



# **Monitoring performance using the Performance Explorer pages**

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# Monitoring performance using the Performance Explorer pages

The Performance Explorer pages display detailed information about the performance of each object in a cluster. The page provides a detailed view into the performance of all cluster objects, enabling you to select and compare the performance data of specific objects across various time periods.

You can also assess the overall performance of all objects, and compare object performance data in a side-by-side format.

## Understanding the root object

The root object is the baseline against which other object comparisons are made. This enables you to view and compare the data from other objects to the root object, providing performance data analysis that helps you to troubleshoot and improve object performance.

The root object name displays at the top of the Comparing pane. Additional objects display below the root object. Although there is no limit to the number of additional objects you can add to the Comparing pane, only one root object is allowed. Data for the root object automatically displays in the graphs in the Counter Charts pane.

You cannot change the root object; it is always set to the object page you are viewing. For example, if you open the Volume Performance Explorer page of Volume1, then Volume1 is the root object and cannot be changed. If you want to compare against a different root object, then you must click the link for an object and open its landing page.



Events and Thresholds are displayed only for root objects.

## Apply filtering to reduce the list of correlated objects in the grid

Filtering enables you to display a smaller, more well-defined subset of objects in the grid. For example, if you have 25 volumes in the grid, filtering enables you to view only those volumes that have throughput less than 90 MBps, or latency greater than 1 ms/op.

## Specifying a time range for correlated objects

The Time Range selector on the Performance Explorer page enables you to specify the time range for object data comparison. Specifying a time range refines the contents of the Performance Explorer pages to show only the object data within the time range you have specified.

## About this task

Refining the time range provides an efficient method of displaying only the performance data in which you are interested. You can select a predefined time range or specify a custom time range. The default time range is the preceding 72 hours.

## Selecting a predefined time range

Selecting a predefined time range is a quick and efficient way for you to customize and focus data output when viewing cluster object performance data. When selecting a predefined time range, data for up to 13 months is available.

### Steps

1. At the top right of the **Performance Explorer** page, click **Time Range**.
2. From the right side of the **Time Range Selection** panel, select a predefined time range.
3. Click **Apply Range**.

## Specifying a custom time range

The Performance Explorer page enables you to specify the date and time range for your performance data. Specifying a custom time range provides greater flexibility than using predefined time ranges when refining cluster object data.

### About this task

You can select a time range between one hour and 390 days. 13 months equals 390 days because each month is counted as 30 days. Specifying a date and time range provides more detail and enables you to zoom in on specific performance events or series of events. Specifying a time range also aids in troubleshooting potential performance issues, as specifying a date and time range displays data surrounding the performance event in finer detail. Use the **Time Range** control to select predefined date and time ranges, or specify your own custom date and time range of up to 390 days. Buttons for predefined time ranges vary from the **Last Hour** through the **Last 13 Months**.

Selecting the **Last 13 Months** option or specifying a custom date range greater than 30 days displays a dialog box alerting you that performance data displayed for a period greater than 30 days is charted using hourly averages and not 5-minute data polling. Therefore, a loss of timeline visual granularity might occur. If you click the **Do not show again** option in the dialog box, the message does not appear when you select the **Last 13 Months** option or specify a custom date range greater than 30 days. Summary data also applies on a smaller time range, if the time range includes a time/date that is more than 30 days from today.

When selecting a time range (either custom or predefined), time ranges of 30 days or fewer are based on 5-minute interval data samples. Time ranges greater than 30 days are based on one-hour interval data samples.

1. Click the **Time Range** drop-down box and the Time Range panel displays.
2. To select a predefined time range, click one of the **Last...** buttons at the right of the **Time Range** panel. When selecting a predefined time range, data for up to 13 months is available. The predefined time range button you selected is highlighted, and the corresponding days and time display in the calendars and time selectors.
3. To select a custom date range, click the start date in the **From** calendar on the left. Click **<** or **>** to navigate forward or backward in the calendar. To specify the end date, click a date in the **To** calendar on the right. Note that the default end date is today unless you specify a different end date. The **Custom Range** button at the right of the Time Range panel is highlighted, indicating that you have selected a custom date range.
4. To select a custom time range, click the **Time** control below the **From** calendar and select the start time. To specify the end time, click the **Time** control below the **To** calendar on the right and select the end time. The **Custom Range** button at the right of the Time Range panel is highlighted, indicating that you have selected a custom time range.
5. Optionally, you can specify the start and end times when selecting a predefined date range. Select the predefined date range as previously described, then select the start and end times as previously described. The selected dates are highlighted in the calendars, your specified start and end times display in the **Time** controls, and the **Custom Range** button is highlighted.
6. After selecting the date and time range, click **Apply Range**. The performance statistics for that time range display in the charts and in the Events timeline.

## Defining the list of correlated objects for comparison graphing

You can define a list of correlated objects for data and performance comparison in the Counter Chart pane. For example, if your storage virtual machine (SVM) is experiencing a performance issue, you can compare all volumes in the SVM to identify which volume might be causing the issue.

### About this task


You can add any object in the correlated objects grid to the Comparing and Counter Chart panes. This enables you to view and compare data of multiple objects and with the root object. You can add and remove objects to and from the correlated objects grid; however, the root object in the Comparing pane is not removable.




Adding many objects to the Comparing pane may have a negative impact on performance. To maintain performance, you should select a limited number of charts for data comparison.

## Steps



1. In the objects grid, locate the object that you want to add, and click the **Add** button.

The **Add** button turns gray, and the object is added to the additional objects list in the Comparing pane. The object's data is added to the graphs in the Counter Charts panes. The color of the object's eye icon (  ) matches the color of the object's data trend line in the graphs.

2. Hide or show data for selected objects:

To do this...	Take this action...
Hide a selected object	Click the selected object's eye icon (  ) in the Comparing pane. The object's data is hidden, and the eye icon for that object turns gray.
Show a hidden object	Click the gray eye icon of the selected object in the Comparing pane. The eye icon returns to its original color, and the object data is added back into the graphs in the Counter Charts pane.

1. Remove selected objects from the **Comparing** pane:

To do this...	Take this action...
Remove a selected object	Hover over the selected object's name in the Comparing pane to show the remove object button (  ), and then click the button. The object is removed from the Comparing pane, and its data is cleared from the counter charts.
Remove all selected objects	Click the remove all object's button (  ) at the top of the Comparing pane. All selected objects and their data are removed, leaving only the root object.

## Understanding counter charts

Charts in the Counter Charts pane enable you to view and compare performance data for the root object and for objects you have added from the correlated objects grid. This can help you understand performance trends and isolate and resolve performance issues.

Counter charts displayed by default are Events, Latency, IOPS, and MBps. Optional charts that you can choose to display are Utilization, Performance Capacity Used, Available IOPS, IOPS/TB, and Cache Miss Ratio. Additionally, you can choose to view total values or breakdown values for the Latency, IOPS, MBps, and Performance Capacity Used charts.

The Performance Explorer displays certain counter charts by default; whether the storage object supports them

all or not. When a counter is not supported, the counter chart is empty and the message `Not applicable for <object>` is displayed.

The charts display performance trends for the root object and for all objects you have selected in the Comparing pane. Data in each chart is arranged as follows:

- **X axis**

Displays the specified time period. If you have not specified a time range, the default is the preceding 72-hour period.

- **Y axis**

Displays counter units unique to the selected object, or objects.

Trend line colors match the color of the object name as displayed in the Comparing pane. You can position your cursor over a point on any trend line to view details for time and value for that point.

If you want to investigate a specific period of time within a chart, you can use one of the following methods:

- Use the **<** button to expand the Counter Charts pane to span the width of the page.
- Use the cursor (when it transitions to a magnifying glass) to select a portion of the timeframe in the chart to focus and enlarge that area. You can click **Reset Chart Zoom** to return the chart to the default timeframe.
- Use the **Zoom View** button to display a large single counter chart that contains expanded details and threshold indicators.



Occasionally, gaps in the trend lines display. Gaps mean that either Unified Manager failed to collect performance data from the storage system or that Unified Manager might have been down.

## Types of performance counter charts


There are standard performance charts that display the counter values for the selected storage object. Each of the Breakdown counter charts display the total values separated out into read, write, and other categories. Furthermore, some Breakdown counter charts display additional detail when the chart is displayed in Zoom view.

The following table shows the available performance counter charts.

Available charts	Chart description
Events	Displays critical, error, warning, and information events in correlation with the statistical charts for the root object. Health events display in addition to performance events to provide a complete picture of the reasons performance may be affected.
Latency - Total	Number of milliseconds required to respond to application requests. Note that the average latency values are I/O weighted.

