Performance

SANtricity 11.5

NetApp
February 12, 2024

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Performance overview

The Performance page provides graphs and tables of data that enable you to assess the storage array's performance in several key areas.

Performance functions allow you to accomplish these tasks:

- View performance data in near real-time to help you determine whether a storage array is experiencing problems.
- Export performance data to construct a historical view of a storage array and identify when a problem started or what caused a problem.
- Select the objects, performance metrics, and time frame you want to view.
- Compare metrics.

You can view performance data in three formats:

- **Real-time graphical** — Plots performance data on a graph in near real-time.
- **Near real-time tabular** — Lists performance data in a table in near real-time.
- **Exported CSV file** — Allows you to save tabular performance data in a file of comma-separated values for further viewing and analysis.

Characteristics of performance data formats

Type of performance monitoring	Sampling interval	Length of time displayed	Maximum number of objects displayed	Ability to save data
Real-time graphical, live Real-time graphical, historical	10 sec (live) 5 min (historical) Data points shown depend on selected time frame	Default time frame is 1 hour. Choices: • 5 minutes • 1 hour • 8 hours • 1 day • 7 days • 30 days	5	No
Near real-time tabular (table view)	10 sec -1 hr	Most current value	Unlimited	Yes

Type of performance monitoring	Sampling interval	Length of time displayed	Maximum number of objects displayed	Ability to save data
Comma-separated values (CSV) file	Depends on selected time frame	Depends on selected time frame	Unlimited	Yes

Guidelines for viewing performance data

- Performance data collection is always on. There is no option to turn it off.
- Each time the sampling interval elapses, the storage array is queried and the data is updated.
- For graphical data, the 5-minute time frame supports 10-second updating averaged over 5 minutes. All other time frames are updated every 5 minutes, averaged over the selected time frame.
- Performance data in the graphical views is updated in real time. Performance data in the table view is updated in near real time.
- If a monitored object changes during the time data is collected, the object might not have a complete set of data points spanning the selected time frame. For example, volume sets can change as volumes are created, deleted, assigned, or unassigned; or drives can be added, removed, or failed.

Performance terminology

Learn how the performance terms apply to your storage array.

Term	Description
Application	An application is a software program, such as SQL or Exchange.
CPU	CPU is short for "central processing unit." CPU indicates the percentage of the storage array’s processing capacity being used.
Host	A host is a server that sends I/O to a volume on a storage array.
IOPS	IOPS stands for input/output operations per second.
Latency	Latency is the time interval between a request, such as for a read or write command, and the response from the host or the storage array.

Term	Description
LUN	A logical unit number (LUN) is the number assigned to the address space that a host uses to access a volume. The volume is presented to the host as capacity in the form of a LUN. Each host has its own LUN address space. Therefore, the same LUN can be used by different hosts to access different volumes.
MiB	MiB is an abbreviation for mebibyte (mega binary byte). One MiB is 220, or 1,048,576 bytes. Compare with MB, which signifies a base 10 value. One MB equals 1,024 bytes.
Object	An object is any logical or physical storage component. Logical objects include volume groups, pools, and volumes. Physical objects include the storage array, array controllers, hosts, and drives.
Pool	A pool is a set of drives that is logically grouped. You can use a pool to create one or more volumes accessible to a host. (You create volumes from either a pool or a volume group.)
Read	Read is short for "read operation," which occurs when the host requests data from the storage array.
Volume	A volume is a container in which applications, databases, and file systems store data. It is the logical component created for the host to access storage on the storage array. A volume is created from the capacity available in a pool or a volume group. A volume has a defined capacity. Although a volume might consist of more than one drive, a volume appears as one logical component to the host.
Volume name	A volume name is a string of characters assigned to the volume when it is created. You can either accept the default name or provide a more descriptive name indicating the type of data stored in the volume.

