



DELL EMC UNITY: PERFORMANCE METRICS

A Detailed Review

ABSTRACT

This white paper explains the Performance Metrics features for Dell EMC™ Unity systems. Viewing performance information, including adding charts, customizing the time range, exporting chart data, and downloading performance archive files is discussed.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
Audience	4
Terminology.....	4
PERFORMANCE METRICS	6
Unisphere Performance Metrics Page.....	6
Download Performance Archive Files	13
Unisphere CLI Performance Metrics	15
REST API Performance Metrics	17
TROUBLESHOOTING TECHNIQUES	19
Performance Categories	19
Triage General Workflow.....	20
CONCLUSION	21
REFERENCES	22
APPENDIX A: AVAILABLE UNISPHERE PERFORMANCE METRICS	23
Historical Performance Metrics.....	23
Real-Time Performance Metrics.....	28

EXECUTIVE SUMMARY

Data is a crucial part of the day to day operations of an organization. Data access and data availability are always top concerns of storage administrators along with system performance and capacity. With the addition of advanced data services like Thin provisioning, Replication, and Snapshots that introduce additional complexity, storage environments require a wide range of understandable and differentiating performance metrics to be able to diagnose and troubleshoot issues or accomplish routine maintenance operations.

Dell EMC Unity storage systems address these types of concerns by providing the ability to view capacity and performance metrics within the friendly and simple-to-use management interface of Unisphere as well as through other interfaces like Unisphere CLI (UEMCLI) and the built-in RESTful API. This expansive set of information enables storage administrators to more easily analyze their system's performance on demand while also being able to monitor capacity details that ensure their users are always able to access their critical data.

This white paper discusses the performance metrics available on Dell EMC Unity storage systems and describes the ways a user can easily view and gather performance metrics data from their storage system. The paper also describes the different functionality available related to performance metrics while providing guidelines in using these features. Note that this paper does not cover off-array monitoring options. More information can be found on Unisphere Online Help, Unisphere CLI documentation, and Dell EMC Unity REST API documentation.

AUDIENCE

This white paper is intended for Dell EMC customers, partners, and employees who are considering the use of capacity and performance metrics for their Dell EMC Unity storage systems. It is assumed that the reader is at least an IT generalist who has experience as a system or network administrator.

TERMINOLOGY

Bandwidth – Maximum amount of data that can be transmitted through a data channel per unit of time. Commonly expressed in megabytes per second (MB/s).

CIFS – Common Internet File System. See Server Message Block (SMB).

Fibre Channel (FC) – A high-speed networking technology that is used to transport Small Computer Systems Interface (SCSI) commands over a Fibre Channel fabric.

Internet SCSI (iSCSI) – A protocol that provides a mechanism for accessing raw block-level data storage over network connections. The iSCSI protocol is based on the network-standard client/server model with iSCSI initiators (hosts) acting as storage clients and iSCSI targets acting as storage interfaces. Once a connection is established between an iSCSI host and the iSCSI interface, the host requests storage resources and services from the interface.

IOPS – Input/output operations per second.

NAS Server – A file storage server that uses SMB or NFS protocols to catalog, organize, and transfer files within designated file system shares. A NAS Server must be created before creating file-level storage resources such as SMB or NFS file systems, or VMWare NFS datastores.

Network File System (NFS) – An access protocol that enables users to access files and folders from Linux/UNIX hosts located on a network.

Pool – A collection of drives configured with a particular storage profile. The storage profile defines the type of drives used to provide storage and the type of RAID configured on the drives. The storage pool's configuration defines the number of drives and quantity of storage associated with the pool.

REST API – An application programming interface that utilizes familiar HTTP operations like GET, POST, and DELETE. REST architecture includes certain constraints that ensure that different implementations of REST conform to the same guiding principles, thereby allowing developers the ease of application development when working with different REST API deployments.

Server Message Block (SMB) – A file sharing protocol that allows users to share files systems over the Internet and intranets. This is typically used in Windows environments. Also known as Common Internet File System (CIFS), Microsoft's implementation of SMB.

Storage Processor – A hardware component that performs Dell EMC Unity storage operations such as creating, managing, and monitoring storage resources.

Unisphere – The web-based user interface for managing Dell EMC Unity storage systems.

Unisphere CLI (UEMCLI) – The command-line interface for managing Dell EMC Unity storage systems.

PERFORMANCE METRICS

Dell EMC Unity storage systems provide you with the ability to view performance metrics from the system level through to the individual drives. The performance metrics are located in the Unisphere Performance page. Performance data can be used to diagnose and troubleshoot issues within a storage environment.

PERFORMANCE METRICS DATABASE

Performance metrics data is located in a database stored on the first four system drives. This performance database space is fixed at 16GB in size and is automatically reserved on every storage system. The fixed size allows the system to retain historical metrics for a fixed duration of time, although not indefinitely (see the *Performance Metrics Aging Policy* section for more information).

The target for total consumed space for storing metrics is 70% of the available 16GB reserved system space for metrics. If there is a lack of space, the system will decrease the retention period for the oldest metrics while attempting to retain at least 24 hours' worth of data for all collected metrics.

PERFORMANCE METRICS AGING POLICY

Performance metrics data is consolidated and averaged depending on the age of the data so that the metrics database can hold older data for longer periods. For example, data that is greater than 3 days old is consolidated from 1 minute intervals to 5 minute intervals for a longer sampling interval. Same concept is applied at 14 days and 28 days respectively. Below is the full list of metric retention periods and associated sampling intervals as shown in Table 1:

Table 1. Sampling intervals and retention periods

Sampling interval	Retention period
1 minute	3 days
5 minutes	14 days
1 hour	28 days
4 hours	90 days

UNISPHERE PERFORMANCE METRICS PAGE

On Dell EMC Unity systems, there are a number of ways you can view metrics data that have been collected by the system. This includes viewing metrics from the Unisphere Performance Page, from the Unisphere CLI, and from the Dell EMC Unity RESTful API.

Overview

As shown in Figure 1, the Performance Page in Unisphere can be found by clicking **Performance** in the left-hand navigation menu under the "SYSTEM" category. In this page, as seen in Figure 2, you can view and modify the metrics charts shown on that dashboard as well as add additional dashboards to tailor the views to your needs. You can also interact with the charts themselves by modifying the time view range or hovering over the charts to see individual metric points and compare with other charts on the page for troubleshooting purposes. Leveraging these capabilities, you can quickly locate any high-level performance issues as well as drill-down further for more details by utilizing various breakdown categories and filter options on each chart. Note that the filter options chosen on one chart do not affect any other charts on the dashboard. By default, the Historical Charts dashboard page is populated with performance charts which show the system's CPU Utilization, File System Bandwidth, LUN IOPS, LUN Bandwidth, and File System IOPS. This page displays data collected within a preset or customized time range.

With Dell EMC Unity OE version 4.1, the Real-time Charts dashboard was added. When viewing metrics in the Real-time dashboards, new data points are automatically added every 5 seconds. The Real-time Charts dashboards display data collected during the current session, over a maximum time range of 15 minutes. The session ends when you navigate away from the current tab and restarts when you navigate back to the tab. You can display up to four real-time metrics charts at a time on a dashboard.

For a full list of available metrics via Unisphere GUI including descriptions, see *Appendix A: Available Unisphere Performance Metrics*.

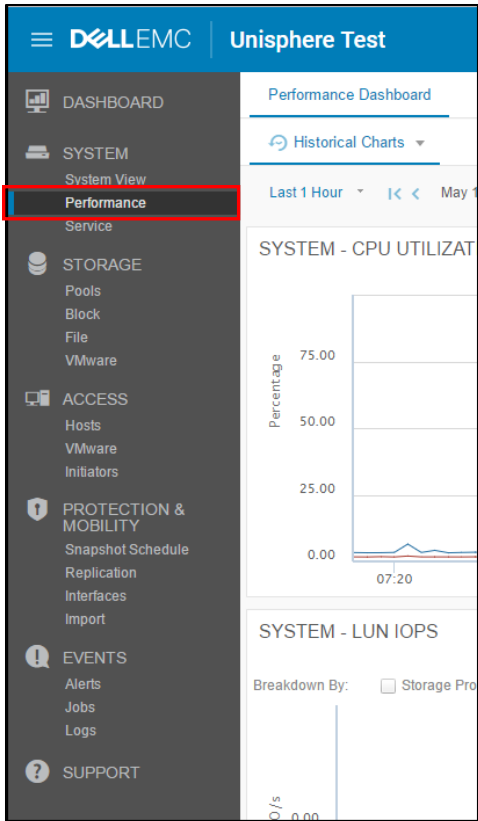


Figure 1 - Performance Page (Navigation Menu)

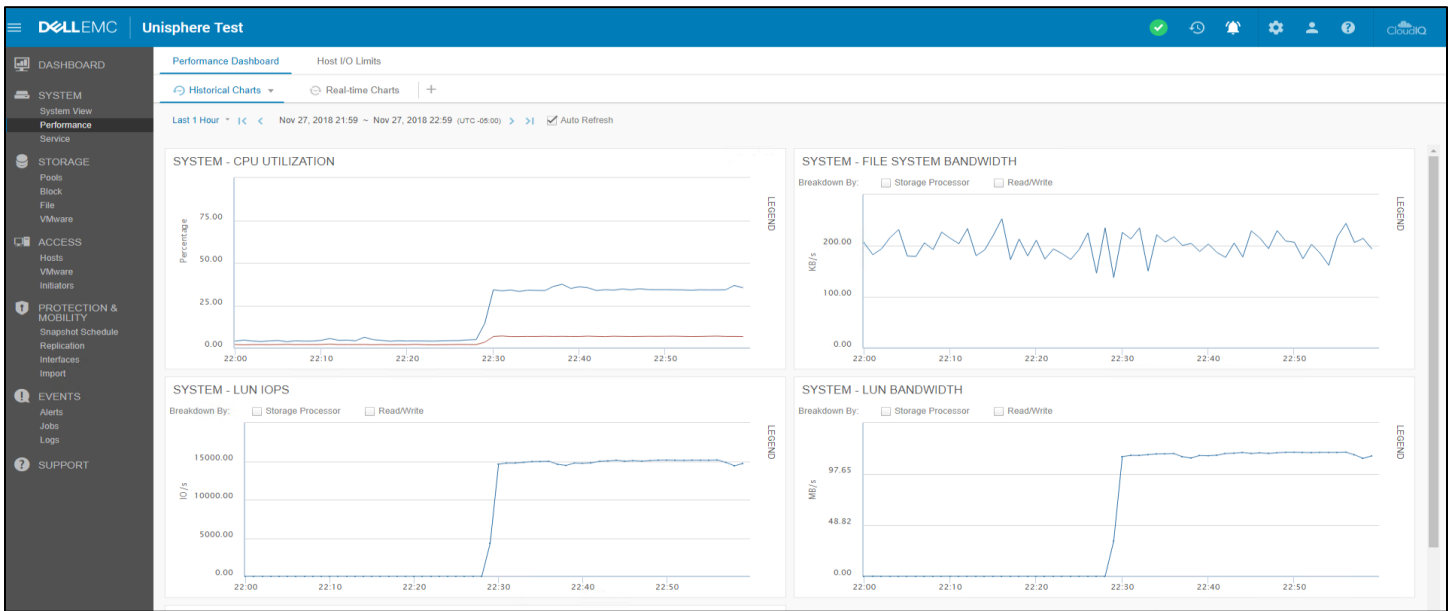


Figure 2 - Performance Page in Unisphere

Add Charts

While in the **Performance** page, to add a chart to a dashboard select the dashboard's name and click **Add Charts**. The available charts that can be added to the dashboard are shown. The Add Historical/Real-Time Charts menu, as shown in Figure 3, separates charts into various categories like system-level or resource-level allowing for easy searches of related metrics.

