Monitoring EMC VNXe Storage system

eG Innovations Product Documentation

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Total Performance Visibility

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Chapter 1: Introduction

The EMC VNXe series is a new unified storage solution for SMB and lower mid-market organizations and remote/branch offices (ROBO) in enterprise organizations. Designed for IT generalists with limited expertise, this unified storage solution facilitates complete storage consolidation with advanced file and block functionality as well as a simple, application driven approach to managing shared storage.

EMC VNXe series is ideal for today's enterprises as it can deliver significant advancements in efficiency, simplicity and affordability.

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 VNXe storage solution should be monitored 24 x 7 and issues in its overall performance and its critical operations should be proactively raised so that the holes are plugged before any data loss occurs. eG Enterprise helps administrators in this regard.

Chapter 2: How to Monitor EMC VNXe Storage system 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 (**UEMCLI.exe**) available as part of the **UniSphere Management Suite** of EMC VNXe for monitoring it. The **UniSphere Management Suite** is the central console using which the EMC VNXe environment can be controlled and monitored. The **UEM CLI** (i.e., the **UEMCLI.exe**) is used for issuing commands to an array, writing scripts, requesting array status, and as a tool for problem determination.

To enable the eG agent to use the UEM CLI, 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 the **UEM CLI** for collecting metrics from EMC VNXe storage system, 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 VNXe Storage system

To enable the eG agent to communicate with the EMC VNXe Storage system, a set of pre-requisites should be fulfilled. These requirements have been discussed below.

2.2.1 Pre-requisites for Monitoring Using the UniSphere Management Suite

To enable the eG agent to use the **UniSphere Management Suite** to collect metrics from EMC VNXe storage system, the following pre-requisites should be fulfilled:

1. If the storage device is SSL-enabled, then, when installing the **UniSphere 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.

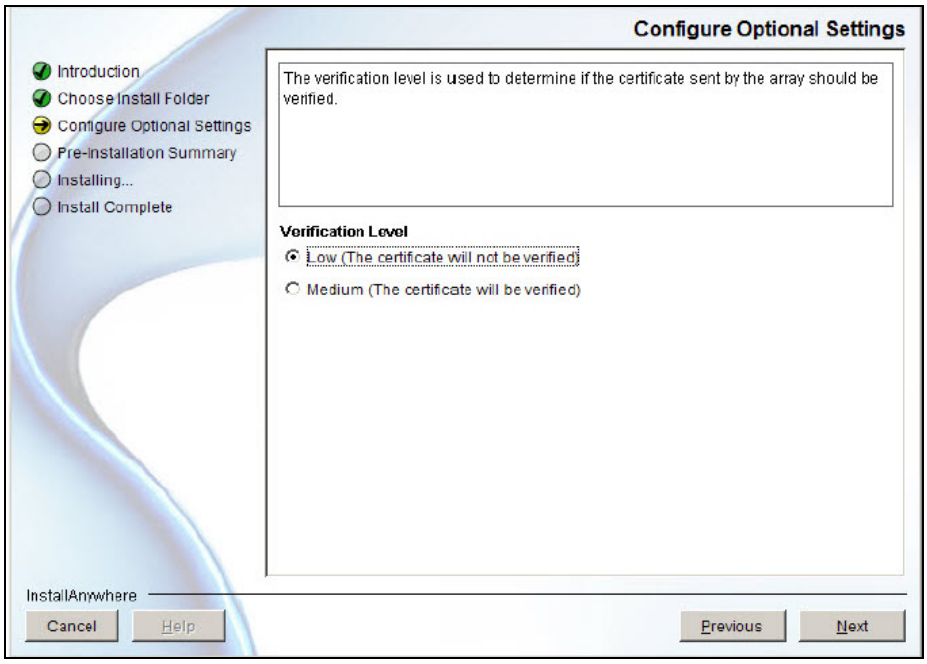

Figure 2.1: Setting verification level

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

2.3 Managing the EMC VNXe Storage system

The eG Enterprise cannot automatically discover the EMC VNXe storage system. 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 an EMC VNXe storage system, 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 VNXe Series as the **Component type**.

Then, click the **Add New Component** button. This will invoke 2.3.

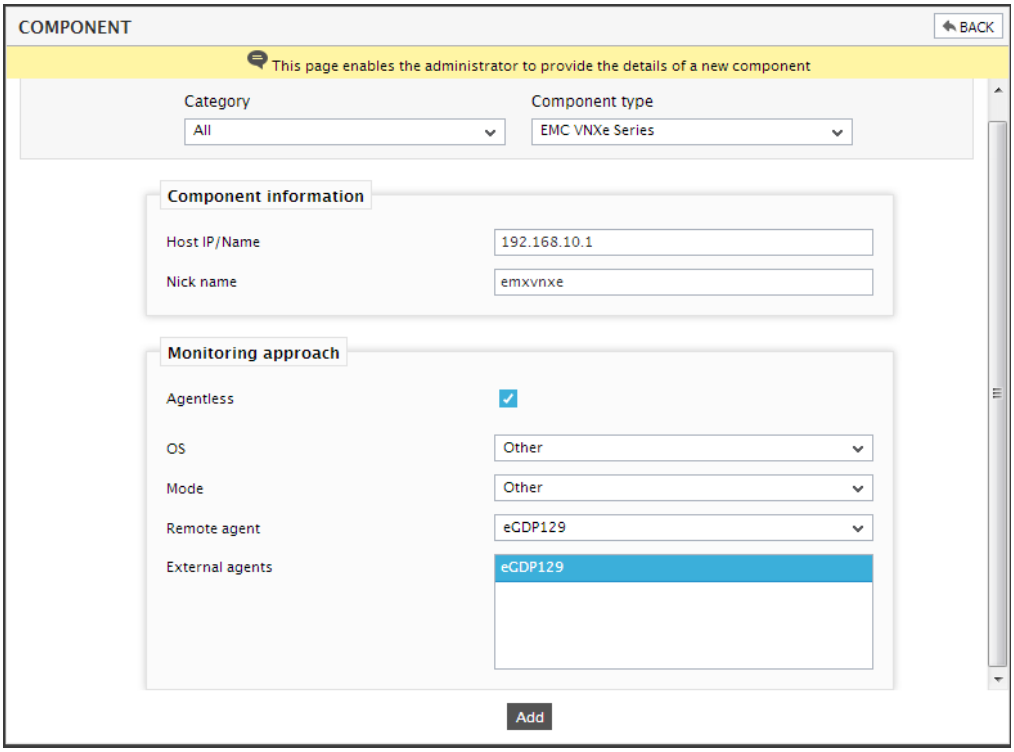

Figure 2.2: Adding a new EMC VNXe storage system

4. Specify the **Host IP/Name** and the **Nick name** of the EMC VNXe storage system. This EMC VNXe storage system can only be monitored in an agentless manner. Therefore, the **Agentless** check box will be checked by default. Next, select **Other** as the **OS** and **Other** as the **Mode**. Then, click the **Add** button to register the changes (see Figure 2.2).