Available charts	Chart description
Latency - Breakdown	The same information shown in Latency Total, but with the performance data separated into read, write, and other latency. This chart option applies only when the selected object is an SVM, node, aggregate, volume, LUN, or namespace.
Latency - Cluster Components	The same information shown in Latency Total, but with the performance data separated into latency by cluster component. This chart option applies only when the selected object is a volume.
IOPS - Total	Number of input/output operations processed per second. When displayed for a node, selecting "Total" displays the IOPS for data moving through this node that may reside on the local or the remote node, and selecting "Total (Local)" displays the IOPS for data that resides only on the current node.
IOPS - Breakdown	<p>The same information shown in IOPS Total, but with the performance data separated into read, write, and other IOPS. This chart option applies only when the selected object is an SVM, node, aggregate, volume, LUN, or namespace.</p> <p>When displayed in Zoom view, the volumes chart displays QoS minimum and maximum throughput values, if configured in ONTAP.</p> <p>When displayed for a node, selecting "Breakdown" displays the IOPS breakdown for data moving through this node that may reside on the local or the remote node, and selecting "Breakdown (Local)" displays the IOPS breakdown for data that resides only on the current node.</p>
IOPS - Protocols	The same information shown in IOPS Total, but the performance data is separated into individual charts for CIFS, NFS, FCP, NVMe, and iSCSI protocol traffic. This chart option applies only when the selected object is an SVM.



Available charts	Chart description
IOPS/TB - Total	<p>Number of input/output operations processed per second based on the total space that is being consumed by the workload, in terabytes. Also called I/O density, this counter measures how much performance can be delivered by a given amount of storage capacity. When displayed in Zoom view the volumes chart displays QoS expected and peak throughput values, if configured in ONTAP.</p> <p>This chart option applies only when the selected object is a volume.</p>
MB/s - Total	<p>Number of megabytes of data transferred to and from the object per second.</p>
MB/s - Breakdown	<p>The same information shown in the MB/s chart, but with the throughput data separated into disk reads, Flash Cache reads, writes, and other. When displayed in Zoom view, the volumes chart displays QoS maximum throughput values, if configured in ONTAP.</p> <p>This chart option applies only when the selected object is an SVM, node, aggregate, volume, LUN, or namespace.</p> <div data-bbox="846 1066 906 1123">  </div> <p>Flash Cache data is displayed only for nodes, and only when a Flash Cache module is installed in the node.</p>
Performance Capacity Used - Total	<p>Percentage of performance capacity that is being consumed by the node or aggregate.</p>
Performance Capacity Used - Breakdown	<p>Performance Capacity Used data separated into user protocols and system background processes. Additionally, the amount of free performance capacity is shown.</p>
Available IOPS - Total	<p>Number of input/output operations per second that are currently available (free) on this object. This number is the result of subtracting the currently used IOPS from the total IOPS that Unified Manager calculates that the object can perform. This chart option applies only when the selected object is a node or aggregate.</p>

Available charts	Chart description
Utilization - Total	Available resource percentage of the object that is being used. Utilization indicates node utilization for nodes, disk utilization for aggregates, and bandwidth utilization for ports. This chart option applies only when the selected object is a node, aggregate, or port.
Cache Miss Ratio - Total	Percentage of read requests from client applications that are returned from the disk instead of being returned from the cache. This chart option applies only when the selected object is a volume.

## Selecting performance charts to display

The Choose charts drop-down list enables you to select the types of performance counter charts to display in the Counter Charts pane. This enables you to view specific data and counters, based on your performance requirements.

### Steps

1. In the **Counter Charts** pane, click the **Choose charts** drop-down list.
2. Add or remove charts:

To...	Do this...
Add or remove individual charts	Click the check boxes next to the charts you want to show or hide
Add all charts	Click <b>Select All</b>
Remove all charts	Click <b>Unselect All</b>

Your chart selections are displayed in the Counter Charts pane. Note that as you add charts, the new charts are inserted into the Counter Charts pane to match the order of the charts listed in the Choose charts drop-down list. Selecting additional charts might require additional scrolling.

## Expanding the Counter Charts pane

You can expand the Counter Charts pane so that the charts are larger and more readable.

### About this task

After you have defined the comparison objects and the time range for counters, you can view a larger Counter Charts pane. You use the < button in the middle of the Performance Explorer window to expand the pane.

## Steps

1. Expand or reduce the **Counter Charts** pane.

To...	Do this...
Expand the Counter Charts pane to fit the width of the page	Click the < button
Reduce the Counter Charts pane to the right half of the page	Click the > button

## Changing the Counter Charts focus to a shorter period of time

You can use your mouse to reduce the time range to focus on a specific period of time in the Counter Chart pane or in the Counter Charts Zoom View window. This enables you to see a more granular and microscopic view of any part of the timeline of performance data, events, and thresholds.

### Before you begin

The cursor must have changed to a magnifying glass to indicate that this functionality is active.



When using this feature, which alters the timeline to display values that correspond to the more granular display, the time and date range on the **Time Range** selector does not change from the original values for the chart.

## Steps

1. To zoom into a specific period of time, click using the magnifying glass and drag the mouse to highlight the area that you want to see in detail.

The counter values for the time period you select fills the counter chart.

2. To return to the original period of time as set in the **Time Range** selector, click the **Reset Chart Zoom** button.

The counter chart displays in its original state.

## Viewing event details in the Events Timeline

You can view all events and their related details in the Events Timeline pane of Performance Explorer. This is a quick and efficient method of viewing all the health and performance events that occurred on the root object during a specified time range, which can be helpful when troubleshooting performance issues.

## About this task

The Events Timeline pane shows critical, error, warning, and informational events that occurred on the root object during the selected time range. Each event severity has its own timeline. Single and multiple events are represented by an event dot on the timeline. You can position your cursor over an event dot to see the event details. To increase the visual granularity of multiple events, you can decrease the time range. This spreads out multiple events into single events, enabling you to separately view and investigate each event.


Each performance event dot on the Events Timeline lines up vertically with a corresponding spike in the counter charts trend lines that are displayed below the Events Timeline. This provides a direct visual correlation between events and overall performance. Health events are displayed on the timeline as well, but these types of events do not necessarily line up with a spike in one of the performance charts.

## Steps

1. On the **Events Timeline** pane, position the cursor over an event dot on a timeline to view a summary of the event or events at that event point.

A pop-up dialog displays information about the event types, the date and time when the events occurred, the state, and the event duration.

2. View full event details for one event or multiple events:

To do this...	Click this...
View details for a single event	<b>View Event Detail</b> in the pop-up dialog.
View details for multiple events	<b>View Event Details</b> in the pop-up dialog. <div> Clicking a single event on the multiple events dialog displays the appropriate Event Details page.</div>

## Counter Charts Zoom View

The Counter Charts provide a Zoom View that enables you to zoom in on performance details over your specified time period. This enables you to see performance details and events with much higher granularity, which is beneficial when troubleshooting performance issues.

When displayed in Zoom View, some of the breakdown charts provide additional information than what appears when the chart is not in Zoom View. For example, the IOPS, IOPS/TB, and MBps Breakdown chart Zoom View pages display QoS policy values for volumes and LUNs if they have been set in ONTAP.



For system-defined performance threshold policies, only the “Node resources over-utilized” and “QoS throughput limit breached” policies are available from the **Policies** list. The other system-defined threshold policies are not available at this time.

## Displaying the Counter Charts Zoom View

The Counter Charts Zoom View provides a finer level of detail for the selected counter chart and its associated timeline. This magnifies the counter chart data, enabling you to have a sharper view into performance events and their underlying causes.

### About this task

You can display the Counter Charts Zoom View for any counter chart.

### Steps

1. Click **Zoom View** to open the selected chart in a new browser window.
2. If you are viewing a Breakdown chart and then click **Zoom View** the Breakdown chart is shown in Zoom View. You can select **Total** while in Zoom View if you want to change the view option.

## Specifying the time range in Zoom View

The **Time Range** control in the Counter Charts Zoom View window enables you to specify a date and time range for the selected chart. This enables you to quickly locate specific data based on either a preset time range or your own custom time range.

### About this task

You can select a time range between one hour and 390 days. 13 months equals 390 days because each month is counted as 30 days. Specifying a date and time range provides more detail and enables you to zoom in on specific performance events or series of events. Specifying a time range also aids in troubleshooting potential performance issues, as specifying a date and time range displays data surrounding the performance event in finer detail. Use the **Time Range** control to select predefined date and time ranges, or specify your own custom date and time range of up to 390 days. Buttons for predefined time ranges vary from the **Last Hour** through the **Last 13 Months**.

Selecting the **Last 13 Months** option or specifying a custom date range greater than 30 days displays a dialog box alerting you that performance data displayed for a period greater than 30 days is charted using hourly averages and not 5-minute data polling. Therefore, a loss of timeline visual granularity might occur. If you click the **Do not show again** option in the dialog box, the message does not appear when you select the **Last 13 Months** option or specify a custom date range greater than 30 days. Summary data also applies on a smaller time range, if the time range includes a time/date that is more than 30 days from today.

