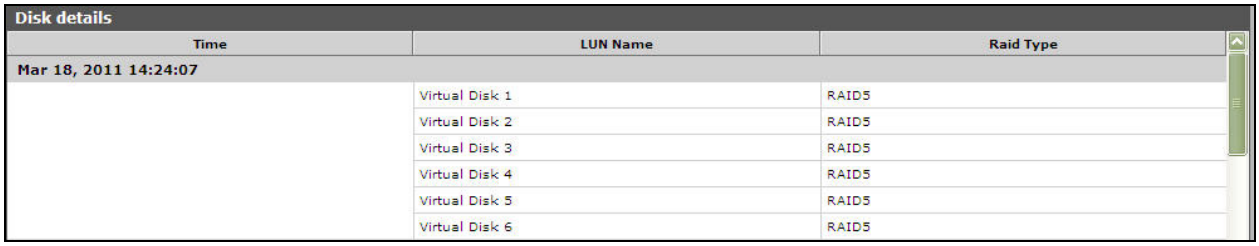

Figure 3.5: The detailed diagnosis of the LUNs measure

3.3.2 EMC RAID Disks Test

This test monitors the current state, overall health, and the load-balancing capability of each disk in the EMC storage system. With the help of this test, administrators can not only identify failed disks, but can also predict the potential failure of a disk, so that efforts can be undertaken to avert the same. In addition, the test also points administrators to disks that are handling more I/O requests than the rest, thus shedding light on irregularities in the distribution of I/O load across disks and prompting administrators to fine-tune the load-balancing algorithm. In addition, the test also proactively alerts administrators to probable slowdowns in I/O processing by specific disks, thereby enabling administrators to initiate pre-emptive actions.

This test is disabled by default. To enable the test, go to the **ENABLE / DISABLE TESTS** page using the menu sequence : Agents -> Tests -> Enable/Disable, pick the *EMC Clariion SAN* as the desired **Component type**, set *Performance* as the **Test type**, choose the test from the **DISABLED TESTS** list, and click on the **<** button to move the test to the **ENABLED TESTS** list. Finally, click the **Update** button.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each disk on the storage system.

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 device listens. The default is *NULL*.
User Name and Password	The SMI-S Provider is paired with the EMC CIM Object Manager Server to provide an SMI-compliant interface for CLARiiON arrays. Against the User and Password parameters, specify the credentials of a user who has been assigned **Monitor** access to the EMC CIM Object Manager Server paired with EMC CLARiiON's SMI-S provider.
Confirm Password	Confirm the Password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
IsEmbedded	By default, this flag is set to **False** for an EMC CLARiiON device. **Do not disturb this default setting**.
SerialNumber	If the SMI-S provider has been implemented as a proxy, then such a provider can be configured to manage multiple storage devices. This is why, you will have to explicitly specify which storage system you want the eG agent to monitor. Since each storage system is uniquely identified by a Serial number, specify the same here. The serial number for an EMC CLARiiON device will be of the format, FCNMM094900059.
NameSpace	Specify the NameSpace that uniquely identifies the profiles specific to the provider in use. For EMC CLARiiON, this parameter will be set to root/emc by default.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates how healthy this disk currently is.		The values that this measure can report and their corresponding numeric values are discussed 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>OK</td><td>0</td></tr>
<tr><td>Unknown</td><td>1</td></tr>
<tr><td>Degraded/Warning</td><td>2</td></tr>
<tr><td>Minor failure</td><td>3</td></tr>
<tr><td>Major failure</td><td>4</td></tr>
<tr><td>Critical failure</td><td>5</td></tr>
<tr><td>Non- recoverable error</td><td>6</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the state of a disk. In the graph of this measure however, states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Operational status</td><td>Indicates the current operational state of this disk.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>OK</td><td>0</td></tr>
<tr><td>In Service</td><td>1</td></tr>
<tr><td>Power Mode</td><td>2</td></tr>
<tr><td>Completed</td><td>3</td></tr>
<tr><td>Starting</td><td>4</td></tr>
<tr><td>Dormant</td><td>5</td></tr>
<tr><td>Other</td><td>6</td></tr>
<tr><td>Unknown</td><td>7</td></tr>
<tr><td>Stopping</td><td>8</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>Stressed</td><td>9</td></tr>
<tr><td>Stopped</td><td>10</td></tr>
<tr><td>Supporting Entity in Error</td><td>11</td></tr>
<tr><td>Degraded or Predicted Failure</td><td>12</td></tr>
<tr><td>Predictive Failure</td><td>13</td></tr>
<tr><td>Lost Communication</td><td>14</td></tr>
<tr><td>No Contact</td><td>15</td></tr>
<tr><td>Aborted</td><td>16</td></tr>
<tr><td>Error</td><td>17</td></tr>
<tr><td>Non- Recoverable Error</td><td>18</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a disk. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational state</td><td>Describes the current operational state of this disk.</td><td></td><td>This measure will be reported only if the API provides a detailed operational state.
Typically, the detailed state will describe why the disk is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a disk, then this measure will explain why that disk is being stopped.
The values that this measure can report</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>and their corresponding numeric values are discussed in the table below:

<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>Online</td><td>0</td></tr><tr><td>Success</td><td>1</td></tr><tr><td>Power Saving Mode</td><td>2</td></tr><tr><td>Write Protected</td><td>3</td></tr><tr><td>Write Disabled</td><td>4</td></tr><tr><td>Not Ready</td><td>5</td></tr><tr><td>Removed</td><td>6</td></tr><tr><td>Rebooting</td><td>7</td></tr><tr><td>Offline</td><td>8</td></tr><tr><td>Failure</td><td>9</td></tr></table>
Note:

By default, this measure reports the Measure Values discussed above to indicate the detailed operational state of a disk. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.</td></tr>
<tr><td>Data transmitted</td><td>Indicates the rate at which data was transmitted by this disk.</td><td>MB/Sec</td><td></td></tr>
<tr><td>IOPS</td><td>Indicates the rate at which I/O operations were performed on this disk.</td><td>IOPS</td><td>Compare the value of this measure across disks to know which disk handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.

You may then want to take a look at the</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			Reads and Writes measure to understand what to fine-tune – the load-balancing algorithm for read requests or that of the write requests.
Reads	Indicates the rate at which read operations were performed on this disk.	Reads/Sec	Compare the value of this measure across disks to know which disk handled the maximum number of read requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.
Writes	Indicates the rate at which write operations were performed on this disk.	Writes/Sec	Compare the value of this measure across disks to know which disk handled the maximum number of write requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.
Data reads	Indicates the rate at which data is read from this disk.	MB/Sec	Compare the value of these measures across disks to identify the slowest disk in terms of servicing read and write requests (respectively).
Data written	Indicates the rate at which data is written to this disk.	MB/Sec	
Disk busy	Indicates the percentage of time this disk was busy processing requests.	Percent	Compare the value of this measure across disks to know which disk was the busiest and which disk was not. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.
Average read size	Indicates the amount of data read from this disk per I/O operation	MB/Op	Compare the value of these measures across disks to identify the slowest disk in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this disk per I/O operation.	MB/Op	

Measurement	Description	Measurement Unit	Interpretation
Read hit	Indicates the percentage of read requests that were serviced by the cache of this disk.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct disk accesses, which are expensive operations, are high.
Write hit	Indicates the percentage of write requests that were serviced by the cache of this disk.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct disk accesses, which are expensive operations, are high.
Average response time	Indicates the time taken by this disk to respond to I/O requests.	Microsecs	Ideally, this value should be low. If not, it implies that the disk is slow.
EMC queue length	Indicates the number of requests that are in queue for this disk.	Number	A consistent increase in this value indicates a potential processing bottleneck with the disk.
EMC queue arrivals	Indicates the number of times a user request arrived while at least one other request was being processed.	Number	

3.4 The EMC Disk Pools Layer

RAID, an acronym for Redundant Array of Independent Disks (Changed from its original term Redundant Array of Inexpensive Disks), is a technology that provides increased storage functions and reliability through redundancy. This is achieved by combining multiple disk drive components into a logical unit, where data is distributed across the drives in one of several ways called "RAID levels".

RAID Groups also allow you to configure the Clariion in a way so that you will know what LUNs, applications, etc., live on what set of disks in the back of the Clariion. For instance, you would not want an Oracle Database LUN on the same RAID Group (Disks) as a SQL Database running on the same Clariion. This allows you to create a RAID Group of a set of disks for the Oracle Database, and another RAID Group of a different set of disks for the SQL Database.

Using the test mapped to this layer, you can monitor the current state, capacity, and usage of each RAID group on the Clariion storage system.