5. The EMC VNXe storage system 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 VNXe storage system.

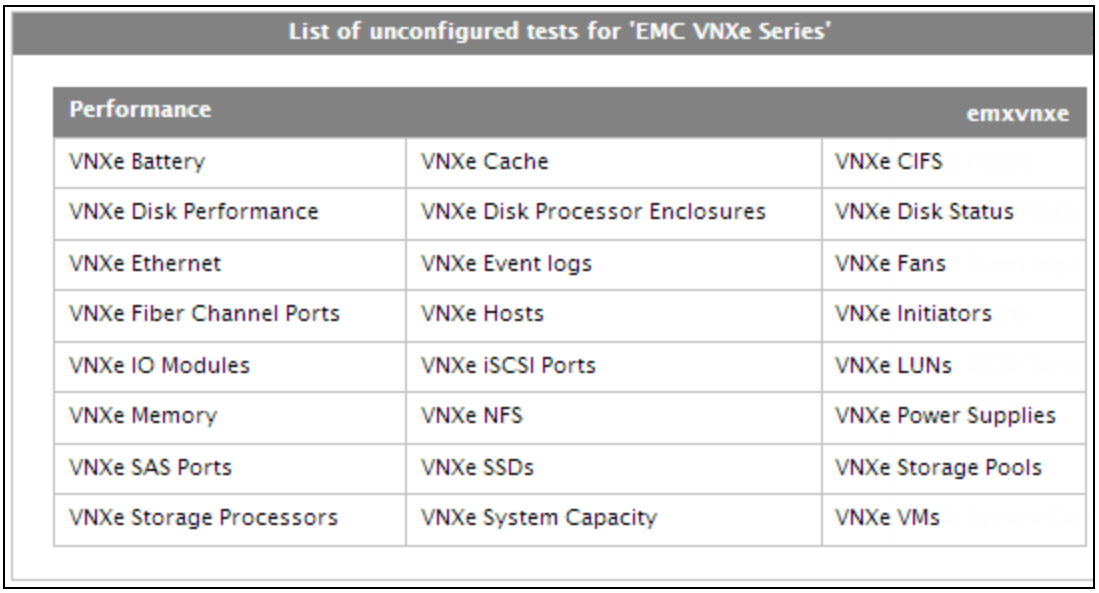

Figure 2.3: A page displaying the tests that need to be configured for the EMC VNXe

6. Click on any test in the list of unconfigured tests. For instance, click on the **VNXe Battery** test to configure it. Figure 2.4 then appears.

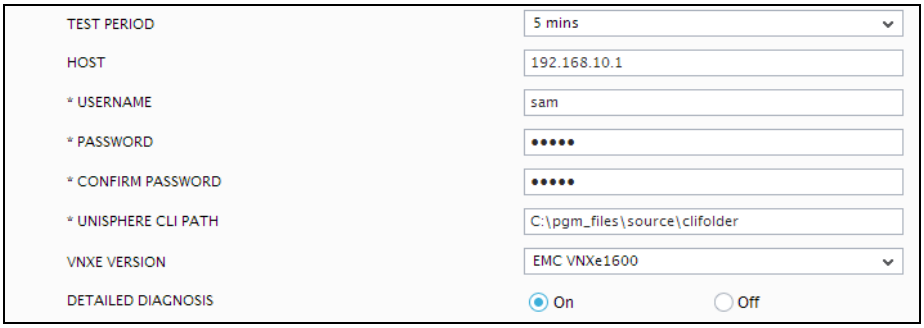

Figure 2.4: Configuring the VNXe Battery test

7. To know how to configure the test, refer to **Monitoring the EMC VNXe Storage system** .
8. Finally, signout of the eG administrative interface.

Chapter 3: Monitoring the EMC VNXe Storage system

eG Enterprise offers a specialized EMC VNXe monitoring model that monitors the core functions and components of the EMC VNXe storage system, 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.

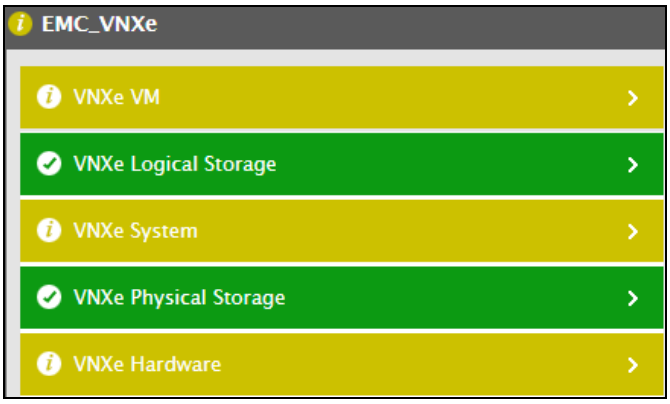

Figure 3.1: The layer model of the EMC VNXe Storage system

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:

- What is the current health of each battery in the Battery Backup Unit? Which batteries are currently unhealthy?
- How many cache clean pages are available in each storage processor?
- How many free cache pages are available in each storage processor?
- How well the read and write requests to each storage processor were serviced by the cache?
- How well the I/O operations were performed using the CIFS protocol on each storage processor?
- How well bandwidth was consumed when CIFS reads and writes are performed on each storage processor?
- How well the I/O Operation were performed on each disk ?

- Which disk was performing too much of I/O operations?
- What is the average time taken by each disk to service user requests?
- What is the maximum time taken by each disk to service user requests?
- What is the average time taken by the disk to respond to user requests?
- What is the current health of each Disk Processor Enclosure?
- What is the current health of each disk?
- What is the amount of disk space allocated to the users accessing each disk?
- What is the health of each storage processor port and management port of each storage processor?
- How well data was sent through and received by each storage processor port and management port of each storage processor?
- What is the maximum amount of packets sent through the storage processor port and management port per second?
- How many warning and critical events were generated for the target storage system?
- What is the current health of each fan? Which fan is currently unhealthy or has failed?
- What is the current health of each Fiber Channel Port?
- How well I/O operations were performed through each Fiber Channel Port?
- What is the amount of data sent through and received by each Fiber Channel Port per second?
- What is the current health of each host connected to the target storage system?
- What is the current health of each initiator?
- What is the current health of each I/O module?
- What is the current health of each iSCSI port? Which port is currently unhealthy or has failed critically?
- What is the current health of each LUN?
- How well data was read from and written to each LUN per second?
- What is the average time taken by each LUN to respond to user requests?
- What is the current health of each memory module?
- How well I/O operations were performed using the NFS protocol on each storage processor?

- What is the total amount of data transacted per second when performing NFS reads and writes?
- What is the current health of each power supply unit?
- What is the current health of each SAS port?
- What is the current health of each SSD on the target storage system?
- What is the current health of each storage pool?
- What is the current health of each storage processor?
- Has the storage processor rebooted recently?
- What is the current temperature of each storage processor?
- What is the current size of the memory allocated to each storage processor?
- What is the total capacity of each disk group?
- How many drives are available in each disk group?
- How many spare drives are available for each disk group?
- What is the health of each VM that is provisioned through the target storage system?

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

3.1 The VNXe Hardware Layer

The tests mapped to this layer report on the overall health of the hardware elements supporting the target EMC VNXe storage system.

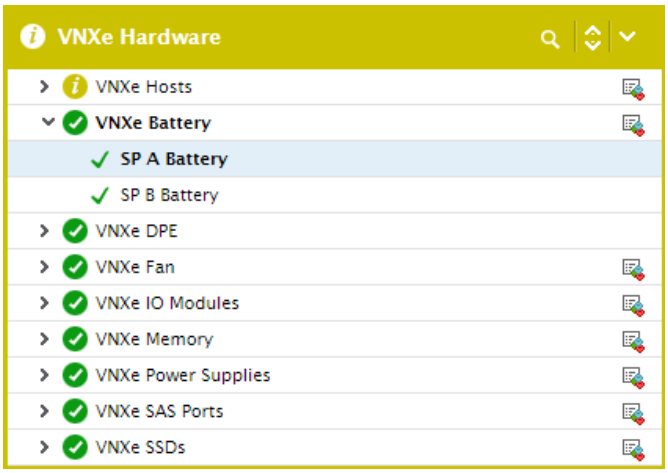

Figure 3.2: The tests mapped to the VNXe Hardware layer

3.1.1 VNXe Host Test

This test reports the current health of each host connected to the target storage system. By closely monitoring the health of the hosts, hosts that have failed can be identified easily!