When selecting a time range (either custom or predefined), time ranges of 30 days or fewer are based on 5-minute interval data samples. Time ranges greater than 30 days are based on one-hour interval data samples.

1. Click the **Time Range** drop-down box and the Time Range panel displays.
2. To select a predefined time range, click one of the **Last...** buttons at the right of the **Time Range** panel. When selecting a predefined time range, data for up to 13 months is available. The predefined time range button you selected is highlighted, and the corresponding days and time display in the calendars and time selectors.
3. To select a custom date range, click the start date in the **From** calendar on the left. Click **<** or **>** to navigate forward or backward in the calendar. To specify the end date, click a date in the **To** calendar on the right. Note that the default end date is today unless you specify a different end date. The **Custom Range** button at the right of the Time Range panel is highlighted, indicating that you have selected a custom date range.
4. To select a custom time range, click the **Time** control below the **From** calendar and select the start time. To specify the end time, click the **Time** control below the **To** calendar on the right and select the end time. The **Custom Range** button at the right of the Time Range panel is highlighted, indicating that you have selected a custom time range.
5. Optionally, you can specify the start and end times when selecting a predefined date range. Select the predefined date range as previously described, then select the start and end times as previously described. The selected dates are highlighted in the calendars, your specified start and end times display in the **Time** controls, and the **Custom Range** button is highlighted.
6. After selecting the date and time range, click **Apply Range**. The performance statistics for that time range display in the charts and in the Events timeline.

## Selecting performance thresholds in Counter Charts Zoom View

Applying thresholds in the Counter Charts Zoom View provides a detailed view of occurrences of performance threshold events. This enables you to apply or remove thresholds, and immediately view the results, which can be helpful while deciding whether troubleshooting should be your next step.

### About this task

Selecting thresholds in the Counter Charts Zoom View enables you to view precise data about performance threshold events. You can apply any threshold that appears under the **Policies** area of the Counter Charts Zoom View.

Only one policy at a time can be applied to the object in the Counter Charts Zoom View.

## Steps

1. Select or deselect the  that is associated with a policy.

The selected threshold is applied to the Counter Charts Zoom View. Critical thresholds are displayed as a red line; warning thresholds are displayed as a yellow line.

## Viewing volume latency by cluster component

You can view detailed latency information for a volume by using the Volume Performance Explorer page. The Latency - Total counter chart shows total latency on the volume, and the Latency - Breakdown counter chart is useful for determining the impact of read and write latency on the volume.

### About this task

Additionally, the Latency - Cluster Components chart shows a detailed comparison of the latency of each cluster component to help determine how each component contributes to the total latency on the volume. The following cluster components are displayed:


- Network
- QoS Limit Max
- QoS Limit Min
- Network Processing
- Cluster Interconnect
- Data Processing
- Aggregate Operations
- Volume Activation
- MetroCluster Resources
- Cloud Latency
- Sync SnapMirror

## Steps

1. In the **Volume Performance Explorer** page for your selected volume, from the Latency chart, select **Cluster Components** from the drop-down menu.

The Latency - Cluster Components chart is displayed.

2. To view a larger version of the chart, select **Zoom View**.

The cluster component comparative chart is displayed. You can restrict the comparison by deselecting or selecting the  that is associated with each cluster component.

3. To view the specific values, move your cursor into the chart area to see the popup window.

# Viewing SVM IOPS traffic by protocol

You can view detailed IOPS information for an SVM by using the Performance/SVM Explorer page. The IOPS - Total counter chart shows total IOPS usage on the SVM, and the IOPS - Breakdown counter chart is useful for determining the impact of read, write, and other IOPS on the SVM.

## About this task

Additionally, the IOPS - Protocols chart shows a detailed comparison of the IOPS traffic for each protocol that is being used on the SVM. The following protocols are available:


- CIFS
- NFS
- FCP
- iSCSI
- NVMe

## Steps

1. In the **Performance/SVM Explorer** page for your selected SVM, from the IOPS chart, select **Protocols** from the drop-down menu.

The IOPS - Protocols chart is displayed.

2. To view a larger version of the chart, select **Zoom View**.

The IOPS advanced protocol comparative chart is displayed. You can restrict the comparison by deselecting or selecting the  that is associated with a protocol.

3. To view the specific values, move your cursor into the chart area of either chart to see the popup window.

# Viewing volume and LUN latency charts to verify performance guarantee

You can view the volumes and LUNs that you have subscribed to the “Performance Guarantee” program to verify that latency has not exceeded the level you have been guaranteed.

## About this task

The latency performance guarantee is a millisecond per operation value that should not be exceeded. It is based on an hourly average, not on the default five minute performance collection period.

## Steps

1. In the **Performance: All Volumes** view or **Performance: All LUNs** view, select the volume or LUN that you are interested in.



2. In the **Performance Explorer** page for your selected volume or LUN, choose **Hourly Average** from the **View statistics in** selector.

The horizontal line in the Latency chart will show a smoother line as the five-minute collections are replaced with the hourly average.

3. If you have other volumes on the same aggregate that are under the performance guarantee, you can add those volumes to view their latency value in the same chart.

## Viewing the performance for All SAN Array clusters

You can use the Performance: All Clusters view to display the performance status of your All SAN Array clusters.

### Before you begin

You must have the Operator, Application Administrator, or Storage Administrator role.

### About this task

You can view overview information for All SAN Array clusters in the Performance: All Clusters view, and details in the Cluster / Performance Explorer page.

### Steps

1. In the left navigation pane, click **Storage > Clusters**.
2. Make sure that the “Personality” column is displayed in the **Health: All Clusters** view, or add it using the **Show / Hide** control.

This column displays “All SAN Array” for your All SAN Array clusters.

3. To view information about the performance in those clusters, select the **Performance: All Clusters** view.

View the performance information for the All SAN Array cluster.

4. To view detailed information about performance in those clusters, click the name of an All SAN Array cluster.
5. Click the **Explorer** tab.
6. On the **Cluster / Performance Explorer** page, select **Nodes on this Cluster** from the **View and Compare** menu.

You can compare the performance statistics of both nodes on this cluster to make sure the load is almost identical on both nodes. If there are large discrepancies between the two nodes you can add the second node to the charts and compare the values over a longer timeframe to identify any configuration issues.

## Viewing node IOPS based on workloads that reside only on the local node

The node IOPS counter chart can highlight where operations are only passing through the local node using a network LIF to perform read/write operations on volumes on a

remote node. The IOPS - “Total (Local)” and “Breakdown (Local)” charts display the IOPS for data that resides in local volumes only on the current node.

## About this task

The “Local” versions of these counter charts are similar to the node charts for Performance Capacity and Utilization because they also show only the statistics for data that resides on local volumes.

By comparing the “Local” versions of these counter charts to the regular Total versions of these counter charts you can see if there is a lot of traffic moving through the local node to access volumes on the remote node. This situation could cause performance issues, possibly indicated by high utilization on the node, if there are too many operations passing through the local node to reach a volume on a remote node. In these cases you may want to move a volume to the local node, or to create a LIF on the remote node where traffic from hosts accessing that volume can be connected.

## Steps

1. In the **Performance/Node Explorer** page for your selected node, from the IOPS chart, select **Total** from the drop-down menu.

The IOPS - Total chart is displayed.

2. Click **Zoom View** to display a larger version of the chart in a new browser tab.
3. Back in the **Performance/Node Explorer** page, from the IOPS chart, select **Total (Local)** from the drop-down menu.

The IOPS - Total (Local) chart is displayed.

4. Click **Zoom View** to display a larger version of the chart in a new browser tab.
5. View both of the charts next to each other and identify areas where the IOPS values appear to be quite different.
6. Move your cursor over these areas to compare the local and total IOPS for a specific point in time.