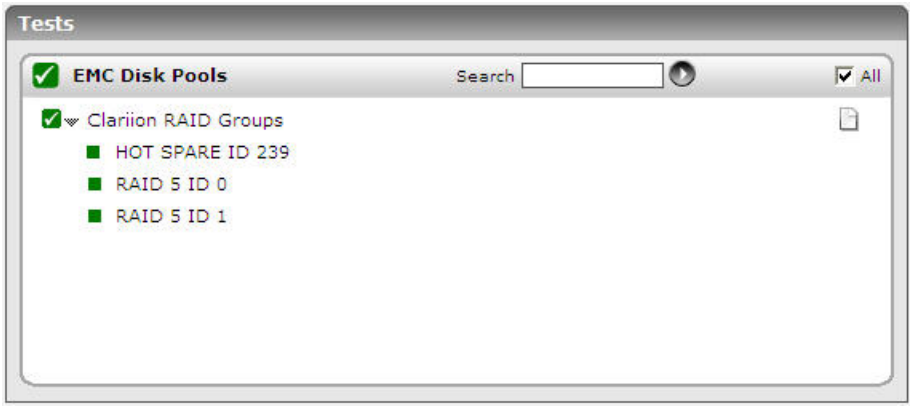

Figure 3.6: The tests mapped to the EMC Disk Pools layer

3.4.1 Clariion RAID Groups Test

Sufficient disk space should be available in a RAID group, as new LUNs cannot be created in a RAID group that suffers from a severe space contention. Also, with many critical applications attached to RAID groups, it is essential for administrators to track the capacity and usage of each RAID group on the storage system to figure out whether enough disk space is available in all RAIDs to support the storage requirements of these applications.

This test auto-discovers the RAID groups on the storage system, and reports the current state, capacity, space usage, and space availability of each RAID group so that, you can instantly identify the RAID groups that are running out of space.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each RAID group supported by the storage device.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Ignore Invalid Raid Groups	By default, this flag is set to **No**, indicating that the test monitors all RAID groups by default. Set this flag to **Yes** if you want the test to consider only the 'valid' RAID groups for monitoring.
Exclude Raid Groups	Provide a comma-separated list of RAID Group IDs that you want to exclude from the monitoring scope of this test. By default, this is set to *none* indicating that no RAID groups are excluded by default.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *1:1*. This indicates that, by default, detailed measures will be generated every 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

Parameter	Description
	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
Raid group state	Indicates the current state of this RAID group.		This measure reports any of the following values as the state of the RAID group: • Invalid • Valid • Defragmenting • Valid LUNs • Expanding • Busy • Explicit Remove The numeric values that correspond to each of the states discussed above are as follows: State: Numeric Value Invalid: 0 Valid: 1 Defragmenting: 2 Valid LUNs: 3 Expanding: 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>
<table>
<tr><th>State</th><th>Numeric Value</th></tr>
<tr><td>Busy</td><td>5</td></tr>
<tr><td>Explicit Remove</td><td>6</td></tr>
<tr><td>Other</td><td>7</td></tr>
</table>
Note:
By default, this measure reports the States listed in the table above to indicate the state of a RAID group. The graph of this measure however, represents RAID group state using the numeric equivalents - 0 to 7.
</td></tr>
<tr><td>Disk count</td><td>Indicates the number of disks assigned to this RAID group.</td><td>Number</td><td>To know which disks have been assigned to a RAID group, use the detailed diagnosis of this measure.</td></tr>
<tr><td>Lun count</td><td>Indicates the number of LUNs sharing this RAID group.</td><td>Number</td><td>To know which LUNs are sharing a particular RAID group, use the detailed diagnosis of this measure.</td></tr>
<tr><td>Raw capacity</td><td>Indicates the amount of raw capacity (in millions of blocks) of this RAID group that is available for binding LUNs.</td><td>TB</td><td></td></tr>
<tr><td>Logical capacity</td><td>Indicates the logical capacity of this RAID group.</td><td>MB</td><td></td></tr>
<tr><td>Free capacity</td><td>Indicates the amount of unused capacity in this RAID group.</td><td>GB</td><td>A high value is generally desired for this measure. A very low value or a consistent dip in this value could indicate a space crunch in the RAID group, which in turn can prevent the creation of new LUNs in the group.</td></tr>
<tr><td>Free</td><td>Indicates the percentage of free space in this RAID group.</td><td>Percent</td><td>A high value is generally desired for this measure. A very low value or a consistent dip in this value could</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			indicate a space crunch in the RAID group, which in turn can prevent the creation of new LUNs in the group.
Defragmented	Indicates the progress (in percentage) of the defragmentation process on this RAID group.	Percent	As you unbind and rebind LUNs on a RAID Group, gaps may be created in the contiguous space across the Group's disks, fragmenting the RAID Group. Fragmentation makes less space available for creating new LUNs. Defragment a RAID Group to compress these gaps and provide more contiguous free space across the disks. Using this measure, you can easily track the progress of the defragmentation activity on each RAID group, and can receive a fair idea as to how long it would take for the defragmentation to complete.
Expanded	Indicates the progress (in percentage) of a RAID group expansion performed on this RAID group.	Percent	You can expand an existing RAID group by adding more disks to it. Expansion makes have more space available in the raid group to create new LUNs. Using this measure, you can easily track the progress of the expansion of each RAID group, and can receive a fair idea as to how long it would take for the expansion to complete.
Maximum number of disks	Indicates the maximum number of disks that this RAID group can contain.	Number	
Maximum number of LUNs	Indicates the maximum number of LUNs that can be created in this RAID group.	Number	
Free contiguous group of unbound	Indicates the size of the largest contiguous span of	GB	The larger this space, higher will be the number of LUNs that can be created on

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>segments</td><td>free space in this RAID group.</td><td></td><td>the corresponding RAID group.</td></tr>
<tr><td>Defrag/Expand priority</td><td>Indicates the current expansion / defragmentation priority of this RAID group.</td><td></td><td>This measure can report one of the following values:
High
Medium
Low
The higher the priority, the more system resources that are used, which can reduce system performance.
The numeric values that correspond to each of the priorities discussed above are as follows:<table><tr><th>Priority</th><th>Numeric Value</th></tr><tr><td>Low</td><td>0</td></tr><tr><td>Medium</td><td>1</td></tr><tr><td>High</td><td>2</td></tr></table>Note:
By default, this measure reports the Priorities listed in the table above to indicate the defrag/expansion priority of a RAID group. The graph of this measure however, represents priorities using the numeric equivalents - 0 to 2.</td></tr>
<tr><td>Disk expanding</td><td>Indicates whether any disk in this RAID group is currently expanding or not.</td><td></td><td>If no disks in the RAID group are expanding currently, then this measure will report the value N/A. If one or more disks are currently expanding, then this measure will report the value Available.
The numeric values that correspond to each of the expansion states discussed</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>above are as follows:
<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>N/A</td><td>0</td></tr><tr><td>Available</td><td>1</td></tr></table>
Note:
By default, this measure reports the States listed in the table above to indicate the expansion state of a RAID group. The graph of this measure however, represents expansion states using the numeric equivalents - 0 and 1.</td></tr>
<tr><td>Lun expansion</td><td>Indicates whether LUN expansion is enabled or disabled for this RAID group.</td><td></td><td>If LUN expansion is enabled for a RAID group, then this measure will report the value Enabled. If not, then the value would be Disabled.
The numeric values that correspond to each of the expansion states discussed above are as follows:
<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Disabled</td><td>0</td></tr><tr><td>Enabled</td><td>1</td></tr></table>
Note:
By default, this measure reports the States listed in the table above to indicate the LUN expansion state of a RAID group. The graph of this measure however, represents expansion states using the numeric equivalents - 0 and 1.</td></tr>
</table>

The detailed diagnosis of the *Disk count* measure lists the disks that have been assigned to a particular RAID group.

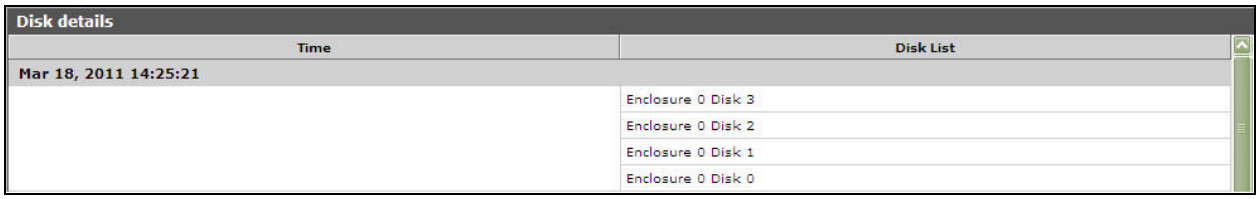

Figure 3.7: The detailed diagnosis of the Disk count measure

The detailed diagnosis of the *LUN count* measure lists the LUNs that are sharing a particular RAID group.