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each host connected to the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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>Health state</td><td>Indicates the current health of this host connected to the target storage system.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Normal</td><td>0</td></tr><tr><td>Attention</td><td>1</td></tr><tr><td>Unknown</td><td>2</td></tr><tr><td>Degraded/Warning</td><td>3</td></tr><tr><td>Minor failure</td><td>4</td></tr><tr><td>Major failure</td><td>5</td></tr><tr><td>Critical failure</td><td>6</td></tr><tr><td>Non-recoverable error</td><td>7</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this host. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.
The detailed diagnosis of this measure lists the address, the type of operating system and the health of the host.</td></tr>
</table>

3.1.2 VNXe Battery Test

A 3 - cell Lithium -Ion Battery Backup Unit (BBU) is located within each Storage Processor (SP) enclosure. The battery is designed to power systems long enough to flush the SP cache contents to an internal mSATA device in the case of a power failure or in the case of SP removal from the Disk Processor Enclosure (DPE). Atleast one BBU is required to be operating normally for SP cache to

remain enabled. Therefore, it is necessary for the administrators to keep constant vigil on the health of the BBUs round the clock. The **VNXe Battery** test helps administrators in this regard!

This test auto-discovers the battery backup unit of the target storage system and for each battery, reports the current health. Using this test, administrators may be alerted to batteries that failed/degraded and replace those batteries well before users identify any impact on the storage system.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each battery of the target EMC VNXe Storage system being monitored.

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	• Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this battery.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this battery. The graph of this measure however is represented using the numeric equivalents only - 0 to 7. The detailed diagnosis of this measure lists the owner of the storage processor, the slot, the health of the battery and the model of the storage system.

3.1.3 VNXe Disk Processor Enclosures Test

This test reports the current health of each Disk Processor Enclosure in the target storage system. By closely monitoring the health of the Disk Processor Enclosures, degraded and failed Disk Processor Enclosures can be identified easily.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Disk Processor Enclosure of the target storage system being monitored.

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this Disk Processor Enclosure.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this Disk Processor Enclosure. The graph of this measure however is represented using the numeric equivalents only - 0 to 7. The detailed diagnosis of this measure lists the health, storage system model, the power of the disk processor enclosure and the temperature.

3.1.4 VNXe Fan Test

Each Storage Processor has three fan modules above it to dissipate heat away from the storage system. For the system to stay operational, atleast two of the three fans on each SP must be active. If either Storage Processor has two or more fans inactive, the system will save cache contents and shut down automatically. In large production environments, administrators may not desire frequent shut downs of their mission critical systems. Therefore, it is necessary for the administrators to frequently monitor the hardware components of the storage system and ensure that a hardware failure does not contribute to the shut down of the storage system. The **VNXe Fans** test helps administrators in this regard!

This test reports the current health of each cooling fan in the target storage system. By closely monitoring the health of the cooling fans, fans that are running abnormally and fans that have failed can be identified and replaced at a faster pace!

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each fan on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this cooling fan.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this cooling fan. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.

Measurement	Description	Measurement Unit	Interpretation
			The detailed diagnosis of this measure lists the ID of the fan, the slot, health, serial number and model of the fan.

3.1.5 VNXe IO Modules Test

This test auto-discovers the I/O modules on the target storage system and for each I/O module, reports the current health. Using this test, administrators may be alerted to I/O module that failed/degraded and replace those I/O module before irreparable damage occurs to the target storage system.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each I/O module on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this I/O module.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this I/O module. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.

Measurement	Description	Measurement Unit	Interpretation
			The detailed diagnosis of this measure lists the ID, slot, health of the I/O module, model and serial number of the I/O module.

3.1.6 VNXe Memory Test

This test auto- discovers the memory modules on the target storage system and for each memory module, reports the current health. Using this test, administrators may be alerted to the memory module that failed/degraded and replace those memory module before irreparable damage occurs to the target storage system.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each memory module on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this memory module.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal / 0 Attention / 1 Unknown / 2 Degraded/Warning / 3 Minor failure / 4 Major failure / 5 Critical failure / 6 Non-recoverable error / 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this memory module. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.

Measurement	Description	Measurement Unit	Interpretation
			The detailed diagnosis of this measure lists the ID, name of the storage processor, slot, health, model and serial number of the memory module.

3.1.7 VNXe Power Supplies Test

This test auto-discovers the power supply units on the target storage system and for each power supply unit, reports the current health. Using this test, administrators may be alerted to power supply units that failed/degraded and replace those power supply units well before users complain that the target storage system is inaccessible.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each power supply unit on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this power supply unit.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this power supply unit. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.

Measurement	Description	Measurement Unit	Interpretation
			The detailed diagnosis of this measure lists the ID, Storage processor, slot, health, manufacturer model and serial number of the power supply unit.

3.1.8 VNXe SAS Ports Test

This test auto-discovers the SAS ports on the target storage system and for each SAS port, reports the current health. Using this test, administrators may be alerted to SAS ports that failed/degraded and replace those ports well before users complain that the target storage system is inaccessible.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each SAS port on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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,

Parameters	Description
	choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this SAS port.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this SAS port. The graph of this measure however is represented using the numeric equivalents only - 0 to 7. The detailed diagnosis of this measure

Measurement	Description	Measurement Unit	Interpretation
			lists the SAS port ID, name of the storage processor, connector type and health of the port.

3.1.9 VNXe SSDs Test

This test auto-discovers the SSD on the target storage system and for each SSD, reports the current health. Using this test, administrators may be alerted to SSD that failed/degraded and replace those SSDs well before users complain that the target storage system is inaccessible.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each SSD on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>Health state</td><td>Indicates the current health of this SSD.</td><td></td><td>The values reported by this measure and its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Normal</td><td>0</td></tr><tr><td>Attention</td><td>1</td></tr><tr><td>Unknown</td><td>2</td></tr><tr><td>Degraded/Warning</td><td>3</td></tr><tr><td>Minor failure</td><td>4</td></tr><tr><td>Major failure</td><td>5</td></tr><tr><td>Critical failure</td><td>6</td></tr><tr><td>Non-recoverable error</td><td>7</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this SSD. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.</td></tr>
</table>

3.2 The VNXe Physical Storage Layer

The tests mapped to this layer monitors the health, the level of activity on and space usage of each disk and storage pool in the target VNXe storage system, and sends out proactive alerts to administrators intimating them of probable disk space contentions and abnormal I/O activity levels.

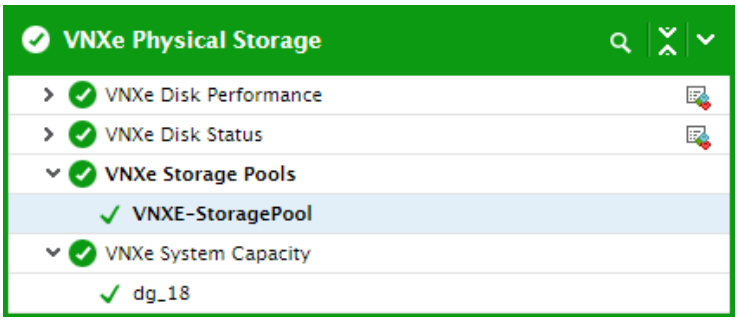

Figure 3.3: The tests mapped to the VNXe Physical Storage layer

3.2.1 VNXe Disk Performance Test

This test monitors the load balancing capability of each disk of the target storage system. Using this test, administrators can pin point the disks that are handling more I/O requests than the rest. This way, irregularities in the distribution of I/O load across disks can be detected at ease and in the process, administrators would be able 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.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Processor: Disk* combination on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.