## Components of the Object Landing pages

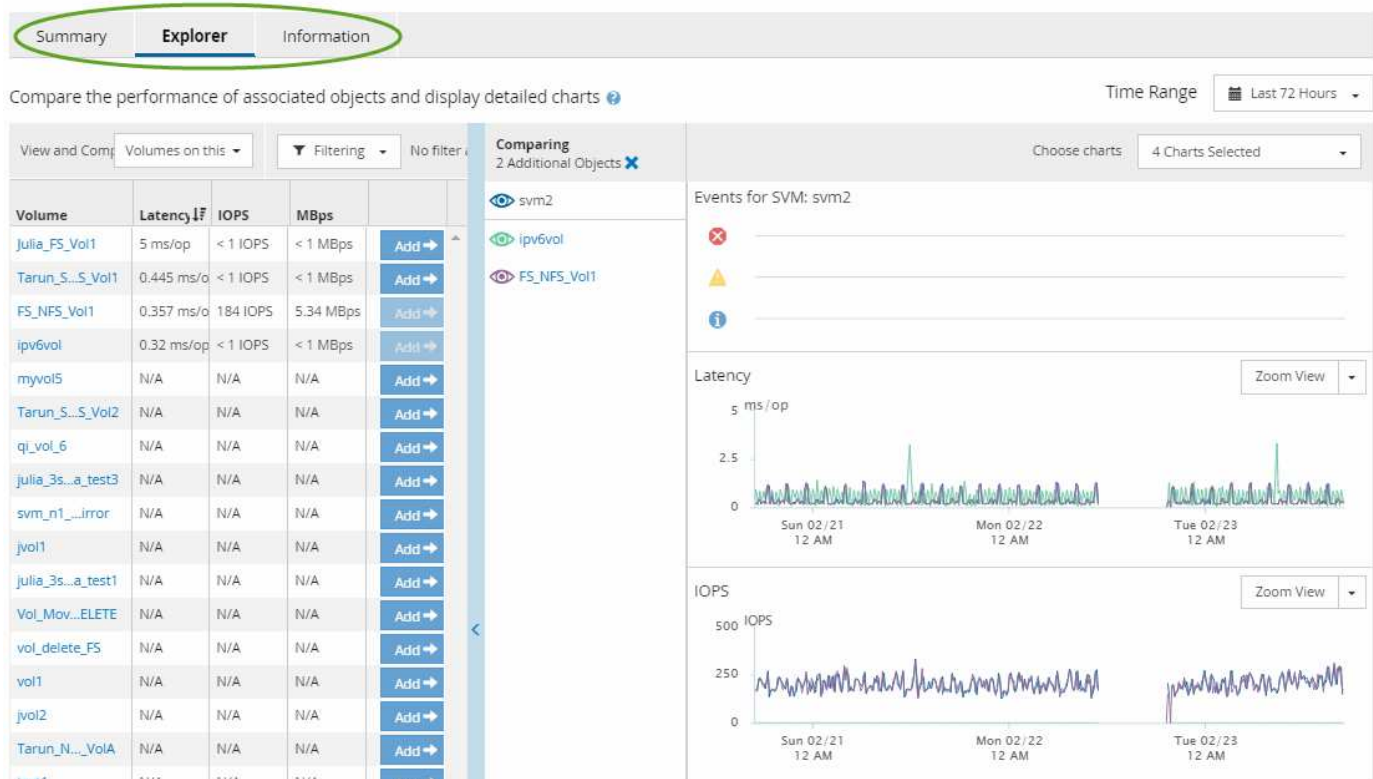
The Object Landing pages provide details about all critical, warning, and informational events. They provide a detailed view into the performance of all cluster objects, enabling you to select and compare individual objects across various time periods.

The Object Landing pages enable you to examine the overall performance of all objects, and to compare object performance data in a side-by-side format. This is beneficial when assessing performance and when troubleshooting events.



The data displayed in the counter summary panels and in the Counter Charts are based on a five-minute sampling interval. The data displayed in the objects inventory grid in the left side of the page is based on a one-hour sampling interval.

The following image shows an example of an Object Landing page displaying the Explorer information:



Depending on the storage object that is being viewed, the Object Landing page can have the following tabs that provide performance data about the object:

- Summary

Displays three or four counter charts containing the events and performance per object for the preceding 72-hour period, including a trend line that shows the high and low values during that period.

- Explorer

Displays a grid of storage objects that are related to the current object, which enables you to compare the performance values of the current object with those of the related objects. This tab includes up to eleven counter charts and a time range selector, which enable you to perform a variety of comparisons.

- Information

Displays values for non-performance configuration attributes about the storage object, including the installed version of ONTAP software, HA partner name, and number of ports and LIFs.

- Top Performers

For clusters: Displays the storage objects that have the highest performance or the lowest performance, based on the performance counter that you select.

- Failover Planning

For nodes: Displays the estimate of the performance impact on a node if the HA partner of the node fails.

- Details

For volumes: Displays detailed performance statistics for all I/O activity and operations for the selected volume workload. This tab is available for FlexVol volumes, FlexGroup volumes, and constituents of FlexGroups.

## Summary page

The Summary page displays counter charts that contain details about the events and performance per object for the preceding 72-hour period. This data is not automatically refreshed, but is current as of the last page load. The charts in the Summary page answer the question *Do I need to look further?*

### Charts and counter statistics

The summary charts provide a quick, high-level overview for the last 72-hour period, and help you to identify possible issues that require further investigation.

The Summary page counter statistics are displayed in graphs.

You can position your cursor over the trend line in a graph to view the counter values for a particular point in time. The summary charts also display the total number of active critical and warning events for the preceding 72-hour period for the following counters:

- **Latency**

Average response time for all I/O requests; expressed in milliseconds per operation.

Displayed for all object types.

- **IOPS**

Average operating speed; expressed in input/output operations per second.

Displayed for all object types.

- **MB/s**

Average throughput; expressed in megabytes per second.

Displayed for all object types.

- **Performance Capacity Used**

Percentage of performance capacity that is being consumed by a node or aggregate.

Displayed for nodes and aggregates only.

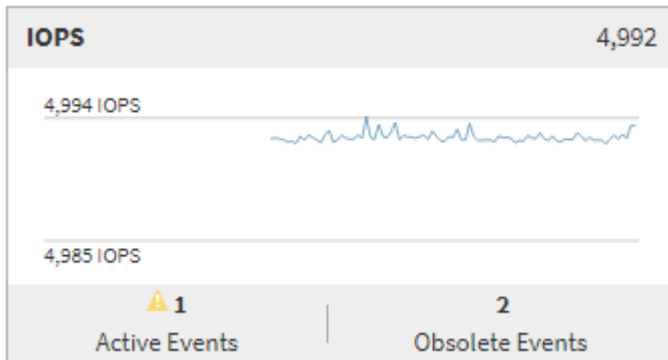
- **Utilization**

Percentage of object utilization for nodes and aggregates, or bandwidth utilization for ports.

Displayed for nodes, aggregates, and ports only.

Positioning the cursor over the event count for Active events shows the type and number of events. Critical events are displayed in red (■), and warning events are displayed in yellow (■).

The number at the top right of the chart in the gray bar is the average value from the last 72-hour period. Numbers shown at the bottom and top of the trend line graph are the minimum and maximum values for the last 72-hour period. The gray bar below the chart contains the count of active (new and acknowledged) events and obsolete events from the last 72-hour period.



- **Latency counter chart**

The Latency counter chart provides a high-level overview of the object latency for the preceding 72-hour period. Latency refers to the average response time for all I/O requests; expressed in milliseconds per operation, the service time, wait time, or both experienced by a data packet or block in the cluster storage component under consideration.

**Top (counter value):** The number in the header displays the average for the preceding 72-hour period.

**Middle (performance graph):** The number at the bottom of the graph displays the lowest latency, and the number at the top of the graph displays the highest latency for the preceding 72-hour period. Position your cursor over the graph trend line to view the latency value for a specific time.

**Bottom (events):** On hover, the pop-up displays the details of the events. Click the **Active Events** link below the graph to navigate to the Events Inventory page to view complete event details.

- **IOPS counter chart**

The IOPS counter chart provides a high-level overview of the object IOPS health for the preceding 72-hour period. IOPS indicates the speed of the storage system in number of input/output operations per second.

**Top (counter value):** The number in the header displays the average for the preceding 72-hour period.

**Middle (performance graph):** The number at the bottom of the graph displays the lowest IOPS, and the number at the top of the graph displays the highest IOPS for the preceding 72-hour period. Position your cursor over the graph trend line to view the IOPS value for a specific time.

**Bottom (events):** On hover, the pop-up displays the details of the events. Click the **Active Events** link below the graph to navigate to the Events Inventory page to view complete event details.

- **MB/s counter chart**

The MB/s counter chart displays the object MB/s performance, and indicates how much data has been transferred to and from the object in megabytes per second. The MB/s counter chart provides a high-level overview of the object's MB/s health for the preceding 72-hour period.

**Top (counter value):** The number in the header displays the average number of MB/s for the preceding 72-hour period.

**Middle (performance graph):** The value at the bottom of the graph displays the lowest number of MB/s, and the value at the top of the graph displays the highest number of MB/s for the preceding 72-hour period. Position your cursor over the graph trend line to view the MB/s value for a specific time.

**Bottom (events):** On hover, the pop-up displays the details of the events. Click the **Active Events** link below the graph to navigate to the Events Inventory page to view complete event details.

- **Performance Capacity Used counter chart**

The Performance Capacity Used counter chart displays the percentage of performance capacity that is being consumed by the object.

