Monitoring Pure Storage FlashArray

eG Innovations Product Documentation

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Total Performance Visibility

Table of Contents

Table of Figures

Chapter 1: Introduction

Built on 100% MLC flash, Pure Storage FlashArray delivers all - flash enterprise storage that is 10X faster, more space and power efficient, more reliable, and infinitely simpler, and yet typically cost less than traditional performance disk arrays.

With PureStorage FlashArray, organizations can dramatically reduce the complexity of storage to make IT more agile and efficient, accelerating your journey to the cloud. PureStorage FlashArray performance can also make your business smarter by unleashing the power of real - time analytics, driving customer loyalty, and creating new, innovative customer experiences that simply weren't possible with disk. PureStorage FlashArray enables you to transform your data center, cloud, or entire business with an affordable all - flash array capable of consolidating and accelerating all your key applications. Any failure detected in the hardware or software of such storage platforms may result in the loss of huge amount of data. Anything that renders the data inaccessible or delays access to data, such as a disk failure or an I/O overload, can be disastrous to these mission-critical IT environments. This is why, it is important that the Pure Storage FlashArray is continuously monitored for performance flaws – both small or big! This is where eG Enterprise helps storage administrators.

Chapter 2: How does eG Enterprise Monitor Pure Storage FlashArray?

eG Enterprise employs an *agentless* approach to monitor the Pure Storage FlashArray. This approach requires that the eG agent be deployed on a remote Windows host in the target environment. To collect the metrics of interest from the Pure Storage FlashArray, this agent uses the *Pure Storage REST APIs*.

The pre-requisites that need to be fulfilled to monitor the target Pure Storage FlashArray are discussed in detail in the forthcoming section.

2.1 Pre-requisites for Monitoring the Pure Storage FlashArray

In high security environments where the eG agent should connect to the target FlashArray and collect the required metrics, administrators of those environments may not wish to provide the credentials of the user possessing administrator privileges. Therefore, to monitor the Pure Storage FlashArray, eG Enterprise requires the administrator of the FlashArray to create a new user with *read-only* privilege and determine the API token for that user. This API token should be provided while configuring the tests that will be executed to collect the required metrics.

1. Login to the Purity GUI as a user with *administrator* privileges.
2. Then, navigate to the **System** tab and click on the Users -> API Tokens. The **API Tokens** page will be displayed in the context -sensitive right panel. The **API Tokens** page displays a list of all users with API tokens and the dates on which the API tokens were created.
3. To view the API token of the created user, right click on that user. A drop-down list will appear next. Clicking the **Show API Token** option in that list reveals the API Token generated for the created user in a separate pop up window.
4. Copy this API token and specify the same in the **API Token** text box while configuring the tests.

Once the aforesaid pre-requisites are fulfilled, add the Pure Storage component for monitoring the FlashArray using eG administrative interface. The steps for achieving this have been discussed in the **How to Monitor Pure Storage FlashArray Using eG Enterprise?** chapter.

Chapter 3: How to Monitor Pure Storage FlashArray Using eG Enterprise?

The broad steps for monitoring Pure Storage FlashArray using eG Enterprise are as follows:

- Managing the Pure Storage FlashArray
- Configuring the tests

These steps have been discussed in following sections.

3.1 Managing the Pure Storage FlashArray

The eG Enterprise cannot automatically discover the Pure Storage FlashArray. This implies that you need to manually add the component for monitoring. Remember that the eG Enterprise automatically manages the components that are added manually. To manage a Pure Storage server, 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 *Pure Storage* as the **Component type**. Then, click the **Add New Component** button. This will invoke Figure 3.1.