Parameters	Description
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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
Peak read bandwidth	Indicates the maximum amount of data read from this disk per second.	MB/sec	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the read bandwidth corresponding to that time.
Average read bandwidth	Indicates the average amount of data read from this disk per second.	MB/sec	
Peak write bandwidth	Indicates the maximum amount of data written to this disk per second.	MB/sec	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the write bandwidth corresponding to that time.
Average write bandwidth	Indicates the average amount of data written to this disk per second.	MB/sec	
Peak read IOPS	Indicates the maximum number of read operations performed on this disk per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the read IOPS corresponding to that time.

Measurement	Description	Measurement Unit	Interpretation
Average read IOPS	Indicates the average number of read operations performed on this disk per second.	IOPS	
Peak write IOPS	Indicates the maximum number of write operations performed on this disk per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the write IOPS corresponding to that time.
Average write IOPS	Indicates the average number of write operations performed on this disk per second.	IOPS	
Peak total IOPS	Indicates the total number of I/O operations performed on this disk per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the total IOPS corresponding to that time.
Average total IOPS	Indicates the average number of I/O operations performed on this disk per second.	IOPS	
Peak service time	Indicates the maximum time taken by this disk to service user requests.	Milliseconds	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and request service time.
Average service time	Indicates the average time taken by this disk to service user requests.	Milliseconds	
Peak response time	Indicates the maximum time taken by this disk to respond to user requests.	Milliseconds	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the response time for user requests.
Average response time	Indicates the average time taken by this disk to respond to user requests.	Milliseconds	

3.2.2 VNXe Disk Status Test

This test monitors the overall health, and the capacity of each disk inserted in the slot of the target 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.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Slot:Disk* combination on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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

Parameters	Description
	measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this disk.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal: 0 Attention: 1 Unknown: 2 Degraded/Warning: 3 Minor failure: 4 Major failure: 5 Critical failure: 6 Non-recoverable error: 7 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current health of this disk. The graph of this measure however is represented using the numeric equivalents only - 0 to 7. The detailed diagnosis of this measure lists the disk ID, health, type of the disk, rotational speed of the disk, current speed of the disk and the maximum speed of the disk.
Capacity	Indicates the total capacity of this disk.	GB	

Measurement	Description	Measurement Unit	Interpretation
User capacity	Indicates the amount of disk space allocated to the users accessing this disk.	GB	

3.2.3 VNXe Storage Pools Test

VNXe storage is contained in storage pools. A storage pool is a group of disks of similar type and speed. When storage is allocated for application use, you have the option of choosing the type of storage pool. Depending on the model of the target VNXe storage system and its disk configuration, different storage pools are available for new storage. Storage pools can be created automatically by the system depending on the disk types present, or they can be custom created via a wizard.

Similarly, thin provisioning is the ability to present a server with more capacity than is actually allocated within the storage system. When thin provisioning is enabled for a storage resource, the amount of storage requested is not allocated immediately to the resource. Instead, a small quantity of the storage is allocated by the EMC VNXe to the storage resource. When the amount of storage consumed within the storage resource reaches the limit of the current allocation, the system allocates additional storage to the storage resource from the storage pool. Thin provisioning allows multiple storage resources to subscribe to common storage capacity within a pool, while the system allocates only a portion of the physical capacity requested by each storage resource. VNXe systems allows the storage pools to be oversubscribed.

Without sufficient space, the disks cannot service I/O requests from users. Similarly, if a storage pool is oversubscribed, the users have to wait longer than usual toretreive the data from the disks. This is why, the storage pool assigned to a disk has to be frequently checked for space. The **Storage Pools** test enables this check. This test monitors the health, subscription and the usage of space in every storage pool and proactively alerts administrators if the storage space in any pool is about to be used up completely! This way, the test prompts administrators to right-size their storage pools, so that users have no issues accessing their disks.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Pool* in the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this storage pool.		The values reported by this measure and its numeric equivalents are mentioned in the table below:

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Normal</td><td>0</td></tr>
<tr><td>Attention</td><td>1</td></tr>
<tr><td>Unknown</td><td>2</td></tr>
<tr><td>Degraded/Warning</td><td>3</td></tr>
<tr><td>Minor failure</td><td>4</td></tr>
<tr><td>Major failure</td><td>5</td></tr>
<tr><td>Critical failure</td><td>6</td></tr>
<tr><td>Non-recoverable error</td><td>7</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this storage pool. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.
The detailed diagnosis of this measure lists the ID, description, health, threshold, RAID level, Fast cache enabled status of the storage pool.
</td></tr>
<tr><td>Total space</td><td>Indicates the total capacity of this storage pool.</td><td>GB</td><td></td></tr>
<tr><td>Current allocation</td><td>Indicates the amount of space that is currently in use in this storage pool.</td><td>GB</td><td>Ideally, the value of this measure should be low.</td></tr>
<tr><td>Remaining space</td><td>Indicates the amount of space that is available for use in this storage pool.</td><td>GB</td><td>Ideally, the value of this measure should be high. Compare the value of this measure across storage pools to identify which storage pool is about to run out of space. You may want to add more space to this storage pool by say, adding more disk volumes to the pool.</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
Used size	Indicates the percentage of space that is currently in use in this storage pool.	Percentage	
Free size	Indicates the percentage of space that is available for use in this storage pool.	Percentage	
Subscription size	Indicates the amount of storage that had been requested by the storage resources associated with this storage pool.	GB	
Subscription	Indicates the percentage of storage that had been requested by the storage resources associated with this storage pool.	Percentage	A value greater than 100 indicates that the storage pool is over subscribed.
Number of Drives	Indicates the number of drives configured for this storage pool.	Number	

3.2.4 VNXe System Capacity Test

When automatic disk configuration is enabled in the EMC VNXe storage system, the system allocates existing disks into a capacity, and/or performance and/or extreme performance pool, depending on the number and type of available disks. SAS disks are allocated in multiples of either 6 or 7 and these disks are collectively termed as disk groups. A spare disk may be assigned for the first 0 to 30 disks and occasionally, one disk will be left unassigned. In larger environments, the spare disks and unassigned disks may vary depending on the total number of disks. If the capacity of the disks in a disk group is full or if a disk in the disk group fails, the spare disk would be used from the disk group. If the spare disks and unassigned disks are used completely, then the disk group may be insufficient to store further data leading to data loss. Therefore, it is necessary to monitor the capacity of the disks in the disk groups and the number of spare disks and unassigned disks in each disk group. The **VNXe System Capacity** test helps administrators in this regard!

This test auto-discovers the disk groups in the target storage system and for each disk group, this test reports the total capacity and the number of drives, spare disks and the unassigned disks.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Disk Group of the target storage system being monitored.

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Each drive capacity	Indicates the average capacity of each drive in this disk group.	GB	
Total capacity	Indicates the total capacity of this disk group.	GB	
Total drives	Indicates the total drives available in this disk group.	Number	
Unconfigured drives	Indicates the number of drives that were	Number	

Measurement	Description	Measurement Unit	Interpretation
	unconfigured/unassigned in this disk group.		
Spare drives	Indicates the number of spare drives that were available for use in this disk group.	Number	

3.3 The VNXe System 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 target storage system. In addition, the cache of the target storage system is also monitored and its usage and effectiveness is determined.