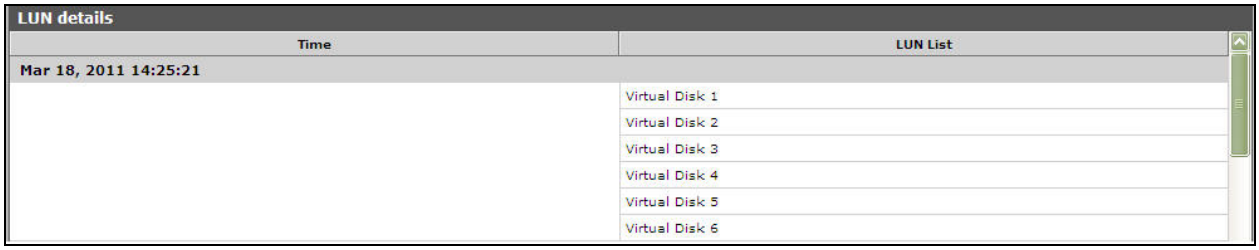

Figure 3.8: The detailed diagnosis of the LUN count measure

3.5 The EMC Luns Layer

A LUN is a Logical Unit Number. It can be used to refer to an entire physical disk, or a subset of a larger physical disk or disk volume. The physical disk or disk volume could be an entire single disk drive, a partition (subset) of a single disk drive, or disk volume from a RAID controller comprising of multiple disk drives aggregated together for larger capacity and redundancy.

Isolate bound and unbound LUNs, overloaded LUNS and those that are experiencing errors using the test mapped to this layer.

Figure 3.9: The test mapped to the EMC Luns layer

3.5.1 Clariion LUNs Test

This test reports the current state of each LUN on a storage system, and measures the level of I/O activity on the LUNs.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each LUN that is monitored on the storage system.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Ignore Disabled LUNs	By default, this flag is set to **No**, indicating that the test monitors all LUNs by default. Set this flag to **Yes** if you want the test to consider only the 'enabled' LUNs for monitoring.
Exclude LUNs	Provide a comma-separated list of LUNs that you want to exclude from the monitoring scope of this test. By default, this is set to *none* indicating that no LUNs are excluded by default.

Parameter	Description
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *1:1*. This indicates that, by default, detailed measures will be generated every 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 abnormalfrequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
LUN binding completion	Indicates the current state of this LUN.	Status	If the state reported by this measure is Bound, it indicates that the LUN is currently in a bound state. A bind creates LUNs on a RAID GROUP. Binding a LUN involves the preparation of allocated storage space. This preparation is particularly important when storage capacity is being reallocated for reuse. LUNs are bound after RAID GROUPS are created. LUNs are available for use immediately after they are created, but

<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 bind is not strictly complete until after all the bound storage has been prepared and verified.

During the preparation step, the storage allocated to the LUN is overwritten with binary zeroes. These zeroes erase any previous data from the storage and set up for the parity calculation. When zeroing is complete, parity and metadata is calculated for the LUN sectors.

If the state reported by this measure is Unbound, it indicates that the LUN is currently in an unbound state.

The numeric values that correspond to each of the states discussed above are as follows:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Bound</td><td>1</td></tr><tr><td>Not bound</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Bound or Unbound to indicate the state of a LUN. The graph of this measure however, represents the LUN state using the numeric equivalents - 0 or 1.

Use the detailed diagnosis of this measure to view additional details of a LUN.</td></tr>
<tr><td>Total hard errors</td><td>Indicates the number of hard errors on this LUN.</td><td>Number</td><td>The values and their respective states are listed below:

• 10 - critical</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			• 5 - major • 2 - minor Increase in the value of this measure indicates that the LUN life is going to end or fail.
Total soft errors	Indicates the total number of uncorrected read and write errors on this LUN.	Number	The values and their respective states are listed below: • 10 - critical • 5 - major • 2 - minor Increase in value of this measure indicates disk life is going to end or fail.
Average queue requests	Indicates the average number of requests to this LUN that are in queue.	Number	A very high value could indicate a processing bottleneck on this LUN.
Current read cache hits	Indicates the number of times read requests to this LUN were fulfilled by the read cache.	Number	A high value is desired for this measure.
Current write cache hits	Indicates the number of times write requests to this LUN were fulfilled by the write cache.	Number	A high value is desired for this measure.
Read cache misses	Indicates the number of times read requests to this LUN were not serviced by the read cache.	Number	Ideally, the value of this measure should be low.
Read hit ratio	Indicates the percentage of read requests to this LUN that were serviced by the cache	Percent	Ideally, the value of this measure should be high. A low value indicates that many read requests are serviced by direct disk accesses, which is a more expensive operation in terms of processing overheads.

Measurement	Description	Measurement Unit	Interpretation
Write hit ratio	Indicates the percentage of write requests to this LUN that were serviced by the cache.	Percent	Ideally, the value of this measure should be high. A low value indicates that data is often directly written to the disk, which is a more expensive operation in terms of processing overheads.
Read requests	Indicates the number of read requests made per second to this LUN.	Reqs/Sec	Comparing the value of these measures across LUNs will clearly indicate which LUN is the busiest in terms of the number of read and write requests handled – it could also shed light on irregularities in load balancing across the LUNs.
Write requests	Indicates the number of write requests made per second to this LUN.	Reqs/Sec	
Data reads	Indicates the rate at which data was read from this LUN.	Blocks/Sec	Comparing the value of these measures across LUNs will clearly indicate which LUN is the busiest in terms of the rate at which data is read and written – it could also shed light on irregularities in load balancing across the LUNs.
Data writes	Indicate the rate at which data was written to this LUN.	Blocks/Sec	
Total I/O	Indicates the rate of the I/O activity on this LUN.	Number	
Rebuild process completion	Indicates the percentage of this LUN that has been rebuilt.	Percent	A rebuild replaces a failed hard disk within a RAID group with an operational disk. If one or more LUNs are bound to the RAID group with the failed disk, then, all the LUNs affected by the failure are rebuilt. A rebuild restores a LUN to its fully assigned number of hard drives using an available hot spare should a drive in one of the RAID groups fail. LUNs are rebuilt one by one. Each LUN is rebuilt by its owning Storage Processor (SP).
LUN binding completion	Indicates the percentage of the LUN binding process that is complete.	Percent	A bind is an information organization, data security, and data integrity feature of CLARiiON. Binding a LUN involves

Measurement	Description	Measurement Unit	Interpretation
			the preparation of allocated storage space. This preparation is particularly important when storage capacity is being reallocated for reuse. This reuse of storage includes erasing any previous data found on the hard drives, and the setting of parity and metadata for the storage. LUNs are typically available for use immediately after they are bound. However, the bind is not strictly complete until after all the bound storage has been prepared and verified. Depending on the LUN size and verify priority, these two steps may take several hours. Using the value of this measure, you will be able to track the progress of the binding function, and will be able to gauge how much longer it will take for the binding to complete.
LUN capacity	Indicates the total capacity of this LUN.	GB	
LUN size	Indicates the LUN size in blocks.	Blocks	

The detailed diagnosis of the *State* measure reveals whether the target LUN is a private LUN or not, the Raid group to which the LUN belongs, the Raid type, and the storage group name.

LUN details

Time	isPrivate	RaidType	RaidGroupID	Storage Group
Mar 18, 2011 14:26:13	NO	RAID5	0	esx4-150

Figure 3.10: The detailed diagnosis of the State measure

3.5.2 EMC RAID LUNs Test

A logical unit number (LUN) is a unique identifier used to designate individual or collections of hard disk devices for address by a protocol associated with a SCSI, iSCSI, Fibre Channel (FC) or similar

interface. LUNs are central to the management of storage arrays shared over a storage area network (SAN). LUN errors, poor LUN cache usage, and abnormal I/O activity on the LUNs, if not promptly detected and resolved, can hence significantly degrade the performance of the storage array. This is why, it is important that LUN performance is continuously monitored. This can be achieved using the **EMC RAID LUNs** test. This test auto-discovers the LUNs in the storage system and reports the current state of each LUN, captures LUN errors, and measures the level of I/O activity on every LUN, so that administrators are notified of LUN-related problems well before they impact storage system performance.

This test is disabled by default. To enable the test, go to the **ENABLE / DISABLE TESTS** page using the menu sequence : Agents -> Tests -> Enable/Disable, pick the *EMC Clariion SAN* as the desired **Component type**, set *Performance* as the **Test type**, choose the test from the **DISABLED TESTS** list, and click on the **<** button to move the test to the **ENABLED TESTS** list. Finally, click the **Update** button.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each LUN on the storage system.