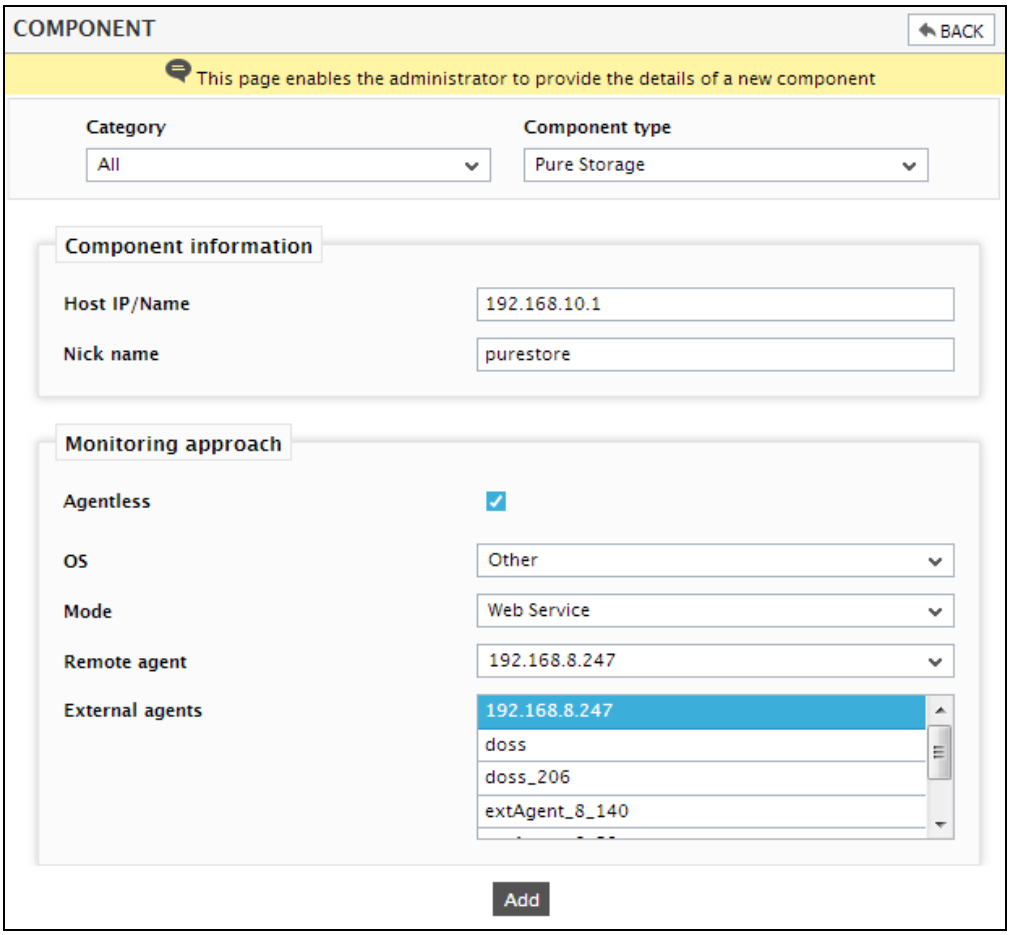

Figure 3.1: Adding the Pure Storage FlashArray

4. Specify the **Host IP** and the **Nick name** for the Pure Storage FlashArray in Figure 3.1. By default, the Pure Storage component is monitored in an agentless manner. Therefore, the **Agentless** flag will be checked by default.
5. Next, choose **Other** as the **OS** and **Web Service** as the **Mode** for monitoring the Pure Storage component.
6. Finally, click the **Add** button to register the changes.

3.2 Configuring the tests

1. When you attempt to sign out of eG administrative interface, a list of unconfigured tests will appear as shown in Figure 3.2. This list reveals the unconfigured tests that require manual configuration.

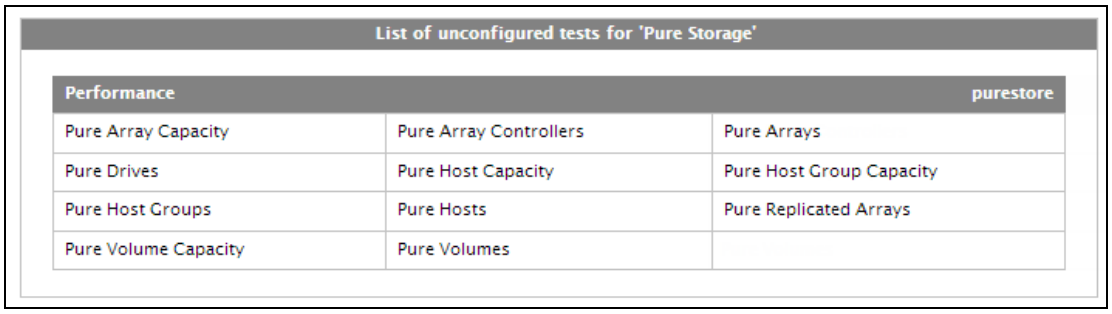

Figure 3.2: List of tests that need to be configured for the Pure Storage FlashArray

2. To configure the tests, click on the test names in the list of unconfigured tests. To know more on how to configure the tests, refer to **Monitoring the Pure Storage FlashArray** chapter.
3. Once all the tests are configured, signout of the eG administrative interface.

Chapter 4: Monitoring the Pure Storage FlashArray

eG Enterprise provides a specialized monitoring model (see Figure 4.1) to monitor the target Pure Storage FlashArray inside-out and sheds light on current or probable performance dips that the FlashAppray suffers.