Term	Description
Volume group	A volume group is a container for volumes with shared characteristics. A volume group has a defined capacity and RAID level. You can use a volume group to create one or more volumes accessible to a host. (You create volumes from either a volume group or a pool.)
Workload	A workload is a storage object that supports an application. You can define one or more workloads, or instances, per application. For some applications, System Manager configures the workload to contain volumes with similar underlying volume characteristics. These volume characteristics are optimized based on the type of application the workload supports. For example, if you create a workload that supports a Microsoft SQL Server application and then subsequently create volumes for that workload, the underlying volume characteristics are optimized to support Microsoft SQL Server.
Write	Write is short for "write operation," when data is sent from the host to the array for storage.

How tos

View graphical performance data

You can view graphical performance data for logical objects, physical objects, applications, and workloads.

About this task

The performance graphs show historical data as well as live data currently being captured. A vertical line on the graph, labeled **Live updating**, distinguishes historical data from live data.

Home page view

The **Home** page contains a graph showing storage array level performance. You can select limited metrics from this view, or you can click **View Performance Details** to select all the available metrics.

Detailed view

The graphs available from the detailed performance view are arranged under three tabs:

- **Logical View** — Displays performance data for logical objects grouped by volume groups and pools. Logical objects include volume groups, pools, and volumes.
- **Physical View** — Displays performance data for the controller, host channels, drive channels, and drives.
- **Applications & Workloads View** — Displays a list of logical objects (volumes) grouped by the application types and workloads you have defined.

Steps

1. Select **Home**.
2. To select an array-level view, click the IOPS, MiB/s, or CPU button.
3. To see more details, click **View Performance Details**.
4. Select **Logical View** tab, **Physical View** tab, or **Applications & Workloads View** tab.

   Depending on the object type, different graphs appear in each tab.

View tabs	Performance data displayed for each object type
Logical View	• **Storage array**: IOPS, MiB/s • **Pools**: Latency, IOPS, MiB/s • **Volume groups**: Latency, IOPS, MiB/s • **Volumes**: Latency, IOPS, MiB/s
Physical View	• **Controllers**: IOPS, MiB/s, CPU, Headroom • **Host channels**: Latency, IOPS, MiB/s, Headroom • **Drive channels**: Latency, IOPS, MiB/s • **Drives**: Latency, IOPS, MiB/s
Applications & Workloads View	• **Storage array**: IOPS, MiB/s • **Applications**: Latency, IOPS, MiB/s • **Workloads**: Latency, IOPS, MiB/s • **Volumes**: Latency, IOPS, MiB/s

5. Use the options to view the objects and information you need.

Options

Options for viewing objects	Description
Expand a drawer to see the list of objects.	*Navigation drawers* contain storage objects, such as pools, volume groups, and drives. Click the drawer to view the list of objects in the drawer.
Select objects to view.	Select the check box to the left of each object to choose the performance data you want to view.
Use Filter to find object names or partial names.	In the Filter box, enter the name or a partial name of objects to list just those objects in the drawer.
Click **Refresh Graphs** after selecting objects.	After selecting objects from the drawers, select **Refresh Graphs** to view graphical data for the items you have selected.
Hide or show graph	Select the graph title to hide or show the graph.

6. As needed, use the additional options for viewing performance data.

Additional options

Option	Description
Time frame	Select the length of time you want to view (5 minutes, 1 hour, 8 hours, 1 day, 7 days, or 30 days). The default is 1 hour. Loading performance data for a 30-day time frame can take several minutes. Do not navigate away from the web page, refresh the web page, or close the browser while data is loading.
Data point details	Hover the cursor over the graph to see metrics for a particular data point.
Scroll bar	Use the scroll bar below the graph to view an earlier or later time span.
Zoom bar	Below the graph, drag the zoom bar handles to zoom out on a time span. The wider the zoom bar, the less granular the details of the graph. To reset the graph, select one of the time frame options.
Drag and drop	On the graph, drag the cursor from one point in time to another to zoom in on a time span. To reset the graph, select one of the time frame options.

View and save tabular performance data

You can view and save performance graphs data in tabular format. This allows you to filter the data you want displayed.