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 device listens. The default is *NULL*.
User Name and Password	The SMI-S Provider is paired with the EMC CIM Object Manager Server to provide an SMI-compliant interface for CLARiiON arrays. Against the User and Password parameters, specify the credentials of a user who has been assigned **Monitor** access to the EMC CIM Object Manager Server paired with EMC CLARiiON's SMI-S provider.
Confirm Password	Confirm the Password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
IsEmbedded	By default, this flag is set to **False** for an EMC CLARiiON device. **Do not disturb this default setting**.
SerialNumber	If the SMI-S provider has been implemented as a proxy, then such a provider can be configured to manage multiple storage devices. This is why, you will have to explicitly

Parameter	Description
	specify which storage system you want the eG agent to monitor. Since each storage system is uniquely identified by a Serial number, specify the same here. The serial number for an EMC CLARiiON device will be of the format, FCNMM094900059.
NameSpace	Specify the NameSpace that uniquely identifies the profiles specific to the provider in use. For EMC CLARiiON, this parameter will be set to root/emc by default.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates how healthy this LUN currently is.		The values that this measure can report and their corresponding numeric values are discussed in the table below: **Measure Value** / **Numeric Value** OK – 0 Unknown – 1 Degraded/Warning – 2 Minor failure – 3 Major failure – 4 Critical failure – 5 Non- recoverable error – 6 **Note:** By default, this measure reports the **Measure Value**s discussed above to indicate the state of a LUN In the graph of this measure however, states are represented using the numeric equivalents only.
Operational status	Indicates the current operational state of this LUN.		The values that this measure can report and their corresponding numeric values are discussed 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>OK</td><td>0</td></tr>
<tr><td>In Service</td><td>1</td></tr>
<tr><td>Power Mode</td><td>2</td></tr>
<tr><td>Completed</td><td>3</td></tr>
<tr><td>Starting</td><td>4</td></tr>
<tr><td>Dormant</td><td>5</td></tr>
<tr><td>Other</td><td>6</td></tr>
<tr><td>Unknown</td><td>7</td></tr>
<tr><td>Stopping</td><td>8</td></tr>
<tr><td>Stressed</td><td>9</td></tr>
<tr><td>Stopped</td><td>10</td></tr>
<tr><td>Supporting Entity in Error</td><td>11</td></tr>
<tr><td>Degraded or Predicted Failure</td><td>12</td></tr>
<tr><td>Predictive Failure</td><td>13</td></tr>
<tr><td>Lost Communication</td><td>14</td></tr>
<tr><td>No Contact</td><td>15</td></tr>
<tr><td>Aborted</td><td>16</td></tr>
<tr><td>Error</td><td>17</td></tr>
<tr><td>Non- Recoverable Error</td><td>18</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a LUN. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational</td><td>Describes the current</td><td></td><td>This measure will be reported only if the</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>state</td><td>operational state of this LUN.</td><td></td><td>API provides a detailed operational state.

Typically, the detailed state will describe why the LUN is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a LUN, then this measure will explain why that LUN is being stopped.

The values that this measure can report and their corresponding numeric values are discussed in the table below:

<table><tr><th>Measure Value</th><th>Numeric Value</th></tr><tr><td>Online</td><td>0</td></tr><tr><td>Success</td><td>1</td></tr><tr><td>Power Saving Mode</td><td>2</td></tr><tr><td>Write Protected</td><td>3</td></tr><tr><td>Write Disabled</td><td>4</td></tr><tr><td>Not Ready</td><td>5</td></tr><tr><td>Removed</td><td>6</td></tr><tr><td>Rebooting</td><td>7</td></tr><tr><td>Offline</td><td>8</td></tr><tr><td>Failure</td><td>9</td></tr></table>
Note:

By default, this measure reports the Measure Values discussed above to indicate the detailed operational state of a LUN. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.</td></tr>
<tr><td>Data transmitted</td><td>Indicates the rate at</td><td>MB/Sec</td><td></td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
	which data was transmitted by this LUN.		
IOPS	Indicates the rate at which I/O operations were performed on this LUN.	IOPS	Compare the value of this measure across LUNs to know which LUN handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across LUNs. You may then want to take a look at the Reads and Writes measures to understand what to fine-tune – the load-balancing algorithm for read requests or that of the write requests.
Reads	Indicates the rate at which read operations were performed on this LUN.	Reads/Sec	Compare the value of this measure across LUNs to know which LUN handled the maximum number of read requests and which handled the least.
Writes	Indicates the rate at which write operations were performed on this LUN.	Writes/Sec	Compare the value of this measure across LUNs to know which LUN handled the maximum number of write requests and which handled the least.
Data reads	Indicates the rate at which data is read from this LUN.	MB/Sec	Compare the value of these measures across LUNs to identify the slowest LUN in terms of servicing read and write requests (respectively).
Data writes	Indicates the rate at which data is written to this LUN.	MB/Sec	
LUN busy	Indicates the percentage of time this LUN was busy processing requests.	Percent	Compare the value of this measure across LUNs to know which LUN was the busiest and which LUN was not. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across LUNs.
Average read size	Indicates the amount of data read from this LUN	MB/Op	Compare the value of these measures across LUNs to identify the slowest

Measurement	Description	Measurement Unit	Interpretation
	per I/O operation		LUN in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this LUN per I/O operation.	MB/Op	
Read hit	Indicates the percentage of read requests that were serviced by the cache of this LUN.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct LUN accesses, which are expensive operations, are high.
Write hit	Indicates the percentage of write requests that were serviced by the cache of this LUN.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct LUN accesses, which are expensive operations, are high.
Average response time	Indicates the time taken by this LUN to respond to I/O requests.	Microsecs	Ideally, this value should be low. If not, it implies that the LUN is slow.
EMC queue length	Indicates the number of requests that are in queue for this LUN.	Number	A consistent increase in this value indicates a potential processing bottleneck with the LUN.
EMC disk crossings	Indicates the number of times an I/O crossed a stripe boundary on a RAID 6, RAID 5, RAID 0, or RAID 1/0 LUN.	Number	A CLARiiON LUN appears to the host as an OS device. Typically, to use the disk device, it has to be formatted with disk partitions. Then OS file systems are created in one or some of the disk partitions formatted. Typically, from a striped LUN, OS disk formatting would create a partition, with a disk partition header. Then, an OS file system is created on that disk partition. As OS files are added to the file system. the first file will have a piece sitting on the first stripe element of the LUN (for example, 64 KB). So, if we try to do an

Measurement	Description	Measurement Unit	Interpretation
			I/O of 64 KB on this OS file, part of the data will end up going to the first stripe element, which belongs to one physical drive, and the rest to the second drive that makes up the striped LUN. This type of drive crossing is called a stripe crossing. Striped crossing results in less efficient dispatches of I/O requests from the CLARiion storage processors to the back-end disk drives, thereby reducing request service efficiency. This is why, ideally, the value of this measure should be very low.
Prefetched	Indicates the amount of data prefetched in the read cache of this LUN.	KB	Prefetching is read-ahead caching. It lets the SP anticipate the data an application will request so that it can read it from disk into its read cache before the data is needed.
Prefetched not used	Indicates the amount of prefetched data in the read cache of this LUN that was not read during the last measurement period.	KB	If the value of this measure keeps growing for a LUN, you may want to fine-tune the pre-fetching to ensure that that LUN's read cache is not unnecessarily filled with data that is not usable. For instance, you may want to reduce the Maximum Prefetch value for a LUN, so that the storage system does not allow too many disk blocks to be prefetched for variable-length prefetching.
EMC queue arrivals	Indicates the number of times a user request arrived while at least one other request was being processed.	Number	
Utilization through SPA	Indicates the amount of data that was utilized in this LUN during storage	KB	Compare the value of this measure across LUNs to identify the top data consumers through SP A.

Measurement	Description	Measurement Unit	Interpretation
	processor A.		
Utilization through SPB	Indicates the amount of data that was utilized in this LUN during storage processor B.	KB	Compare the value of this measure across LUNs to identify the top data consumers through SP B.
Response through SPA	Indicates the time taken by this LUN to respond to I/O requests through storage processor A.	Microsec	Compare the value of this measure across LUNs to identify the least responsive LUN through SP A.
Response through SPB	Indicates the time taken by this LUN to respond to I/O requests through storage processor B.	Microsec	Compare the value of this measure across LUNs to identify the least responsive LUN through SP B.

3.6 The EMC Cache Layer

A storage-system cache has two parts: a read cache and a write cache. The read cache uses a read-ahead mechanism that lets the storage system prefetch data from the disk. Therefore the data will be ready in the cache when the application needs it. The write cache buffers and optimizes writes by absorbing peak loads, combining small writes, and eliminating rewrites.

Measure the extent and effectiveness of cache usage using the test mapped to this layer.