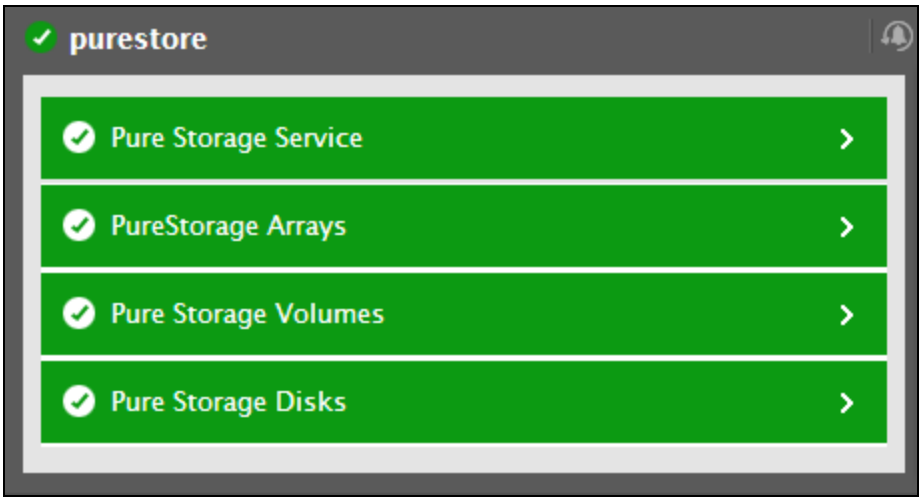

Figure 4.1: The layer model of the Pure Storage FlashArray

Every layer of the layer model is mapped to a variety of tests that monitor critical performance parameters such as processing ability, load, and operational state, of the core components of the FlashArray's architecture. To pull out such useful performance data from the storage system, the eG agent needs to be deployed on a remote Windows host in the environment and connect to the REST API of the Pure Storage FlashArray to collect critical statistics pertaining to its performance. The metrics reported by these tests enable administrators to answer the following questions:

- What is the current status of each drive on the target FlashArray?
- What is the current state of each array controller?
- What is the rate at which read and write operations were performed on the target FlashAray?
- What is the I/O latency of the FlashArray?
- What is the rate at which read and write I/O operations were performed on the target FlashArray?
- What is the rate at which read and write operations were performed on each volume of the target FlashArray?
- What is the space utilization of each array? Are any arrays running out of space?

- What is the connection state of each replicated array?
- What is the I/O latency of each volume?
- What is the rate at which read and write I/O operations were performed on each volume of the target FlashArray?
- What is the total capacity of each volume?
- What is the space utilization of each volume? Is space contention noticed in any of the volumes?
- How much of space is allocated to the volume, volume snapshot etc from the total capacity of each volume?
- How well the read and write operations were performed on the each host connected to the target FlashArray?
- What is the rate at which read and write I/O operations were performed on each host?
- What is the I/O latency of each host?
- What is the space utilization of each host?
- What is the rate at which read and write I/O operations were performed on each host group?
- What is the I/O latency of each host group?
- What is the space utilization of each host group?

The sections that will follow discusses each of the layers of Figure 4.1 in great detail.

4.1 The Pure Storage Disks Layer

Using the test mapped to this layer, administrators can monitor the drives on the FlashArray and figure out how healthy each drive is.

Figure 4.2: The test mapped to the Pure Storage Disks layer

4.1.1 Pure Drives Test

The FlashArray consists of solid-state drives (SSDs) for persistent storage of user data. The NVRAM modules of the FlashArray are used as non-volatile write cache. Health and availability of

the drives/NVRAM modules are vital for storing user data and performing I/O operations on the FlashArray. Unhealthy, failed, unused or empty drives/NVRAM modules can degrade the overall performance of the FlashArray. This is why, it is important to monitor the health of the drives/NVRAM modules round the clock! This can be achieved using the **Pure Drives** test.

This test auto-discovers the drives and NVRAM modules on the target FlashArray, and reports the health status of each drive/NVRAM module. Using this test, administrators can identify unhealthy and failed drives immediately and take remedial actions before end users complain of unavailability of data stored in the FlashArray or data loss.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each drive/NVRAM module on the target FlashArray being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option.

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

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Status	Indicates the current status of this drive.		The table below indicates the values that this measure can report and their corresponding numeric equivalents: **Measure value** / **Numeric Value** Failed: 0 Unrecognized: 1 Identifying: 2 Healthy: 3 Empty: 4 Unused: 5 **Note:** By default, this measure reports the above-mentioned **Measure Value**s while indicating the current status of the drive. However, in the graph of this measure, drive states will be represented using the corresponding numeric equivalents only - i.e., *0 to 5*. The detailed diagnosis of this measure reveals the total capacity of the drive, the time stamp at which the drive failed and the time stamp at which the last evaluation was completed.

