Monitoring Dell Compellent

eG Innovations Product Documentation

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Total Performance Visibility

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Chapter 1: Introduction

The Dell Compellent Storage Center is an enterprise class storage area network (SAN) that significantly lowers capital expenditures, reduces storage management and administration time, provides continuous data availability and enables storage virtualization. Storage Center's industry-standard hardware and sophisticated software manage data at the block-level, maximizing utilization, automating tiered storage, simplifying replication and speeding data recovery.

Chapter 2: How does eG Enterprise Monitor a Dell Compellent Storage Center?

Storage Management Initiative Specification (SMI-S) is a standard interface specification developed by the Storage Networking Industry Association (SNIA). Based on the Common Information Model (CIM) and Web-Based Enterprise Management (WBEM) standards, SMI-S defines common protocols and data models that enable interoperability between storage vendor software and hardware.

The Dell Compellent SMI-S Provider version 1.4 works with the open source OpenPegasus CIM Server, which is included with the Enterprise Manager Data Collector. SMI-S can be configured during initial Data Collector installation or post-installation by modifying the properties of the Enterprise Manager Data Collector. When SMI-S is enabled and configured, the Data Collector automatically installs and manages the Dell Compellent SMI-S Provider and the OpenPegasus CIM Server; no additional installation is required.

The Dell Compellent SMI-S Provider is set up via the **Properties** section of the **Compellent Enterprise Data Collector Manager**. Once the Dell Compellent is configured, the eG agent will poll the SMI-S Provider of the Dell Compellent Storage Center at set intervals and collect the required performance metrics. Since the SMI-S Provider is embedded within the Dell Compellent Storage System, eG Enterprise Suite uses a **remote** agent to monitor the Dell Compellent Storage Center.

SMI-S can be set up during the Data Collector installation or at a latertime. Configuring the Dell Compellent SMI-S Provider consists of setting the following Data Collector Service properties:

- Selecting the **Service User Type** for the Data Collector Service. You can either choose the **Local User Account** or the **Local Service Account**.
- Manually/automatically creating the Pegasus Users according to the chosen **Service User Type**. If you choose the **Local User Account**, then the user type should possess admin privileges and should allow the Data Collector to automatically add a Pegasus CIM User. If you choose **Local Service Account** from this list, then you will be required to manually add atleast one Pegasus user to the Pegasus CIM Server.
- Enabling SMI-S properties including SLP/HTTP services, and selecting to manually/automatically manage the Pegasus users.

2.1 Configuring the Dell Compellent SMI-S Provider using a Local User Account (v5.5.4 and above)

To configure the Dell Compellent SMI-S Provider using a **Local User Account**, follow the steps as discussed below:

1. Login to the Windows server on which the the Dell Compellent Data Collector Manager is installed.
2. Create a local user on the server. The maximum length of the username and password should be 8 characters. **Note that the specified password should be Alpha-numeric**. **No special characters are allowed while specifying the user name.**
3. Add the local user to the **Administrators** group by following the steps mentioned below:
    - Select the **Groups** option from the **Local User and Groups** subnode of the **Server Manager** node. A context sensitive **Groups** section will appear in the right panel.
    - Clicking the **Administrators** group will invoke the **Administrators Properties** pop up window (see Figure 2.1)
    - The user that you have created will be listed in the **Members** section as shown in Figure 2.1.
    - Select the user and click the **Add** button to add the user to the **Administrators** group.

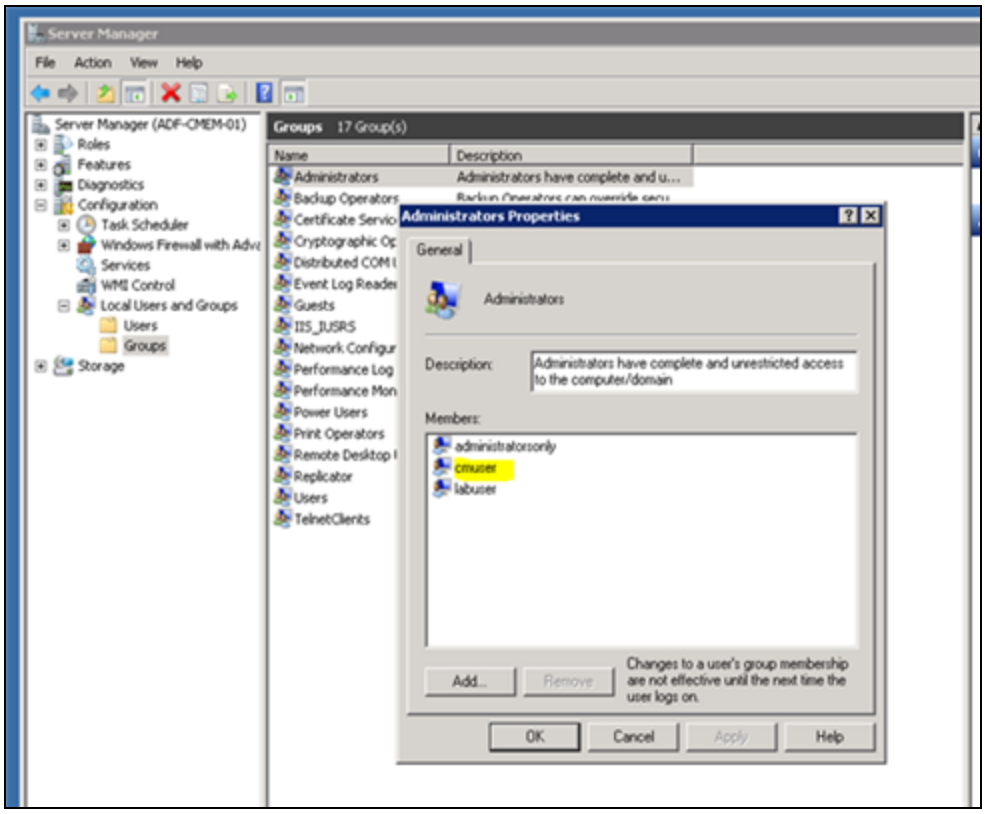

Figure 2.1: Adding the created local user to the Administrators group

4. Then, you will be required to associate this user to the **Logon as a Service** policy. To assoicate this user to the policy, do the following:

    - Follow the menu sequence in the Windows server: Start -> All Programs -> Administrative Tools -> Local Policies -> User Rights Assignment
    - A list of policies will then appear in the context sensitive right panel. Clicking the **Logon as a Service** policy will invoke the **Logon as a service Properties** window (see Figure 2.2).
    - Select the local user that you have created and click the **Add User or Group** button. Finally, clicking the **OK** button will register the necessary changes.