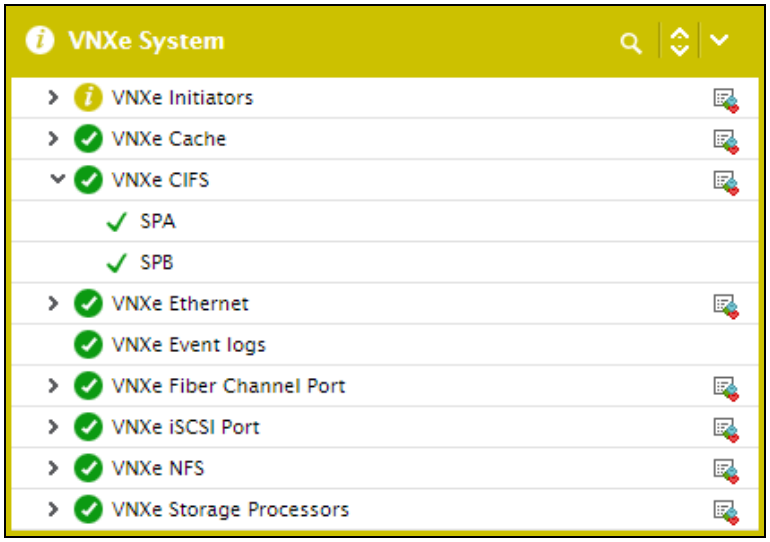

Figure 3.4: The tests mapped to the VNXe System layer

3.3.1 VNXe Initiators Test

This test auto-discovers the initiators used to connect the host to the target storage system and for each initiator, reports the current health. Using this test, administrators may be alerted to initiators that failed/degraded and replace those initiators well before users complain that the hosts are inaccessible.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Host: Initiator* combination on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

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

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Normal</td><td>0</td></tr>
<tr><td>Attention</td><td>1</td></tr>
<tr><td>Unknown</td><td>2</td></tr>
<tr><td>Degraded/Warning</td><td>3</td></tr>
<tr><td>Minor failure</td><td>4</td></tr>
<tr><td>Major failure</td><td>5</td></tr>
<tr><td>Critical failure</td><td>6</td></tr>
<tr><td>Non-recoverable error</td><td>7</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this initiator. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.
The detailed diagnosis of this measure lists the Host UID, initiator type, port login and the health of the initiator.
</td></tr>
</table>

3.3.2 VNXe Cache Test

This test monitors the usage of the cache supported by the storage system.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Storage Processor of the target storage system being monitored.

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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
Clean pages	Indicates the number of cache clean pages in this storage processor.	Number	
Dirty pages	Indicates the number of dirty cache pages in this storage processor.	Number	These are pages in write cache that have received new data from hosts but have not yet been flushed to disk.

Measurement	Description	Measurement Unit	Interpretation
			While a high value (i.e., a value between 60-80% of the write cache) for this measure is good 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, a very high value – i.e., a value equal to or close to the total number of pages in the write cache – is a sign of bad health, as it indicates that the write cache is over-stressed.
Flushed blocks	Indicates the rate at which data blocks were flushed into the cache of this storage processor.	Blocks/sec	
Flush rate	Indicates the rate at which flush operations were performed on the cache of this storage processor.	Operations/sec	
Free pages	Indicates the number of free cache pages in this storage processor.	Number	
Peak read hits	Indicates the maximum number of read requests serviced by the cache of this storage processor per second.	Hits/sec	The detailed diagnosis of this measure lists the time, name of the storage processor and the read hits during that time period.
Peak read misses	Indicates the maximum number of read requests that failed to be serviced from the cache of this storage processor per second.	Misses/sec	The detailed diagnosis of this measure lists the time, name of the storage processor and the read misses during that time period.
Peak write hits	Indicates the maximum number of write requests to this storage processor that were serviced by the	Hits/sec	The detailed diagnosis of this measure lists the time, name of the storage processor and the write hits during that time period.

Measurement	Description	Measurement Unit	Interpretation
	cache per second.		
Peak write misses	Indicates the maximum number of write requests that failed to be serviced to the cache of this storage processor per second.	Misses/sec	The detailed diagnosis of this measure lists the time, name of the storage processor and the write misses during that time period.
Peak dirty cache	Indicates the maximum amount of dirty data available in the dirty cache pages of this storage processor.	MB	
Average read hits	Indicates the average rate of read requests to this storage processor that were serviced by the cache.	Hits/sec	
Average read misses	Indicates the average number of read requests that failed to be serviced from the cache of this storage processor per second.	Misses/sec	
Average write hits	Indicates the average rate of write requests to this storage processor that were serviced by the cache.	Hits/sec	
Average write misses	Indicates the average number of write requests that failed to be serviced to the cache of this storage processor per second.	Misses/sec	
Average dirty cache	Indicates the average amount of dirty data available in the dirty cache pages of this storage processor.	MB	

Measurement	Description	Measurement Unit	Interpretation
Free pages percent	Indicates the percentage of free cache pages.	Percentage	
Dirty pages percent	Indicates the percentage of dirty cache pages.	Percentage	

3.3.3 VNXe CIFS Test

EMC VNX uses Common Internet File System (CIFS) protocol as an open standard for network file service. CIFS is a file access protocol designed for the Internet and is based on the Server Message Block (SMB) protocol that the Microsoft Windows operating system uses for distributed file sharing. The CIFS protocol lets remote users access file systems over the network. You can configure the CIFS protocol on a storage processor to enable that data mover to allow remote users to access the file systems that it contains via CIFS. By continuously monitoring the CIFS operations on every storage processor, you can easily identify that data mover on which CIFS is most ineffective/problematic. This is where, the **VNXe CIFS** test helps. This test monitors the CIFS reads and writes performed on each storage processor in the target storage system and reports the following:

- How well the I/O operations were performed using the CIFS protocol, and whether any delays were noticed;
- The bandwidth consumption when CIFS reads and writes are performed on the storage processor

These statistics will not only enable administrators to promptly detect current or probable latencies in I/O operations when using CIFS, but will also help them figure out which I/O activity was most latent – i.e., whether reading or writing – and on which storage processor.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Processor* of the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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
Peak read bandwidth	Indicates the maximum amount of data read through CIFS protocol from this storage processor per second.	MB/sec	The detailed diagnosis of this measure lists the time, name of the storage processor and the read bandwidth corresponding to that time.
Average read	Indicates the average	MB/sec	Compare the value of this measure

Measurement	Description	Measurement Unit	Interpretation
bandwidth	amount of data read through CIFS protocol from this storage processor per second.		across the storage processors to figure out the storage processor on which maximum bandwidth is consumed for reading the data.
Peak write bandwidth	Indicates the maximum amount of data written using CIFS protocol to this storage processor per second.	MB/sec	The detailed diagnosis of this measure lists the time, name of the storage processor and the write bandwidth corresponding to that time.
Average write bandwidth	Indicates the average amount of data written using CIFS protocol to this storage processor per second.	MB/sec	Compare the value of this measure across the storage processors to figure out the storage processor on which maximum bandwidth is consumed for writing the data.
Peak read IOPS	Indicates the maximum number of read operations performed using CIFS protocol on this storage processor per second.	IOPS	The detailed diagnosis of this measure lists the time, the name of the storage processor and the read IOPS corresponding to that time.
Average read IOPS	Indicates the average number of read operations performed using CIFS protocol on this storage processor per second.	IOPS	Compare the value of this measure across the storage processors to figure out the storage processor that is performing the maximum read operations.
Peak write IOPS	Indicates the maximum number of write operations performed using CIFS protocol on this storage processor per second.	IOPS	The detailed diagnosis of this measure lists the time, name of the storage processor and the write IOPS corresponding to that time.
Average write IOPS	Indicates the average number of write operations performed using CIFS protocol on this storage processor per second.	IOPS	Compare the value of this measure across the storage processors to figure out the storage processor that is performing the maximum write operations.
Peak total IOPS	Indicates the total number of I/O operations	IOPS	The detailed diagnosis of this measure lists the time, name of the storage

Measurement	Description	Measurement Unit	Interpretation
	performed using CIFS protocol on this storage processor per second.		processor and the total IOPS corresponding to that time.
Average total IOPS	Indicates the average number of I/O operations performed using CIFS protocol on this storage processor per second.	IOPS	Compare the value of this measure across the storage processors to figure out the storage processor that is performing the maximum I/O operations.