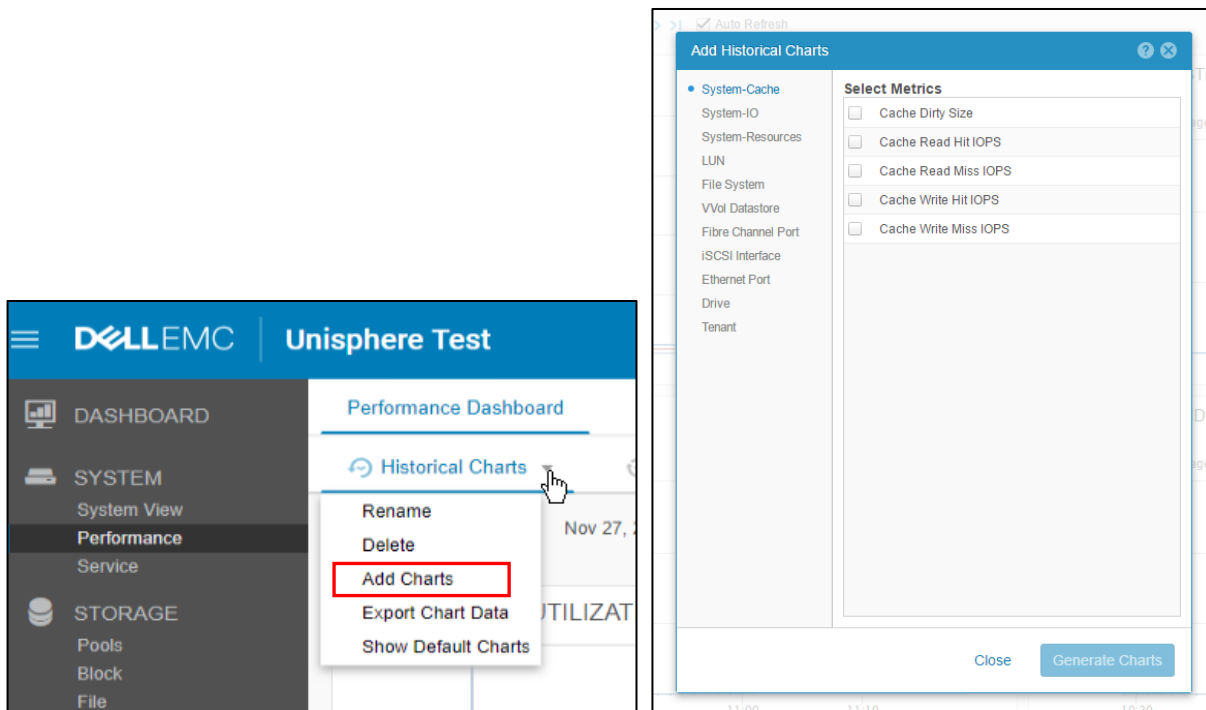


Figure 3 – Dashboard Actions and Add Charts Menu

Viewing Metrics

When viewing metrics on the Performance page of Unisphere, you can always hover your mouse over individual charts to see specific graphed metric values along with associated timestamps. You'll notice that hovering over one chart automatically shows metric values in all other visible charts on the page for the same timestamp as seen in Figure 4. This allows for fast comparison between metric charts when conducting troubleshooting steps.

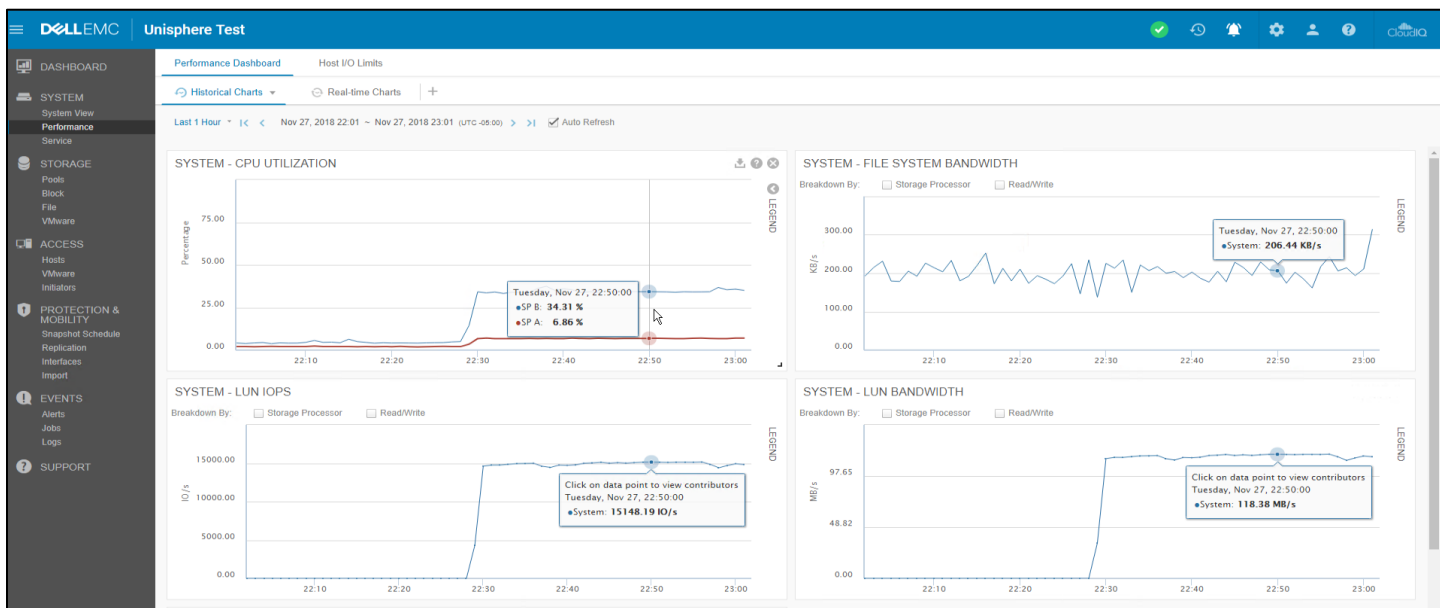


Figure 4 - Metric Charts (Hover)

For more customized viewing, you can move charts to different parts of the dashboard by hovering over the top part of a given chart where the cursor will change to a movement cursor as seen in Figure 5. Clicking-and-dragging with the movement cursor enabled will allow you to move the given chart to a new location within the page.

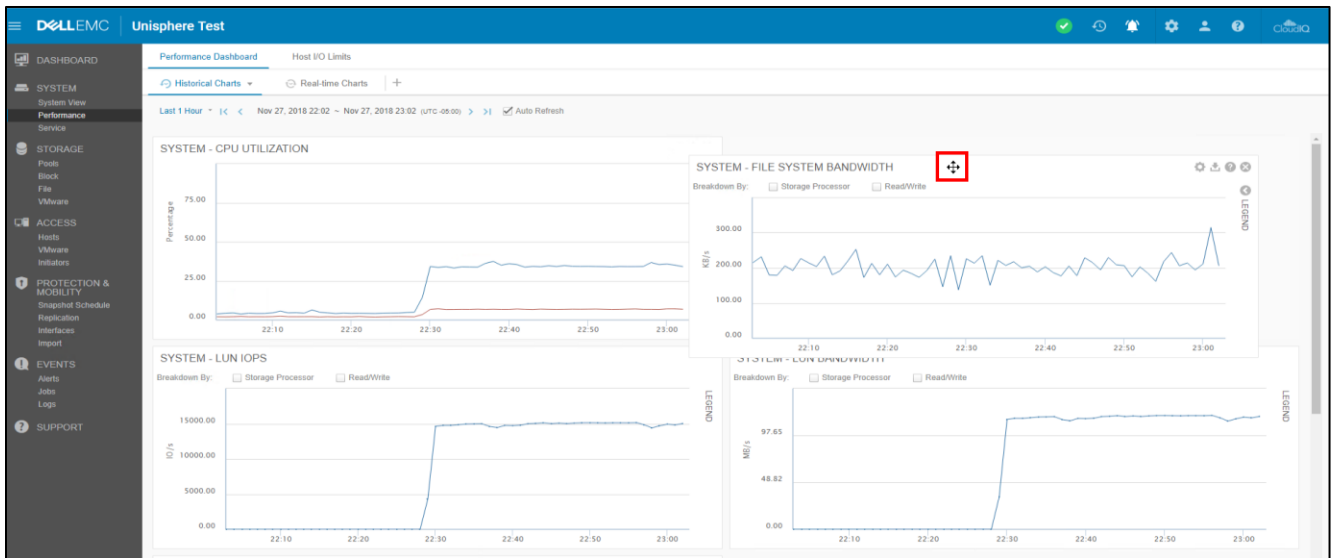


Figure 5 - Relocating Metric Charts (Cursor highlighted)

The Performance page also supports the expansion of metric charts for easier viewing. This can be done by hovering over a given chart and click-and-dragging the bottom right corner of the chart to the right of the page as seen in Figure 6. Note that the chart must be on the left side of the page to be expanded to the right.

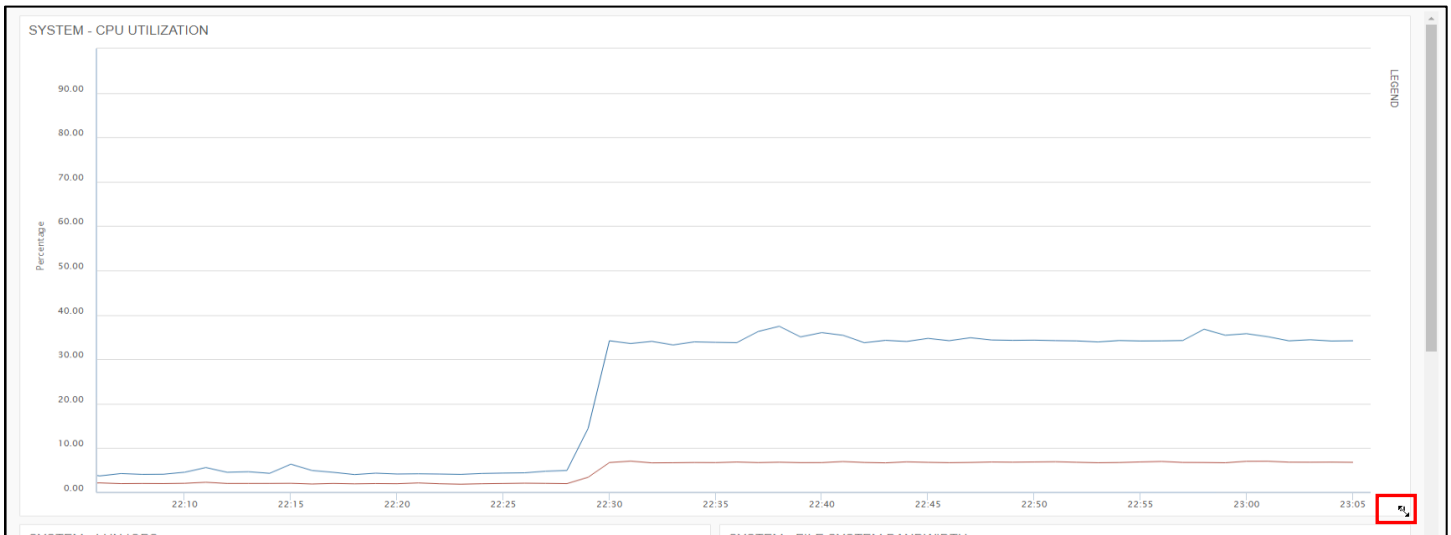


Figure 6 - Expanding charts (Chart expansion corner highlighted)

Viewing Range and Charts Refresh

To change the viewing time range of the metric charts displayed on the dashboard, you can use the default time ranges (Last 1 Hour, Last 4 Hours, Last 12 Hours, Last 24 Hours, Last 7 Days, Last 30 Days, and Last 90 Days) or a Custom time range as seen in Figure 7. The different time ranges correlate to specific sampling intervals, as shown in the following table:

Table 2. Time ranges and associated sampling intervals

Time range setting	Sampling interval
Last 1 Hour	1 minute
Last 4 Hours	1 minute
Last 12 Hours	5 minutes
Last 24 Hours	5 minutes
Last 7 Days	1 hour
Last 30 Days	4 hours
Last 90 Days	4 hours
Custom	Varies based on the length of the range. If the range is more than one week, the sampling interval is 4 hours.