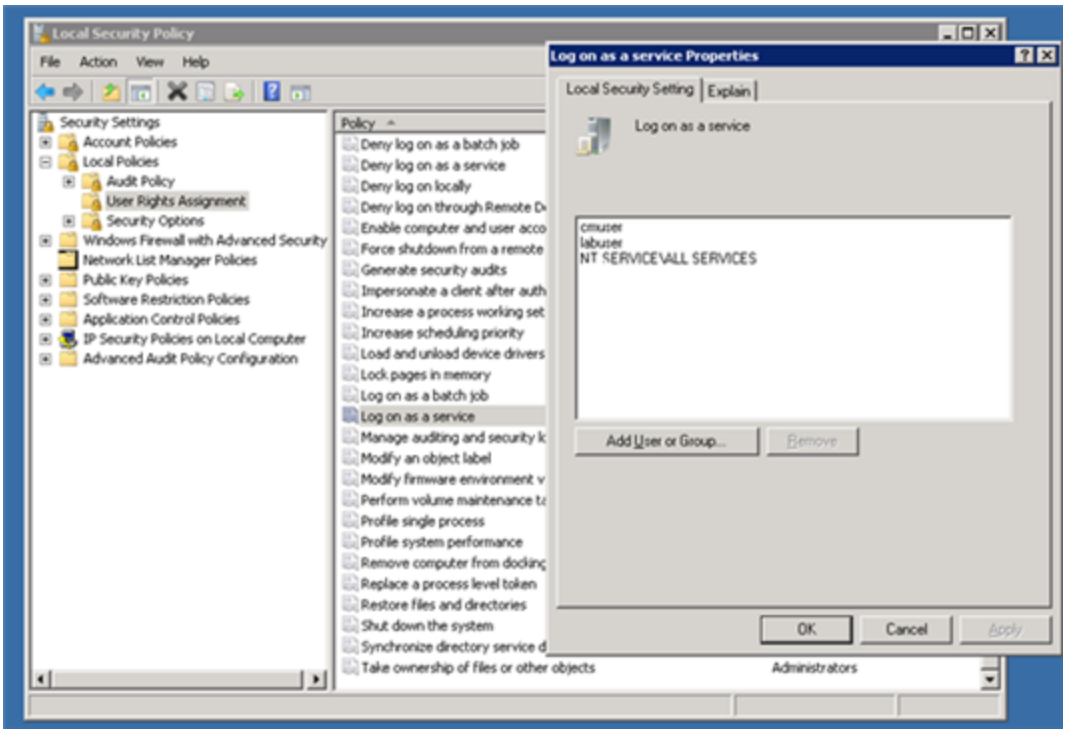

Figure 2.2: Associating the user to the Logon as a service policy

Note:

For the changes made in Step 3 and Step 4 to be effective, logoff and login to the Windows server with the credentials of the created local user.

5. Once you have provided the necessary privileges to the created local user, you will be required to add the same user to the Compellent Enterprise Manager.
6. If you have used the open security policy, then you can add the user through the Enterprise Manager Client Application. If you have used the Advanced security policy, then you can add the user from the Data Collector Manager Interface. Since we have used the open security policy, the user is added through the Enterprise Manager Client Application (see Figure 2.3).

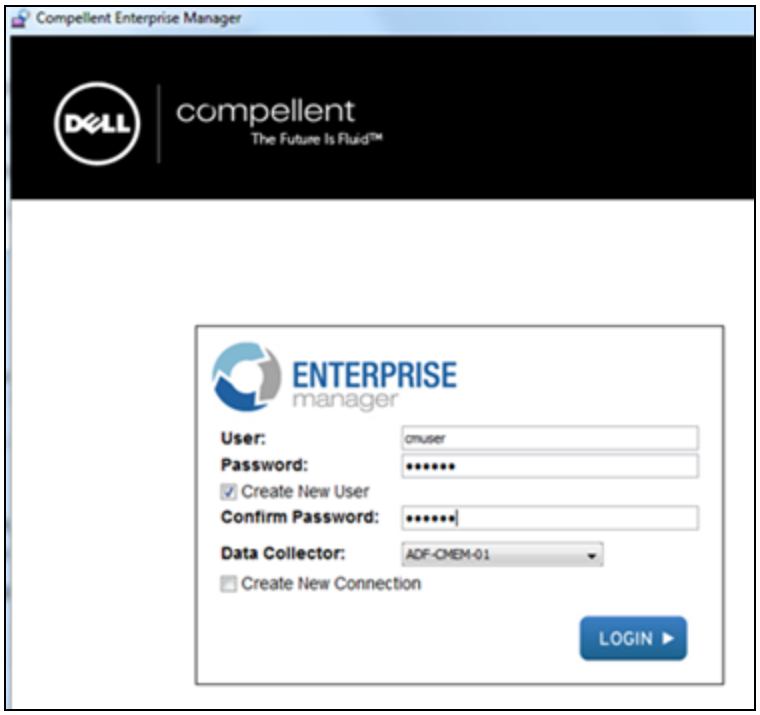

Figure 2.3: Adding a new user through the Compellent Enterprise Manager Client Application

7. Select the **Create New User** check box (see Figure 2.3) and then specify the **User** which is the same as the local user that you have created on the Windows server.
8. Specify the **Password** and then click the **LOGIN** button. **The password need not be the same as that of the password of the local user.**
9. Next, add the target Dell Compellent Storage Center that is to be monitored by clicking the **Add Storage Center** option that appears upon clicking the **Management** menu (see Figure 2.4):

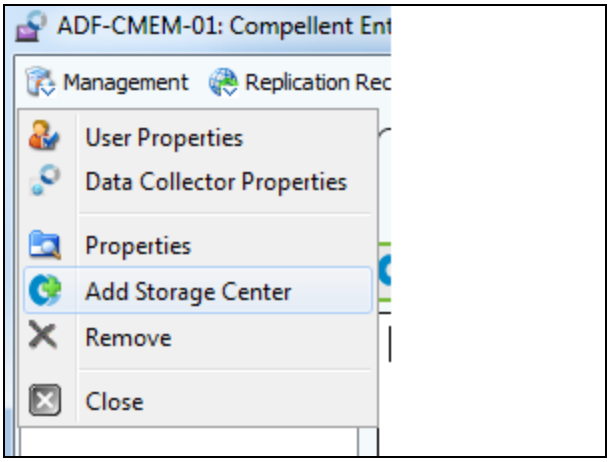

Figure 2.4: Navigating through the Management menu

10. In Figure 2.5 that appears, specify the following:

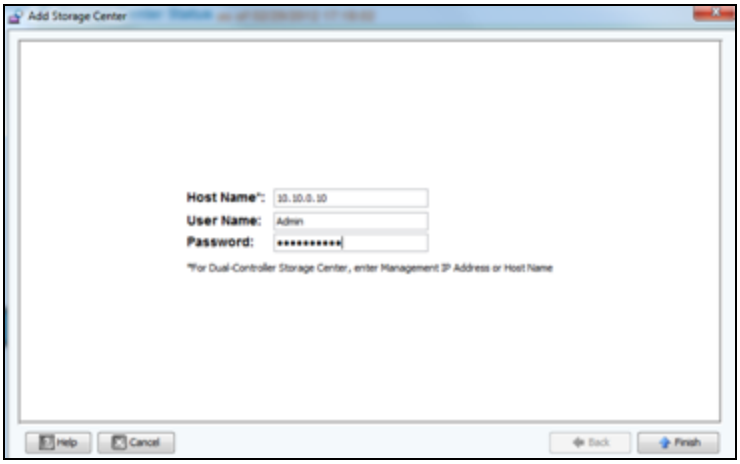

Figure 2.5: Specifying the credentials of the target Dell Compellent Storage Center

- Host Name – Specify the IP address of the target Dell Compellent Storage Center
- User Name – Specify the name of the user who is authorized to access the target Storage Center
- Password - Specify the password that corresponds to the specified User Name.

Note:

If the user has been successfully added, then you can view the user when you click the **User Viewer** that appears upon clicking the **Properties** button of the **Compellent Enterprise Manager Data Collector**.