4.2 The Pure Storage Volumes Layer

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

Figure 4.3: The test mapped to the Pure Storage Volumes layer

4.2.1 Pure Volume Capacity Test

A volume or logical drive is a single accessible storage area with a single file system, typically (though not necessarily) resident on a single partition of a hard disk. If a volume is over-utilized or is unable to process I/O requests quickly, it can damage the user experience with the entire FlashArray. It is hence the responsibility of the storage administrator to keep an eye out for space contentions and processing bottlenecks with each of the volumes in FlashArray, detect such anomalies even before they occur, and resolve them before users complain. The **Pure Volume Capacity** test helps the storage administrator discharge his duties efficiently.

This test auto-discovers the volumes on the target FlashArray, and for each volume, this test reports the total capacity, the space availability, the size and the amount of space occupied. This enables administrators to proactively detect a potential slowdown in processing or a probable contention in the volume, identify which volume is contributing to these abnormal phenomena, and intervene to ensure that the problem is resolved before it spirals out of control.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each volume on the target FlashArray.

Configurable parameters for the test

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

Parameter	Description
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Total capacity	Indicates the total capacity of this volume.	TB	The detailed diagnosis of this measure reveals the details on data reductions performed on each volume.
Used capacity	Indicates the amount of space utilized in this volume.	TB	If the value of this measure is close to the *Total Capacity* measure, then, it indicates that the volume is running out of space.
Free capacity	Indicates amount of space	TB	A low value is desired for this

Measurement	Description	Measurement Unit	Interpretation
	that is available for use on this volume.		measure.
Capacity used	Indicates the percentage of space utilized on this volume.	Percent	Ideally, the value of this measure should be low.
Capacity free	Indicates the percentage of space that is available for use on this volume.	Percent	A high value is desired for this measure.
Volume	Indicates the amount of space allocated for this volume.	TB	
Snapshot	Indicates the amount of space allocated for storing the snapshots on this volume.	TB	
Shared	Indicates the amount of space allocated for the shared connections on this volume.	TB	
System	Indicates the amount of storage space allocated for RAID-3D parity and other metadata on this volume.	TB	

4.2.2 Pure Volumes Test

For users to be able to read from/write data into volumes quickly, adequate space must be available in the volumes and the I/O requests should be processed rapidly by the volumes. Slowdowns in data storage/retrieval can be attributed to storage space contentions experienced by one/more volumes or I/O processing bottlenecks. In the event of such slowdowns, administrators need to swiftly isolate the following:

- Which volumes are over-utilized?
- Which volumes are overloaded?

- Which volumes are experiencing serious latencies?
- When were these latencies observed most frequently – while reading or writing?

The **Pure Volumes** test provides accurate answers to these questions. With the help of these answers, you can quickly diagnose the root-cause of slowdowns when reading from/writing into a volume.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each volume of the target FlashArray.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the amount of data utilized for performing read operations on this volume per second.	MB/Sec	A consistent decrease in the value of these measures for a volume indicates an I/O processing bottleneck.
Write bandwidth	Indicates the amount of data utilized for performing write operations on this volume per second.	MB/Sec	
Average bandwidth	Indicates the average amount of data utilized for	MB/Sec	Compare the value of this measure across the volumes to know the

Measurement	Description	Measurement Unit	Interpretation
	performing I/O operations on this volume per second.		volume that uses more bandwidth to process the I/O requests.
Read IOPS	Indicates the number of read operations performed on this host per second.	IOPS	A consistent decrease in the value of these measures for a volume indicates an I/O processing bottleneck.
Write IOPS	Indicates the number of write operations performed on this volume per second.	IOPS	
Average IOPS	Indicates the average number of I/O operations performed on this volume per second.	IOPS	This measure is a good indicator of I/O load on every host connected to the FlashArray.
Read latency	Indicates the time taken by this volume to process the read operations during the last measurement period.	Milliseconds	Very high values for these measures are indicative of the existence of road-blocks to rapid reading/writing on the volumes.
Write latency	Indicates the time taken by this volume to process the write operations during the last measurement period.	Milliseconds	
Average latency	Indicates the average time taken by this volume to process the I/O operations during the last measurement period.	Milliseconds	A consistently high value for this measure is a cause of concern.