Steps

1. From any performance data graph, click **Launch table view**.

   A table appears that lists all the performance data for the selected objects.

2. Use the object selection pull-down and the filter as needed.
3. Click the Show/Hide Columns button to select the columns you want to include in the table.

   You can click each check box to select or deselect an item.

4. Select **Export** at the bottom of the screen to save the tabular view to a file of comma-separated values (CSV).

   The **Export Table** dialog box appears, indicating the number of rows to be exported and the file format of the export (comma-separated values, or CSV format).

5. Click **Export** to proceed with the download, or click **Cancel**.

   Depending on your browser settings, the file is either saved, or you are prompted to choose a name and location for the file.

   The default file name format is `performanceStatistics-yyyy-mm-dd_hh-mm-ss.csv`, which includes the date and time when the file was exported.

Interpret performance data

Performance data can guide you in tuning the performance of your storage array.

When interpreting Performance data, keep in mind that several factors affect the performance of your storage array. The following table describes the main areas to consider.

Performance data	Implications for performance tuning
Latency (milliseconds, or ms)	Monitor the I/O activity of a specific object. Potentially identify objects that are bottlenecks: • If a volume group is shared among several volumes, the individual volumes might need their own volume groups to improve the sequential performance of the drives and decrease latency. • With pools, larger latencies are introduced and uneven workloads might exist between drives, making the latency values less meaningful and, in general, higher. • Drive type and speed influence latency. With random I/O, faster spinning drives spend less time moving to and from different locations on the disk. • Too few drives result in more queued commands and a greater period of time for the drive to process the command, increasing the general latency of the system. • Larger I/Os have greater latency due to the additional time involved with transferring data. • Higher latency might indicate that the I/O pattern is random in nature. Drives with random I/O will have greater latency than those with sequential streams. • A disparity in latency among drives or volumes of a common volume group could indicate a slow drive.

Performance data	Implications for performance tuning
IOPS	Factors that affect input/output operations per second (IOPS or IOs/sec) include these items: • Access pattern (random or sequential) • I/O size • RAID level • Cache block size • Whether read caching is enabled • Whether write caching is enabled • Dynamic cache read prefetch • Segment size • The number of drives in the volume groups or storage array The higher the cache hit rate, the higher I/O rates will be. Higher write I/O rates are experienced with write caching enabled compared to disabled. In deciding whether to enable write caching for an individual volume, look at the current IOPS and the maximum IOPS. You should see higher rates for sequential I/O patterns than for random I/O patterns. Regardless of your I/O pattern, enable write caching to maximize the I/O rate and to shorten the application response time. You can see performance improvements caused by changing the segment size in the IOPS statistics for a volume. Experiment to determine the optimal segment size, or use the file system size or database block size.
MiB/s	Transfer or throughput rates are determined by the application I/O size and the I/O rate. Generally, small application I/O requests result in a lower transfer rate but provide a faster I/O rate and shorter response time. With larger application I/O requests, higher throughput rates are possible. Understanding your typical application I/O patterns can help you determine the maximum I/O transfer rates for a specific storage array.

Performance data	Implications for performance tuning
CPU	This value is a percentage of processing capacity that is being used. You might notice a disparity in the CPU usage of the same types of objects. For example, the CPU usage of one controller is heavy or is increasing over time while that of the other controller is lighter or more stable. In this case, you might want to change the controller ownership of one or more volumes to the controller with the lower CPU percentage. You might want to monitor CPU across the storage array. If CPU continues to increase over time while application performance decreases, you might need to add storage arrays. By adding storage arrays to your enterprise, you can continue to meet application needs at an acceptable performance level.
Headroom	Headroom refers to the remaining performance capability of the controllers, the controller host channels, and the controller drive channels. This value is expressed as a percentage and represents the gap between the maximum possible performance these objects are able to deliver and the current performance levels. • For the controllers, headroom is a percentage of maximum possible IOPS. • For the channels, headroom is a percentage of maximum throughput, or MiB/s. Read throughput, write throughput, and bidirectional throughput are included in the calculation.