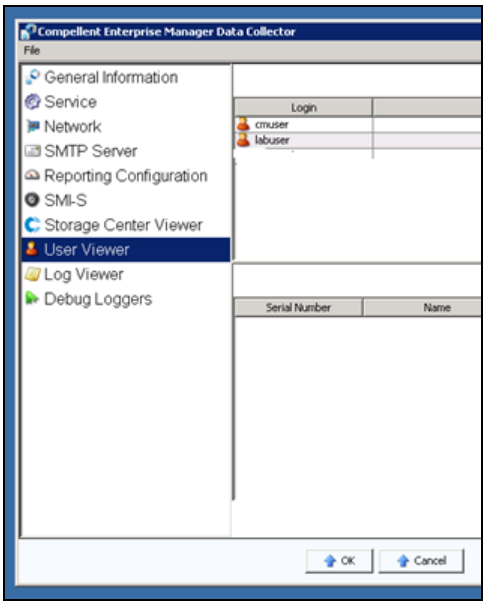

Figure 2.6: Viewing the created user by clicking the User Viewer node

11. Once you have created the Compellent Enterprise Manager User, you will be required to provide the necessary **Data Collector Service Properties** by following the menu sequence: Start -> All Programs -> Compellent Technologies -> Compellent Enterprise Manager -> Compellent Enterprise Data Collection Manager - > Service. Figure 2.7 will then appear.

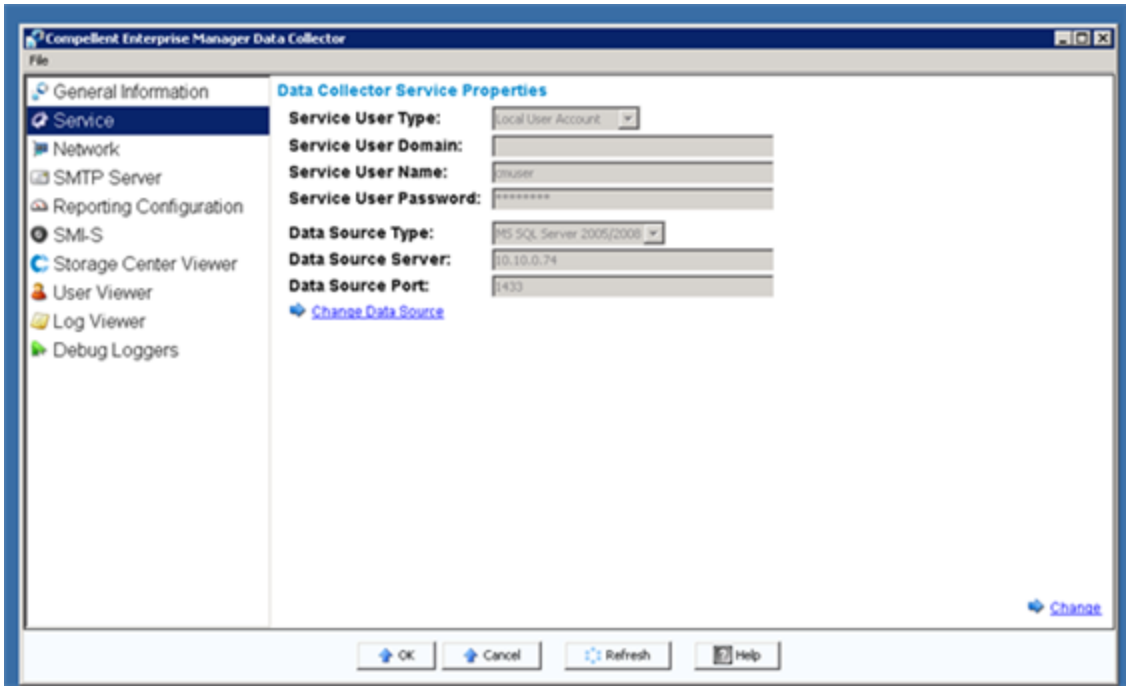

Figure 2.7: Specifying the Data Collector Service Properties

12. Clicking the **Change** link in Figure 2.7 will enable you to edit the properties of the **Data Collector Service**. Now, choose **Local User Account** from the **Service User Type** drop down list.
13. Then, in the **Service User Name** and **Service User Password** text boxes, specify the credentials of the local user that you have created in Step 2.
14. Finally, you will be required to enable the SMI-S Server properties as shown in Figure 2.8 . Clicking the **Change** link in Figure 2.8 will enable you to make the following changes to the **SMI-S Server Configuration**:

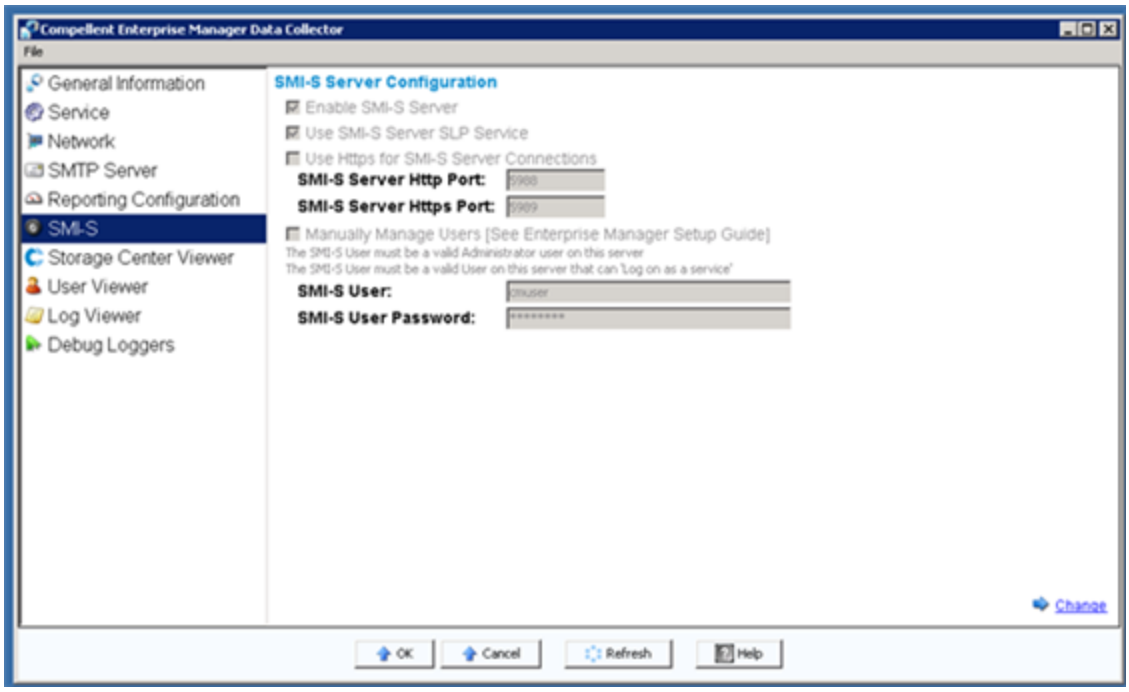

Figure 2.8: Enabling the SMI-S Server properties

- Select the checkbox that appears before the **Enable SMI-S Server** option.
- Uncheck the **Use Https for SMI-S Server Connections** option.
- Uncheck the **Manually Manage Users** option and then provide the credentials of the Enterprise Manager user that you have created in the **SMI-S User** and **SMI-S User Password** text boxes.
- Finally, clicking the **Apply Changes** link will apply the changes that you have made in the **SMI-S Server Configuration** section.