In the center of Figure 7, you will notice the date and times for the start and end point of your viewing window which correlates to what metric points are shown in the metric charts. To view the latest metrics, click the Auto-refresh checkbox to the right of the time window. To change the viewing window itself, you can use the arrows to go back and forth through time or zoom into a specific range as shown in Figure 8.

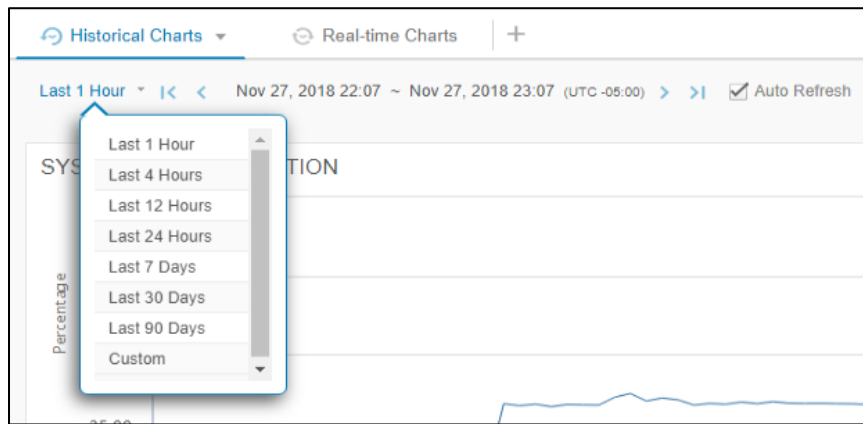


Figure 7 - Navigator bar, Default time ranges, and Auto-Refresh button

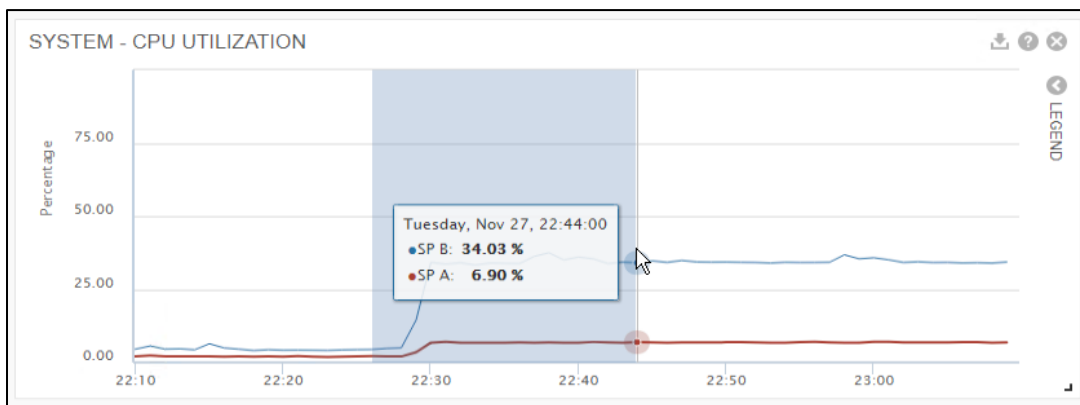


Figure 8 – Zoom in a chart

Breakdown Categories and Filter Options

At the top of each metric chart there are different checkbox buttons (breakdown categories) that are available to be selected. When selected, the chart will update according to the chosen breakdown category with separate lines designating each component of the

breakdown. For example, Figure 9 shows the LUN IOPS metric chart with the “Storage Processor” breakdown category selected allowing for SP A, SP B, and Average metrics to be graphed on separate lines. Note that you can click the “LEGEND” in each chart to see the labels for each graphed line.

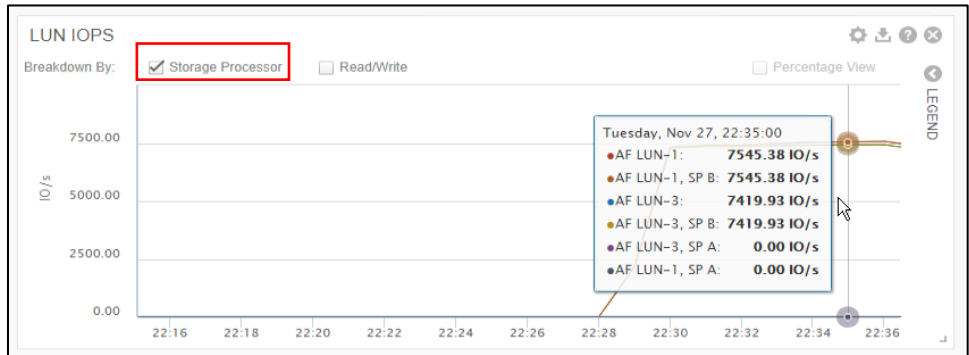


Figure 9 – LUN IOPS Metric Chart (Breakdown)

You can also use a filter option to hide certain lines from being graphed by clicking on the checkbox next to the line labels in the legend, as seen in Figure 10. This helps better isolate what metrics you would like to investigate further.

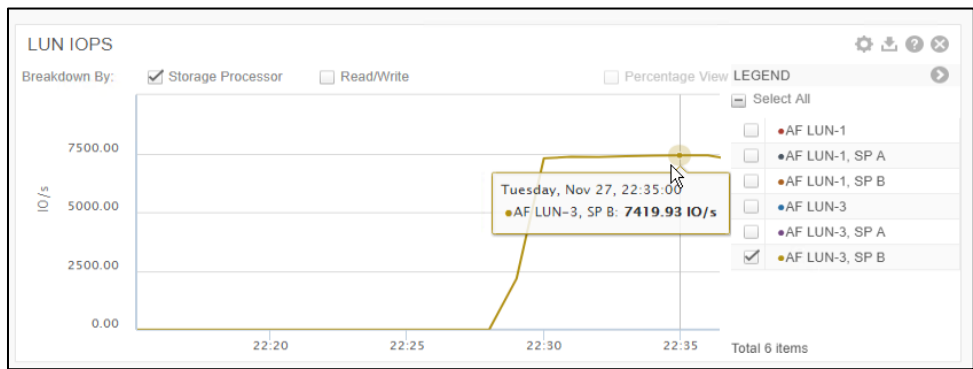


Figure 10 – LUN IOPS Metric Chart (Filtered)

With the Unity OE 4.5 release, for object-level line charts, such as those for LUNS, file systems, drives, and so forth, you can select **Percentage View** to view the data points as percentage values instead of absolute values.

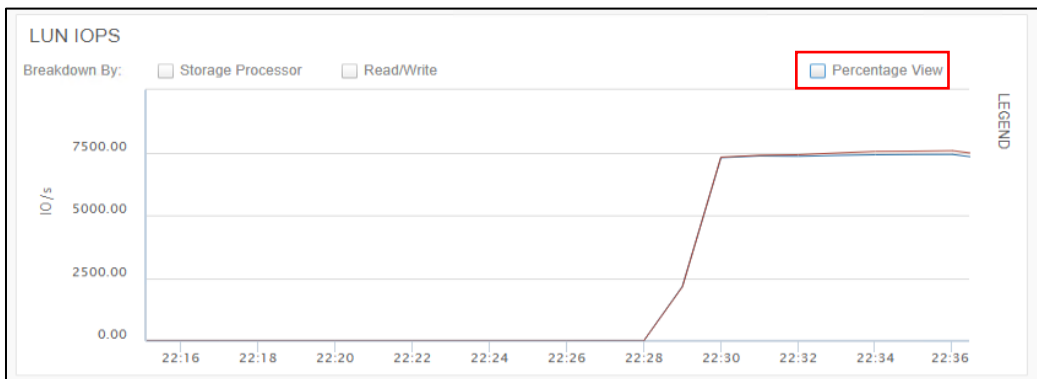


Figure 11 – Percentage View option

The Percentage View breakdown shows each resource’s contribution as a percentage of the total. This option is only available in Unisphere and is available for both historical and real-time charts. As well, it is deselected by default and only available when all other breakdown options are deselected.

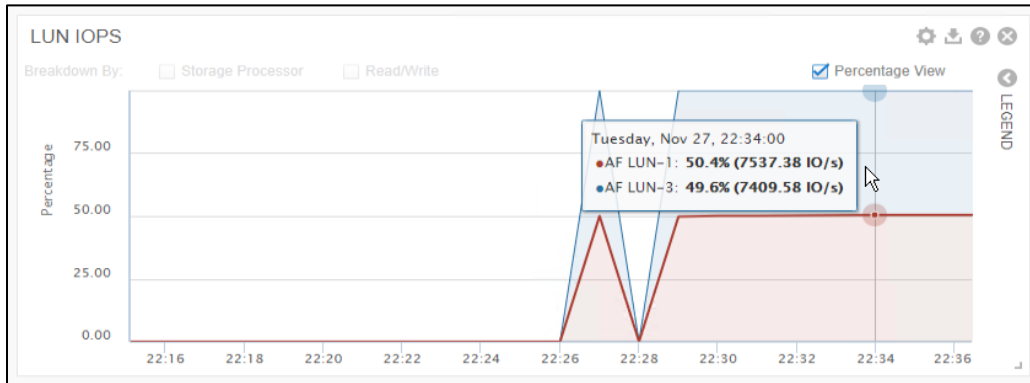


Figure 12 – Percentage View example

Click on data point to view contributors

To get more details, the user can click a data point tooltip in a chart that has the message “Click on a data point to view contributors”. If the user clicks in a data point on the chart with the message the “Top 20 Contributors” tooltip is shown, as seen in Figure 13. In the tooltip, the Choose Group dropdown can be used to view the line chart for the option selected, the options given in the dropdown will vary depending on the “Breakdown By” field that was chosen. To compare the metrics, the user can select the resources and click the Generate Chart button, which as result will generate a chart with the metrics for the resources selected.

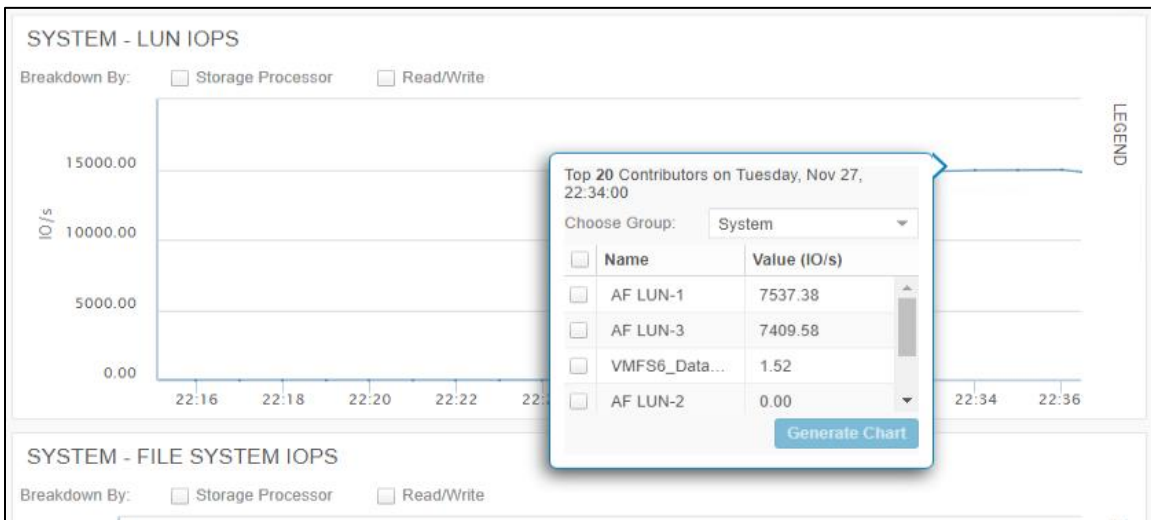


Figure 13 – Top 20 Contributors for a data point

Export Option

If you would like to export metrics data into a CSV (comma separated value) format, you can do so by hovering over a given metric chart and clicking the Export button as seen on Figure 14. This action will download the metrics into a CSV file of what is currently being shown in the graph including any applied breakdown categories and filter options; therefore, you can change the chart to what you want to gather before clicking the export button.