4.3 The Pure Storage Arrays Layer

Using the tests mapped to this layer, administrators can monitor the capacity and status of the arrays. Additionally, administrators can find out the status of the controllers in the arrays and status of the replicated arrays.

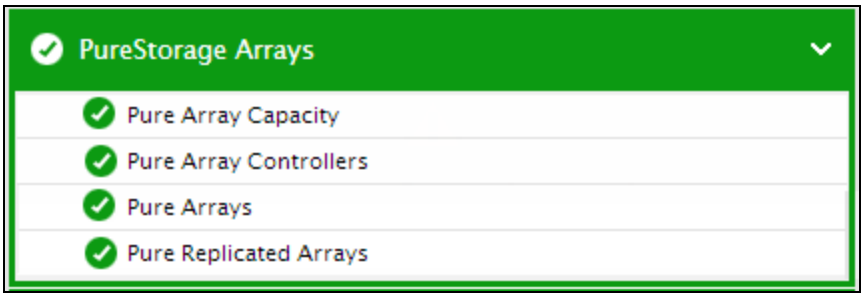

Figure 4.4: The test mapped to the Pure Storage Arrays layer

4.3.1 Pure Array Capacity Test

Adequate space should be available in the FlashArray to ensure uninterrupted functioning of the mission-critical applications that are using the storage services provided by the FlashArray. If the FlashArray is about to run out of space, then, administrators should be intimated of the space crunch well in advance so that, storage space in the FlashArray can be enhanced before service levels start taking a turn for the worse! This test periodically checks the space usage in the FlashArray and proactively alerts administrators to potential storage space contentions so that, amends are made before application performance deteriorates.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the FlashArray being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage FlashArray by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be

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

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Total capacity	Indicates the total storage space available in the FlashArray.	TB	The detailed diagnosis of this measure reveals the details about data reductions on the array.
Used capacity	Indicates the amount of storage space that is currently in use on the FlashArray.	TB	Ideally, the value of this measure should be low. If this value grows closer to that of the *Total capacity* measure, then administrators may want to consider adding more storage to the FlashArray, or freeing space in the FlashArray by deleting unnecessary data.
Free capacity	Indicates the amount of storage space that is available for use on the FlashArray.	TB	A high value is typically desired for this measure. A very low value for this measure indicates a shortage of storage space on the FlashArray.
Capacity used	Indicates the percentage of storage space utilized on	Percent	

Measurement	Description	Measurement Unit	Interpretation
	the FlashArray.		
Capacity free	Indicates the percentage of storage space available for use on the FlashArray.	Percent	Ideally, the value of this measure is desired to be high.
Volume	Indicates the amount of storage space allocated for volumes.	TB	Typically, volumes are used to store non-shared data in the FlashArray. This measure shows the size of non-shared data on the FlashArray.
Snapshot	Indicates the amount of storage space allocated for volume snapshots.	TB	Snapshots are typically used for quick recovery and offloading backup operations. If the FlashArray appears to be running out of space, then, the value of this measure will indicate if the snapshots have in any way contributed to the space crunch.
Shared	Indicates the amount of storage space allocated for shared (deduplicated) data.	TB	
System	Indicates the amount of storage space utilized by RAID-3D parity and other metadata	TB	

4.3.2 Pure Array Controllers Test

A highly available FlashArray consists of two controllers that are interconnected by dual point-to-point Infiniband links. Each controller is a 2U rack-mounted chassis that houses:

- **Main board** - Contains the 12-core processor complex that runs the Purity software, DRAM used to hold Purity code and for data buffering and staging, 7 PCI Express slots containing SAS, Infiniband, and host interface cards, and other internal components and interfaces.
- **Boot drive** - A SSD that holds two local copies of Purity for booting convenience, as well as log records containing diagnostic and service information
- **Host interfaces** - Either (a) two dual-port 8 Gb/s PCI Express Fibre Channel interface cards, or (b) two dual-port 10GbE (iSCSI) cards, that provide the controller's four host ports.

- **Storage shelf interfaces** - Two dual-port PCI Express SAS interface cards that consist of 4-lane, 6 Gb/s ports to provide a total maximum of 96Gb/s data transfer capability to storage shelf I/O modules.
- **Inter-controller interfaces** - A dual-port PCI Express Infiniband interface card, used to interconnect the controllers in a highly-available FlashArray
- **Administrative interfaces** - GbE Ethernet ports, one of which connects to a network through which an array is administered, and video, serial, and USB ports used for initial configuration. Once configured, FlashArrays are administered from network workstations using either the browser-based GUI or the CLI.
- **Redundant cooling fans and hot-swappable power supplies**.