Figure 3.11: The EMS Cache Layer

3.6.1 Clariion Cache Test

This test monitors the current state, size, and usage of the read and write caches supported by the storage system.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the storage system 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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read hit ratio	Indicates the percentage of read requests to this LUN that were serviced by the cache	Percent	Ideally, the value of this measure should be high. A low value indicates that many read requests are serviced by direct disk accesses, which is a more expensive operation in terms of processing overheads.
Write hit ratio	Indicates the percentage of write requests to this LUN that were serviced by the cache.	Percent	Ideally, the value of this measure should be high. A low value indicates that many write requests are serviced by direct disk accesses, which is a more expensive operation in terms of processing overheads.
Dirty cache pages	Indicates the number of dirty cache pages.	Number	
Cache pages owned	Indicates the number of cache pages owned.	Number	
SPA read cache state	Indicates the current state of the read cache for Storage Processor (SP) A.		If the read cache of the storage processor (SP) A is enabled, then this measure will report the value *Enabled*. If not, then, this measure will report the value *Disabled*. The numeric values that correspond to each of the states discussed above are available in the table below: **State** / **Numeric Value**: Enabled / 1; Disabled / 0 **Note:** By default, this measure reports the values Disabled or Enabled to indicate the status of the read cache. The graph of this measure however, represents the cache status using the numeric

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>equivalents - 0 or 1.</td></tr>
<tr><td>SPA write cache state</td><td>Indicates the current state of the write cache for Storage Processor (SP) A.</td><td></td><td>If the write cache of the storage processor (SP) A is enabled, then this measure will report the value Enabled. If not, then, this measure will report the value Disabled.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Enabled</td><td>1</td></tr><tr><td>Disabled</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Disabled or Enabled to indicate the status of the write cache. The graph of this measure however, represents the cache status using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>SPA cache pages</td><td>Indicates the total number of pages in the cache of Storage Processor A.</td><td>Number</td><td>For best performance, each Storage Processor (SP) should have the maximum amount of its memory in cache and should use the default settings for the cache properties. Therefore, ideally the number of memory pages in the cache should be high.</td></tr>
<tr><td>SPA read cache size</td><td>Indicates the current size of the read cache of Storage Processor A.</td><td>MB</td><td>The read cache holds data that is expected to be accessed in the near future. If a request for data that is in the cache arrives, the request can be serviced from the cache faster than from the disks. Each request satisfied from cache eliminates the need for a</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			disk access, reducing disk load. If the workload exhibits a "locality of reference" behavior, where a relatively small set of data is accessed frequently and repeatedly, the read cache can improve performance. In read-intensive environments, where more than 70 percent of all requests are reads, the read cache should be large enough to accommodate the dataset that is most frequently accessed. For sequential reads from a LUN, data that is expected to be accessed by subsequent read requests is read (prefetched) into the cache before being requested. Therefore, for optimal performance, the read cache should be large enough to accommodate prefetched data for sequential reads from each LUN.
SPA write cache size	Indicates the current size of the write cache of Storage Processor A.	MB	Write cache serves as a temporary buffer where data is stored temporarily before it is written to the disks. Cache writes are far faster than disk writes. Also, write-cached data is consolidated into larger I/Os when possible, and written to the disks more efficiently. (This reduces the expensive small writes in case of RAID 5 LUNs.) Also, in cases where data is modified frequently, the data is overwritten in the cache and written to the disks only once for several updates in the cache. This reduces disk load. Consequently, the write cache absorbs write data during heavy load periods and writes them to the disks, in an optimal fashion, during light load periods. However, if the amount of write data

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>during an I/O burst exceeds the write cache size, the cache fills. Subsequent requests must wait for cached data to be flushed and for cache pages to become available for writing new data. It is hence imperative that you rightly size the write cache.</td></tr>
<tr><td>SPA free memory size</td><td>Indicates the amount of physical memory of storage processor A that is currently unused.</td><td>MB</td><td></td></tr>
<tr><td>SPA system buffer</td><td>Indicates the size of the system buffer of storage processor A.</td><td>MB</td><td></td></tr>
<tr><td>SPA physical memory</td><td>Indicates the total physical memory of storage processor A.</td><td>MB</td><td></td></tr>
<tr><td>SPB read cache state</td><td>Indicates the current state of the read cache of storage processor B.</td><td></td><td>If the read cache of the storage processor (SP) B is enabled, then this measure will report the value Enabled. If not, then, this measure will report the value Disabled.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Enabled</td><td>1</td></tr><tr><td>Disabled</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Disabled or Enabled to indicate the status of the read cache. The graph of this measure however, represents the cache status using the numeric</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>equivalents - 0 or 1.</td></tr>
<tr><td>SPB write cache state</td><td>Indicates the current state of the write cache of storage processor B.</td><td></td><td>If the write cache of the storage processor (SP) B is enabled, then this measure will report the value Enabled. If not, then, this measure will report the value Disabled.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Enabled</td><td>1</td></tr><tr><td>Disabled</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Disabled or Enabled to indicate the status of the write cache. The graph of this measure however, represents the cache status using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>SPB cache pages</td><td>Indicates the number of pages read cache of storage processor B.</td><td>Number</td><td>For best performance, each Storage Processor (SP) should have the maximum amount of its memory in cache and should use the default settings for the cache properties. Therefore, ideally the number of memory pages in the cache should be high.</td></tr>
<tr><td>SPB read cache size</td><td>Indicates the current size of the read cache of Storage Processor B.</td><td>MB</td><td>The read cache holds data that is expected to be accessed in the near future. If a request for data that is in the cache arrives, the request can be serviced from the cache faster than from the disks. Each request satisfied from cache eliminates the need for a</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			disk access, reducing disk load. If the workload exhibits a "locality of reference" behavior, where a relatively small set of data is accessed frequently and repeatedly, the read cache can improve performance. In read-intensive environments, where more than 70 percent of all requests are reads, the read cache should be large enough to accommodate the dataset that is most frequently accessed. For sequential reads from a LUN, data that is expected to be accessed by subsequent read requests is read (prefetched) into the cache before being requested. Therefore, for optimal performance, the read cache should be large enough to accommodate prefetched data for sequential reads from each LUN.
SPB write cache size	Indicates the current size of the write cache of Storage Processor B.		Write cache serves as a temporary buffer where data is stored temporarily before it is written to the disks. Cache writes are far faster than disk writes. Also, write-cached data is consolidated into larger I/Os when possible, and written to the disks more efficiently. (This reduces the expensive small writes in case of RAID 5 LUNs.) Also, in cases where data is modified frequently, the data is overwritten in the cache and written to the disks only once for several updates in the cache. This reduces disk load. Consequently, the write cache absorbs write data during heavy load periods and writes them to the disks, in an optimal fashion, during light load periods. However, if the amount of write data

Measurement	Description	Measurement Unit	Interpretation
			during an I/O burst exceeds the write cache size, the cache fills. Subsequent requests must wait for cached data to be flushed and for cache pages to become available for writing new data. It is hence imperative that you rightly size the write cache.
SPB free memory size	Indicates the amount of memory unused with storage processor B.	MB	
SPB system buffer	Indicates the size of the system buffer of storage processor B.	MB	
SPB physical memory	Indicates the total physical memory of storage processor B.	MB	
SP read cache state	Indicates the state of the read cache of the storage processor.		If the read cache of the storage processor (SP) is enabled, then this measure will report the value *Enabled*. If not, then, this measure will report the value *Disabled*. The numeric values that correspond to each of the states discussed above are available in the table below: **State** / **Numeric Value** Enabled / 1 Disabled / 0 **Note:** By default, this measure reports the values Disabled or Enabled to indicate the status of the read cache. The graph of this measure however, represents the cache status using the numeric equivalents - 0 or 1.

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>SP write cache state</td><td>Indicates the current state of the write cache of the storage processor.</td><td></td><td>If the write cache of the storage processor (SP) is enabled, then this measure will report the value Enabled. If not, then, this measure will report the value Disabled.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Enabled</td><td>1</td></tr><tr><td>Disabled</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Disabled or Enabled to indicate the status of the write cache. The graph of this measure however, represents the cache status using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>Cache page size</td><td>Indicates the number of pages currently in cache.</td><td>Number</td><td>To service I/O requests faster, to reduce disk overloads, and to eliminate disk abuse, the read/write caches should be sized with sufficient memory pages.

Ideally, a cache page can be of size 2, 4, 8, or 16 KB. As a general guideline, EMC suggests 8 KB. The ideal cache page size depends on the operating system and application.</td></tr>
<tr><td>Write cache mirrored</td><td>Indicates the write cache mirrored status.</td><td></td><td>Each storage processor (SP) has a write cache in its memory, which mirrors the write cache on the other SP. Because these caches mirror each other, they are always either enabled or disabled, and always the same size. On powerup, a storage system</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>automatically enables the write cache on each SP if the write cache size is non-zero.

Using this measure, you can determine whether the write cache of both SPs is currently enabled/disabled.

If the write cache is disabled, then this measure will report the value Enabled. If not, the measure will report the value Disabled.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Enabled</td><td>1</td></tr><tr><td>Disabled</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Disabled or Enabled to indicate the status of the write cache. The graph of this measure however, represents the cache status using the numeric equivalents - 0 or 1.</td></tr>
</table>

3.7 The EMC Storage Processor Layer

The tests mapped to this layer monitor the current state, I/O load, and overall health of each storage port and each storage processor on the EMC CLARiiON device.