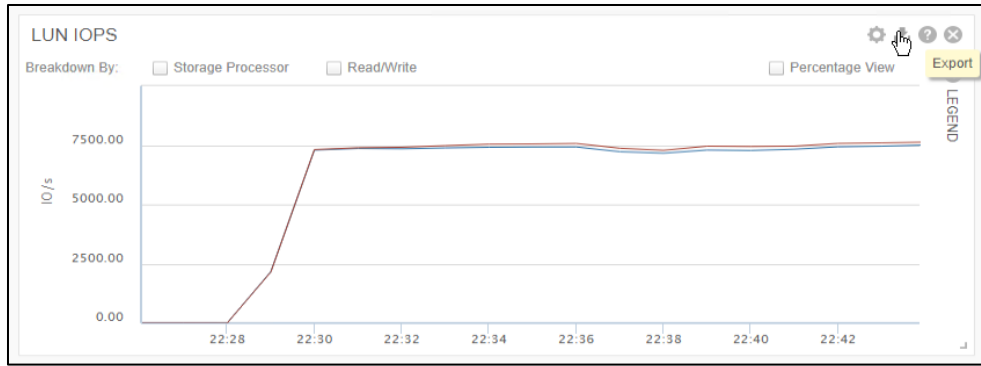


Figure 14 – Export Metrics Button

With Dell EMC Unity OE version 4.2, Historical Charts dashboards contain an option to export the data of all the displayed charts to a single CSV file. While in the **Performance** page, to export all the data, select the dashboard's name and click **Export Chart Data**, as seen on Figure 15.

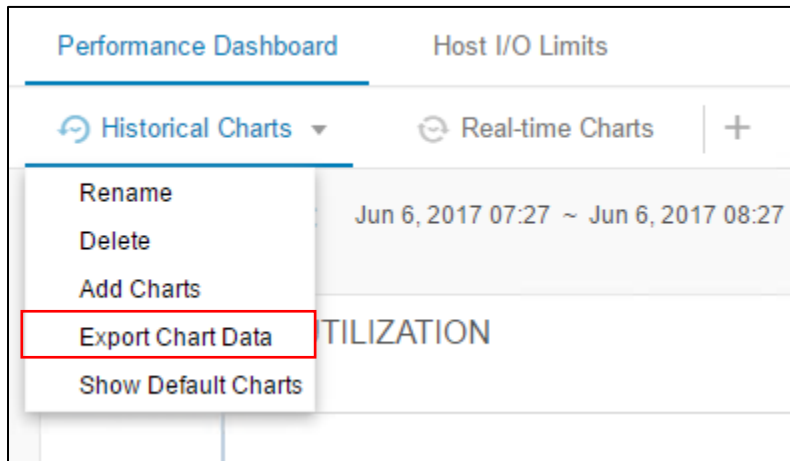



Figure 15 – Export Chart Data

DOWNLOAD PERFORMANCE ARCHIVE FILES

Dell EMC Unity OE version 4.2, introduced an option to download Performance Archive Files from Unisphere, UEMCLI and REST API. Performance Archive Files are similar to Performance historical metrics except the archives collect raw data at predefined interval (10 secs) and are never averaged into larger intervals. The system will generate a performance archive file for every hour and assures there are performance archives for at least the last 48 hours. You can download performance archive files to send to Dell EMC Support to troubleshoot performance issues.

To download a performance archive file from Unisphere, navigate to the **Downloads** page, as seen in Figure 16. You can download individual archive files, or all files within a specific time range. With the **Select specific archive files** option, as shown in Figure 17, the user can select individual archive files from the list. While with the **Select files within a specific time range**, as shown in Figure 18, the user can click the calendar icon  to select a custom date and time range.

To have a record of performance for an extended period of time, is recommended to download the Performance Archive Files from the system for the period in need. For example, if in need to have one week worth of data, ensure to download the Performance Archive Files for each day of the week.

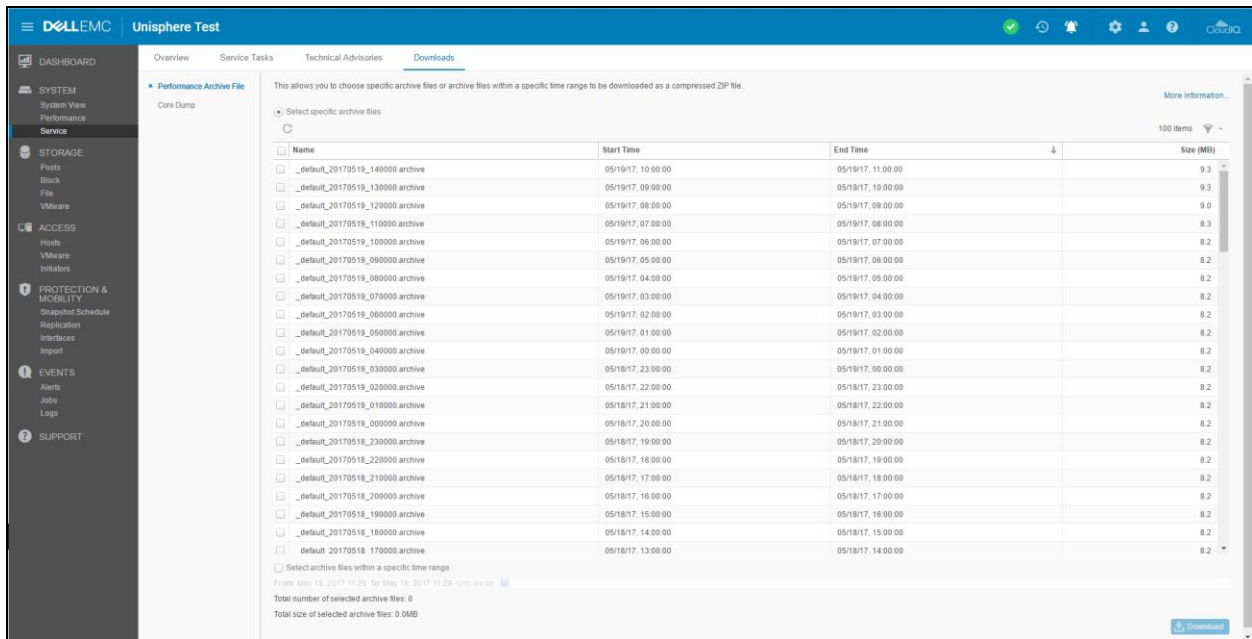



Figure 16 – Service > Downloads > Performance Archive File page

The Size column for a Performance Archive File table gives the size of the archive file in the system. Once the user clicks the Download button  the file(s) is (are) compressed into a zip file of smaller size.

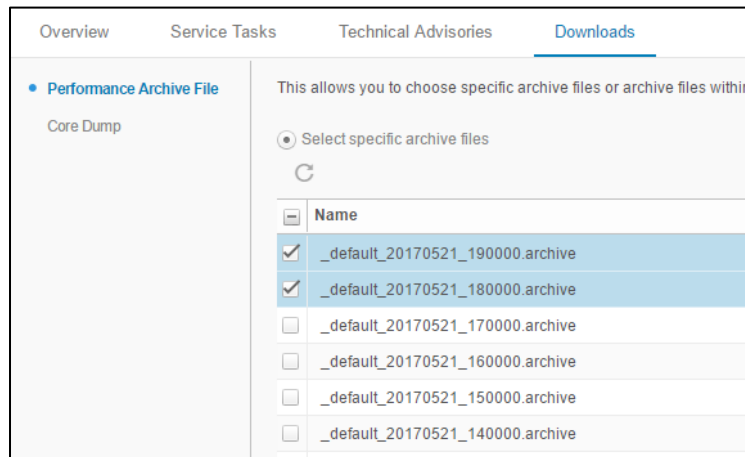


Figure 17 – Select specific archive files

The “Total number of selected archive files” field states the number of files that the user selected or are within the time range selected. The “Total size of selected archive files” give the size of the file(s) that the user has selected. Both field update accordingly to the selection made by the user.

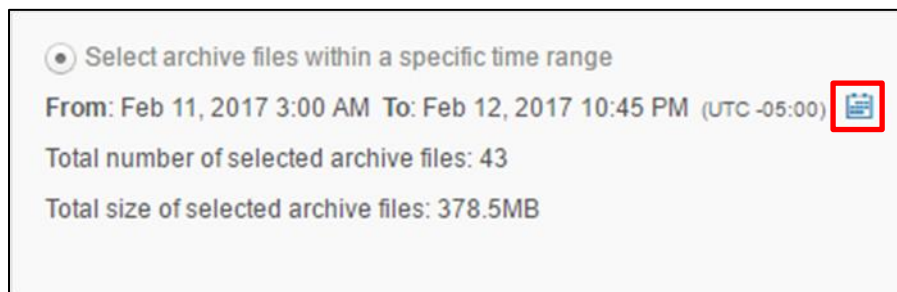


Figure 18 – Select archive files within a specific time range

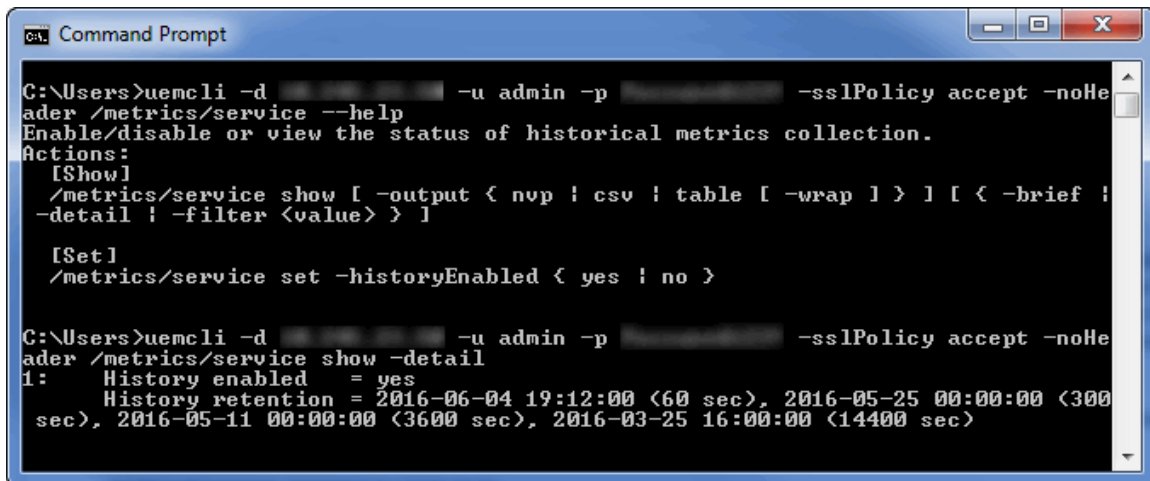
UNISPHERE CLI PERFORMANCE METRICS

Unisphere CLI allows you to run commands to a Dell EMC Unity system via a command prompt on a number of different host types including Microsoft Windows and Unix/Linux hosts. Unisphere CLI is intended to be used by advanced users who would like to use command prompts for purposes of scripting complex or routine tasks. The same actions that can be done via the Unisphere GUI can also be done through Unisphere CLI. In terms of performance metrics, you can use Unisphere CLI to enable/disable metrics collection service, view available metrics paths, and view historical as well as real-time metric values. Note that the metrics collection service is enabled by default.