**Top (counter value):** The number in the header displays the average used performance capacity for the preceding 72-hour period.

**Middle (performance graph):** The value at the bottom of the graph displays the lowest used performance capacity percentage, and the value at the top of the graph displays the highest used performance capacity percentage for the preceding 72-hour period. Position your cursor over the graph trend line to view the used performance capacity value for a specific time.

**Bottom (events):** On hover, the pop-up displays the details of the events. Click the **Active Events** link below the graph to navigate to the Events Inventory page to view complete event details.

- **Utilization counter chart**

The Utilization counter chart displays the object utilization percentage. The Utilization counter chart provides a high-level overview of the percentage of the object or bandwidth utilization for the preceding 72-hour period.

**Top (counter value):** The number in the header displays the average utilization percentage for the preceding 72-hour period.

**Middle (performance graph):** The value at the bottom of the graph displays the lowest utilization percentage, and the value at the top of the graph displays the highest utilization percentage for the preceding 72-hour period. Position your cursor over the graph trend line to view the utilization value for a specific time.

**Bottom (events):** On hover, the pop-up displays the details of the events. Click the **Active Events** link below the graph to navigate to the Events Inventory page to view complete event details.

## Events

The events history table, where applicable, lists the most recent events that occurred on that object. Clicking the event name displays details of the event on the Event Details page.

## Components of the Performance Explorer page

The Performance Explorer page enables you to compare the performance of similar objects in a cluster—for example, all the volumes in a cluster. This is beneficial when troubleshooting performance events and fine-tuning object performance. You can also compare objects with the root object, which is the baseline against which other object comparisons are made.

You can click the **Switch to Health View** button to display the Health details page for this object. In some cases you can learn important information about the storage configuration settings for this object that may help when troubleshooting an issue.

The Performance Explorer page displays a list of cluster objects and their performance data. This page displays all the cluster objects of the same type (for example, volumes and their object-specific performance statistics) in a tabular format. This view provides an efficient overview of cluster object performance.



If “N/A” appears in any cell of the table, it means that a value for that counter is not available because there is no I/O on that object at this time.

The Performance Explorer page contains the following components:

- **Time Range**

Enables you to select a time range for the object data.

You can choose a predefined range, or specify your own custom time range.

- **View and Compare**

Enables you to select which type of correlated object is displayed in the grid.

The options available depend on the root object type and its available data. You can click the View and Compare drop-down list to select an object type. The object type that you select is displayed in the list.

- **Filtering**

Enables you to narrow the amount of data you receive, based on your preferences.

You can create filters that apply to the object data—for example, IOPS greater than 4. You can add up to four simultaneous filters.

- **Comparing**

Displays a list of the objects that you have selected for comparison with the root object.

Data for the objects in the Comparing pane is displayed in the Counter Charts.

- **View Statistics In**

For volume and LUNs, enables you to select whether the statistics are displayed after each collection cycle (default 5 minutes), or whether the statistics are shown as an hourly average. This functionality enables you to view the latency chart in support of the NetApp® Performance Guarantee™ program.

- **Counter Charts**

Displays graphed data for each object performance category.

Typically, only three or four charts are displayed by default. The Choose charts component enables you to display additional charts, or hide specific charts. You can also choose to show or hide the Events Timeline.

- **Events Timeline**

Displays performance and health events occurring across the timeline that you selected in the Time Range

component.

## Descriptions of the counter charts

You use the Performance Explorer counter charts to view and compare performance data for selected storage objects. These charts can help you to understand performance trends and isolate and resolve performance issues.

### Latency performance counter charts

The Latency counter charts display the number of milliseconds that are required for the selected storage object to respond to application requests.

The popup window that is displayed when your cursor is in the chart area shows the specific counter values at specific times.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile latency for the selected time range.

There are three types of Latency charts available:

#### Latency - Total counter chart

Displays the number of milliseconds required to respond to application requests. The average latency values are I/O weighted.

#### Latency - Breakdown counter chart

Displays the same latency data separated into read, write, and other latency.

This chart option applies when the selected object is an SVM, node, aggregate, volume, or LUN.

#### Latency - Cluster Components counter chart

Displays the latency data by cluster component. This enables you to identify the cluster component that is responsible for the latency. By hovering your cursor in the chart you can view the exact latency contribution for each component.

This chart option applies when the selected object is an SVM, node, aggregate, volume, or LUN.

### Zoom View button

Displays a magnified view of the counter chart data.

- Events

The occurrence of critical, warning, and informational events are indicated on the time lines above the charts.


- Thresholds

The dashed, horizontal line indicates the utilization warning threshold value set in Unified Manager.



The solid red line indicates the utilization critical threshold value set in Unified Manager.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter hides and shows that counter information from the chart and can help when comparing object latency.

## IOPS performance counter charts

The IOPS counter charts display the number of input/output operations processed per second by the selected storage object.

The popup window that displays when you move the cursor across the chart area shows the counter values at specific times.

When displayed in Zoom view, the volume and LUN IOPS charts also display Quality of Service (QoS) maximum and minimum throughput threshold settings, if configured. The IOPS/TB charts display QoS peak and expected throughput threshold settings, if adaptive QoS policies are configured.



In some cases when using adaptive QoS policies, the Max and Min values are set to the same value in the charts. This happens either on large volumes where very little space is being used, or on very small volumes.

When viewing a volume or LUN that is sharing the IOPS of a shared QoS policy, a line for “Total Workload IOPS” is displayed to show the IOPS that are being used by all other workloads sharing this policy.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile IOPS for this object over the selected time range.

There are four types of IOPS charts available:

### IOPS - Total counter chart

Displays the number of input/output operations processed per second.

When displayed for a node, selecting “Total” displays the IOPS for data moving through this node that may reside on either the local or the remote node, and selecting “Total (Local)” displays the IOPS for data that resides only on the current node.

### IOPS - Breakdown counter chart

Displays the same IOPS data separated into read, write, and other IOPS.

This chart option applies when the selected object is an SVM, node, aggregate, volume, or LUN.

When displayed for a node, selecting “Breakdown” displays the IOPS breakdown for data moving through this node that may reside on either the local or the remote node, and selecting “Breakdown (Local)” displays the IOPS breakdown for data that resides only on the current node.

### IOPS - Protocols counter chart

Displays the same IOPS data, but for SVMs the performance data is separated into individual components for

CIFS, NFS, FCP, NVMe, and iSCSI protocol traffic.

## IOPS/TB - Total counter chart

Displays the number of input/output operations processed per second based on the total logical space that is being consumed by the volume, in terabytes. Also called I/O density, this counter measures how much performance can be delivered by a given amount of storage capacity.

This chart option is available only when the selected object is a volume. It displays performance data only when the logical capacity used by the volume is greater than or equal to 128 GB. Gaps will be displayed in the chart when the used capacity falls below 128 GB during the selected timeframe.

### Zoom View button

Displays a magnified view of the counter chart data.

- Events


The occurrence of critical, error, warning, and informational events are indicated on the time lines above the charts.

- Thresholds

The dashed, horizontal line indicates the utilization warning threshold value set in Unified Manager.

The solid red line indicates the utilization critical threshold value set in Unified Manager.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter hides and shows that counter information from the chart and can help when comparing object IOPS.

## MB/s performance counter charts

The MB/s counter charts display the number of megabytes of data transferred to and from the selected object per second.

The popup window that is displayed when your cursor is in the chart area shows the specific counter values at specific times.

When displayed in Zoom view, the volume and LUN charts also display Quality of Service (QoS) maximum MB/s throughput threshold settings, if configured.

When viewing a volume or LUN that is sharing the MB/s of a shared QoS policy, a line for “Total Workload MB/s” is displayed to show the MB/s that are being used by all other workloads sharing this policy.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile MB/s for the selected time range.

There are two types of MB/s charts available:

### MB/s - Total counter chart

Displays the number of megabytes of data transferred to and from the selected object per second.

### MB/s - Breakdown counter chart

Displays the same MB/s data separated into disk read, Flash Cache read, write, and other operations.

This chart option applies when the selected object is an SVM, node, aggregate, volume, or LUN.



Flash Cache data is displayed only for nodes, and only when a Flash Cache module is installed in the node.

### Zoom View button

Displays a magnified view of the counter chart data.

- Events


The occurrence of critical, error, warning, and informational events are indicated on the time lines above the charts.

- Thresholds

The dashed, horizontal line indicates the utilization warning threshold value set in Unified Manager.

The solid red line indicates the utilization critical threshold value set in Unified Manager.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter hides and shows that counter information from the chart and can help when comparing object MB/s.

### Utilization performance counter chart

The Utilization counter chart displays the average percentage of the selected resource that is being used.

The popup window that is displayed when your cursor is in the chart area shows the specific counter values at specific times.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile utilization for the selected time range.