15. Now, you can proceed to configure the tests that pertain to the Dell Compellent Storage Center.

2.2 Configuring the Dell Compellent SMI-S Provider using a Local Service Account (v5.5.4 and above)

To configure the Dell Compellent SMI-S Provider using a Local Service Account, follow the Step 1 through Step 12 mentioned in Section **2.1** and proceed with the following steps:

1. Clicking the **Change** link in Figure 2.7 will enable you to edit the properties of the **Data Collector Service**. Now, set the **Service User Type** to **Local Service Account**.
2. If the **Service User Name** and **Service User Password** text boxes are populated, you will be required to clear those text boxes. Then, clicking the **Apply Changes** link will help you update the changes as per your selection.
3. Finally, you will be required to enable the SMI-S server properties as shown in Figure 2.9 . Clicking the **Change** link in Figure 2.9 will enable you to make the following changes to the SMI-S Server Configuration:

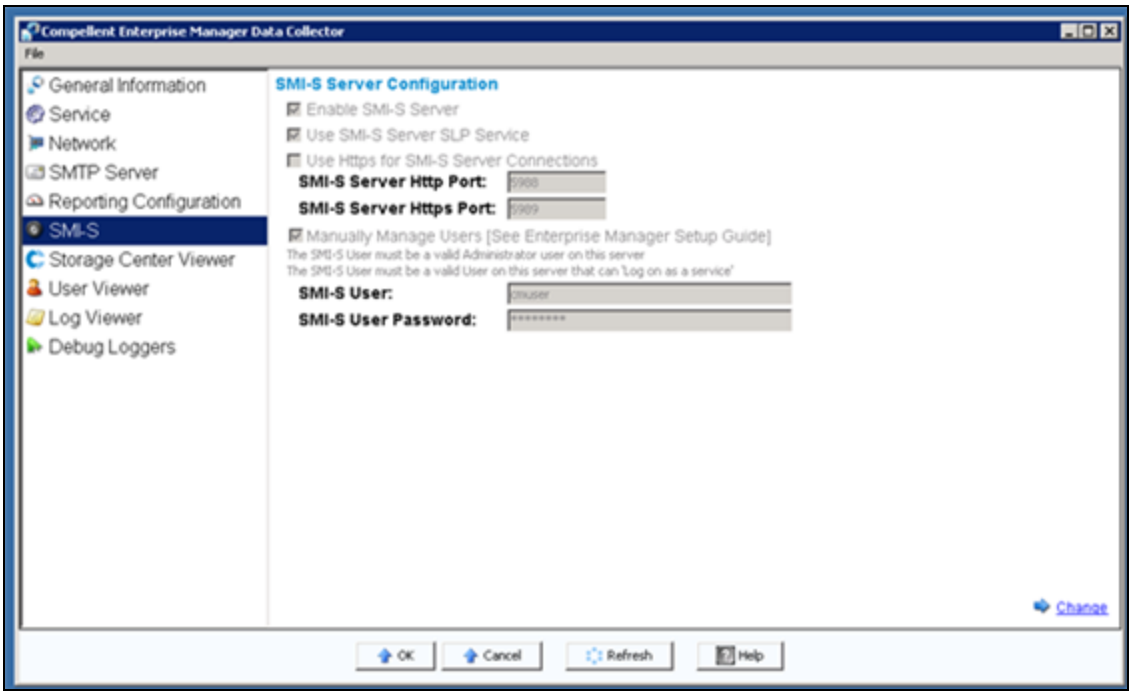

Figure 2.9: Enabling the SMI-S Server properties for a Local Service Account Service User Type

- Select the check box that appears before the **Enable SMI-S Server** option.
- Uncheck the **Use Https for SMI-S Server Connections** option.
- Select the check box that appears before the **Manually Manage Users** option.

- Finally, clicking the **Apply Changes** link will apply the changes that you have made in the **SMI-S Server Configuration** section.

4. Now, you will be required to add the SMI-S user through the Command Line Interface of the Dell Compellent Storage Center as discussed in Section 1.1.2.1.

2.2.0.1 Adding the SMI-S User from CLI

To add the SMI-S User from the Command Line Interface, do the following:

1. Open a Command prompt in the Dell Compellent Storage Center.
2. Change the directory of the Storage Center to *<Dell_ Compellent_ install_ Dir>\Compellent Enterprise Manager\msaservice\Pegasus\bin*.
3. Then you will be required to execute the following command:

   ```
   cimuser.exe –a <Username> -w <password>
   ```

   where,

   Username is the name of the Enterprise Manager user

   Password is the password that corresponds to the Enterprise Manager user

4. If you have chosen to check the Use Https for SMI-S Server Connections check box, then you have to run the following command too:

   ```
   cimtrust.exe
   ```

   By running the command, you can add the Pegasus user to the list of trusted users.

5. Restarting the Data Collector Manager Service will add the SMI-S user to the SMI-S Provider.
6. Now, you can proceed to configure the tests that pertain to the Dell Compellent Storage Center.

The sections discussed below helps you to analyze each and every layer of the Dell Compellent Storage Center.

2.3 Managing the Dell Compellent

The Dell Compellent cannot be automatically discovered by eG Enterprise. This implies that you will have to manually add the Dell Compellent into the eG Enterprise system to manage it. Follow the steps below to achieve the same:

1. Login to the eG administrative interface.
2. Follow the Components -> Add/Modify menu sequence in the **Infrastructure** tile of the **Admin** menu.
3. In the **COMPONENTS** page that appears, select *Dell Compellent* from the **Component type** drop-down and then click the **Add New Component** button.

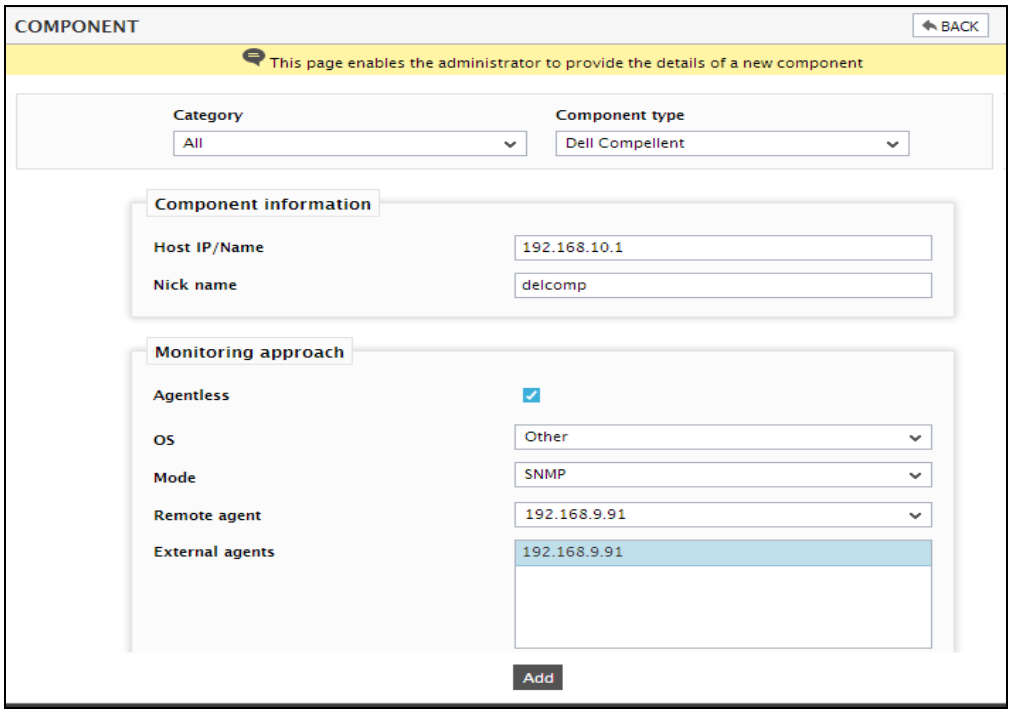

Figure 2.10: Adding a Dell Compellent

4. Specify the **Host IP/Name** and the **Nick name** of the switch in 2.3. Then, click the **Add** button to add the switch for monitoring.