3.3.4 VNXe Ethernet Test

The EMC VNXe provides flexible DAS, NAS, or SAN connectivity options through Ethernet and Fibre Channel ports and supports a wide range of protocols including CIFS (SMB 1, SMB 2 and SMB 3), NFSv3, iSCSI, and Fibre Channel. By periodically checking the health of the ports and measuring the I/O load on the ports, you can identify overloaded ports, isolate the storage processor they support, and thus proactively detect potential/existing load-balancing irregularities and/or processing bottlenecks with the storage processors. The **VNXe Ethernet** test facilitates this port check. For every port configured on each of the storage processors (A and B) supported by the target storage system, this test reports the health of the ports, the I/O load on the ports and the processing ability of the ports. In the process, the test not only points administrators to overloaded ports, but also puts a finger on ports that are slow when processing I/O requests.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage processor port* on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere Management Suite**, to communicate with and monitor the storage device.

Parameters	Description
	To enable the eG agent to invoke the CLI, configure the full path to the CLI in the UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this port.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Unconfigured / 0 Normal / 1 Attention / 2 Unknown / 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>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Degraded/Warning</td><td>4</td></tr>
<tr><td>Minor failure</td><td>5</td></tr>
<tr><td>Major failure</td><td>6</td></tr>
<tr><td>Critical failure</td><td>7</td></tr>
<tr><td>Non-recoverable error</td><td>8</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this storage processor port. The graph of this measure however is represented using the numeric equivalents only - 0 to 8.
The detailed diagnosis of this measure lists the name of the storage processor, the protocol using which the port is accessed, the MTU size of the interface card, speed, port ID, time, connector type, MAC address etc.
</td></tr>
<tr><td>Peak bandwidth in</td><td>Indicates the maximum amount of data received by this port per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the name of the storage processor, the protocol, the MTU size, speed, port ID, time, connector type, MAC address, input bandwidth etc.</td></tr>
<tr><td>Average bandwidth in</td><td>Indicates the average amount of data received by this port per second.</td><td>MB/sec</td><td></td></tr>
<tr><td>Peak bandwidth out</td><td>Indicates the maximum amount of data sent through this port per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the name of the storage processor, the protocol, the MTU size, speed, port ID, time, connector type, MAC address, output bandwidth etc.</td></tr>
<tr><td>Average bandwidth</td><td>Indicates the maximum</td><td>MB/sec</td><td></td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
out	amount of data sent through this port per second.		
Peak packets in	Indicates the maximum amount of packets received by this port per second.	Packets/sec	The detailed diagnosis of this measure lists the name of the storage processor, the protocol, the MTU size, speed, port ID, time, connector type, MAC address, packets received etc.
Average packets in	Indicates the average amount of packets received by this port per second.	Packets/sec	
Peak packets out	Indicates the maximum amount of packets sent through this port per second.	Packets/sec	The detailed diagnosis of this measure lists the name of the storage processor, the protocol, the MTU size, speed, port ID, time, connector type, MAC address, packets sent etc.
Average packets out	Indicates the average amount of packets sent through this port per second.	Packets/sec	

3.3.5 VNXe Event logs Test

This test reports the statistical information about the events generated by the target storage system.

Target of the Test: An EMC VNXe Storage System

Agent deploying the test: A remote agent

Output of the test: One set of results for the target storage system being monitored.

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.

Parameters	Description
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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.

Measures reported by the test

Measurement	Description	Measurement Unit	Interpretation
Warning	Indicates the number of warnings generated during the test's last execution.	Number	A high value of this measure indicates problems that may not have an immediate impact, but may cause future problems. The detailed diagnosis of this measure describes all the warning events captured during the last measurement period.
Error	This refers to the number of error events generated during the last execution of the	Number	A very low value (zero) is desired for this measure, as it indicates good health. An increasing trend or a high value indicates the existence of problems.

Measurement	Description	Measurement Unit	Interpretation
	test.		The detailed diagnosis of this measure describes all the error events captured during the last measurement period.
Critical	Indicates the number of critical events that were generated when the test was last executed.	Number	A critical event is one that the storage system cannot automatically recover from. A very low value (zero) indicates that the system is in a healthy state and is running smoothly without any potential problems. An increasing trend or high value indicates the existence of fatal/irrepairable problems. The detailed diagnosis of this measure describes all the critical events captured during the last measurement period.

3.3.6 VNXe Fiber Channel Port Test

By periodically checking the health of the ports and measuring the I/O load on the ports, you can identify overloaded ports, isolate the storage processor they support, and thus proactively detect potential/existing load-balancing irregularities and/or processing bottlenecks with the storage processors. The **VNXe Fiber Channel Port** test facilitates this port check. For every port configured on each of the storage processors (A and B) supported by the target storage system, this test reports the health of the ports, the I/O load on the ports and the processing ability of the ports. In the process, the test not only points administrators to overloaded ports, but also puts a finger on ports that are slow when processing I/O requests.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Fiber Channel Port on the target storage system being monitored

Configurable parameters for the test

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

Parameters	Description
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this Fiber Channel Port.		The values reported by this measure and its numeric equivalents are mentioned in the table below: Measure value: Unconfigured — Numeric 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>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Normal</td><td>1</td></tr>
<tr><td>Attention</td><td>2</td></tr>
<tr><td>Unknown</td><td>3</td></tr>
<tr><td>Degraded/Warning</td><td>4</td></tr>
<tr><td>Minor failure</td><td>5</td></tr>
<tr><td>Major failure</td><td>6</td></tr>
<tr><td>Critical failure</td><td>7</td></tr>
<tr><td>Non-recoverable error</td><td>8</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this Fiber Channel Port. The graph of this measure however is represented using the numeric equivalents only - 0 to 8.
The detailed diagnosis of this measure lists the name of the storage processor, health, speed, connector type etc.
</td></tr>
<tr><td>Peak read bandwidth</td><td>Indicates the maximum amount of data read using this port per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the name of the storage processor, health, speed, connector type, time, read bandwidth etc.</td></tr>
<tr><td>Average read bandwidth</td><td>Indicates the average amount of data read using this port per second.</td><td>MB/sec</td><td></td></tr>
<tr><td>Peak write bandwidth</td><td>Indicates the maximum amount of data written through this port to the disk per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the name of the storage processor, health, speed, connector type, time, write bandwidth etc.</td></tr>
<tr><td>Average write</td><td>Indicates the average</td><td>MB/sec</td><td></td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
bandwidth	amount of data written through this port to the disk per second.		
Peak read IOPS	Indicates the maximum number of read operations performed using this port per second.	IOPS	The detailed diagnosis of this measure lists the name of the storage processor, health, speed, connector type, time, read IOPS etc.
Average read IOPS	Indicates the average number of read operations performed using this port per second.	IOPS	
Peak write IOPS	Indicates the maximum number of write operations performed through this port to the disk per second.	IOPS	The detailed diagnosis of this measure lists the name of the storage processor, health, speed, connector type, time, write IOPS etc.
Average write IOPS	Indicates the average number of write operations performed through this port on the disk per second.	IOPS	