Excessive usage of or heavy I/O load on a single controller can cause deterioration in the overall performance of the FlashArray, as it is indicative of severe deficiencies in the load-balancing algorithm that drives the controllers. Using the **Pure Storage Controllers** test, administrators can easily monitor the current state of the FlashArray, quickly detect the controller that is not ready, and promptly initiate measures to resolve the issue, so as to ensure the optimal performance of the FlashArray.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each controller on the FlashArray being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the specified host listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Status	Indicates the current status of this array controller.		The values reported by this measure and its numeric equivalents are mentioned in the table below: **Measure value** / **Numeric Value** Updating / 0 Not Ready / 1 Ready / 2 **Note:** By default, this measure reports the **Measure Value**s listed in the table above to indicate the current status of each controller. The graph of this measure however is represented using the numeric equivalents only - 0 to 2.

4.3.3 Pure Arrays Test

Using this test, administrators can figure out how well the FlashArray processes the I/O requests and detect delay encountered during processing the I/O requests. In addition, this test also reports the data utilization for performing read/write operations on the FlashArray. Using the metrics reported by this test, administrators can take remedial measures to keep a check on the irregularities, if any.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the target FlashArray being monitored.

Configurable parameters for the test

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

Parameter	Description
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the amount of data utilized for performing read operations on this FlashArray per second.	MB/Sec	A consistent decrease in the value of these measures indicates an I/O processing bottleneck.
Write bandwidth	Indicates the amount of data utilized for performing write operations on this FlashArray per second.	MB/Sec	
Average bandwidth	Indicates the average amount of data utilized for performing I/O operations on this FlashArray per second.	MB/Sec	
Read IOPS	Indicates the number of read operations performed on this FlashArray per second.	IOPS	A consistent decrease in the value of these measures indicates an I/O processing bottleneck.
Write IOPS	Indicates the number of write operations performed on this FlashArray per second.	IOPS	
Average IOPS	Indicates the average number of I/O operations performed on this FlashArray per second.	IOPS	

Measurement	Description	Measurement Unit	Interpretation
Read latency	Indicates the time taken to process the read operations during the last measurement period.	Milliseconds	Very high values for these measures are indicative of the existence of road-blocks to rapid reading/writing by the FlashArray.
Write latency	Indicates the time taken to process the write operations during the last measurement period.	Milliseconds	
Average latency	Indicates the average time taken to process the I/O operations during the last measurement period.	Milliseconds	Ideally, the value of this measure should be very low. A high value or a steady increase in this value could indicate an I/O processing bottleneck on the array. In such a case, compare the value of the *Read latency* and *Write latency* measures to figure out where the slowness is worst - when processing read requests? or write requests?
Queue depth	Indicates the number of IO requests in the queue.	Number	A consistent increase in this value indicates a potential processing bottleneck with the FlashArray.

4.3.4 Pure Replicated Arrays Test

The FlashArray enables connecting two arrays to provide high availability and data protection, and to prevent single point of failure. When the arrays are connected, the array where the data is being transferred from is called the source array, and the array where data is being transferred to is called the target array. After two arrays are connected, the target array must allow the connection from the source array to accept the data being transferred. If the connection is not established or lost between the arrays, the data will not be transferred to the target array. The very purpose of the high availability and data protection of the arrays may therefore, be defeated. To prevent such eventualities, administrators should continuously monitor the connection status between the source and target arrays. To achieve this, administrators can use the **Pure Replicated Arrays** test.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for the FlashArray being monitored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Replicated Array Connection Status	Indicates the connection status of the replicated		The values reported by this measure and its numeric equivalents are

<table>
<tr><th>Measurement</th><th>Description</th><th>Measurement Unit</th><th>Interpretation</th></tr>
<tr><td></td><td>array.</td><td></td><td>mentioned in the table below:
<table><tr><th>Measure value</th><th>Numeric Value</th></tr><tr><td>Connected</td><td>100</td></tr><tr><td>Not connected</td><td>0</td></tr></table>
Note:
By default, this measure reports the Measure Values listed in the table above to indicate whether the replicated array is connected or not. The graph of this measure however is represented using the numeric equivalents only - 0 or 100.
The detailed diagnosis of this measure reveals the name, ID and type of the replicated array.</td></tr>
</table>

4.4 The Pure Storage Service Layer

Using the tests mapped to this layer, administrators can monitor the space usage of the hosts and host groups and promptly point administrators to those entities that have or are about to run out of space. In the process, the tests also monitor how quickly the host and host groups process I/O requests and warns administrators of potential processing slowdowns.

