Introduction

Intended audience

This document is intended for storage administrators who are familiar with the HP P2000 G3 Modular Smart Array (MSA) Array storage features.

Overview

HP P2000 G3 MSA Systems provide storage solution offering excellent performance at a very competitive price point. The system delivers high performance, is low cost, and has a consolidated storage array solution to meet the needs of departmental and small-to-medium business requirements. It also gives flexibility to share the array resources over two protocols, supporting the needs of different departments and budgets. The P2000 G3 arrays are integrated with Web browser and command line interface (CLI)-based software for storage and RAID management, setup, configuration, and troubleshooting.

The HP P2000 G3 MSA Arrays have statistical counters that provide array performance measurements across different levels, such as disks, Vdisks, host ports, controllers, and volumes. Each component supports a list of performance metrics such as IOPS, Queue Depth, and Bytes per second. For full list of metrics supported, refer HP P2000 G3 MSA System CLI Reference Guide.

These metrics can be used in different scenarios like when a support personnel needs to view a selected set of P2000 G3 Arrays performance counters for each array during a typical daily transaction or when the IT team needs to collect a file set of monthly four hour performance run for each of the P2000 G3 Arrays systems.

This white paper tells the user about accessing the performance metrics of P2000 G3 arrays using different interfaces like CLI and SMU and host software solution, which helps user to collect metrics from array.
Performance monitoring with P2000 G3 arrays

Using command line

You can access the CLI interface of array using telnet or SSH. P2000 G3 array has a rich set of CLI commands (refer to CLI reference guide for full set of commands), which help user to perform operations on array, monitor array performance.

Table 1: Commands used for monitoring array performance

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>show controller-statistics</td>
<td>Shows live performance statistics for controller A, B, or both</td>
</tr>
<tr>
<td>show Vdisk-statistics</td>
<td>Shows live or historical performance statistics for Vdisks</td>
</tr>
<tr>
<td>show disk-statistics</td>
<td>Shows live or historical performance statistics for disks</td>
</tr>
<tr>
<td>show volume-statistics</td>
<td>Shows live performance statistics for all or specified volumes</td>
</tr>
<tr>
<td>show host-port-statistics</td>
<td>Shows live performance statistics for each controller host port</td>
</tr>
</tbody>
</table>

Note: For detailed information of these commands and available metrics for each command, refer CLI reference guide.

CLI command output can be viewed in multiple formats like console, API or JSON. Console mode supports interactive use of the CLI by displaying command output in easily readable format. This format automatically sizes fields according to content. API mode is useful for scripting environments where the output is shown in XML and user can use any XML parser to get data from XML and use it. You can refer the HP P2000 G3 MSA System CLI Reference Guide to see sample XML output for each performance statistics commands. API mode also gives additional performance metrics to user compared to the console mode.

Table 2: Set of CLI commands available to reset the performance counters

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>reset all-statistics</td>
<td>Resets all the performance statistics for both the controllers</td>
</tr>
<tr>
<td>reset controller-statistics</td>
<td>This command resets all controller statistics except Power On Time</td>
</tr>
<tr>
<td>reset Vdisk-statistics</td>
<td>Resets performance statistics for all or specified Vdisks</td>
</tr>
<tr>
<td>reset disk-statistics</td>
<td>Resets performance statistics for disks</td>
</tr>
<tr>
<td>reset volume-statistics</td>
<td>Resets performance statistics for all or specified volumes</td>
</tr>
<tr>
<td>reset host-port-statistics</td>
<td>Resets performance statistics for controller host ports</td>
</tr>
</tbody>
</table>

Note: For more detailed information about these CLI commands, refer to CLI reference guide.
Using SMU

You can access the P2000 G3 array using any supported browsers like Internet Explorer or Mozilla to manage or view array objects. With T240 or above, firmware user can now view performance of Vdisk and disk by logging into Storage Management Utility (SMU) via browser.

Using SMU, the user can only view performance statistics of Vdisk and disk. To view performance data of other objects like controller, volume, and host port the user needs to use either CLI or a host based tool.

Vdisk performance

When you select the Vdisk component and click the Performance tab, the Performance Statistics panel shows three graphs of historical performance statistics for the Vdisk. Data samples are taken every quarter hour and the graphs represent up to 50 samples.
To specify a time range of samples to display, set the start and end values and click Update. The system determines whether the number of samples in the time range exceeds the number of samples that can be displayed (50), requiring aggregation.

- Example 1: A 1-hour range includes 4 samples. 4 is less than 50 so all 4 samples are displayed.
- Example 2: A 15-hour range includes 60 samples. 60 divided by 50 gives a quotient of 1 and a remainder of 10. Therefore, the newest 50 samples will be displayed and the oldest 10 samples will be excluded.
- Example 3: A 30-hour range includes 120 samples. 120 divided by 50 gives a quotient of 2 and a remainder of 20. Therefore, each two newest samples will be aggregated into one sample for display and the oldest 20 samples will be excluded.