For more information on using Unisphere CLI and its related syntax, please see the Dell EMC Unity Family Unisphere CLI User Guide on Dell EMC Online Support or on the Dell EMC Unity InfoHub.

PERFORMANCE METRICS SERVICE

Using Unisphere CLI, you can enable or disable the metrics collection service on your Dell EMC Unity system by using the `/metrics/service` CLI command path. When viewing the current status of the metrics collection service, you'll notice that the system displays the current metrics data aging retention policy values as shown in Figure 19. Note that even if the metrics collection service is disabled, the 16GB of reserved metrics space will still be reserved by the system.



```
ca. Command Prompt
C:\Users>uemcli -d [redacted] -u admin -p [redacted] -sslPolicy accept -noHe
ader /metrics/service --help
Enable/disable or view the status of historical metrics collection.
Actions:
[Show]
/metrics/service show [ -output < nvp | csv | table [ -wrap ] > ] [ < -brief |
-detail | -filter <value> > ]

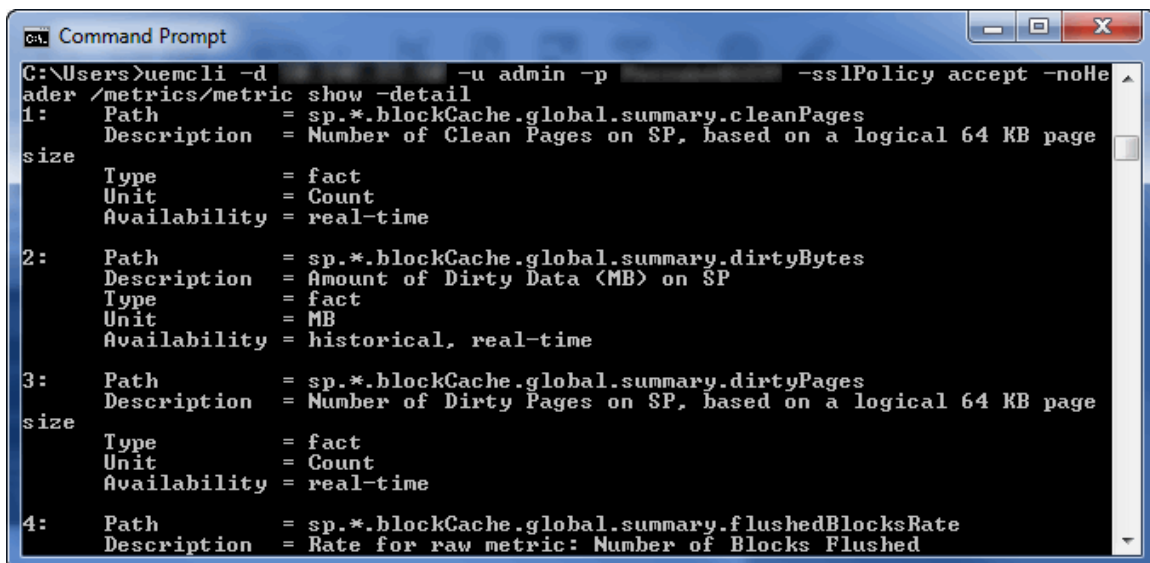
[Set]
/metrics/service set -historyEnabled < yes | no >

C:\Users>uemcli -d [redacted] -u admin -p [redacted] -sslPolicy accept -noHe
ader /metrics/service show -detail
1:   History enabled      = yes
     History retention   = 2016-06-04 19:12:00 (60 sec), 2016-05-25 00:00:00 (300
sec), 2016-05-11 00:00:00 (3600 sec), 2016-03-25 16:00:00 (14400 sec)
```

Figure 19 - Unisphere CLI Metrics Service Command

AVAILABLE PERFORMANCE METRICS

Unisphere CLI allows you to use the `/metrics/metric` command path to see all available metrics paths (both historical and real-time). A metrics path must be specified when viewing metrics using Unisphere CLI. An example of the output running the `/metrics/metric` command can be seen in Figure 20.



```
ca. Command Prompt
C:\Users>uemcli -d [redacted] -u admin -p [redacted] -sslPolicy accept -noHe
ader /metrics/metric show -detail
1:   Path                = sp.*.blockCache.global.summary.cleanPages
     Description         = Number of Clean Pages on SP, based on a logical 64 KB page
size
     Type                = fact
     Unit                = Count
     Availability        = real-time

2:   Path                = sp.*.blockCache.global.summary.dirtyBytes
     Description         = Amount of Dirty Data (MB) on SP
     Type                = fact
     Unit                = MB
     Availability        = historical, real-time

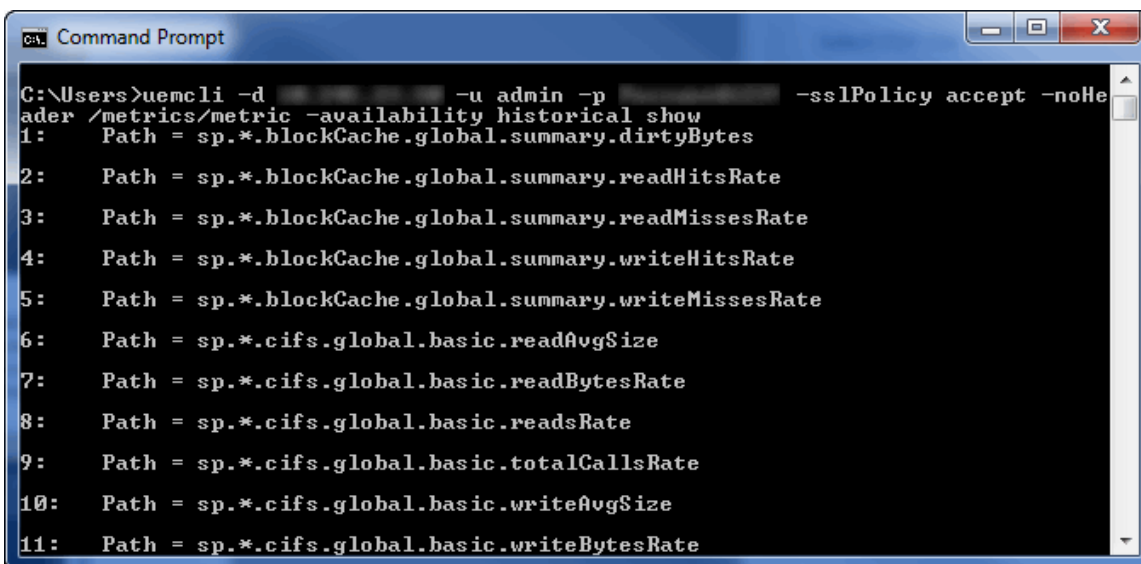
3:   Path                = sp.*.blockCache.global.summary.dirtyPages
     Description         = Number of Dirty Pages on SP, based on a logical 64 KB page
size
     Type                = fact
     Unit                = Count
     Availability        = real-time

4:   Path                = sp.*.blockCache.global.summary.flushedBlocksRate
     Description         = Rate for raw metric: Number of Blocks Flushed
```

Figure 20 - Unisphere CLI Available Metrics Paths Command

HISTORICAL PERFORMANCE METRICS

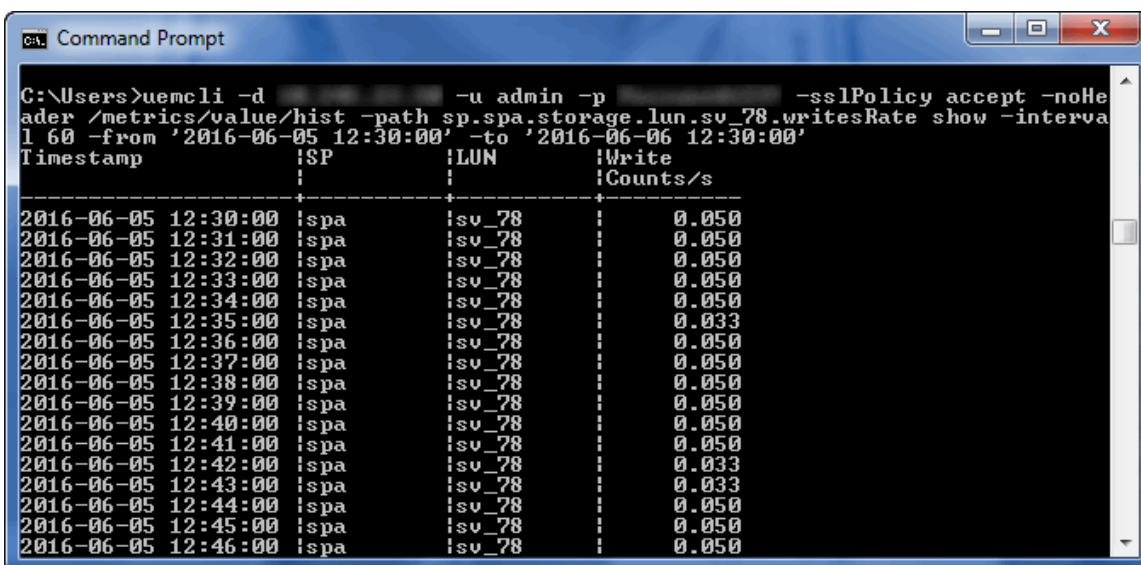
Unisphere CLI allows you to view historical performance metrics of your Dell EMC Unity system in predefined intervals. To view all of the available historical metrics paths, you can use the same `/metrics/metric` command path as before, but with the added `-availability historical` option as shown in Figure 21.



```
C:\Users>uemcli -d [redacted] -u admin -p [redacted] -sslPolicy accept -noHeader /metrics/metric -availability historical show
1: Path = sp.*.blockCache.global.summary.dirtyBytes
2: Path = sp.*.blockCache.global.summary.readHitsRate
3: Path = sp.*.blockCache.global.summary.readMissesRate
4: Path = sp.*.blockCache.global.summary.writeHitsRate
5: Path = sp.*.blockCache.global.summary.writeMissesRate
6: Path = sp.*.cifs.global.basic.readAvgSize
7: Path = sp.*.cifs.global.basic.readBytesRate
8: Path = sp.*.cifs.global.basic.readsRate
9: Path = sp.*.cifs.global.basic.totalCallsRate
10: Path = sp.*.cifs.global.basic.writeAvgSize
11: Path = sp.*.cifs.global.basic.writeBytesRate
```