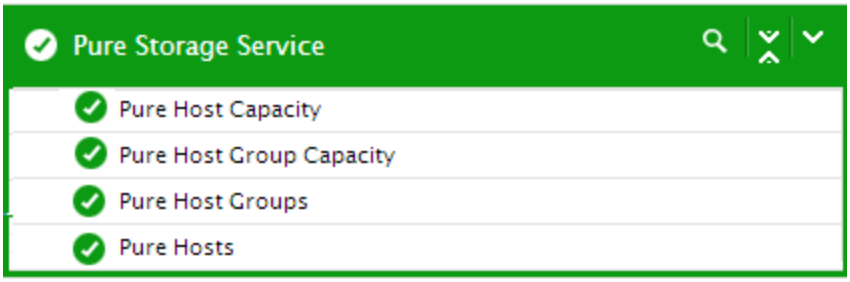

Figure 4.5: The test mapped to the Pure Storage Service layer

4.4.1 Pure Host Capacity Test

This test auto-discovers the hosts connected to the target FlashArray, and for each host, this test reports the total capacity, the space availability, the size of the volume and the amount of space occupied by the snapshots.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

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

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled:

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

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Total capacity	Indicates the total capacity allocated to this host.	TB	The detailed diagnosis of this measure reveals the details on data reductions.
Used capacity	Indicates the amount of space utilized by this host.	TB	
Free capacity	Indicates amount of space that is available for use by this host.	TB	
Capacity used	Indicates the percentage of space utilized by this host.	Percent	
Capacity free	Indicates the percentage of space that is available for use by this host.	Percent	
Volume	Indicates the size of the volume utilized by this host.	TB	Ideally, the value of these measures are desired to be low.
Snapshot	Indicates the space utilized for storing the snapshots of the volume to which this host has been connected with.	TB	

4.4.2 Pure Host Group Capacity Test

Using this test, administrators can monitor each host group connected to the FlashArray and can pin point the host group that is utilizing the maximum space than the rest. This way, irregularities in the space utilization across the host groups can be detected at ease!. In addition, the test also

proactively alerts administrators to probable slowdowns in I/O processing by specific host group, thereby enabling administrators to initiate pre-emptive actions.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each host group connected to the target FlashArray being moniored.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.
DD Frequency	Refers to the frequency with which detailed diagnosis measures are to be generated for this test. The default is *2:1*. This indicates that, by default, detailed measures will be generated every time this test runs, and also every time the test detects a problem. You can modify this frequency, if you so desire. Also, if you intend to disable the detailed diagnosis capability for this test, you can do so by specifying *none* against DD frequency.
Detailed Diagnosis	To make diagnosis more efficient and accurate, the eG Enterprise suite embeds an optional detailed diagnostic capability. With this capability, the eG agents can be configured to run detailed, more elaborate tests as and when specific problems are detected. To enable the detailed diagnosis capability of this test for a particular server, choose the **On** option. To disable the capability, click on the **Off** option. The option to selectively enable/disable the detailed diagnosis capability will be available only if the following conditions are fulfilled: • The eG manager license should allow the detailed diagnosis capability • Both the normal and abnormal frequencies configured for the detailed diagnosis measures should not be 0.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Total capacity	Indicates the total capacity allocated to this host group.	TB	The detailed diagnosis of this measure reveals the details on data reductions.
Used capacity	Indicates the amount of space utilized by this host group.	TB	Ideally, the value of this measure should be low. If this value grows closer to that of the *Total capacity* measure, then administrators may want to consider adding more storage to the host group, or freeing space in the host group by deleting unnecessary data.
Free capacity	Indicates amount of space that is available for use by this host group.	TB	A high value is typically desired for this measure. A very low value for this measure indicates a shortage of storage space on the host group.
Capacity used	Indicates the percentage of space utilized by this host group.	Percent	
Capacity free	Indicates the percentage of space that is available for use by this host group.	Percent	Ideally, the value of this measure is desired to be high.
Volume	Indicates the amount of space allocated to the volumes of this host group.	TB	The FlashArray presents disk-like volumes to connected hosts in the host group and maintains immutable snapshots of volume contents. Ideally, a low value is desired for these measures.
Snapshot	Indicates the amount of space allocated for storing the volume snapshots on this host group.	TB	

4.4.3 Pure Host Groups Test

Host groups are collections of hosts for which the FlashArray maintains consistent shared volume connections. The hosts are virtual or physical computers (typically application or database servers) that are connected to the FlashArray network through their Fibre Channel or iSCSI ports.