If aggregation is required, the system aggregates samples for each disk in the Vdisk (as described in the “Disk performance” section of help for the Enclosure Overview panel) and then aggregates the resulting values as follows:

- For a count statistic such as data transferred, the aggregated values are added to produce the value of the aggregated sample.
- For a rate statistic such as data throughput, the aggregated values are added and are then divided by their combined interval (seconds per sample multiplied by the number of samples).

The system will change the time settings to match the times of the oldest and newest samples displayed. The graphs are updated each time you click either the Performance tab or the Update button.

- For the Vdisk, the Data Transferred graph shows the amount of data read and written and the combined total over the sampling time period. The base unit is bytes.
- For the Vdisk, the Data Throughput graph shows the rates at which data is read and written and the combined total over the sampling time period. The base unit is bytes per second.
- For each disk in the Vdisk, the Average Response Time graph shows the average response times for reads and writes over the sampling time period. The base unit is microseconds. To view the graph’s legend, which identifies the color-coding for each disk, select Show Legend.

**Tip:** If you specify a time range, it is recommended to specify a range of 12 hours or less.

To view summary performance data for a Vdisk, use the Vdisk Overview panel. To view live (non-historical) performance statistics for one or more Vdisks in the CLI, use the show Vdisk-statistics command.
Disk performance

When you select a disk and click the Performance tab, a table shows eight graphs of historical performance statistics for the disk. Data samples are taken every quarter hour and the graphs represent up to 50 samples. By default, the graphs show the newest 50 samples.

To specify a time range of samples to display, set the start and end values and click Update. The system determines whether the number of samples in the time range exceeds the number of samples that can be displayed (50), requiring aggregation.

• Example 1: A 1-hour range includes 4 samples. 4 is less than 50 so all 4 samples are displayed.
• Example 2: A 15-hour range includes 60 samples. 60 divided by 50 gives a quotient of 1 and a remainder of 10. Therefore, the newest 50 samples will be displayed and the oldest 10 samples will be excluded.
• Example 3: A 30-hour range includes 120 samples. 120 divided by 50 gives a quotient of 2 and a remainder of 20. Therefore, each two newest samples will be aggregated into one sample for display and the oldest 20 samples will be excluded.

If aggregation is required, the system calculates values for the aggregated samples. For a count statistic (total data transferred, data read, data written, total I/Os, number of reads, number of writes), the samples’ values are added to produce the value of the aggregated sample. For a rate statistic (total data throughput, read throughput, write throughput, total IOPS, read IOPS, write IOPS), the samples’ values are added and are then divided by their combined interval. The base unit for data throughput is bytes per second.

• Example 1: Two samples’ number-of-reads values must be aggregated into one sample. If the value for sample 1 is 1060 and the value for sample 2 is 2000, then the value of the aggregated sample is 3060.
• Example 2: Continuing from example 1, each sample’s interval is 900 seconds so their combined interval is 1800 seconds. Their aggregate read-IOPS value is their aggregate number of reads (3060) divided by their combined interval (1800 seconds), which is 1.7.
The system will change the time settings to match the times of the oldest and newest samples displayed. The graphs are updated each time you click either the Performance tab or the Update button.

- The Data Transferred graph shows the amounts of data read and written and the combined total over the sampling time period. The base unit is bytes.
- The Data Throughput graph shows the rates at which data is read and written and the combined total over the sampling time period. The base unit is bytes per second.
- The I/O graph shows the numbers of reads and writes and the combined total over the sampling time period.
- The IOPS graph shows the numbers of reads and writes per second and the combined total over the sampling time period.
- The Average Response Time graph shows the average response times for reads and writes and the combined average over the sampling time period. The base unit is microseconds.
- The Average I/O Size graph shows the average sizes of reads and writes and the combined average over the sampling time period. The base unit is bytes.
- The Disk Error Counters graph shows the number of disk errors over the sampling time period.
- The Average Queue Depth graph shows the average number of pending I/O operations that are being serviced over the sampling time period. This value represents periods of activity only and excludes periods of inactivity.

Tip: If you specify a time range, it is recommended to specify a range of 12 hours or less.

To view performance data for an individual disk, use the Enclosure Overview panel. To view live (non-historical) performance statistics for one or more disks, in the CLI use the show disk-statistics command.

Using Performance Tool

The HP P2000 G3 MSA Arrays have statistical counters that provide array performance measurements across different levels, such as disks, Vdisks, host ports, controllers, and volumes. Since it is difficult to obtain these values from the array by using CLI commands, HP P2000 Performance Tool is introduced to run on any host system and collect performance details of one or more arrays.

The HP P2000 Performance Tool is used in various scenarios such as:

- When a support personnel needs to view a selected set of P2000 G3 Arrays performance counters for each array during a typical daily transaction.
- When the IT team needs to collect a file set of monthly four hour performance run for each of the P2000 G3 Arrays systems. The set of files are used with MS Excel to create performance graphs.
- When a presales solution architect needs to validate if the proposed storage solution containing multiple P2000 G3 Arrays can satisfy the customer performance.