Figure 21 - Unisphere CLI Available Historical Metrics Available Paths Command

You can then use a specific historical metrics path to view corresponding metric values by using the `/metrics/value/hist` command path in Unisphere CLI. For this command, you will also need to specify the time interval of the data you wish to see by using the `-interval` option. The predefined interval values are 60 (1 minute), 300 (5 minutes), 3600 (1 hour), and 14400 seconds (4 hours). You can also specify the start and end times of the period of time you wish to get metrics for by adding `-from` and `-to` options. An example of a historical metrics command can be seen in Figure 22.



```
C:\Users>uemcli -d [redacted] -u admin -p [redacted] -sslPolicy accept -noHeader /metrics/value/hist -path sp.spa.storage.lun.sv_78.writesRate show -interval 60 -from '2016-06-05 12:30:00' -to '2016-06-06 12:30:00'
Timestamp      |SP      |LUN      |Write
-----|-----|-----|-----
Counts/s
2016-06-05 12:30:00 |spa     |sv_78    |0.050
2016-06-05 12:31:00 |spa     |sv_78    |0.050
2016-06-05 12:32:00 |spa     |sv_78    |0.050
2016-06-05 12:33:00 |spa     |sv_78    |0.050
2016-06-05 12:34:00 |spa     |sv_78    |0.050
2016-06-05 12:35:00 |spa     |sv_78    |0.033
2016-06-05 12:36:00 |spa     |sv_78    |0.050
2016-06-05 12:37:00 |spa     |sv_78    |0.050
2016-06-05 12:38:00 |spa     |sv_78    |0.050
2016-06-05 12:39:00 |spa     |sv_78    |0.050
2016-06-05 12:40:00 |spa     |sv_78    |0.050
2016-06-05 12:41:00 |spa     |sv_78    |0.050
2016-06-05 12:42:00 |spa     |sv_78    |0.033
2016-06-05 12:43:00 |spa     |sv_78    |0.033
2016-06-05 12:44:00 |spa     |sv_78    |0.050
2016-06-05 12:45:00 |spa     |sv_78    |0.050
2016-06-05 12:46:00 |spa     |sv_78    |0.050
```

Figure 22 - Unisphere CLI Historical Metrics

REAL-TIME PERFORMANCE METRICS

All available metrics in the `/metrics/metric` path command can be used to view real-time metrics on Dell EMC Unity systems. Real-time metrics can be viewed using the `/metrics/value/rt` command and using the `-path` option to specify a specific metric path to view metric values for. You will also have to specify the interval using the `-interval` option and providing an acceptable value (5 – 300 seconds). An example of this command being run is seen in Figure 23.


```

C:\Users>uemcli -d [redacted] -u admin -p [redacted] -sslPolicy accept -noHeader /metrics/value/rt -path sp.sp.a.storage.lun.sv_78.writesRate show -interval 5
Timestamp      |ISP      |LUN      |Write
-----|-----|-----|-----
2016-06-07 19:39:00 |spa      |sv_78    |0
2016-06-07 19:39:05 |spa      |sv_78    |0
2016-06-07 19:39:10 |spa      |sv_78    |0
2016-06-07 19:39:15 |spa      |sv_78    |0
2016-06-07 19:39:20 |spa      |sv_78    |0
2016-06-07 19:39:25 |spa      |sv_78    |0.200
2016-06-07 19:39:30 |spa      |sv_78    |0
2016-06-07 19:39:35 |spa      |sv_78    |0
2016-06-07 19:39:40 |spa      |sv_78    |0
2016-06-07 19:39:45 |spa      |sv_78    |0
2016-06-07 19:39:50 |spa      |sv_78    |0
2016-06-07 19:39:55 |spa      |sv_78    |0.200
2016-06-07 19:40:00 |spa      |sv_78    |0.200
2016-06-07 19:40:05 |spa      |sv_78    |0
2016-06-07 19:40:10 |spa      |sv_78    |0
2016-06-07 19:40:15 |spa      |sv_78    |0
2016-06-07 19:40:20 |spa      |sv_78    |0

```

Figure 23 - Unisphere CLI Real-Time Metrics

REST API PERFORMANCE METRICS

REST API can be used to collect performance metrics from Dell EMC Unity systems. To view all available performance metrics, you can run the `GET /api/types/metric/instances` REST API command. An example of the command being run is shown on Figure 24. Note additional information can be added to the query to find out if a metric path is available for historical or real-time metrics by adding `isHistoricalAvailable` or `isRealTimeAvailable` as additional fields to display.

```

GET https://[redacted]/api/types/metric/instances?fields=isRealtimeAvailable,name,path
116.1 KB 245 ms SUCCESS 200

RESPONSE HEADERS
1 {
2   "@base": "https://[redacted]/api/types/metric/instances?fields=isRealtimeAvailable,name,path,id&per_page=2000",
3   "updated": "2016-06-10T19:07:55.338Z",
4   "links": [
5     {
6       "rel": "self",
7       "href": "&page=1"
8     }
9   ],
10  "entries": [
11    {
12      "@base": "https://[redacted]/api/instances/metric",
13      "updated": "2016-06-10T19:07:55.338Z",
14      "links": [
15        {
16          "rel": "self",
17          "href": "/10208"
18        }
19      ],
20      "content": {
21        "id": 10208,
22        "name": "Block Cache Clean Pages",
23        "path": "sp.*.blockCache.global.summary.cleanPages",
24        "isRealtimeAvailable": true
25      }
26    }
27  ]
}

```

Figure 24 - Available Metrics Paths through REST API

Once you have a specific path, use the name of the path to query metrics from REST API by using the `GET /api/types/metricValue/instances` for historical metrics or the `POST /api/types/metricRealTimeQuery/instances` command for real-time metrics. An example of a historical metric query is shown in Figure 25 with the metric path of "sp.*.cpu.summary.utilization".

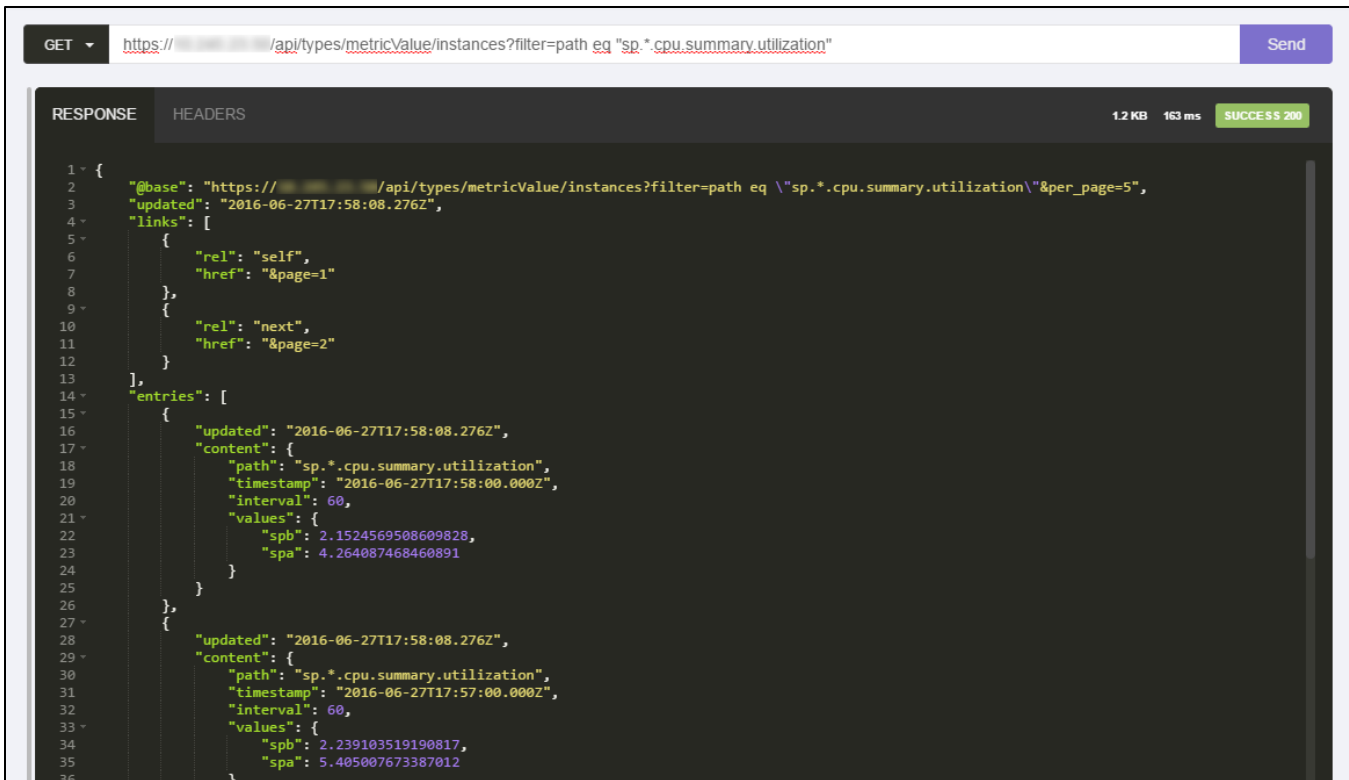


Figure 25 - Historical Metrics Query

For real-time metrics, a query first needs to be initiated as seen in Figure 26 with the path "sp.*.cpu.summary.busyTicks". The system will then reply with a query ID which can then be used to gather results via `GET /api/types/metricQueryResult/instances?queryId EQ <#>` command path as seen in Figure 27.