2.4 Configuring the tests

1. When you attempt to sign out, a list of unconfigured tests will appear as shown in Figure 2.11.

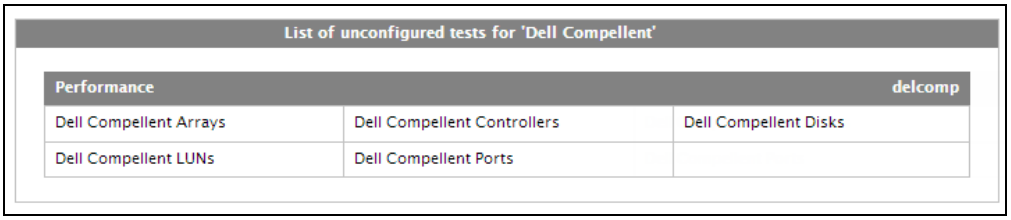

Figure 2.11: List of unconfigured tests to be configured for the Dell Compellent

2. Click on the tests to configure them. To know how to configure these tests, refer to the **Monitoring Dell Compellent Storage Center** chapter.
3. Finally, signout of the eG administrative interface.

Chapter 3: Monitoring Dell Compellent Storage Center

eG Enterprise provides a specialized Dell Compellent Storage Center monitoring model (see Figure 3.1) to monitor the overall health and current stateof the disks, LUNs, arrays and controllers and analyze how well the Storage Center balances I/O load across the disks, LUNs etc.

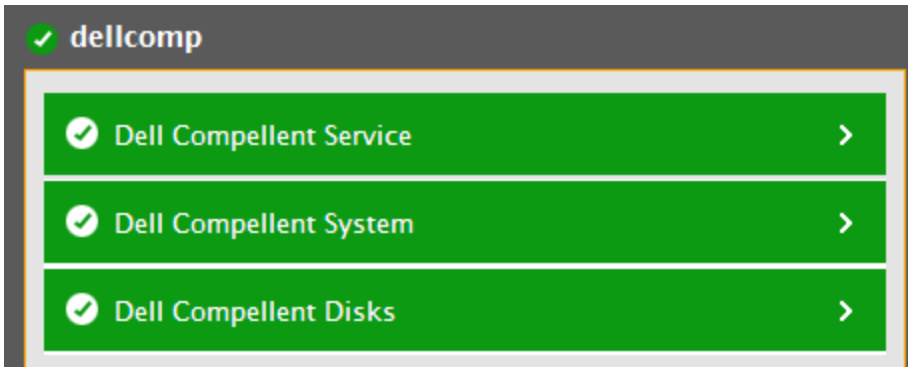

Figure 3.1: The layer model of a Dell Compellent Storage Center

Every layer of Figure 3.1 is mapped to a variety of tests which connect to the SMI-S Provider of the Dell Compellent Storage Center to collect critical statistics pertaining to its performance.

3.1 The Dell Compellent Disk Layer

This layer monitors the disks of the Dell Compellent Storage Center and reports how healthy each disk is and how well the Storage Center balances I/O load across disks.

Figure 3.2: The tests mapped to the Dell Compellent Disk layer

3.1.1 Dell Compellent Disks Test

This test monitors the current state, overall health, and the load-balancing capability of each disk in the Storage Center. With the help of this test, administrators can not only identify failed disks, but can also predict the potential failure of a disk, so that efforts can be undertaken to avert the same. In addition, the test also points administrators to disks that are handling more I/O requests than the rest, thus shedding light on irregularities in the distribution of I/O load across disks and prompting

administrators to fine-tune the load-balancing algorithm. In addition, the test also proactively alerts administrators to probable slowdowns in I/O processing by specific disks, thereby enabling administrators to initiate pre-emptive actions.

Target of the test : A Dell Compellent Storage Center

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each disk on the Dell Compellent Storage Center.

Configurable parameters for the test

Parameter	Description
Test period	How often should the test be executed
Host	The storage device for which the test is to be configured.
Port	The port number at which the specified storage device listens to. By default, this will be *NULL*.
User and Password	Specify the credentials of a user who has the right to execute API commands on the Dell Compellent Storage Center and pull out metrics. The specified user is the *Pegasus CIM User* who should possess *Administator* privileges and should be associated with the *Logon* as a Service policy.
Confirm Password	Confirm the password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
CIM Server Port	The SMI–S provider of the Dell Compellent Storage Center provides access for monitoring and management via the HTTP and HTTPS protocols for CIM API request/response semantics. To enable the eG agent to access the SMI-S Provider, invoke the CIM API commands, and collect the required metrics, you need to specify the service port on the SMI- S provider in the CIM Server Port text box that listens for HTTP/HTTPS requests for CIM API semantics. By default, this is port 5988. If the service port on the SMI-S Provider listens only to HTTPS requests, then specify the port as 5989.
IsEmbedded	If this flag is set to **True**, it indicates that the SMI-S Provider is embedded on the Storage Center. On the other hand, if this flag is set to **False**, it indicates that the SMI-S Provider has been implemented as a proxy.
SerialNumber	If the SMI-S Provider has been implemented as a proxy, then such a provider can be configured to manage multiple Storage Centers. This is why, if the IsEmbedded flag is set to **False**, you will have to explicitly specify which Storage Center you want the eG agent to monitor. Since each Storage Center is uniquely identified by a serial number,

Parameter	Description
	specify the same in the SerialNumber text box.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise system 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 against Detailed Diagnosis. 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 how healthy this disk currently is.		The values that this measure can report and their corresponding numeric values are discussed in the table below: Numeric Value / Measure Value 0 / OK 1 / Unknown 2 / Degraded/Warning 3 / Minor failure 4 / Major failure 5 / Critical failure 6 / Non-recoverable error **Note:** By default, this measure reports the **Measure Value**s discussed above to

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>indicate the state of a disk. In the graph of this measure however, states are represented using the numeric equivalents only.

The detailed diagnosis of this measure if enabled, lists the capacity of the disk.</td></tr>
<tr><td>Operational status</td><td>Indicates the current operational state of this disk.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:

<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>0</td><td>OK</td></tr>
<tr><td>1</td><td>In Service</td></tr>
<tr><td>2</td><td>Power Mode</td></tr>
<tr><td>3</td><td>Completed</td></tr>
<tr><td>4</td><td>Starting</td></tr>
<tr><td>5</td><td>Dormant</td></tr>
<tr><td>6</td><td>Other</td></tr>
<tr><td>7</td><td>Unknown</td></tr>
<tr><td>8</td><td>Stopping</td></tr>
<tr><td>9</td><td>Stressed</td></tr>
<tr><td>10</td><td>Stopped</td></tr>
<tr><td>11</td><td>Supporting Entity in Error</td></tr>
<tr><td>12</td><td>Degraded or Predicted Failure</td></tr>
<tr><td>13</td><td>Predictive Failure</td></tr>
<tr><td>14</td><td>Lost Communication</td></tr>
<tr><td>15</td><td>No Contact</td></tr>
<tr><td>16</td><td>Aborted</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>17</td><td>Error</td></tr>
<tr><td>18</td><td>Non-Recov-erable Error</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a disk. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational status</td><td>Describes the current operational state of this disk.</td><td></td><td>Typically, the detailed state will describe why the disk is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a disk, then this measure will explain why that disk is being stopped.
The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>0</td><td>Online</td></tr>
<tr><td>1</td><td>Success</td></tr>
<tr><td>2</td><td>Power Saving Mode</td></tr>
<tr><td>3</td><td>Write Protected</td></tr>
<tr><td>4</td><td>Write Disabled</td></tr>
<tr><td>5</td><td>Not Ready</td></tr>
<tr><td>6</td><td>Removed</td></tr>
<tr><td>7</td><td>Rebooting</td></tr>
<tr><td>8</td><td>Offline</td></tr>
<tr><td>9</td><td>Failure</td></tr>
</table>
</td></tr>
</table>