### Utilization - Total counter chart

Displays the average percentage of the selected resource that is being used. For nodes this indicates utilization of node resources (CPU and RAM), for aggregates this indicates utilization of the disks in the aggregate, and for ports this indicates the bandwidth utilization of the port.

This chart option applies when the selected object is a node, aggregate, or port.

## Zoom View button

Displays a magnified view of the counter chart data.

- Events


The occurrence of critical, warning, and informational events are indicated on the time lines above the charts.

- Thresholds

The dashed, horizontal line indicates the utilization warning threshold value set in Unified Manager.

The solid red line indicates the utilization critical threshold value set in Unified Manager.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter hides and shows that counter information from the chart and can help when comparing object utilization.

## Performance Capacity Used performance counter charts

The Performance Capacity Used counter charts display the percentage of performance capacity that is being consumed by the node or aggregate.

These charts apply only when the selected object is a node or aggregate.

The popup window that is displayed when your cursor is in the chart area shows the specific counter values at specific times.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile performance capacity used for the selected time range.

There are two types of Performance Capacity Used charts available:

### Performance Capacity Used - Total counter chart

Displays the percentage of performance capacity that is being consumed by the node or aggregate.

- Green zone

The capacity value is under the warning threshold set in Unified Manager.

- Yellow zone

The capacity value is approaching the warning threshold set in Unified Manager.

- Red zone

The capacity value is above the warning threshold and approaching the maximum threshold set in Unified Manager.

## Performance Capacity Used - Breakdown counter chart

Displays the same percentage of performance capacity separated into user protocols, system background processes, and the amount of free performance capacity.

### Zoom View button

Displays a magnified view of the counter chart data.

- Events

The occurrence of critical, warning, and informational events are indicated on the time lines above the charts.


- Thresholds

The dashed, horizontal line indicates the capacity warning threshold value set in Unified Manager.

The solid red line indicates the capacity critical threshold value set in Unified Manager.

The solid black line at 100% is the recommended maximum performance capacity used value.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter can restrict the comparison.

## Available IOPS performance counter chart

The Available IOPS counter chart displays the number of input/output operations per second that are currently available (free) on the selected storage object.

The popup window that is displayed when your cursor is in the chart area shows the specific counter values at specific times.

This chart option applies only when the selected object is a node or aggregate.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile performance capacity used for the selected time range.

### Available IOPS - Total counter chart

Displays the number of input/output operations per second that are currently available (free) on the selected storage object. This number is the result of subtracting the currently used IOPS from the total IOPS that Unified Manager calculates that the object can perform.


### Zoom View button

Displays a magnified view of the counter chart data.

- Events

The occurrence of critical, warning, and informational events are indicated on the time lines above the charts.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter hides and shows that counter information from the chart and can help when comparing objects.

## Cache Miss Ratio performance counter chart

The Cache Miss Ratio counter chart displays the percentage of read requests from client applications that are returned from the disk instead of being returned from the cache.

The popup window that is displayed when your cursor is in the chart area shows the specific counter values at specific times.

The bottom of the chart page displays information for the minimum, maximum, average, and 95th percentile cache miss ratio for the selected time range.

### Cache Miss Ratio - Total counter chart

Displays the percentage of read requests from client applications that are returned from the disk instead of being returned from the cache.

This chart option applies only when the selected object is a volume.


### Zoom View button

Displays a magnified view of the counter chart data.

- Events

The occurrence of critical, warning, and informational events are indicated on the time lines above the charts.

- Counters

The counters in the left pane show which counter values are being displayed. Deselecting or selecting the  that is associated with a counter hides and shows that counter information from the chart and can help when comparing objects.

## Descriptions of the Performance Explorer pages

You use the Performance Explorer pages to view detailed performance information about each of the available storage object; such as clusters, aggregates, volumes, and so on. These pages enable you to assess the overall performance of all objects and compare object performance data in a side-by-side format.

### Cluster/Performance Explorer page

The Cluster/Performance Explorer page provides a detailed performance overview of all the clusters that are managed by Unified Manager.

The Cluster/Performance Explorer page enables you to track cluster performance and compare the objects within that cluster during a specific time period, which helps in troubleshooting and fine-tuning the performance of a cluster.

Using the View and Compare functionality you can compare the performance of the cluster with:

- the nodes on this cluster
- the storage VMs of this cluster
- the aggregates on this cluster

The Cluster/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track cluster performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## Node/Performance Explorer page

The Node/Performance Explorer page provides a detailed performance overview of all nodes within a cluster.

The Node/Performance Explorer page enables you to track and compare node performance during a specific time period, which helps you to troubleshoot and fine-tune the performance of your nodes.

Using the View and Compare functionality you can compare the performance of this node with:

- other nodes on the same cluster
- the aggregates on the node
- the ports on the node

The Node/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare node performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## Aggregate/Performance Explorer page

The Aggregate/Performance Explorer page provides a detailed performance overview of all the aggregates in a cluster.

The Aggregate/Performance Explorer page enables you to track and compare aggregate performance during a specific time period, which helps in troubleshooting and fine-tuning the performance of an aggregate.



Root aggregates are not displayed on this page.

Using the View and Compare functionality you can compare the performance of this aggregate with:

- other aggregates on the same node
- other aggregates on the same cluster
- the node on which the aggregate resides
- all nodes on the cluster that is using this aggregate
- the volumes that reside on this aggregate

The Aggregate/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare aggregate performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## Storage VM/Performance Explorer page

The Storage VM/Performance Explorer page provides a detailed performance overview of all the storage virtual machines (SVMs) in a cluster.

This page enables you to track and compare storage VM performance during a specific time period, which helps you to troubleshoot and fine-tune your SVM performance.

Using the View and Compare functionality you can compare the performance of this storage VM with:

- other SVMs on the same cluster
- the volumes on this SVM
- the network interfaces on this SVM

The Storage VM/Performance page enables you to:

- View threshold-related issues and their details
- Track and compare SVM performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## Volume/Performance Explorer page

This page provides detailed performance information for a volume in a cluster. The title of this page depends on whether you are viewing a FlexVol volume or a FlexGroup volume.

The Volume/Performance Explorer page enables you to track and compare volume performance during a specific time period, which helps you to troubleshoot and fine-tune your volume performance.



Root volumes are not displayed on this page.

Using the View and Compare functionality:

- For FlexVol volumes, you can compare the performance of this volume with:



- other volumes on the same aggregate
- other volumes that are in the same QoS policy group
- the aggregate on which this volume resides
- the storage VM on which this volume resides
- the LUNs that are on this volume
- For FlexGroup volumes, you can compare the performance of this FlexGroup with:
  - the aggregates on which the FlexGroup resides
  - the storage VM on which the FlexGroup resides
  - the constituent volumes of the FlexGroup

The statistics in the charts are updated after each collection period; which by default is every 5 minutes. The View statistics in selector provides an option to show statistics averaged over the previous hour. This functionality enables you to view the latency chart in support of the NetApp™ Performance Guarantee™ program.

The Volume/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare volume performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues
- Launch System Manager to make a configuration change to the volume

The **Configure Volume** button is available if you are logged in to Unified Manager with the Application Administrator or Storage Administrator role, and when using ONTAP 9.5 or greater.



For data protection (DP) volumes, only counter values for user-generated traffic are displayed.

## Constituent Volume/Performance Explorer page

The Constituent Volume/Performance Explorer page provides detailed performance information for the selected FlexGroup constituent.

The Constituent Volume/Performance Explorer page enables you to track and compare constituent performance during a specific time period, which helps in troubleshooting and fine-tuning the performance of a FlexGroup volume and its constituent volumes.

Using the View and Compare functionality you can compare the performance of this constituent volume with:

- the aggregate on which this constituent volume resides
- the storage VM on which this constituent volume resides
- the FlexGroup volume to which the constituent volume belongs
- other volumes that are on the same aggregate

The Constituent Volume/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare constituent performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues



For data protection (DP) volumes, only counter values for user-generated traffic are displayed.

## LUN/Performance Explorer page

The LUN/Performance Explorer page provides a detailed overview of the performance of all the LUNs within a cluster.

The LUN/Performance Explorer page enables you to track and compare LUN performance during a specific time period, which helps you to troubleshoot and fine-tune the performance of your LUNs.

Using the View and Compare functionality you can compare the performance of this LUN with:

- other LUNs that are on the same volume
- other LUNs that are in the same QoS policy group
- the volume on which the LUN resides

The statistics in the charts are updated after each collection period; which by default is every 5 minutes. The View statistics in selector provides an option to show statistics averaged over the previous hour. This functionality enables you to view the latency chart in support of the NetApp “Performance Guarantee” program.