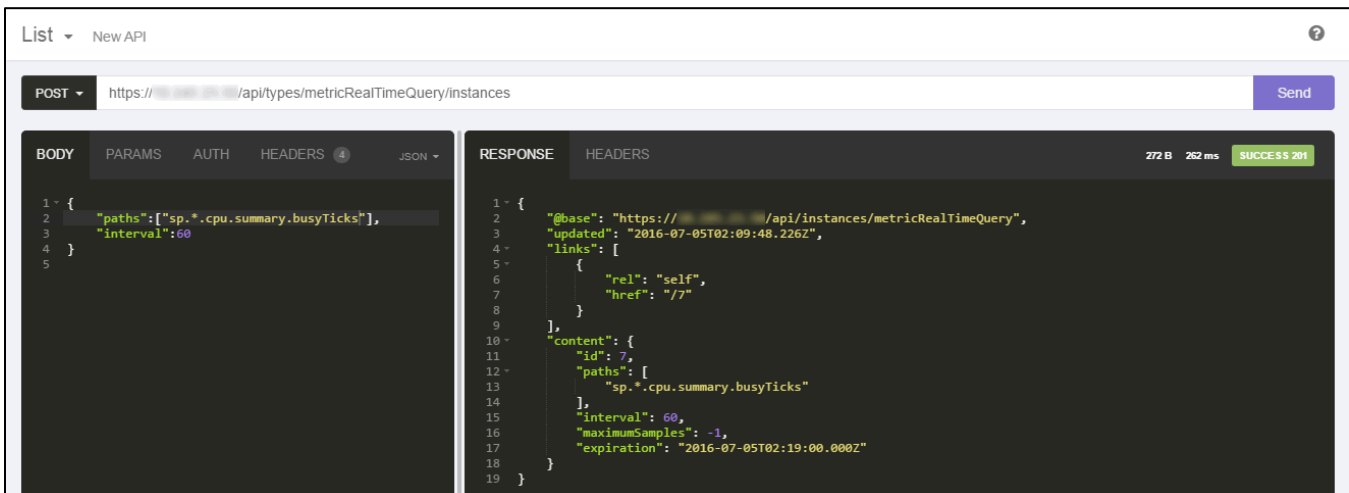


Figure 26 – Real-Time Metrics Query

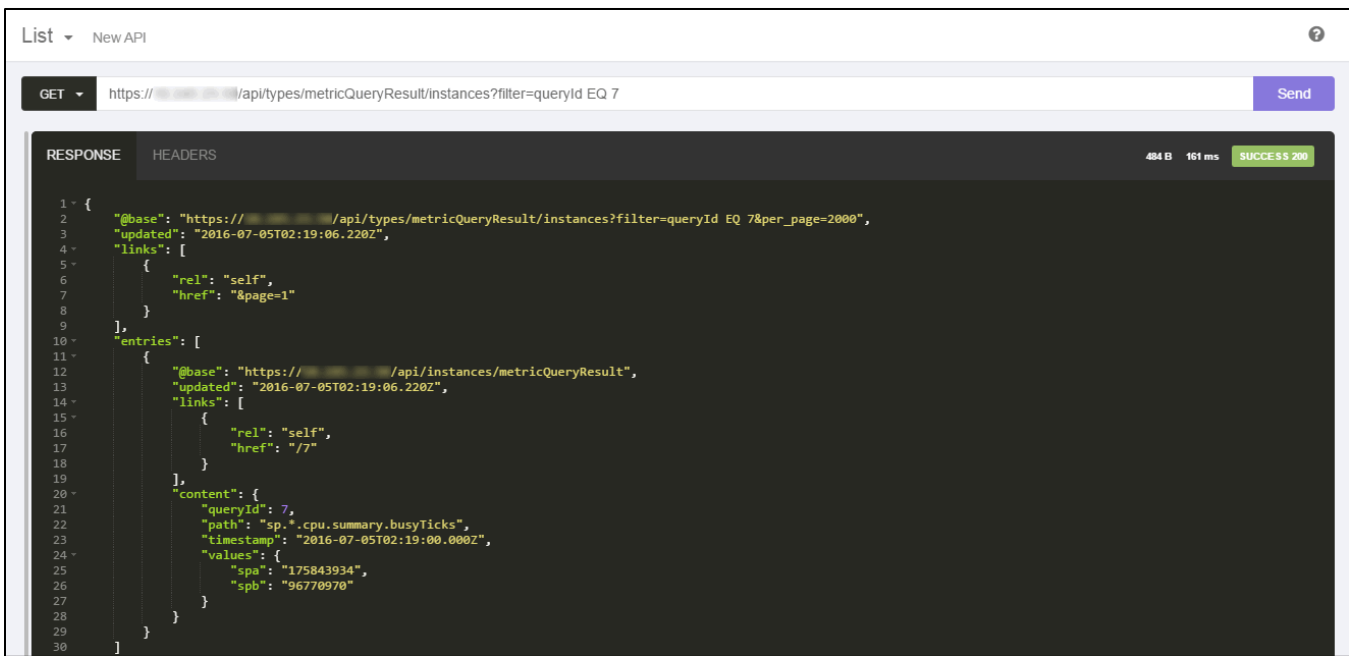


Figure 27 - Metric Query Result (Real-Time Metrics)

For additional information on using REST API and associated syntax, please see the Dell EMC Unity Family Unisphere Management REST API Reference Guide and the Dell EMC Unity Family Unisphere Management REST API Programmer’s Guide on Dell EMC Online Support or on Dell EMC Unity InfoHub.

TROUBLESHOOTING TECHNIQUES

PERFORMANCE CATEGORIES

When viewing historical metrics on Dell EMC Unity systems, there are several performance metrics available that are separated into several high-level performance categories. Table 3 explains the meaning of each category for better understanding of what charts to look at when troubleshooting your system(s):

Table 3. Performance Categories (Unisphere GUI)

Performance Category	Description
System-Cache	Provides a high-level view of the cache friendliness of the workload.
System-IO	Provides a system-level aggregation of front-end (client-to-system) activity.
System-Resources	Provides a system-level aggregation of hardware activity (i.e. CPU, drives, ports).
LUN	Provides a detailed breakdown of client Block activity on a per-LUN basis.
File System	Provides a detailed breakdown of client File activity on a per-FS basis.
VVol Datastore	Provides a detailed breakdown of VVol datastore activity on a per-VVol basis.
Fibre Channel Port	Provides a detailed breakdown of client Block activity on a per-port basis (for FC).
iSCSI Interface	Provides a detailed breakdown of client Block activity on a per-port basis (for iSCSI).
Ethernet Port	Provides a detailed breakdown of client Block/File activity on a per-port basis.
Drive	Provides a detailed breakdown of drive activity on a per-drive basis.
Tenant	Provides a detailed breakdown of Tenant activity on a per-Tenant basis.

TRIAGE GENERAL WORKFLOW

Using the available performance metrics on Dell EMC Unity systems, you will be able to do performance troubleshooting on your system to determine the potential bottlenecks/issues within your storage environment. When conducting performance troubleshooting, it is useful to know what metrics charts provide the necessary information to drill-down to the root cause of the issue. For a broad example, assume that your application running on a Dell EMC Unity storage system is reported to be experiencing slow response times and client, server, and network issues have been determined to not be the cause of the issue. You will want to initiate performance troubleshooting in your storage environment to try and resolve the slow response times. The following is a general workflow when conducting performance troubleshooting on Dell EMC Unity systems:

1. Starting at a system-level, investigate aggregated system statistics
 - a. Look at System-IO metric charts and find where the bulk of client workload is originating (i.e. LUN, FS (SMB, NFS))
 - b. Look at System-Resources metric charts and determine if hardware usage aligns with incoming client workload and also see if CPU Utilization may be an issue
2. Drill-down to potential hardware bottlenecks
 - a. If affected workload is from a LUN (via FC), go to the Fibre Channel Port metric charts to see if the load is distributed evenly among configured ports, and/or if any ports are too heavily utilized
 - b. If affected workload is from a LUN (via iSCSI), go to the iSCSI Interface metric charts to see if the load is distributed evenly among configured ports, and/or if any ports are too heavily utilized
 - c. If affected workload is from a File System go to the Ethernet Port metric charts to see if the load is distributed evenly among configured ports, and/or if any ports are too heavily utilized
3. If load on ports is determined not be the issue, start to investigate physical drives
 - a. Track the busiest system resources (LUN, FS, Datastore) back to the physical drives which comprise the corresponding storage pool
 - i. Go to Drive metric charts and select the appropriate drives and see if they are causing the bottleneck. The drives can be sorted by Pool as shown in Figure 28

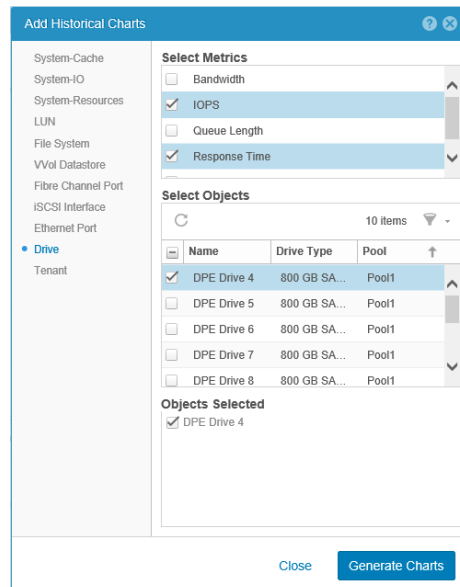


Figure 28 – Add Historical Charts > Drive

All of the above is best complemented by using the Dell EMC Unity Best Practices Guide when configuring system settings and system resources including recommendations on system utilization and workloads. The guide also includes recommended max limits for hardware resources. The Dell EMC Unity: Best Practices Guide can be found on Dell EMC Online Support or on Dell EMC Unity InfoHub.

CONCLUSION

By leveraging performance metrics functionality on Dell EMC Unity systems, administrators have the ability to view, monitor, and analyze metrics data within the Unisphere graphical interface or via Unisphere CLI or through REST API. Administrators with different experience backgrounds and knowledge can gather information from their Dell EMC Unity storage systems in whichever method that is most familiar to them. Whether users are diagnosing current issues or planning for future initiatives, the available metrics functionality provides administrators the ability to make well-informed decisions for their storage environments.

REFERENCES

CLI Guide

- Unisphere Command Line Interface User Guide

REST API Guides

- Unisphere Management REST API Programmer's Guide
- Unisphere Management REST API Reference Guide

Best Practices Guide

- Dell EMC Unity: Best Practices Guide

Additional Documentation

- Dell EMC Online Support
- Dell EMC Unity InfoHub (<http://bit.ly/unityinfohub>)

APPENDIX A: AVAILABLE UNISPHERE PERFORMANCE METRICS

The following tables outline the various performance metrics available in Unisphere. The tables are organized by breakdown category, and include each performance metric and a brief description. For more information on each performance metric, please refer to Unisphere Online Help, found on your Dell EMC Unity system or on Dell EMC Online Support.

HISTORICAL PERFORMANCE METRICS

Table 4. System-Cache Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Cache Dirty Size	Total amount of data in the write cache, in MB, that has not yet been flushed out to drives.	Storage Processor
Cache Read Hit IOPS*	Total number of read I/O requests, in I/O per second that do not demand a new allocation of cache memory.	Storage Processor
Cache Read Miss IOPS*	Total number of read I/O requests, in I/O per second, passing through, that is, not served by cache.	Storage Processor
Cache Write Hit IOPS*	Total number of write I/O requests, in I/O per second that do not demand a new allocation of cache memory.	Storage Processor
Cache Write Miss IOPS*	Total number of write I/O requests, in I/O per second, passing through, that is, not served by cache.	Storage Processor
FAST Cache Dirty Ratio	Ratio of dirty pages to total pages in the FAST Cache, expressed as a percent.	Storage Processor

*Note: If FAST Cache is configured, this metric includes I/O requests passing through the FAST Cache.

Table 5. System-I/O Performance Metrics

Metric Name	Description	Additional Breakdown Categories
CIFS Bandwidth	Total amount of CIFS (SMB) I/O requests, in KB/s, across all ports in the storage system.	Storage Processor Read/Write
CIFS I/O Size	Average size of CIFS (SMB) I/O requests, in KB, across all ports in the storage system. Calculated as a weighted average, which gives more weight to the SP with the highest number of CIFS I/O requests.	Storage Processor Read/Write
CIFS IOPS	Total number of CIFS (SMB) I/O requests, in I/O per second, across all ports in the storage system.	Storage Processor Read/Write
CIFS Response Time	Average time spent completing CIFS I/O requests, in microseconds, across all file systems in the storage system. Calculated as a weighted average, which gives more weight to the file systems with the highest number of I/O requests.	Storage Processor Read/Write
Client File System Bandwidth	Total amount of file system client I/O requests, in KB/s, across all file systems in the storage system.	Storage Processor Read/Write
Client File System I/O Size	Average size of file system client I/O requests, in KB, across all file systems in the storage system.	Storage Processor Read/Write
Client File System IOPS	Total number of file system client I/O requests, in I/O per second, across all file systems in the storage system.	Storage Processor Read/Write

Client File System Response Time	Average time spent completing file system client I/O requests, in microseconds, across file systems in the storage system.	Storage Processor Read/Write
File System Bandwidth	Total amount of file system I/O requests, in KB/s, across all file systems in the storage system.	Storage Processor Read/Write
File System I/O Size	Average size of file system I/O requests, in KB, across all file systems in the storage system. Calculated as a weighted average, which gives more weight to the file systems with the highest number of I/O requests.	Storage Processor Read/Write
File System IOPS	Total number of file system I/O requests, in I/O per second, across all file systems in the storage system.	Storage Processor Read/Write
LUN Bandwidth	Total amount of LUN I/O requests, in KB/s, across all LUNs in the storage system.	Storage Processor Read/Write
LUN I/O Size	Average size of LUN I/O requests, in KB, across all LUNs in the storage system. Calculated as a weighted average, which gives more weight to the LUNs with the highest number of I/O requests.	Storage Processor Read/Write
LUN IOPS	Total amount of LUN I/O requests, in I/O per second, across all LUNs in the storage system.	Storage Processor Read/Write
LUN Queue Length	Average number of LUN I/O requests in the system queue, in counts per second, across all LUNs in the storage system. Calculated as a weighted average, which gives more weight to the LUNs with the highest number of I/O requests.	Storage Processor Read/Write
LUN Response Time	Average time spent completing LUN I/O requests, in microseconds, across all LUNs in the storage system. Calculated as a weighted average, which gives more weight to the LUNs with the highest number of I/O requests.	Storage Processor
NFS Bandwidth	Total amount of NFS I/O requests, in KB/s, across all ports in the storage system.	Storage Processor Read/Write
NFS I/O Size	Average size of NFS I/O requests, in KB, across all ports in the storage system. Calculated as a weighted average, which gives more weight to the SP with the highest number of NFS I/O requests.	Storage Processor Read/Write
NFS IOPS	Total number of NFS I/O requests, in I/O per second, across all ports in the storage system.	Storage Processor Read/Write
NFS Response Time	Average time spent completing NFS I/O requests, in microseconds, across all file systems in the storage system. Calculated as a weighted average, which gives more weight to the LUNs with the highest number of I/O requests.	Storage Processor Read/Write
VVol Datastore Bandwidth	Total amount of VVol I/O requests, in KB/s, across all VVols in the storage system.	Storage Processor Read/Write
VVol Datastore IOPS	Total number of VVol I/O requests, in I/O per second, across all VVols in the storage system.	Storage Processor Read/Write
VVol Datastore Response Time	Average time spent completing VVol I/O requests, in microseconds, across all VVols in the storage system.	Storage Processor