By monitoring each host group associated with the FlashArray, administrators can pin point the host groups that are handling more I/O requests than the rest. This way, irregularities in the distribution of I/O load across host groups can be detected at ease. In addition, the test also proactively alerts administrators to probable slowdowns in I/O processing by specific host group, thereby enabling administrators to initiate pre-emptive actions.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

Outputs of the test : One set of results for each host group for which the target FlashArray provisions volume.

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the amount of data utilized for performing read operations on this host group per second.	MB/Sec	A consistent decrease in the value of these measures for the host groups indicates an I/O processing bottleneck.
Write bandwidth	Indicates the amount of data utilized for performing write operations on this host group per second.	MB/Sec	
Average bandwidth	Indicates the average amount of data utilized for	MB/Sec	

Measurement	Description	Measurement Unit	Interpretation
	performing I/O operations on this host group per second.		
Read IOPS	Indicates the number of read operations performed on this host group per second.	IOPS	A consistent decrease in the value of these measures for the host groups indicates an I/O processing bottleneck.
Write IOPS	Indicates the number of write operations performed on this host group per second.	IOPS	
Average IOPS	Indicates the average number of I/O operations performed on this host group per second.	IOPS	
Read latency	Indicates the time taken to process the read operations during the last measurement period.	Milliseconds	Very high values for these measures are indicative of the existence of road-blocks to rapid reading/writing on the host group.
Write latency	Indicates the time taken to process the write operations during the last measurement period.	Milliseconds	
Average latency	Indicates the average time taken to process the I/O operations during the last measurement period.	Milliseconds	Ideally, the value of this measure is preferred to be low. A high value of this measure indicates that the I/O operations are slowly performed on the host group.

4.4.4 Pure Hosts Test

Hosts are virtual or physical computers (typically application or database servers) that are connected with the FlashArray network through their Fibre Channel or iSCSI port. The FlashArray recognizes and communicates with the hosts by Fibre Channel worldwide names (WWNs) or iSCSI qualified names (IQNs) associated with the ports. The I/O requests and data stored on the FlashArray volume are communicated to the hosts through the ports.

Using this test, administrators can monitor each host connected with the FlashArray and can pin point the hosts that are handling more I/O requests than the rest. This way, irregularities in the distribution of I/O load across hosts can be detected at ease. In addition, the test also proactively alerts administrators to probable slowdowns in I/O processing by a specific host, thereby enabling administrators to initiate pre-emptive actions.

Target of the test : Pure Storage FlashArray

Agent deploying the test : A remote agent

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

Configurable parameters for the test

Parameter	Description
Test Period	How often should the test be executed.
Host	The IP address of the host for which this test is to be configured.
Port	The port at which the device listens. By default, this will be *NULL*.
API Token	The eG agent collects the required metrics from the Pure Storage Flash Array by executing API commands using Pure Storage REST API on the FlashArray and pulls out critical metrics. In order to collect metrics, the eG agent should be provided with a valid API token. To know how to determine the API token, refer to Section **2.1**. Specify the determined API token in the API Token text box.

Measurements made by the test

Measurement	Description	Measurement Unit	Interpretation
Read bandwidth	Indicates the amount of data utilized for performing read operations on this host per second.	MB/Sec	A consistent decrease in the value of these measures for the hosts indicates an I/O processing bottleneck.
Write bandwidth	Indicates the amount of data utilized for performing write operations on this host per second.	MB/Sec	
Average bandwidth	Indicates the average amount of data utilized for	MB/Sec	Compare the value of this measure across the hosts to know the host that

Measurement	Description	Measurement Unit	Interpretation
	performing I/O operations on this host per second.		uses more bandwidth to process the I/O requests.
Read IOPS	Indicates the number of read operations performed on this host per second.	IOPS	Ideally, the value of this measure should be very low. A high value or a steady increase in this value could indicate an I/O processing bottleneck on the array.
Write IOPS	Indicates the number of write operations performed on this host per second.	IOPS	
Average IOPS	Indicates the average number of I/O operations performed on this host per second.	IOPS	This measure is a good indicator of I/O load on every host connected to the FlashArray.
Read latency	Indicates the time taken to process the read operations during the last measurement period.	Milliseconds	Very high values for these measures are indicative of the existence of road-blocks to rapid reading/writing on the hosts.
Write latency	Indicates the time taken to process the write operations during the last measurement period.	Milliseconds	
Average latency	Indicates the average time taken to process the I/O operations during the last measurement period.	Milliseconds	Ideally, the value of this measure should be very low. A high value or a steady increase in this value could indicate an I/O processing bottleneck on the host.

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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