FAQs

How do performance statistics for individual volumes relate to the total?

The statistics for pools and volume groups are calculated by aggregating all volumes, including reserved capacity volumes.

Reserved capacity is used internally by the storage system to support thin volumes, snapshots, and asynchronous mirroring, and are not visible to I/O hosts. As a result, the pool, controller, and storage array statistics may not add up to be the sum of the viewable volumes.

However, for application and workload statistics, only the visible volumes are aggregated.

Why does data display as zero in the graphs and table?

When a zero is displayed for a data point in the graphs and table, it means there is no I/O

activity for the object for that point in time. This situation could occur because the host is not initiating I/O to that object, or it could be a problem with the object itself.

The historical data for the object is still available for viewing. The graphs and table will show non-zero data once I/O activity begins occurring for the object.

The following table lists the most common reasons why a data point value might be zero for any given object.

Array-level object type	Reason data displays as zero
Volume	• Volume had no host assignment.
Volume group	• Volume group is being imported. • Volume group does not contain a volume that is assigned to a host, ***and*** volume group does not contain any reserved capacity.
Drive	• Drive has failed. • Drive has been removed. • Drive is in an unknown state.
Controller	• Controller is offline. • Controller has failed. • Controller has been removed. • Controller is in an unknown state.
Storage array	• Storage array does not contain volumes.

What does the Latency graph show?

The **Latency** graph provides latency statistics, in milliseconds (ms), for volumes, volume groups, pools, applications, and workloads. This graph appears in the Logical View, Physical View, and Applications & Workloads View tabs.

Latency refers to any delay that occurs as data is read or written. Hover your cursor over a point on the graph to view the following values, in milliseconds (ms), for that point in time:

- Read time.
- Write time.
- Average I/O size.

What does the IOPS graph show?

The **IOPS** graph displays statistics for input/output operations per second. On the **Home** page, this graph displays statistics for the storage array. In the Logical View, Physical View, and Applications & Workloads View tabs of the **Performance** tile, this graph

displays statistics for the storage array, volumes, volume groups, pools, applications, and workloads.

IOPS is an abbreviation for *input/output (I/O) operations per second*. Hover your cursor over a point on the graph to view the following values for that point in time:

- Number of read operations.
- Number of write operations.
- Total read and write operations combined.

What does the MiB/s graph show?

The **MiB/s** graph displays transfer speed statistics in mebibytes per second. On the **Home** page, this graph displays statistics for the storage array. In the Logical View, Physical View, and Applications & Workloads View tabs of the **Performance** tile, this graph displays statistics for the storage array, volumes, volume groups, pools, applications, and workloads.

MiB/s is an abbreviation for *mebibytes per second*, or 1,048,576 bytes per second. Hover your cursor over a point on the graph to view the following values for that point in time:

- The amount of data read.
- The amount of data written.
- The combined total amount of data read and written.

What does the CPU graph show?

The CPU graph displays processing capacity statistics for each controller (controller A and controller B). CPU is an abbreviation for *central processing unit*. On the **Home** page, this graph displays statistics for the storage array. On the Physical View tab of the **Performance** tile, this graph displays statistics for the storage array and drives.

The CPU graph shows the percentage of CPU processing capacity being used against operations on the array. Even when no external I/O is occurring, the CPU utilization percentage can be non-zero because the storage operating system might be doing background operations and monitoring. Hover your cursor over a point on the graph to view a percentage of processing capability being used at that point in time.

What does the Headroom graph show?

The Headroom graph is related to remaining performance capability for the storage array controllers. This graph is visible on the **Home** page and on the Physical View tab of the **Performance** tile.

The Headroom graph shows the remaining performance capability of the physical objects in the storage system. Hover your cursor over a point on the graph to view the percentages of IOPS and MiB/s capability remaining for controller A and for controller B.

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