	Calculated as a weighted average, which gives more weight to the VVols with the highest number of I/O requests.	
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Table 6. System – Resources Performance Metrics

Metric Name	Description	Additional Breakdown Categories
CPU Utilization	Total amount of processing cycles, as a percentage, across all cores in the storage system SPs.	Storage Processor
Drive Bandwidth	Total amount of drive I/O requests, in KB/s, across all drives in the storage system used in provisioned storage.	Storage Processor Read/Write
Drive IOPS	Total number of drive I/O requests, in I/O per second, across all drives in the storage system used in provisioned storage.	Storage Processor Read/Write
Ethernet Bandwidth	Total amount of Ethernet I/O requests, in KB/s, across all non-management Ethernet ports in the storage system.	Storage Processor Read/Write
Ethernet Packets	Total amount of Ethernet I/O requests, in I/O per second, across all non-management Ethernet ports in the storage system.	Storage Processor Read/Write
Fibre Channel Bandwidth	Total amount of Fibre Channel I/O requests, in KB/s, across all ports in the storage system.	Storage Processor Read/Write
Fibre Channel IOPS	Total number of Fibre Channel I/O requests, in I/O per second, across all ports in the storage system.	Storage Processor Read/Write
iSCSI Bandwidth	Total amount of iSCSI I/O requests, in KB/s, across all ports in the storage system.	Storage Processor Read/Write
iSCSI IOPS	Total number of iSCSI I/O requests, in I/O per second, across all ports in the storage system.	Storage Processor Read/Write

Table 7. LUN Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of LUN I/O requests, in KB/s, for the selected LUN or LUNs.	Storage Processor Read/Write
I/O Size	Average size of LUN I/O requests, in KB/s, for the selected LUN or LUNs.	Storage Processor Read/Write
IOPS	Total amount of LUN I/O requests, in I/O per second, for the selected LUN or LUNs.	Storage Processor Read/Write
Queue Length	Average number of LUN I/O requests in the system queue, in counts per second, for the selected LUN or LUNs.	Storage Processor Read/Write
Response Time	Average time spent completing LUN I/O requests, in microseconds, for the selected LUNs in the storage system. Calculated as a weighted average, which gives more weight to the LUNs with the highest number of I/O requests.	Storage Processor

Table 8. File System Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of file system I/O requests, in KB/s, for the selected file system or file systems.	Storage Processor Read/Write
Client Bandwidth	Total amount of file system client I/O requests, in KB/s, for the selected file systems.	Read/Write
Client I/O Size	Average size of file system client I/O requests, in KB, for the selected file systems.	Read/Write
Client IOPS	Total number of file system client I/O requests, in I/O per second, for the selected file systems.	Read/Write
Client Response Time	Average time spent completing file system client I/O requests, in microseconds, for the selected file systems.	Read/Write
I/O Size	Average size of file system I/O requests, in KB, for the selected file systems or file systems. Calculated as a weighted average, which gives more weight to the file systems with the highest number of I/O requests.	Storage Processor Read/Write
IOPS	Total number of file system I/O requests, in I/O per second, for the selected file system or file systems.	Storage Processor Read/Write

Table 9. VVol Datastore Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of VVol I/O requests, in KB/s, for the selected VVols.	Storage Processor Read/Write
IOPS	Total amount of VVol I/O requests, in I/O per second, for the selected VVols.	Storage Processor Read/Write
Response Time	Average time spent completing VVol I/O requests, in microseconds, for the selected VVols in the storage system. Calculated as a weighted average, which gives more weight to the VVols with the highest number of I/O requests.	Storage Processor

Table 10. Fibre Channel Port Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of Fibre Channel I/O requests, in KB/s, for the selected Storage Processors and associated Fibre Channel ports.	Read/Write
Replication Bandwidth	Total number of Fibre Channel I/O replication requests, in KB/s per second, for the selected Storage Processors and associated Fibre Channel ports.	Read/Write
IOPS	Total number of Fibre Channel I/O requests, in I/O per second, for the selected Storage Processors and associated Fibre Channel ports.	Read/Write
Replication IOPS	Total number of Fibre Channel I/O replication requests, in I/O per second, for the selected Storage Processors and associated Fibre Channel ports.	Read/Write

Total Link Errors	Total number of link errors, in I/O per second, for the selected Storage Processors and associated Fibre Channel (FC) ports.	
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Table 11. iSCSI Interface Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of iSCSI I/O requests, in KB/s, for the selected iSCSI interfaces.	Read/Write
IOPS	Total number of iSCSI I/O requests, in I/O per second, for the selected iSCSI interfaces.	Read/Write

Table 12. Ethernet Port Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of Ethernet I/O requests, in KB/s, for the selected Storage Processors and associated Ethernet ports.	Read/Write
Packets	Total amount of Ethernet I/O requests, in I/O per second, for the selected Storage Processors and associated Ethernet ports.	Read/Write

Table 13. Drive Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of drive I/O requests, in KB/s, for the selected drives used in provisioned storage.	Storage Processor Read/Write
IOPS	Total number of drive I/O requests, in I/O per second, for the selected drives used in provisioned storage.	Storage Processor Read/Write
Queue Length	Average number of drive I/O requests in the system queue, in counts per second, for the selected drives used in provisioned storage. Calculated as a weighted average, which gives more weight to the drives with the highest number of I/O requests.	Storage Processor
Response Time	Average time spent completing drive I/O requests, in microseconds, for the selected drives used in provisioned storage, including time spent in the queue. Calculated as a weighted average, which gives more weight to the drives with the highest number of I/O requests.	Storage Processor
Service Time	Average time spent completing drive I/O requests, in microseconds, for the selected drives used in provisioned storage, not including time spent in the queue. Calculated as a weighted average, which gives more weight to the drives with the highest number of I/O requests.	Storage Processor

Table 14. Tenant Performance Metrics

Metric Name	Description	Additional Breakdown Categories
Bandwidth	Total amount of I/O requests, in KB/s, for the selected tenant.	Read/Write

REAL-TIME PERFORMANCE METRICS

Table 15. System-Cache Performance Metrics

Metric Name	Description
Cache Dirty Size	Amount of data in the write cache, in MB, that has not yet been flushed out to disks.
Cache Read Hit IOPS	Read IO served by Cache.
Cache Read Miss IOPS	Read IO not served by Cache.
Cache Write Hit IOPS	Write IO served by Cache, in I/O per second, that does not demand a new allocation of cache memory.
Cache Write Miss IOPS	Write IO served by Cache, in I/O per second, that demands a new allocation of cache memory.

Table 16. System-Resources Performance Metrics

Metric Name	Description
CPU Utilization	Total amount of processing cycles, as a percentage, across all cores in the storage system SPs.

Table 17. System-IO Performance Metrics

Metric Name	Description
CIFS Bandwidth Read, Write, or Total	Amount of SMB read, write, or total I/O requests, in KB/s, for all LUNs in the storage system.
CIFS I/O Size Read, Write, or Total	Average size of SMB read or write I/O requests, in microseconds, for all LUNs in the storage system.
CIFS IOPS Read Write or Total	Number of SMB read, write, or total I/O requests, in I/O per second, for the selected LUNs.
CIFS Response Time Read or Write	Average time spent completing CIFS (SMB) read or write I/O requests, in microseconds, for all file systems in the storage system.
CIFS Response Time (Total)	Average time spent completing all CIFS (SMB) I/O requests, in microseconds, for all file systems in the storage system.
NFS Response Time Read or Write	Average time spent completing NFS read or write I/O requests, in microseconds, for all file systems in the storage system.
NFS Response Time (Total)	Average time spent completing all NFS I/O requests, in microseconds, for all file systems in the storage system.

Table 18. LUN Performance Metrics

Metric Name	Description
Bandwidth Read, Write, or Total	Amount of LUN read, write, or total I/O requests, in KB/s, for the selected LUNs.
I/O Size Read or Write	Average size of LUN read or write I/O requests, in KB, across all LUNs in the storage system. Calculated as a

	weighted average, which gives more weight to the LUNs with the highest number of I/O requests.
IOPS Read, Write, or Total	Number of LUN read, write, or total I/O requests, in I/O per second, for the selected LUNs.
Queue Length	Average number of LUN I/O requests in the system queue, in counts per second, for the selected LUNs.
Response Time	Average time spent completing LUN I/O requests, in microseconds, for the selected LUNs in the storage system. Calculated as a weighted average, which gives more weight to the LUNs with the highest number of I/O requests.

Table 19. File System Performance Metrics

Metric Name	Description
Bandwidth Read or Write	Amount of file system read or write I/O requests, in KB/s, for the selected file systems.
I/O Size Read or Write	Average size of file system read or write I/O requests, in KB, across all file systems in the storage system. Calculated as a weighted average, which gives more weight to the file systems with the highest number of I/O requests.
IOPS Read or Write	Number of file system read or write I/O requests, in I/O per second, for the selected file systems.

Table 20. Fibre Channel Port Performance Metrics

Metric Name	Description
Bandwidth Read or Write	Amount of Fibre Channel read or write I/O requests, in KB/s, for the selected Storage Processors and associated Fibre Channel ports.
Requests/Second Read or Write	Number of Fibre Channel read or write I/O requests, in I/O per second, for the selected Storage Processors and associated Fibre Channel ports.

Table 21. iSCSI Interface Performance Metrics

Metric Name	Description
Bandwidth Read or Write	Amount of iSCSI read or write I/O requests, in KB/s, for the selected iSCSI interfaces.
Requests/Second Read or Write	Number of iSCSI read or write I/O requests, in I/O per second, for the selected iSCSI interfaces.

Table 22. Ethernet Port Performance Metrics

Metric Name	Description
Bandwidth Read or Write	Amount of iSCSI read or write I/O requests, in KB/s, for the selected iSCSI interfaces.

Packets Read or Write	Number of Ethernet read or write packets per second, for the selected Storage Processors and associated Ethernet ports.
-----------------------	---

Table 23. Drive Performance Metrics

Metric Name	Description
Bandwidth Read or Write	Amount of drive read or write I/O requests, in KB/s, for the selected drives used in provisioned storage.
IOPS Read, Write, or Total	Number of drive read, write, or total I/O requests, in I/O per second, for the selected drives used in provisioned storage.
Queue Length	Average number of drive I/O requests in the system queue, in counts per second, for the selected drives used in provisioned storage. Calculated as a weighted average, which gives more weight to the drives with the highest number of I/O requests.
Response Time	Average time spent completing drive I/O requests, in microseconds, for the selected drives used in provisioned storage, including time spent in the queue. Calculated as a weighted average, which gives more weight to the drives with the highest number of I/O requests.
Service Time	Average time spent completing drive I/O requests, in microseconds, for the selected drives used in provisioned storage, not including time spent in the queue. Calculated as a weighted average, which gives more weight to the drives with the highest number of I/O requests.

Table 24. Tenant Performance Metrics

Metric Name	Description
Bandwidth Read or Write	Amount of read or write I/O requests, in KB/s, for the selected tenants in the storage system.