Figure 3.12: The tests mapped to the EMC Storage Processor layer

3.7.1 Clariion Storage Ports Test

This test reports the current status and overall health of each port on each storage processor supported by the storage system being monitored.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the each storage processor port on the storage system.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.

Parameter	Description
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Ignore Disabled SPPorts	By default, this flag is set to **No**, indicating that the test monitors all ports on all storage processors by default. Set this flag to **Yes** if you want the test to consider only the 'enabled' storage processor pors for monitoring.
Exclude SPPorts	Provide a comma-separated list of PortName PortID pairs that you want to exclude from the monitoring scope of this test. For instance, your specification can be: *SPA 0,SPA 1,SPB 2*. By default, this is set to *none* indicating that no ports are excluded by default.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *1:1*. This indicates that, by default, detailed measures will be generated every 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 abnormalfrequencies 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>Link state</td><td>Indicates the link state of this storage processor port.</td><td></td><td>If the storage port is up and running, then this measure will report the value Up. If not, then, this measure will report the value Down.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Up</td><td>1</td></tr><tr><td>Down</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Up or Down to indicate the status of a port. The graph of this measure however, represents the port status using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>Port state</td><td>Indicates the current state of this port.</td><td>Status</td><td>The operational state of a port can be Online, Offline or Not Applicable.

The numeric values that correspond to each of the states discussed above are available in the table below:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Online</td><td>1</td></tr><tr><td>Offline</td><td>2</td></tr><tr><td>Not Applicable</td><td>0</td></tr></table>
Note:

By default, this measure reports the values Up or Down to indicate the status of a port. The graph of this measure however, represents the port status</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>using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>SFP state</td><td>Indicates the SFP state of this port.</td><td>Number</td><td>This measure can report any one of the following values:
Online
Faulted
Removed
The numeric values that correspond to each of the states discussed above are available in the table below:<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>Online</td><td>1</td></tr><tr><td>Faulted</td><td>2</td></tr><tr><td>Removed</td><td>0</td></tr></table>Note:
By default, this measure reports the values Up or Down to indicate the status of a port. The graph of this measure however, represents the port status using the numeric equivalents - 0 or 1.</td></tr>
<tr><td>Reads</td><td>Indicates the number of reads per second made on this port.</td><td>Number</td><td rowspan="2">Comparing the value of these measures across ports will clearly indicate which port is overloaded - it could also shed light on irregularities in load balancing across the ports.</td></tr>
<tr><td>Writes</td><td>Indicates the number of writes per second made on this port.</td><td>Number</td></tr>
<tr><td>Data reads</td><td>Indicates the rate at which data is read through this port.</td><td>Blocks/Sec</td><td></td></tr>
<tr><td>Data writes</td><td>Indicates the rate at which data is written through this port.</td><td>Blocks/Sec</td><td></td></tr>
</table>

3.7.2 Clariion Storage Processors Test

The storage processor enables the administrator in serving the purpose of the following:

- Creating raid group
- Binding luns
- All CLI commands can be executed
- Read/write operations from external server to SAN

This test monitors the current state and I/O activity on each of the storage processors supported by the storage system.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each storage processor on the storage system.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.

Parameter	Description
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Fault state	Indicates the current state of this storage processor.		If the storage processor is up and running, then the value of this measure will be *On*. If not, then this measure will report the value *Off*. The numeric values that correspond to the aforesaid states are as follows: State: On = 1; Off = 0 **Note:** By default, this measure reports the values On or Off to indicate the status of a storage processor. The graph of this measure however, represents the processor status using the numeric equivalents - 0 or 1.
Busy	Indicates percent utilization of the storage processor.	Percent	The numeric value that corresponds to individual states are listed below: • 90%-Critical • 80%-Major • 60%-Minor
Idle	Indicates the percentage of time for which this storage processor was idle.	Percent	This value varies with respect to the value of the Busy measure.

Measurement	Description	Measurement Unit	Interpretation
Read requests	Indicates the rate of read requests to this storage processor.	Reqs/Sec	Comparing the value of these measures across storage processors will clearly indicate which processor is overloaded – it could also shed light on irregularities in load balancing across the processors.
Write requests	Indicates the rate of write requests to this storage processor.	Reqs/Sec	
Total throughput	Indicates the sum of read and write request rates.	I/O/Sec	
Data writes	Indicates the rate at which data is written via this storage processor.	Blocks/Sec	
Data reads	Indicates the rate at which data is read via this storage processor.	Blocks/Sec	

3.7.3 EMC RAID Arrays Test

This test monitors the current state, overall health, and the load-balancing capability of each storage array in the EMC CLARiiON storage system. With the help of this test, administrators can be proactively alerted to potential array failures / slowdowns / overload conditions. This way, irregularities in the distribution of I/O load across arrays comes to light, prompting administrators to fine-tune the load-balancing algorithm.

This test is disabled by default. To enable the test, go to the **ENABLE / DISABLE TESTS** page using the menu sequence : Agents -> Tests -> Enable/Disable, pick the *EMC Clariion SAN* as the desired **Component type**, set *Performance* as the **Test type**, choose the test from the **DISABLED TESTS** list, and click on the **<** button to move the test to the **ENABLED TESTS** list. Finally, click the **Update** button.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each RAID array on the storage system.

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 device listens. The default is *NULL*.
User Name and Password	The SMI-S Provider is paired with the EMC CIM Object Manager Server to provide an SMI-compliant interface for CLARiiON arrays. Against the User and Password parameters, specify the credentials of a user who has been assigned **Monitor** access to the EMC CIM Object Manager Server paired with EMC CLARiiON's SMI-S provider.
Confirm Password	Confirm the Password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
IsEmbedded	By default, this flag is set to **False** for an EMC CLARiiON device. **Do not disturb this default setting**.
SerialNumber	If the SMI-S provider has been implemented as a proxy, then such a provider can be configured to manage multiple storage devices. This is why, you will have to explicitly specify which storage system you want the eG agent to monitor. Since each storage system is uniquely identified by a Serial number, specify the same here. The serial number for an EMC CLARiiON device will be of the format, FCNMM094900059.
NameSpace	Specify the NameSpace that uniquely identifies the profiles specific to the provider in use. For EMC CLARiiON, this parameter will be set to root/emc by default.

Measurements made by the test

Measurements	Description	Measurement Unit	Interpretation
Operational status	Indicates the current operational state of this RAID array.		The values that this measure can report and their corresponding numeric values are discussed in the table below: **Measure Value** / **Numeric Value** OK / 0 In Service / 1

<table>
<tr><th>Measurements</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>Power Mode</td><td>2</td></tr>
<tr><td>Completed</td><td>3</td></tr>
<tr><td>Starting</td><td>4</td></tr>
<tr><td>Dormant</td><td>5</td></tr>
<tr><td>Other</td><td>6</td></tr>
<tr><td>Unknown</td><td>7</td></tr>
<tr><td>Stopping</td><td>8</td></tr>
<tr><td>Stressed</td><td>9</td></tr>
<tr><td>Stopped</td><td>10</td></tr>
<tr><td>Supporting Entity in Error</td><td>11</td></tr>
<tr><td>Degraded or Predicted Failure</td><td>12</td></tr>
<tr><td>Predictive Failure</td><td>13</td></tr>
<tr><td>Lost Communication</td><td>14</td></tr>
<tr><td>No Contact</td><td>15</td></tr>
<tr><td>Aborted</td><td>16</td></tr>
<tr><td>Error</td><td>17</td></tr>
<tr><td>Non- Recoverable Error</td><td>18</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a storage array. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational state</td><td>Describes the current operational state of this RAID array.</td><td></td><td>This measure will be reported only if the API provides a detailed operational state.</td></tr>
</table>

<table>
<tr><th>Measurements</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>Typically, the detailed state will describe why the storage array is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a storage array, then this measure will explain why that storage array is being stopped.