3.3.7 VNXe iSCSI Port Test

Storage ports help the storage processors receive and process I/O requests. By periodically checking the health of the ports and measuring the I/O load on the ports, you can identify overloaded ports, isolate the storage processor they support, and thus proactively detect potential/existing load-balancing irregularities and/or processing bottlenecks with the storage processors. The **VNXe iSCSI Port** test facilitates this port check. For every port configured on each of the storage processors (A and B) supported by the target storage system, this test reports the health of the ports, the I/O load on the ports and the processing ability of the ports. In the process, the test not only points administrators to overloaded ports, but also puts a finger on ports that are slow when processing I/O requests.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Processor: iSCSI port* combination on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current		The values reported by this measure and

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td>health of this iSCSI port.</td><td></td><td>its numeric equivalents are mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Unconfigured</td><td>0</td></tr><tr><td>Normal</td><td>1</td></tr><tr><td>Attention</td><td>2</td></tr><tr><td>Unknown</td><td>3</td></tr><tr><td>Degraded/Warning</td><td>4</td></tr><tr><td>Minor failure</td><td>5</td></tr><tr><td>Major failure</td><td>6</td></tr><tr><td>Critical failure</td><td>7</td></tr><tr><td>Non-recoverable error</td><td>8</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this iSCSI port. The graph of this measure however is represented using the numeric equivalents only - 0 to 8.</td></tr>
<tr><td>Peak read bandwidth</td><td>Indicates the maximum amount of data read through this port per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the read bandwidth.</td></tr>
<tr><td>Average read bandwidth</td><td>Indicates the average amount of data read through this port per second.</td><td>MB/sec</td><td></td></tr>
<tr><td>Peak write bandwidth</td><td>Indicates the maximum amount of data written through this port per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the write bandwidth.</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
Average write bandwidth	Indicates the average amount of data written through this port per second.	MB/sec	
Peak read IOPS	Indicates the maximum number of read operations performed through this iSCSI port per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the read IOPS.
Average read IOPS	Indicates the average number of read operations performed through this iSCSI port per second.	IOPS	
Peak write IOPS	Indicates the maximum number of write operations performed through this iSCSI port per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and the write IOPS.
Average write IOPS	Indicates the average number of write operations performed through this iSCSI port per second.	IOPS	

3.3.8 VNXe NFS Test

By continuously monitoring the NFS operations on every storage processor, you can easily identify that storage processor on which NFS is most ineffective/problematic. This is where, the **VNXe NFS** test helps. This test monitors the NFS reads and writes performed on each storage processor in the target storage system and reports the following:

- How well the I/O operations were performed using the NFS protocol, and whether any delays were noticed;
- The total amount of data transacted when performing NFS reads and writes

These statistics will not only enable administrators to promptly detect current or probable latencies in I/O operations when using NFS, but will also help them figure out which I/O activity was most latent – i.e., whether reading or writing – and on which storage processor.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Processor* of the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
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
Peak read bandwidth	Indicates the maximum amount of data read through NFS protocol from this storage processor per second.	MB/sec	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and read bandwidth of the storage processor.
Average read bandwidth	Indicates the average amount of data read through NFS protocol from this storage processor per second.	MB/sec	
Peak write bandwidth	Indicates the maximum amount of data written using NFS protocol to this storage processor per second.	MB/sec	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and write bandwidth of the storage processor.
Average write bandwidth	Indicates the average amount of data written using NFS protocol to this storage processor per second.	MB/sec	
Peak read IOPS	Indicates the maximum number of read operations performed using NFS protocol on this storage processor per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and read IOPS of the storage processor.
Average read IOPS	Indicates the average number of read operations performed using NFS protocol on this storage processor per second.	IOPS	
Peak write IOPS	Indicates the maximum number of write operations performed using NFS protocol on this storage processor per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and write IOPS of the storage processor.

Measurement	Description	Measurement Unit	Interpretation
Average write IOPS	Indicates the average number of write operations performed using NFS protocol on this storage processor per second.	IOPS	
Peak total IOPS	Indicates the total number of I/O operations performed using NFS protocol on this storage processor per second.	IOPS	The detailed diagnosis of this measure lists the VNX time, name of the storage processor and total IOPS of the storage processor.
Average total IOPS	Indicates the average number of I/O operations performed using NFS protocol on this storage processor per second.	IOPS	

3.3.9 VNXe Storage Processors Test

This test auto-discovers the storage processors on the target storage system and for each storage processor, reports the current health, uptime and the temperature. Using this test, administrators may be alerted to storage processors that failed/degraded, rebooted too often and operating at abnormal temperature range and take remedial steps to replace those storage processors before end users start complaining.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each Storage Processor on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the

Parameters	Description
	UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the User Name and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Health state	Indicates the current health of this storage processor.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Normal / 0 Attention / 1 Unknown / 2

<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>Degraded/Warning</td><td>3</td></tr>
<tr><td>Minor failure</td><td>4</td></tr>
<tr><td>Major failure</td><td>5</td></tr>
<tr><td>Critical failure</td><td>6</td></tr>
<tr><td>Non-recoverable error</td><td>7</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this storage processor. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.
The detailed diagnosis of this measure lists the storage processor name, the health , the name of the disk processor enclosure, the manufacturer model and mode of the storage processor.
</td></tr>
<tr><td>Memory size</td><td>Indicates the current memory of this storage processor.</td><td>GB</td><td></td></tr>
<tr><td>Peak utilization</td><td>Indicates the maximum percentage of core utilization detected on this storage processor.</td><td>Percentage</td><td>A consistently high value for this measure is a cause of concern.
The detailed diagnosis of this measure lists the name of the storage processor, the VNX time and the CPU utilization of the storage processor.</td></tr>
<tr><td>Average utilization</td><td>Indicates the average percentage of core utilization detected on this storage processor.</td><td>Percentage</td><td></td></tr>
<tr><td>Uptime</td><td>Indicates the total time that this storage</td><td></td><td>This measure displays the number of</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
	processor has been up since its last reboot.		years, months, days, hours, minutes and seconds since the last reboot. Administrators may wish to be alerted if the storage processor has been running without a reboot for a very long period. Setting a threshold for this metric allows administrators to determine such conditions.
Is rebooted?	Indicates whether this storage processor has been rebooted during the last measurement period or not.		If the value of this measure is *Yes*, it means that the storage processor was rebooted during the last measurement period. By checking the time periods when this metric changes from *No* to *Yes*, an administrator can determine the times when this storage processor was rebooted.
Temperature	Indicates the current temperature of this storage processor.	Celsius	Ideally, the temperature of this storage processor should be within permissible range. An abnormally high temperature of may lead to irreversible damage of the storage processor

3.4 The VNXe Logical Storage Layer

The test mapped to this layer helps administrators determine the health of each LUN and also figure out how quickly the LUNs process I/O requests. By closely monitoring the LUNs, administrators may be warned of potential processing slowdowns in the LUNs.