The LUN/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare LUN performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## NVMe Namespace/Performance Explorer page

The NVMe Namespace/Performance Explorer page provides a detailed overview of the performance of all the NVMe Namespaces within a cluster.

The NVMe Namespace/Performance Explorer page enables you to track and compare NVMe Namespace performance during a specific time period, which helps you to troubleshoot and fine-tune the performance of your Namespaces.

Using the View and Compare functionality you can compare the performance of this NVMe Namespace with:

- the volume on which the Namespace resides
- other Namespaces that are on the same volume
- other Namespaces that are on the same storage VM

The NVMe Namespace/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare Namespace performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues
- Launch System Manager to make a configuration change to the Namespace

The **Configure NVMe Namespace** button is available if you are logged in to Unified Manager with the Application Administrator or Storage Administrator role, and when using ONTAP 9.5 or greater.

## Network Interface/Performance Explorer page

The Network Interface/Performance Explorer page provides a detailed performance overview for all of the network interfaces (LIFs) within a cluster.

The Network Interface/Performance Explorer page enables you to track and compare network interface performance during a specific time period, which helps you to troubleshoot and fine-tune your network interface performance.

Using the View and Compare functionality you can compare the performance of this network interface with:

- other network interfaces that are on the same port
- other network interfaces that are on the same storage VM
- the port on which the network interface resides
- the storage VM on which the network interface resides

The Network Interface/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare network interface performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## Port/Performance Explorer page

The Port/Performance Explorer page provides a detailed performance overview of all ports in a cluster.



Performance counter values are displayed for physical ports only. Counter values are not displayed for VLANs or interface groups.

The Port/Performance Explorer page enables you to track and compare port performance during a specific time period, which helps you to troubleshoot and fine-tune your port performance.

Using the View and Compare functionality you can compare the performance of this port with:

- other ports on the same node
- the node on which the port resides

- network interfaces that are on the port



Only cluster and data LIFs are displayed when filtering using the “network interfaces on this port” option. No intercluster LIFs are shown.

The Port/Performance Explorer page enables you to:

- View threshold-related issues and their details
- Track and compare port performance data
- Investigate and troubleshoot threshold-related issues
- Investigate and troubleshoot performance issues

## Cluster/Performance Information page

Use the Cluster/Performance Information page to view a list of the physical and logical attributes of the cluster. This information might help in answering performance-related questions.

### Cluster attributes

- **Management Network Interface**

The name of the cluster management LIF, and whether the LIF is currently available (Up), or not (Down).

- **IP Address**

The IPv4 or IPv6 address of the cluster management LIF.

- **FQDN**

The fully qualified domain name (FQDN) of the cluster management LIF.

- **OS Version**

The version of ONTAP software installed on the cluster.



If different versions of ONTAP software are installed on the nodes in the cluster, the listed version is the lowest version number. Check the Node/Performance Information page to view the version of ONTAP software installed on each node.

- **Serial Number**

The unique identification number of the cluster.

- **Model / Family**

The platform model number and model family of all the nodes in the cluster.

- **Capacity (free/total)**

The total storage available to the cluster, in gigabytes, and the amount of storage currently available.

- **Logical Space Used**

The real size of the data that is being stored on this aggregates of this cluster without applying the savings from using ONTAP storage efficiency technologies.

- **Allowed Protocols**

The list of all protocols that can be serviced by this cluster. The available protocols are FC/FCoE, iSCSI, HTTP, NVMe, NDMP, NFS, and CIFS.

- **Nodes**

The number of nodes in this cluster. You can click the number to display the nodes in the Performance/Nodes Inventory page.

- **Storage VM**

The number of SVMs in this cluster. You can click the number to display the SVMs in the Performance/Storage VMs Inventory page.

- **Network Interfaces**

The number of LIFs in this cluster. You can click the number to display the LIFs in the Performance/LIFs Inventory page.

- **Contact / Location**

If available, the name of the storage administrator to contact regarding this cluster, and the location of the cluster.

## Node/Performance Information page

Use the Node/Performance Information page to view a list of the physical and logical attributes of the node. This information might help in answering performance-related questions.

### Node attributes

- **IP Address**

The IPv4 or IPv6 address of the node management LIF.

- **FQDN**

The fully qualified domain name (FQDN) of the node management LIF.

- **OS Version**

The version of ONTAP software installed on the node.

- **Model / Family**

The platform model number of the node.

- **Capacity (free/total)**

The total storage available to the node, in gigabytes, and the amount of storage currently available.

- **Cluster**

The name of the cluster to which this node belongs. You can click the name to display cluster details the Cluster/Performance Explorer page.

- **HA Partner**

The name of the HA partner node, if applicable. You can click the name to display partner node details in the Node/Performance Explorer page.

- **Aggregates**

The number of aggregates on this node. You can click the number to display the aggregates in the Performance/Aggregates Inventory page.



The number listed here may not match the number in the Performance/Aggregates Inventory page because the inventory page does not include root aggregates.

- **Ports**

The number of ports on this node. You can click the number to display the ports in the Performance/Ports Inventory page.



The number listed here may not match the number in the Performance/Ports Inventory page because the inventory page does not include node management ports.

- **Contact / Location**

If available, the name of the administrator to contact regarding this node, and the location of the node.

- **# of Cores / Speed**

If available, the number of CPU cores on the controller, and the speed of the CPU cores.

- **RAM**

If available, the total memory available on the controller.

## Flash Devices



Flash Cache data is displayed only for nodes, and only when a Flash Cache module is installed in the node.

- **Slot Number**

The slot number in which the Flash Cache module is installed.

- **Status**

The operational status of the module. Valid values:

- Online
- Offline\_failed
- Offline\_threshold

- **Model / Family**

The model number of the module.

- **Firmware Rev**

The version of firmware installed on the module.

- **Capacity**

The size of the installed Flash Cache module.

## Aggregate/Performance Information page

Use the Aggregate/Performance Information page to view a list of the physical and logical attributes of the aggregate. This information might help in answering performance-related questions.

### Aggregate attributes

- **Type**

The type of aggregate:

- HDD
- Hybrid

Combines HDDs and SSDs, but Flash Pool has not been enabled.

- Hybrid (Flash Pool)

Combines HDDs and SSDs, and Flash Pool has been enabled.

- SSD
- SSD (FabricPool)

Combines SSDs and a cloud tier

- HDD (FabricPool)

Combines HDDs and a cloud tier

- VMDisk (SDS)

Virtual disks within a virtual machine

- VMDisk (FabricPool)

Combines virtual disks and a cloud tier

- LUN (FlexArray)

- **Cluster**

The name of the cluster to which the aggregate belongs. You can click the name to display cluster details in the Cluster/Performance Explorer page.

- **Node**

The name of the node to which the disks of the aggregate belong. You can click the name to display node details in the Node/Performance Explorer page.

- **Flash Pool**

Whether this is a Flash Pool aggregate: Yes or No.

A Flash Pool aggregate is a hybrid aggregate that consists of both SSDs and HDDs.

- **FabricPool**

Whether this is a FabricPool aggregate: Yes or No.

A FabricPool aggregate is an aggregate that consists of either SSDs and a cloud tier, or HDDs and a cloud tier (starting with ONTAP 9.8).

- **Inactive Data Reporting**

Whether the inactive data reporting capability is enabled or disabled on this aggregate. When enabled, volumes on this aggregate display the amount of cold data in the Performance/Volumes inventory page.

The value in this field is “N/A” when the version of ONTAP does not support inactive data reporting.

- **Logical Space Used**

The real size of the data that is being stored on this aggregate without applying the savings from using ONTAP storage efficiency technologies.

## Storage VM/Performance Information page

Use the Storage VM/Performance Information page to view a list of the configured attributes of the SVM. This information might help in answering performance-related questions.

### Storage VM attributes

- **IP Address**

The IPv4 or IPv6 addresses of all interfaces connected to this SVM.

- **IPspace**

The IPspace in which this SVM resides.

- **Domain Name**



The fully qualified domain names (FQDNs) of the interfaces connected to this SVM.

- **Service Type**

The type of SVM.

Possible values include: “Admin” for the cluster-wide management SVM, “System” for cluster-level communications in an IPspace, “Data” for data serving SVM, and “Node” for node management SVM.

- **Capacity (free/total)**

The total storage available to the SVM, in gigabytes, and the amount of storage currently available.

- **Cluster**

The name of the cluster to which the SVM belongs. You can click the name to display cluster details in the Cluster/Performance Explorer page.

- **Volumes**

The number of volumes in the SVM. You can click the number to display the volumes in the Performance/Volumes Inventory page.

- **Network Interfaces**

The number of network interfaces available to the SVM.

- **Data Network Interfaces**

The number and type of Data network interfaces available to the SVM.

- **Allowed Volume Type**

The type of volume that can be created on the SVM.

SVMs can contain one or more FlexVol volumes or FlexGroup volumes.