Measurement	Description	Measurement Unit	Interpretation
			Note: By default, this measure reports the **Measure Value**s discussed above to indicate the detailed operational state of a disk. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.
Data transmitted	Indicates the rate at which data was transmitted by this disk.	MB/Sec	
IOPS	Indicates the rate at which I/O operations were performed on this disk.	IOPS	Compare the value of this measure across disks to know which disk handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks. You may then want to take a look at the Reads and Writes measure to understand what to fine-tune – the load-balancing algorithm for read requests or that of the write requests.
Reads	Indicates the rate at which read operations were performed on this disk.	Reads/Sec	Compare the value of this measure across disks to know which disk handled the maximum number of read requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.
Writes	Indicates the rate at which write operations were performed on this disk.	Writes/Sec	Compare the value of this measure across disks to know which disk handled the maximum number of write requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.

Measurement	Description	Measurement Unit	Interpretation
Data reads	Indicates the rate at which data is read from this disk.	MB/Sec	Compare the value of these measures across disks to identify the slowest disk in terms of servicing read and write requests (respectively).
Data writes	Indicates the rate at which data is written to this disk.	MB/Sec	
Disk busy	Indicates the percentage of time this disk was busy processing requests.	Percent	Compare the value of this measure across disks to know which disk was the busiest and which disk was not. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across disks.
Average read size	Indicates the amount of data read from this disk per I/O operation	MB/Op	Compare the value of these measures across disks to identify the slowest disk in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this disk per I/O operation.	MB/Op	
Read hits	Indicates the percentage of read requests that were serviced by the cache of this disk.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct disk accesses, which are expensive operations, are high.
Write hits	Indicates the percentage of write requests that were serviced by the cache of this disk.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct disk accesses, which are expensive operations, are high.
Average response time	Indicates the time taken by this disk to respond to I/O requests.	Microsecs	Ideally, this value should be low. If not, it implies that the disk is slow.
Queue depth	Indicates the number of requests that are in queue for this disk.	Number	A consistent increase in this value indicates a potential processing bottleneck with the disk.

3.2 The Dell Compellent System Layer

Using the test mapped to this layer, administrators can monitor the overall health, operational state, and I/O activity on the arrays, controllers and the I/O load on the ports.

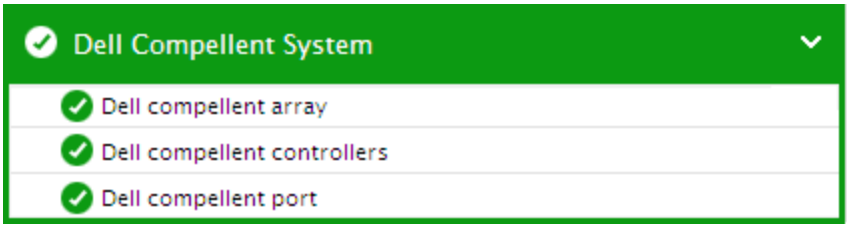

Figure 3.3: The tests mapped to the Dell Compellent System layer

3.2.1 Dell Compellent Arrays Test

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

Target of the test : A Dell Compellent Storage Center

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each storage array on the Dell Compellent Storage Center.

Configurable parameters for the test

Parameter	Description
Test period	How often should the test be executed
Host	The storage device for which the test is to be configured.
Port	The port number at which the specified storage device listens to. By default, this will be *NULL*.
User and Password	Specify the credentials of a user who has the right to execute API commands on the Dell Compellent Storage Center and pull out metrics. The specified user is the *Pegasus CIM User* who should possess *Administator* privileges and should be associated with the *Logon* as a Service policy.

Parameter	Description
Confirm Password	Confirm the password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
CIM Server Port	The SMI–S provider of the Dell Compellent Storage Center provides access for monitoring and management via the HTTP and HTTPS protocols for CIM API request/response semantics. To enable the eG agent to access the SMI-S Provider, invoke the CIM API commands, and collect the required metrics, you need to specify the service port on the SMI- S provider in the CIM Server Port text box that listens for HTTP/HTTPS requests for CIM API semantics. By default, this is port 5988. If the service port on the SMI-S Provider listens only to HTTPS requests, then specify the port as 5989.
IsEmbedded	If this flag is set to **True**, it indicates that the SMI-S Provider is embedded on the Storage Center. On the other hand, if this flag is set to **False**, it indicates that the SMI-S Provider has been implemented as a proxy.
SerialNumber	If the SMI-S Provider has been implemented as a proxy, then such a provider can be configured to manage multiple Storage Centers. This is why, if the IsEmbedded flag is set to **False**, you will have to explicitly specify which Storage Center you want the eG agent to monitor. Since each Storage Center is uniquely identified by a serial number, specify the same in the SerialNumber text box.

Measurements made by the test

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td>Operational status</td><td>Indicates the current operational state of this storage array.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>0</td><td>OK</td></tr>
<tr><td>1</td><td>In Service</td></tr>
<tr><td>2</td><td>Power Mode</td></tr>
<tr><td>3</td><td>Completed</td></tr>
<tr><td>4</td><td>Starting</td></tr>
<tr><td>5</td><td>Dormant</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>6</td><td>Other</td></tr>
<tr><td>7</td><td>Unknown</td></tr>
<tr><td>8</td><td>Stopping</td></tr>
<tr><td>9</td><td>Stressed</td></tr>
<tr><td>10</td><td>Stopped</td></tr>
<tr><td>11</td><td>Supporting Entity in Error</td></tr>
<tr><td>12</td><td>Degraded or Predicted Failure</td></tr>
<tr><td>13</td><td>Predictive Failure</td></tr>
<tr><td>14</td><td>Lost Communication</td></tr>
<tr><td>15</td><td>No Contact</td></tr>
<tr><td>16</td><td>Aborted</td></tr>
<tr><td>17</td><td>Error</td></tr>
<tr><td>18</td><td>Non-Recoverable Error</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a storage array. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational status</td><td>Describes the current operational state of this storage array.</td><td></td><td>Typically, the detailed state will describe why the storage array is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a storage array, then this measure will explain why that storage array is being stopped.</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table><tr><th>Numeric Value</th><th>Measure Value</th></tr><tr><td>0</td><td>Online</td></tr><tr><td>1</td><td>Success</td></tr><tr><td>2</td><td>Power Saving Mode</td></tr><tr><td>3</td><td>Write Protected</td></tr><tr><td>4</td><td>Write Disabled</td></tr><tr><td>5</td><td>Not Ready</td></tr><tr><td>6</td><td>Removed</td></tr><tr><td>7</td><td>Rebooting</td></tr><tr><td>8</td><td>Offline</td></tr><tr><td>9</td><td>Failure</td></tr></table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the detailed operational state of an array. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.</td></tr>
<tr><td>Data transmitted</td><td>Indicates the rate at which data was transmitted by this storage array.</td><td>MB/Sec</td><td></td></tr>
<tr><td>IOPS</td><td>Indicates the rate at which I/O operations were performed on this storage array.</td><td>IOPS</td><td>Compare the value of this measure across storage arrays to know which storage array handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing</td></tr>
</table>

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

Measurement	Description	Measurement Unit	Interpretation
	storage array per I/O operation.		slowest storage array in terms of servicing read and write requests (respectively).
Average write size	Indicates the amount of data written to this storage array per I/O operation.	MB/Op	

3.2.2 Dell Compellent Controllers Test

The controller of the Dell Compellent Storage Center enables the administrator in serving the purpose of the following:

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

Excessive usage of or heavy I/O load on a single controller can cause deterioration in the overall performance of the storage center, as it is indicative of severe deficiencies in the load-balancing algorithm that drives the controllers. Using the **Dell Compellent Controllers** test, administrators can easily monitor the current state, usage, and load on each of the controller on the Storage Center, quickly detect an overload condition, precisely point to the controller that is overloaded, and promptly initiate measures to resolve the issue, so as to ensure the optimal performance of the Storage Center.