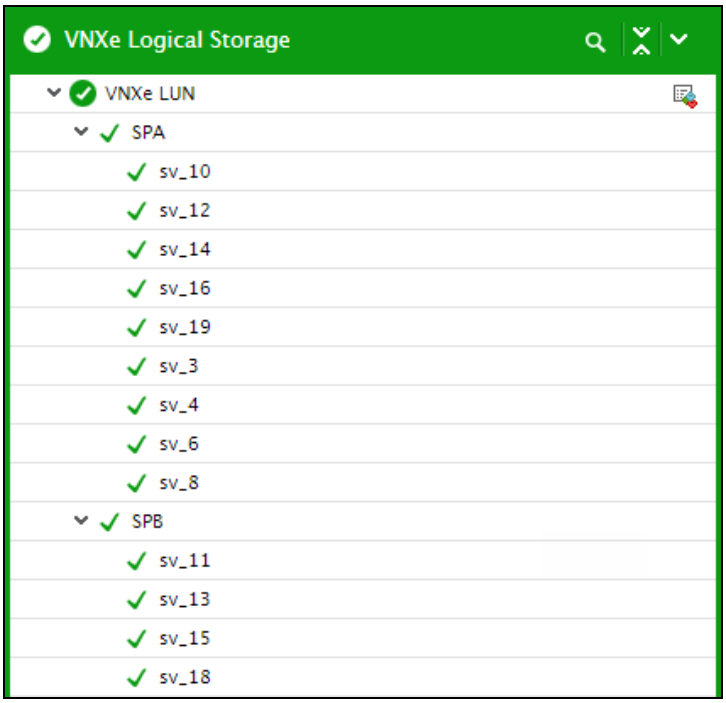

Figure 3.5: The tests mapped to the VNXe Logical Storage layer

3.4.1 VNXe LUN 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 block 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 target storage system. This is why, it is important that LUN performance is continuously monitored. This can be achieved using the **Vnxe LUN** test. This test auto-discovers the LUNs in the target storage system and reports the current state of each LUN 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.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each *Storage Processor: LUN* combination on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere 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 UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

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

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Measure value</th><th>Numeric Value</th></tr>
<tr><td>Normal</td><td>0</td></tr>
<tr><td>Attention</td><td>1</td></tr>
<tr><td>Unknown</td><td>2</td></tr>
<tr><td>Degraded/Warning</td><td>3</td></tr>
<tr><td>Minor failure</td><td>4</td></tr>
<tr><td>Major failure</td><td>5</td></tr>
<tr><td>Critical failure</td><td>6</td></tr>
<tr><td>Non-recoverable error</td><td>7</td></tr>
</table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate the current health of this LUN. The graph of this measure however is represented using the numeric equivalents only - 0 to 7.
The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
</td></tr>
<tr><td>Peak read bandwidth</td><td>Indicates the maximum amount of data read from this LUN per second.</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, read bandwidth, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.</td></tr>
<tr><td>Average read bandwidth</td><td>Indicates the average amount of data read from this LUN per second.</td><td>MB/sec</td><td></td></tr>
<tr><td>Peak write bandwidth</td><td>Indicates the maximum amount of data written to</td><td>MB/sec</td><td>The detailed diagnosis of this measure lists the LUN ID, name of the storage</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
	this disk per second.		processor, health, write bandwidth, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
Average write bandwidth	Indicates the average amount of data written to this LUN per second.	MB/sec	
Peak read IOPS	Indicates the maximum number of read operations performed on this LUN per second.	IOPS	The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, read IOPS, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
Average read IOPS	Indicates the average number of read operations performed on this disk per second.	IOPS	
Peak write IOPS	Indicates the maximum number of write operations performed on this LUN per second.	IOPS	The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, write IOPS, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
Average write IOPS	Indicates the average number of write operations performed on this LUN per second.	IOPS	
Peak total IOPS	Indicates the total number of I/O operations performed on this disk per second.	IOPS	The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, total IOPS, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
Average total IOPS	Indicates the average number of I/O operations performed on this LUN	IOPS	

Measurement	Description	Measurement Unit	Interpretation
	per second.		
Peak queue length	Indicates the maximum number of requests to this LUN that are in queue.	Number	The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, queue length, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
Average queue length	Indicates the average number of requests to this LUN that are in queue.	Number	A very high value could indicate a processing bottleneck on the LUN. By comparing the value of this measure across LUNs, you can quickly identify which LUN has too many pending requests - this LUN could probably be the one with the processing bottleneck.
Peak response time	Indicates the maximum time taken by this LUN to respond to user requests.	Milliseconds	The detailed diagnosis of this measure lists the LUN ID, name of the storage processor, health, response time, the host accessing the LUN, thin provisioning, snapshot count, replication destination etc.
Average response time	Indicates the average time taken by this LUN to respond to user requests.	Milliseconds	

3.5 The VNXe VM Layer

The tests mapped to this layer monitors the health of each virtual machine provisioned through the LUNs and disks of the target VNXe storage system, and sends out proactive alerts to administrators intimating them of unhealthy virtual machines.

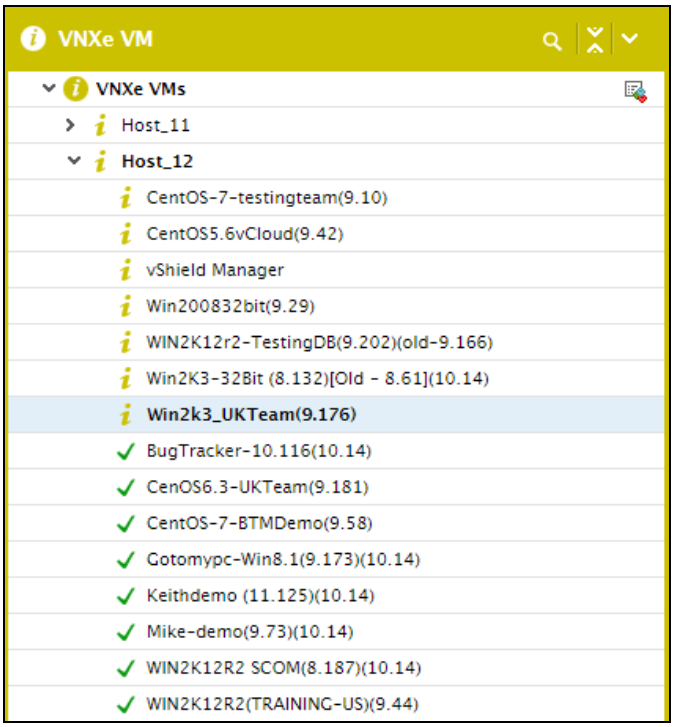

Figure 3.6: The tests mapped to the VNXe VM layer

3.5.1 VNXe VMs Test

This test auto-discovers the virtual machines on the target storage system and for each virtual machine, reports the current health. Using this test, administrators may be alerted to virtual machines that failed/degraded and replace those virtual machines well before users complain that the target storage system is inaccessible.

Target of the test : An EMC VNXe Storage system

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each VM on the target storage system being monitored

Configurable parameters for the test

Parameters	Description
Test Period	How often should the test be executed.
Host	The host for which the test is to be configured.
Unisphere CLI Path	The eG agent uses the command-line utility, **UEMCli.exe**, which is part of the **UniSphere Management Suite**, to communicate with and monitor the storage device.

Parameters	Description
	To enable the eG agent to invoke the CLI, configure the full path to the CLI in the UniSphere CLI Path text box.
Username and Password	Provide the credentials of a user possessing monitor role to access the storage device in the Username and Password text boxes.
Confirm Password	Confirm the password by retyping it here.
VNXe Version	Select the version of the target EMC VNXe storage system that is to be monitored from this list. By default, 1600 will be chosen from this list.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
State	Indicates the current state of this VM.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Powered on: 0 Powered off: 1 Suspended: 2 **Note:** By default, this measure reports the Measure Values listed in the table above to indicate the current state of this VM. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.

About eG Innovations

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

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

To learn more visit www.eginnovations.com.

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