The values that this measure can report and their corresponding numeric values are discussed in the table below:

<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>Online</td><td>0</td></tr>
<tr><td>Success</td><td>1</td></tr>
<tr><td>Power Saving Mode</td><td>2</td></tr>
<tr><td>Write Protected</td><td>3</td></tr>
<tr><td>Write Disabled</td><td>4</td></tr>
<tr><td>Not Ready</td><td>5</td></tr>
<tr><td>Removed</td><td>6</td></tr>
<tr><td>Rebooting</td><td>7</td></tr>
<tr><td>Offline</td><td>8</td></tr>
<tr><td>Failure</td><td>9</td></tr>
</table>

Note:

By default, this measure reports the Measure Values discussed above to indicate the detailed operational state of an array. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.</td></tr>
<tr><td>Data transmitted</td><td>Indicates the rate at which data was transmitted by this RAID</td><td>MB/Sec</td><td></td></tr>
</table>

Measurements	Description	Measurement Unit	Interpretation
	array.		
IOPS	Indicates the rate at which I/O operations were performed on this RAID array.	IOPS	Compare the value of this measure across storage arrays to know which storage array handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across storage arrays. You may then want to take a look at the Reads and Writes measures to understand what to fine-tune - the load-balancing algorithm for read requests or that of the write requests.
Reads	Indicates the rate at which read operations were performed on this RAID array.	Reads/Sec	Compare the value of this measure across storage arrays to know which storage array handled the maximum number of read requests and which handled the least.
Writes	Indicates the rate at which write operations were performed on this RAID array.	Writes/Sec	Compare the value of this measure across storage arrays to know which storage array handled the maximum number of write requests and which handled the least.
Data reads	Indicates the rate at which data is read from this RAID array.	MB/Sec	Compare the value of these measures across storage arrays to identify the slowest storage array in terms of servicing read and write requests (respectively).
Data written	Indicates the rate at which data is written to this RAID array.	MB/Sec	
Average read size	Indicates the amount of data read from this RAID array per I/O operation	MB/Op	Compare the value of these measures across disks to identify the slowest disk in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this RAID per I/O operation.	MB/Op	

Measurements	Description	Measurement Unit	Interpretation
Read hit	Indicates the percentage of read requests that were serviced by the cache of this RAID array.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct storage array accesses, which are expensive operations, are high.
Write hit	Indicates the percentage of write requests that were serviced by the cache of this RAID array.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct storage array accesses, which are resource-intensive operations, are high.
EFD data flushed SPA	Indicates the amount of data flushed to the EFDs from the write cache of this RAID array through storage processor A.	KB	One of the key features of EMC is the availability of Enterprise Flash Drives (EFDs). With this capability, EMC creates new ultra-performing “Tier 0” storage that removes the performance limitations of magnetic disk drives. EFDs increase performance of latency-sensitive applications, and are ideal for applications with high transaction rates and those requiring the fastest possible storage and retrieval. EMC CLARiiON storage arrays support both enabling and disabled read/write caches. The default recommendation is to turn off both read and write caches on all LUNs that reside on EFDs for the following reasons: • EFDs are extremely fast, so when the read cache is enabled for the LUNs residing on them, the read cache lookup for each read is significantly higher as compared to FC drives, in an application profile that is not expected to get many read

Measurements	Description	Measurement Unit	Interpretation
			cache hits at any rate. So, it is faster to directly read from the EFDs. • If the storage array is being shared by several applications and is deployed with slower SATA drives, the write cache may be fully saturated, placing the EFDs in a force flush situation, which adds latency. In these situations, it is better to write the block directly to EFDs than to the write cache. If the read and write caches are disabled, these measures will not report any values.
EFD data flushed SPB	Indicates the amount of data flushed to the EFDs from the write cache of this RAID array through storage processor B.	KB	
EFD dirty cache SPA	Indicates the percentage of pages in write cache that have received new data from hosts but have not yet been flushed to the EFD through storage processor A.	Percent	You should have a high percentage of dirty pages as it increases the chance of a read coming from cache or additional writes to the same block of data being absorbed by the cache. If an IO is served from cache the performance is better than if the data had to be retrieved from disk. That's why the default watermarks are usually around 60/80% or 70/90%. You don't want dirty pages to reach 100%, they should fluctuate between the high and low watermarks (which means the Cache is healthy). Periodic spikes or drops outside the watermarks are ok, but consistently hitting 100% indicates that the write cache is overstressed.
EFD dirty cache SPB	Indicates the percentage of pages in write cache that have received new data from hosts but have not yet been flushed to the EFD through storage processor B.	Percent	

3.7.4 EMC RAID System Test

The storage processor enables the administrator in serving the purpose of the following:

- creating raid groups
- binding LUNs
- execute CLI commands
- perform read/write operations from external server to SAN

Excessive usage of or heavy I/O load on a single storage processor can cause a marked deterioration in the overall performance of the storage sub-system, as it is indicative of severe deficiencies in the load-balancing algorithm that drives the storage processors. Using the **EMC RAID System** test, administrators can easily monitor the current state, usage, and load on each of the storage processors on the storage system, quickly detect an overload condition, precisely point to the storage processor that is bearing its brunt, and promptly initiate measures to resolve the issue, so as to ensure the optimal performance of the storage system.

This test is disabled by default. To enable the test, go to the **ENABLE / DISABLE TESTS** page using the menu sequence : Agents -> Tests -> Enable/Disable, pick the *EMC Clariion SAN* as the desired **Component type**, set *Performance* as the **Test type**, choose the test from the **DISABLED TESTS** list, and click on the **<** button to move the test to the **ENABLED TESTS** list. Finally, click the **Update** button.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each storage processor on the storage system.

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 device listens. The default is *NULL*.
User Name and Password	The SMI-S Provider is paired with the EMC CIM Object Manager Server to provide an SMI-compliant interface for CLARiiON arrays. Against the User and Password parameters, specify the credentials of a user who has been assigned **Monitor** access to the EMC CIM Object Manager Server paired with EMC CLARiiON's SMI-S provider.
Confirm Password	Confirm the Password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.

Parameter	Description
IsEmbedded	By default, this flag is set to **False** for an EMC CLARiiON device. **Do not disturb this default setting**.
SerialNumber	If the SMI-S provider has been implemented as a proxy, then such a provider can be configured to manage multiple storage devices. This is why, you will have to explicitly specify which storage system you want the eG agent to monitor. Since each storage system is uniquely identified by a Serial number, specify the same here. The serial number for an EMC CLARiiON device will be of the format, FCNMM094900059.
NameSpace	Specify the NameSpace that uniquely identifies the profiles specific to the provider in use. For EMC CLARiiON, this parameter will be set to root/emc by default.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>Operational status</td><td>Indicates the current operational state of this storage processor.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table>
<tr><th>Measure Value</th><th>Numeric Value</th></tr>
<tr><td>OK</td><td>0</td></tr>
<tr><td>In Service</td><td>1</td></tr>
<tr><td>Power Mode</td><td>2</td></tr>
<tr><td>Completed</td><td>3</td></tr>
<tr><td>Starting</td><td>4</td></tr>
<tr><td>Dormant</td><td>5</td></tr>
<tr><td>Other</td><td>6</td></tr>
<tr><td>Unknown</td><td>7</td></tr>
<tr><td>Stopping</td><td>8</td></tr>
<tr><td>Stressed</td><td>9</td></tr>
<tr><td>Stopped</td><td>10</td></tr>
<tr><td>Supporting Entity in Error</td><td>11</td></tr>
<tr><td>Degraded or Predicted Fail-</td><td>12</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>ure</td><td></td></tr>
<tr><td>Predictive Fail-ure</td><td>13</td></tr>
<tr><td>Lost Com-munication</td><td>14</td></tr>
<tr><td>No Contact</td><td>15</td></tr>
<tr><td>Aborted</td><td>16</td></tr>
<tr><td>Error</td><td>17</td></tr>
<tr><td>Non- Recov-erable Error</td><td>18</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a storage processor. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational status</td><td>Describes the current operational state of this storage processor.</td><td></td><td>This measure will be reported only if the API provides a detailed operational state.
Typically, the detailed state will describe why the storage processor is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a storage processor, then this measure will explain why that storage processor is being stopped.
The values that this measure can report and their corresponding numeric values are discussed 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>Online</td><td>0</td></tr>
<tr><td>Success</td><td>1</td></tr>
<tr><td>Power Saving Mode</td><td>2</td></tr>
<tr><td>Write Protected</td><td>3</td></tr>
<tr><td>Write Disabled</td><td>4</td></tr>
<tr><td>Not Ready</td><td>5</td></tr>
<tr><td>Removed</td><td>6</td></tr>
<tr><td>Rebooting</td><td>7</td></tr>
<tr><td>Offline</td><td>8</td></tr>
<tr><td>Failure</td><td>9</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the detailed operational state of a storage processor. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Data transmitted</td><td>Indicates the rate at which data was transmitted by this storage processor.</td><td>MB/Sec</td><td></td></tr>
<tr><td>IOPS</td><td>Indicates the rate at which I/O operations were performed on this storage processor.</td><td>IOPS</td><td>Compare the value of this measure across storage processorsto know which storage processor handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across storage processors.
You may then want to take a look at the Reads and Writes measures to</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			understand what to fine-tune – the load-balancing algorithm for read requests or that of the write requests.
Reads	Indicates the rate at which read operations were performed on this storage processor.	Reads/Sec	Compare the value of this measure across storage processors to know which storage processor handled the maximum number of read requests and which handled the least.
Writes	Indicates the rate at which write operations were performed on this storage processor.	Writes/Sec	Compare the value of this measure across storage processors to know which storage processor handled the maximum number of write requests and which handled the least.
Data reads	Indicates the rate at which data is read from this storage processor.	MB/Sec	Compare the value of these measures across storage processors to identify the slowest storage processor in terms of servicing read and write requests (respectively).
Data writes	Indicates the rate at which data is written to this storage processor.	MB/Sec	
Average read size	Indicates the amount of data read from this storage processor per I/O operation	MB/Op	Compare the value of these measures across storage processors to identify the slowest storage processor in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this storage processor per I/O operation.	MB/Op	
Read hit	Indicates the percentage of read requests that were serviced by the cache of this storage processor.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct storage processor accesses, which are expensive operations, are high.
Write hit	Indicates the percentage of write requests that were serviced by the	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very