Target of the test : A Dell Compellent Storage Center

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each controller on the Dell Compellent Storage Center.

Configurable parameters for the test

Parameter	Description
Test period	How often should the test be executed
Host	The storage device for which the test is to be configured.
Port	The port number at which the specified storage device listens to. By default, this will be *NULL*.

Parameter	Description
User and Password	Specify the credentials of a user who has the right to execute API commands on the Dell Compellent Storage Center and pull out metrics. The specified user is the *Pegasus CIM User* who should possess *Administator* privileges and should be associated with the *Logon* as a Service policy.
Confirm Password	Confirm the password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
CIM Server Port	The SMI–S provider of the Dell Compellent Storage Center provides access for monitoring and management via the HTTP and HTTPS protocols for CIM API request/response semantics. To enable the eG agent to access the SMI-S Provider, invoke the CIM API commands, and collect the required metrics, you need to specify the service port on the SMI- S provider in the CIM Server Port text box that listens for HTTP/HTTPS requests for CIM API semantics. By default, this is port 5988. If the service port on the SMI-S Provider listens only to HTTPS requests, then specify the port as 5989.
IsEmbedded	If this flag is set to **True**, it indicates that the SMI-S Provider is embedded on the Storage Center. On the other hand, if this flag is set to **False**, it indicates that the SMI-S Provider has been implemented as a proxy.
SerialNumber	If the SMI-S Provider has been implemented as a proxy, then such a provider can be configured to manage multiple Storage Centers. This is why, if the IsEmbedded flag is set to **False**, you will have to explicitly specify which Storage Center you want the eG agent to monitor. Since each Storage Center is uniquely identified by a serial number, specify the same in the SerialNumber text box.

Measurements made by the test

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

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

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

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

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

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

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

Measurement	Description	Measurement Unit	Interpretation
Read hits	Indicates the percentage of read requests that were serviced by the cache of this controller.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct controller accesses, which are expensive operations, are high.
Write hits	Indicates the percentage of write requests that were serviced by the cache of this controller.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct controller accesses, which are expensive operations, are high.

3.2.3 Dell Compellent Ports Test

Storage ports help the controllers receive and process I/O requests. By periodically checking port status and measuring the I/O load on the ports, you can identify overloaded ports and thus proactively detect potential/existing load-balancing irregularities and/or processing bottlenecks with the ports. The **Dell Compellent Ports** test facilitates this port check. For every port configured for the controllers supported by the Storage Center, this test reports the port state, 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 : A Dell Compellent Storage Center

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each storage port on the Dell Compellent Storage Center.

Configurable parameters for the test

Parameter	Description
Test period	How often should the test be executed
Host	The storage device for which the test is to be configured.
Port	The port number at which the specified storage device listens to. By default, this will be *NULL*.

Parameter	Description
User and Password	Specify the credentials of a user who has the right to execute API commands on the Dell Compellent Storage Center and pull out metrics. The specified user is the *Pegasus CIM User* who should possess *Administator* privileges and should be associated with the *Logon* as a Service policy.
Confirm Password	Confirm the password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
CIM Server Port	The SMI–S provider of the Dell Compellent Storage Center provides access for monitoring and management via the HTTP and HTTPS protocols for CIM API request/response semantics. To enable the eG agent to access the SMI-S Provider, invoke the CIM API commands, and collect the required metrics, you need to specify the service port on the SMI- S provider in the CIM Server Port text box that listens for HTTP/HTTPS requests for CIM API semantics. By default, this is port 5988. If the service port on the SMI-S Provider listens only to HTTPS requests, then specify the port as 5989.
IsEmbedded	If this flag is set to **True**, it indicates that the SMI-S Provider is embedded on the Storage Center. On the other hand, if this flag is set to **False**, it indicates that the SMI-S Provider has been implemented as a proxy.
SerialNumber	If the SMI-S Provider has been implemented as a proxy, then such a provider can be configured to manage multiple Storage Centers. This is why, if the IsEmbedded flag is set to **False**, you will have to explicitly specify which Storage Center you want the eG agent to monitor. Since each Storage Center is uniquely identified by a serial number, specify the same in the SerialNumber text box.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise system 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 against Detailed Diagnosis. 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 how healthy this port currently is.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table><tr><th>Numeric Value</th><th>Measure Value</th></tr><tr><td>0</td><td>OK</td></tr><tr><td>1</td><td>Unknown</td></tr><tr><td>2</td><td>Degraded/Warning</td></tr><tr><td>3</td><td>Minor failure</td></tr><tr><td>4</td><td>Major failure</td></tr><tr><td>5</td><td>Critical failure</td></tr><tr><td>6</td><td>Non-recoverable error</td></tr></table>Note:
By default, this measure reports the Measure Values discussed above to indicate the state of a port. In the graph of this measure however, states are represented using the numeric equivalents only.</td></tr>
<tr><td>Operational status</td><td>Indicates the current operational state of this port.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table><tr><th>Numeric Value</th><th>Measure Value</th></tr><tr><td>0</td><td>OK</td></tr><tr><td>1</td><td>In Service</td></tr><tr><td>2</td><td>Power Mode</td></tr><tr><td>3</td><td>Completed</td></tr><tr><td>4</td><td>Starting</td></tr></table></td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>5</td><td>Dormant</td></tr>
<tr><td>6</td><td>Other</td></tr>
<tr><td>7</td><td>Unknown</td></tr>
<tr><td>8</td><td>Stopping</td></tr>
<tr><td>9</td><td>Stressed</td></tr>
<tr><td>10</td><td>Stopped</td></tr>
<tr><td>11</td><td>Supporting Entity in Error</td></tr>
<tr><td>12</td><td>Degraded or Predicted Failure</td></tr>
<tr><td>13</td><td>Predictive Failure</td></tr>
<tr><td>14</td><td>Lost Communication</td></tr>
<tr><td>15</td><td>No Contact</td></tr>
<tr><td>16</td><td>Aborted</td></tr>
<tr><td>17</td><td>Error</td></tr>
<tr><td>18</td><td>Non-Recoverable Error</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a port. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational status</td><td>Describes the current operational state of this port.</td><td></td><td>Typically, the detailed state will describe why the port is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a port, then this measure will explain why that port is being stopped.</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:

<table><tr><th>Numeric Value</th><th>Measure Value</th></tr><tr><td>0</td><td>Online</td></tr><tr><td>1</td><td>Success</td></tr><tr><td>2</td><td>Power Saving Mode</td></tr><tr><td>3</td><td>Write Protected</td></tr><tr><td>4</td><td>Write Disabled</td></tr><tr><td>5</td><td>Not Ready</td></tr><tr><td>6</td><td>Removed</td></tr><tr><td>7</td><td>Rebooting</td></tr><tr><td>8</td><td>Offline</td></tr><tr><td>9</td><td>Failure</td></tr></table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the detailed operational state of a port. In the graph of this measure however, detailed operational states are represented using the numeric equivalents only.</td></tr>
<tr><td>Data transmitted</td><td>Indicates the rate at which data was transmitted by this port.</td><td>MB/Sec</td><td></td></tr>
<tr><td>IOPS</td><td>Indicates the rate at which I/O operations were performed on this port.</td><td>IOPS</td><td>Compare the value of this measure across ports to know which port handled the maximum number of I/O requests and which handled the least. If the gap between the two is very high, then it indicates serious irregularities in load-balancing across ports.</td></tr>
</table>

3.3 The Dell Compellent Service Layer

This layer monitors the LUNs and reports how healthy each LUN is and how well the storage system balances I/O load across LUNs.