- **Allowed Protocols**

The list of all protocols that can be serviced by this SVM. The available protocols are FC/FCoE, iSCSI, HTTP, NDMP, NVMe, NFS, and CIFS.

- **Port Set**

If defined for FCP or iSCSI protocols, the port set that is assigned to this SVM.

## **Volume/Performance Information page**

Use this page to view a list of the physical and logical attributes of the volume. This information might help in answering performance-related questions. The title of this page depends on whether you are viewing a FlexVol volume or a FlexGroup volume.

## Volume attributes

- **Type**

The volume's type; either read-write (RW) or data-protection (DP).

- **Style**

The style of volume; either FlexVol or FlexGroup.

- **Cluster**

The name of the cluster to which this FlexVol volume or FlexGroup volume belongs. You can click the name to display cluster details in the Cluster/Performance Explorer page.

- **Aggregates**

The name of the aggregate on which this FlexVol volume resides, or the number of aggregates on which this FlexGroup volume resides.

For FlexVol volumes, you can click the name to display aggregate details in the Aggregate/Performance Explorer page. For FlexGroup volumes, you can click the number to display the aggregates that are used in this FlexGroup volume in the Performance/Aggregates Inventory page.

- **Storage VM**

The name of the SVM to which this FlexVol volume or FlexGroup volume belongs. You can click the name to display SVM details in the Storage VM/Performance Explorer page.

- **Tiering Policy**

The tiering policy set on the volume. The policy takes affect only when the volume is deployed on a FabricPool aggregate. The available policies are:

- None. The data for this volume always remains on the performance tier.
- Snapshot Only. Only Snapshot data is moved automatically to the cloud tier. All other data remains on the performance tier.
- Backup. On data protection volumes, all transferred user data starts in the cloud tier, but later client reads can cause hot data to move to the performance tier.
- Auto. Data on this volume is moved between the performance tier and the cloud tier automatically when ONTAP determines that the data is "hot" or "cold".
- All. The data for this volume always remains on the cloud tier.

- **RAID Type**

The redundancy type that is being used on the performance tier of the aggregate where this volume resides. Possible types:

- RAID0
- RAID4
- RAID-DP
- RAID-TEC



The value “Not Applicable” is displayed for FlexGroup volumes because the constituent volumes can be on aggregates of different RAID types.

- **Capacity (free/total)**

The total storage available on the volume, in gigabytes, and the amount of storage currently available.

- **Logical Space Used**

The real size of the data that is being stored on this volume without applying the savings from using ONTAP storage efficiency technologies.

## Constituent Volume/Performance Information page

Use the Constituent Volume/Performance Information page to view a list of the physical and logical attributes of the FlexGroup constituent volume. This information might help in answering performance-related questions.

### Constituent Volume attributes

- **Type**

The constituent's type; either read-write (RW) or data-protection (DP).

- **Style**

The style of volume; this is a constituent volume of a FlexGroup volume.

- **Cluster**

The name of the cluster to which this FlexGroup constituent volume belongs. You can click the name to display cluster details in the Cluster/Performance Explorer page.

- **Aggregate**

The name of the aggregate on which this FlexGroup constituent volume resides. You can click the name to display aggregate details in the Aggregate/Performance Explorer page.

- **FlexGroup**

The name of the FlexGroup volume to which this constituent belongs. You can click the name to display FlexGroup volume details in the Constituent Volume/Performance Explorer page.

- **Storage VM**

The name of the SVM to which this FlexGroup constituent volume belongs. You can click the name to display SVM details in the Performance/SVM Explorer page.

- **Tiering Policy**

The tiering policy set on the volume. The policy takes affect only when the volume is deployed on a FabricPool aggregate. The available policies are:

- None. The data for this volume always remains on the performance tier.
- Snapshot Only. Only Snapshot data is moved automatically to the cloud tier. All other data remains on the performance tier.
- Backup. On data protection volumes, all transferred user data starts in the cloud tier, but later client reads can cause hot data to move to the performance tier.
- Auto. Data on this volume is moved between the performance tier and the cloud tier automatically when ONTAP determines that the data is “hot” or “cold”.
- All. The data for this volume always remains on the cloud tier.

- **RAID Type**

The redundancy type that is being used on the aggregate where this constituent resides. Possible types:

- RAID0
- RAID4
- RAID-DP
- RAID-TEC

- **Capacity (free/total)**

The total storage available on the constituent, in gigabytes, and the amount of storage currently available.

## LUN/Performance Information page

Use the LUN/Performance Information page to view a list of the physical and logical attributes of the LUN. This information might help in answering performance-related questions.

### LUN attributes

- **WWN**

The WWN (World Wide Name) of the LUN.

- **Path**

The full path of the LUN, for example, /vol/vol1/lun1.

- **Alignment**

Indicates the alignment state of the LUN. Possible values:

- Not mapped
- Aligned
- Misaligned
- Possibly misaligned
- Indeterminate

- **Capacity (free/total)**

The total storage available on the LUN, in gigabytes, and the amount of storage currently available.

- **Volume**

The name of the volume to which the LUN belongs. You can click the name to display volume details in the Volume/Performance Explorer page.

- **Storage VM**

The name of the SVM to which the LUN belongs. You can click the name to display SVM details in the Storage VM/Performance Explorer page.

- **Node**

The name of the node on which the LUN resides. You can click the name to display node details in the Node/Performance Explorer page.

- **Cluster**

The name of the cluster to which the LUN belongs. You can click the name to display cluster details in the Cluster/Performance Explorer page.

- **State**

The state of the LUN. Valid states can be online, offline, nvfail, space-error, and foreign-lun-error.

- **Mapped**

Whether the LUN is mapped to an initiator group (true), or not (false).

## **NVMe Namespace/Performance Information page**

Use the NVMe Namespace/Performance Information page to view a list of the physical and logical attributes of the Namespace. This information might help in answering performance-related questions.

### **NVMe Namespace attributes**

- **Cluster**

The name of the cluster to which the Namespace belongs. You can click the name to display cluster details in the Cluster/Performance Explorer page.

- **Capacity (free/total)**

The total storage capacity of the Namespace and the amount of storage currently available.

- **Node**

The name of the node on which the Namespace resides. You can click the name to display node details in the Node/Performance Explorer page.

- **Path**

The full path of the NVMe Namespace, for example, `/vol/vol1/namespace1`.

- **State**

The state of the Namespace. Valid states can be online, offline, nvfail, and space-error.

- **Subsystem**

The subsystem of the Namespace.

- **Storage VM**

The name of the SVM to which the Namespace belongs. You can click the name to display SVM details in the Storage VM/Performance Explorer page.

- **Volume**

The name of the volume to which the Namespace belongs. You can click the name to display volume details in the Volume/Performance Explorer page.

## Network Interface/Performance Information page

Use the Network Interface/Performance Information page to view a list of the configured attributes of the network interface (LIF). This information might help in answering performance-related questions.

### Network Interface attributes

- **IP Address**

The IPv4 or IPv6 address assigned to the LIF. There can be multiple IP addresses assigned to a LIF.

- **Role**

The role determines the kind of traffic that is supported over the LIF.

LIFs can have one of the following roles:

- Data
- Cluster
- Node Management
- Intercluster

- **Failover Group**

The name of the failover group that is assigned to the network interface.

This field applies only to network LIFs, not to SAN (FC/ISCSI) and NVMe LIFs.

- **Failover Policy**

The name of the failover policy that is assigned to the LIF.

This field applies only to network LIFs, not to SAN (FC/ISCSI) and NVMe LIFs.

- **Home Port**

The name of the node and port that has been defined as the home port for this interface. You can click the name to display port details in the Port/Performance Explorer page.

- **Current Port**

The name of the node and port on which the interface is currently hosted. You can click the name to display port details in the Port/Performance Explorer page.

## Port/Performance Information page

Use the Port/Performance Information page to view a list of the physical and logical attributes of the port. This information might help in answering performance-related questions.

### Port attributes

- **WWN**

The WWN (World Wide Name) of the port.

- **Node**

The name of the node on which the physical port resides. You can click the name to display node details in the Node/Performance Explorer page.

- **Cluster**

The name of the cluster to which the port belongs. You can click the name to display cluster details the Cluster/Performance Explorer page.

- **Operational Speed**

The actual speed at which the port is configured to run.

FCP ports are auto-sensing and display as “Auto”.

- **Role**

The network port function: either Data or Cluster.

FCP ports cannot have a role, and this field is not displayed.

- **Type**

The port type: either Network or FCP (Fibre Channel Protocol).

- **State**

The link status of the port.

- For network ports, an active port is listed as “Up” and an inactive port is listed as “Down”.
- For FCP ports, an active port is listed as “Online” and an inactive port is listed as “Link not connected”.



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