The main page of the HP P2000 MSA Performance Tool displays the following tabs:

- Getting Started: Displays general information about the tool.
- Arrays: Lists the discovered arrays.
- Performance: Displays performance details for the selected array.
- Schedule: Displays settings for scheduling performance.

You can use the Settings page to modify the Performance Tool behavior. You can change various parameters like Discovery Options, Array Authentication, and SNMP Settings to alter the search criteria. The tool also maintains a log which can be viewed using the Logs page.
You can use the tool for:

**Discovering arrays**
You can discover arrays in the local network or in a specified IP range and view configuration summary of the discovered arrays. Configuration summary displays basic information about array like system name, serial number, firmware version, and management IP address.

**Viewing performance**
Using the “Get Sample” operation, you can view the current performance statistics of the selected array. This operation collects statistics from the array in two minutes interval and displays the metrics in a tabular form, which can be viewed and can also be printed. It also collects and displays the current configuration of the array (Vdisk, disk, host-ports, controllers, and volume details).

**Scheduling performance collection**
You can create a scheduler using the tool specifying the interval at which it should run. You can also create a scheduler for each array you want to monitor. The scheduler will run in set intervals and will collect performance metrics from the array, and store data in CSV files. The tool collects statistics for different objects in the storage array like controllers, Vdisks, disks, volumes, and host-ports.

**Viewing scheduled performance**
You can view performance statistics collected using the scheduled task either graphically or in a tabular form using the CSV files. The tool allows you to represent graphs with different metrics like IOPS, Bytes per second, Average I/O size, cache hit ratio, and so on. You can view available metrics in the CSV files generated by the tool and can also analyze this data outside the tool by presenting the data in the tabular format from CSV file.

HP P2000 Performance Tool gives users more flexibility in analyzing array performance in comparison with the CLI or SMU interfaces of array.

- Scheduling collection in desired intervals
- Plotting graph with desired metrics
- Availability of CSV file for all the collection metrics
- Manage multiple arrays from a single host-based solution
- Additional calculated metrics

Performance Tool uses calculated metrics to display performance data to end user.

- Delta-read-bytes-perSec = data-read-numeric (current sample) - data-read-numeric (previous sample) / interval time
  (seconds)
- Delta-write-bytes-perSec = data-write-numeric (current sample) - data-write-numeric (previous sample) / interval time
  (seconds)
- Total-Bytes-perSec = delta-read-bytes-perSec + delta-write-bytes-perSec
- Delta-read-iop = number-of-reads(current sample) - number-of-reads(previous sample) / interval (seconds)
- Delta-write-iop = number-of-writes(current sample) - number-of-writes(previous sample) / interval (seconds)
- Total IOPS = delta-read-iop + delta-write-iop
- Delta-avg-readSize = delta-read-bytes-perSec / delta-read-iop
- Delta-avg-writeSize= delta-write-bytes-perSec / delta-read-iop
- Delta-avg-ioSize = delta-avg-readSize + delta-avg-writeSize
- delta-write-cache-hitRatio = write-cache-hits(current sample) - write-cache-hits(previous sample) / number-of-writes
- delta-read-cache-hitRatio = read-cache-hits(current sample) - read-cache-hits(previous sample) / number-of-reads

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1 When a reset has not happened between current sample time and previous sample time, interval time = current sample time – previous sample time. If a reset has happened, interval time = current sample time – current reset time. Also when a reset has happened previous sample value is taken as 0.
Summary table

The following table summarizes the features supported by all of the three interfaces discussed above.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Command line</th>
<th>SMU</th>
<th>Performance tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical data collection</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Live data collection</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Entities supported</td>
<td>All</td>
<td>Vdisks</td>
<td>All</td>
</tr>
<tr>
<td>Multiple array support</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Graphing</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Export to CSV</td>
<td>FTP</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Delta calculation</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Target based/Host based</td>
<td>Target based</td>
<td>Target based</td>
<td>Host based</td>
</tr>
</tbody>
</table>

FAQs

1. Is there any additional metrics supported with T240 firmware?
   Yes, they are average response time, average read response time, and average write response time. (These metrics are applicable only for Vdisks and host-ports.)

2. Is there minimum firmware which needs to be running on array to use Performance Tool?
   Yes, array should be in T201 firmware to see basic performance metrics. For complete metrics, use T230 or higher firmware.

Reference

HP P2000 G3 MSA System CLI Reference Guide

HP P2000 G3 MSA System SMU Reference Guide

HP P2000 MSA Performance Tool
http://h20000.www2.hp.com/bizsupport/TechSupport/SoftwareDescription.jsp?cc=us&lang=en&mode=2&prodNameld=4118563&prodSeriesId=4118559&prodTypeld=12169&swEnvOID=1005&swItem=MTX-5e878f833e2c4d078c0e8368bd&swLang=8&taskId=135

For more information on HP P2000 G3 Modular Smart Array Systems and storage solutions, visit hp.com/go/msa2000

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