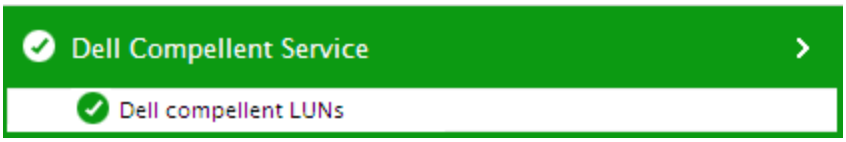

Figure 3.4: The tests mapped to the Dell Compellent Service layer

3.3.1 Dell Compellent LUNs Test

A logical unit number (LUN) is a unique identifier used to designate individual or collections of hard disk devices for address by a protocol associated with a SCSI, iSCSI, Fibre Channel (FC) or similar interface. LUNs are central to the management of storage arrays shared over a storage area network (SAN). LUN errors, poor LUN cache usage, and abnormal I/O activity on the LUNs, if not promptly detected and resolved, can hence significantly degrade the performance of the storage array. This is why, it is important that LUN performance is continuously monitored. This can be achieved using the **Dell Compellent LUNs** test. This test auto-discovers the LUNs in the Storage Center and reports the current state of each LUN, captures LUN errors, and measures the level of I/O activity on every LUN, so that administrators are notified of LUN-related problems well before they impact Storage Center performance.

Target of the test : A Dell Compellent Storage Center

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each LUN on the Dell Compellent Storage Center.

Configurable parameters for the test

Parameter	Description
Test period	How often should the test be executed
Host	The storage device for which the test is to be configured.
Port	The port number at which the specified storage device listens to. By default, this will be *NULL*.
User and Password	Specify the credentials of a user who has the right to execute API commands on the Dell Compellent Storage Center and pull out metrics. The specified user is the

Parameter	Description
	Pegasus CIM User who should possess *Administator* privileges and should be associated with the *Logon* as a Service policy.
Confirm Password	Confirm the password by retyping it here.
SSL	Set this flag to **Yes**, if the storage device being monitored is SSL-enabled.
CIM Server Port	The SMI–S provider of the Dell Compellent Storage Center provides access for monitoring and management via the HTTP and HTTPS protocols for CIM API request/response semantics. To enable the eG agent to access the SMI-S Provider, invoke the CIM API commands, and collect the required metrics, you need to specify the service port on the SMI- S provider in the CIM Server Port text box that listens for HTTP/HTTPS requests for CIM API semantics. By default, this is port 5988. If the service port on the SMI-S Provider listens only to HTTPS requests, then specify the port as 5989.
IsEmbedded	If this flag is set to **True**, it indicates that the SMI-S Provider is embedded on the Storage Center. On the other hand, if this flag is set to **False**, it indicates that the SMI-S Provider has been implemented as a proxy.
SerialNumber	If the SMI-S Provider has been implemented as a proxy, then such a provider can be configured to manage multiple Storage Centers. This is why, if the IsEmbedded flag is set to **False**, you will have to explicitly specify which Storage Center you want the eG agent to monitor. Since each Storage Center is uniquely identified by a serial number, specify the same in the SerialNumber text box.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise system 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 against Detailed Diagnosis. 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 how healthy this LUN currently is.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table><tr><th>Numeric Value</th><th>Measure Value</th></tr><tr><td>0</td><td>OK</td></tr><tr><td>1</td><td>Unknown</td></tr><tr><td>2</td><td>Degraded/Warning</td></tr><tr><td>3</td><td>Minor failure</td></tr><tr><td>4</td><td>Major failure</td></tr><tr><td>5</td><td>Critical failure</td></tr><tr><td>6</td><td>Non-recoverable error</td></tr></table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the state of a LUN In the graph of this measure however, states are represented using the numeric equivalents only.
The detailed diagnosis of this measure if enabled, lists the capacity of the LUN.</td></tr>
<tr><td>Operational status</td><td>Indicates the current operational state of this LUN.</td><td></td><td>The values that this measure can report and their corresponding numeric values are discussed in the table below:
<table><tr><th>Numeric Value</th><th>Measure Value</th></tr><tr><td>0</td><td>OK</td></tr><tr><td>1</td><td>In Service</td></tr><tr><td>2</td><td>Power Mode</td></tr></table></td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th>Numeric Value</th><th>Measure Value</th></tr>
<tr><td>3</td><td>Completed</td></tr>
<tr><td>4</td><td>Starting</td></tr>
<tr><td>5</td><td>Dormant</td></tr>
<tr><td>6</td><td>Other</td></tr>
<tr><td>7</td><td>Unknown</td></tr>
<tr><td>8</td><td>Stopping</td></tr>
<tr><td>9</td><td>Stressed</td></tr>
<tr><td>10</td><td>Stopped</td></tr>
<tr><td>11</td><td>Supporting Entity in Error</td></tr>
<tr><td>12</td><td>Degraded or Predicted Failure</td></tr>
<tr><td>13</td><td>Predictive Failure</td></tr>
<tr><td>14</td><td>Lost Communication</td></tr>
<tr><td>15</td><td>No Contact</td></tr>
<tr><td>16</td><td>Aborted</td></tr>
<tr><td>17</td><td>Error</td></tr>
<tr><td>18</td><td>Non-Recoverable Error</td></tr>
</table>
Note:
By default, this measure reports the Measure Values discussed above to indicate the operational state of a LUN. In the graph of this measure however, operational states are represented using the numeric equivalents only.
</td></tr>
<tr><td>Detailed operational state</td><td>Describes the current operational state of this LUN.</td><td></td><td>Typically, the detailed state will describe why the LUN is in a particular operational state. For instance, if the Operational status measure reports the value Stopping for a LUN, then this measure</td></tr>
</table>

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td></td><td></td><td>will explain why that LUN is being stopped.

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

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

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

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

Measurement	Description	Measurement Unit	Interpretation
	cache of this LUN.		poor; this in turn implies that direct LUN accesses, which are expensive operations, are high.
Write hits	Indicates the percentage of write requests that were serviced by the cache of this LUN.	Percent	A high value is desired for this measure. A very low value is a cause for concern, as it indicates that cache usage is very poor; this in turn implies that direct LUN accesses, which are expensive operations, are high.
Average response time	Indicates the time taken by this LUN to respond to I/O requests.	Microsecs	Ideally, this value should be low. If not, it implies that the LUN is slow.
Queue depth	Indicates the number of requests that are in queue for this LUN.	Number	A consistent increase in this value indicates a potential processing bottleneck with the LUN.

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.

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