Measurement	Description	Measurement Unit	Interpretation
	cache of this storage processor.		poor; this in turn implies that direct storage processor accesses, which are expensive operations, are high.
High water flushes	Indicates the count of times data was flushed out of the write cache of this storage processor because a high watermark was violated.	Number	To regulate cache usage, watermark levels can be set using Navisphere Manager, Let's assume your Low Watermark (LWM) is set at 60% and your High Watermark (HWM) is at 80%. In this scenario, Clariion Algorithms will try to keep your cache levels between 60% and 80% since those are defined as the low and high watermarks. If for some reason the cache exceeds 80% occupancy (HWM), Forced Flushing kicks in disabling all the write cache in the Clariion.
Idle water flushes	Indicates the count of times data was flushed out of the write cache of this storage processor via idle cache flushing.	Number	When a host is writing data to the connected Clariion Disk via cache on the Clariion, the Clariion takes that data, writes it to cache and acknowledges back to the host that the data has been written to disk. This data can actually be sitting in the cache or being written to the disk when this acknowledgement goes out. The process happens in 64 Kilobyte chunks when the data is being transferred to the disk from the cache. Due to large chunks of data coming in from the host, sometimes Idle Cache Flushing is not able to maintain the Low Watermark (LWM), in those cases Watermark Cache Flushing kicks in.
Low water flushes	Indicates the count of times data was flushed out of the write cache of this storage processor because a low watermark	Number	Due to large chunks of data coming in from the host, sometimes Idle Cache Flushing is not able to maintain the Low Watermark (LWM), in those cases Watermark Cache Flushing kicks in.

Measurement	Description	Measurement Unit	Interpretation
	was violated.		
Write flushes	Indicates the number of requests to flush the write cache of this storage processor.	Number	
Write cache flushed	Indicates the amount of data flushed out of the write cache of this storage processor.	KB	
Queue arrivals	Indicates the number of times a user request arrived while at least one other request was being processed by this storage processor.	Number	
Queue length	Indicates the count of queue length by arrivals for this storage processor.	Number	A consistent increase in the value of this measure could indicate a processing bottleneck.
Dirty pages	Indicates the percentage of dirty pages currently in cache, that is, pages that have been modified in the SP's write cache, but that have not yet been written to disk.	Percent	A high percentage of dirty pages means the cache is handling many write requests.

3.8 EMC HBA Layer

A HBA, or Host Bus Adapter, is the interface card which connects a host to a SAN (Storage Area Network). It is an electronic circuit board and/or integrated circuit adapter that offers input/output (I/O) operations and physical connectivity among a server and a storage device.

Using the **Clariion HBA Ports** test attached to this layer, you can verify whether the HBA ports are connected to the fibre channel, and identify ports that are not trusted or defined.

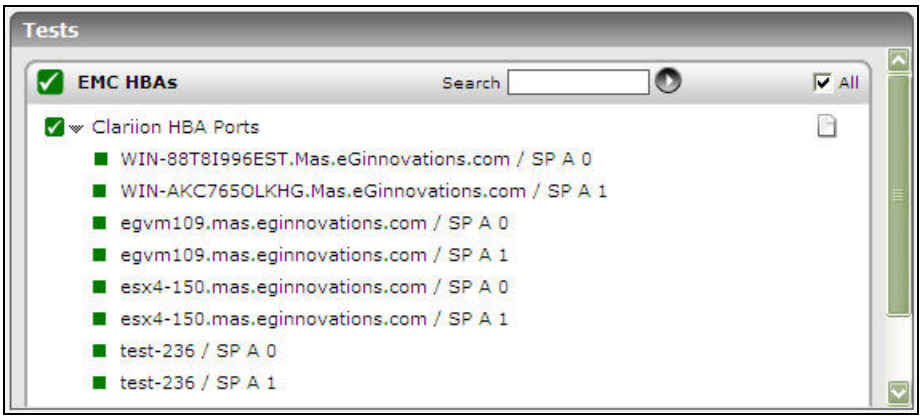

Figure 3.13: The test mapped to the EMC HBAs layer

3.8.1 Clariion HBA Ports Test

Using this test, you can verify whether the HBA ports are currently connected to the fibre channel or not, and identify ports that are not trusted or defined.

Target of the test : An EMC CLARiiON storage device

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each HBA port on the storage device.

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 device listens. The default is *NULL*.
CLARiiON IP	By default, the host IP will be displayed here. If the eG agent has also been configured to use the SMI-S provider for metrics collection, then the IP address of host on which the SMI-S provider has been installed, will be displayed here by default. In this case, you should change the value of this parameter to reflect the IP address of the EMC CLARiiON storage device. However, if the eG agent uses only the **NaviSphere CLI** for monitoring, then the default settings can remain.
NaviseccliPath	The eG agent uses the command-line utility, **NaviSecCli.exe**, which is part of the **NaviSphere Management Suite**, to communicate with and monitor the storage device. To enable the eG agent to invoke the CLI, configure the full path to the CLI in the NaviseccliPath text box.

Parameter	Description
User Name and Password	Provide the credentials of a user who is authorized to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
Show Device Name	This test reports measures for each HBA port on the storage system. By default, the test represents a HBA port as a unique combination of the Server name (i.e., the name of the server with which the HBA port is connecting), the *Storage Processor name*, and the *Storage Processor ID*. For instance, if the server named *nlpc20234* is connecting to the storage system via an HBA port using the storage processor, SP A, with ID 0, then, by default, this HBA port will be represented as *nlpc20234 / SP A 0*, in the eG monitoring console. If you want to append the HBA device name also to this representation, then, set the show device name flag to Yes. By default, this flag is set to No.
Timeout	Indicate the duration (in seconds) for which this test should wait for a response from the storage device. By default, this is set to 120 seconds. **Note that the 'Timeout' value should always be set between 3 and 600 seconds only**.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *1:1*. This indicates that, by default, detailed measures will be generated every 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>Logged in</td><td>Indicates whether this port is logged into the storage system or not.</td><td></td><td>This measure reports the value Yes if the port is logged into the storage system, and No if it is not.

The numeric values that correspond to each of the states discussed above are as follows:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>No</td><td>0</td></tr><tr><td>Yes</td><td>1</td></tr></table>
Note:

By default, this measure reports the States listed in the table above to indicate the logged in status of an HBA port. The graph of this measure however, represents logged in states using the numeric equivalents - 0 and 1.

You can use the detailed diagnosis of this measure to view additional details about the HBA.</td></tr>
<tr><td>Trusted</td><td>Indicates whether/not the HBA port is trusted.</td><td></td><td>This measure reports the value Yes if the port is trusted, and No if it is not.

The numeric values that correspond to each of the states discussed above are as follows:

<table><tr><th>State</th><th>Numeric Value</th></tr><tr><td>No</td><td>0</td></tr><tr><td>Yes</td><td>1</td></tr></table>
Note:</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			By default, this measure reports the **State**s listed in the table above to indicate the trust status of an HBA port. The graph of this measure however, represents trust states using the numeric equivalents - 0 and 1.
Defined	Indicates whether / not the HBA port is defined.		This measure reports the value Yes if the port is defined, and No if it is not. The numeric values that correspond to each of the states discussed above are as follows: **State** / **Numeric Value** No / 0 Yes / 1 **Note:** By default, this measure reports the **State**s listed in the table above to indicate the defined status of an HBA port. The graph of this measure however, represents defined states using the numeric equivalents - 0 and 1.

The detailed diagnosis of the *Logged in* measure reveals additional details about an HBA, such as, the HBA UID, the IP address of the server with which it is communicating, the HBA Model, the HBA vendor, the HBA device driver name, the storage group name, and more.

HBA SP port details

Time	HBA UID	Server IP Adress	HBA Model Description	HBA Vendor Description	HBA Device Driver Name	StorageGroup Name
Mar 18, 2011 14:32:05						
	20:00:00:00:C9:95:5E:61:10:00:00:00:C9:95:5E:61	192.168.10.136	-	VMware ESXi 4.0.0	-	egvm109.mas.eginnovations.com

Figure 3.14: The detailed diagnosis of the Logged in measure

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.

Contact Us

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To contact eG Innovations sales team, email sales@eginnovations.com.