Performance metrics

Contents

Performance metrics

Tivoli® Storage Productivity Center can collect information about the performance of monitored storage systems and switches. This information includes metrics that measure the performance of volumes, ports, and disks.

You can view performance metrics in the web-based GUI and stand-alone GUI at the following locations:

Resource pages in the web-based GUI
To access a view of performance metrics for a resource, go to the following pages in the web-based GUI:

- Server details page > Related Resources
- Storage systems page, Storage system details page
- Switches page, Switch details page

Reports in the web-based GUI
To view detailed performance reports for multiple resources in the web-based GUI, hover the mouse pointer over **Reporting** in the navigation pane and select an option.

Reports in the stand-alone GUI
To view detailed performance reports for multiple resources in the stand-alone GUI, run the reports that are available under the following nodes in the navigation tree:

- **Disk Manager** > **Reporting**
- **Fabric Manager** > **Reporting**
- **Tivoli Storage Productivity Center** > **System Reports**

Common information

The following table contains information that is common to performance reports in the stand-alone GUI.

Column	Description
Time	Date and time that the data was collected
Interval	Size of the sample interval in seconds. You can specify a minimum interval length of 5 minutes and a maximum interval length of 60 minutes for the following storage systems: • TotalStorage Enterprise Storage Server® • DS6000™ • DS8000® • XIV® system For SAN Volume Controller models earlier than V4.1, you can specify a minimum interval length of 15 minutes and a maximum interval length of 60 minutes. For SAN Volume Controller models V4.1 and later, you can specify a minimum interval length of 5 minutes, and a maximum interval length of 60 minutes.

Metrics for ESS and DS6000 and DS8000 storage systems

When you view metrics for the ESS and DS6000 and DS8000 storage systems, you must take into account the following differences between IBM® Tivoli Storage Productivity Center reports and the native reports of those systems:

- Tivoli Storage Productivity Center reports display port performance metrics as send and receive metrics, such as Send Data Rate and Receive Data Rate.
- Reports that are included with storage systems (for example, reports based on data that is collected by the DS CLI) display port performance metrics as read and write metrics, such as Byteread and Bytewrite.

When a host runs a read operation, the DS port sends data to the host. Therefore, "read" metrics in DS6000 and DS8000 reports correspond to "send" metrics in Tivoli Storage Productivity Center reports. When a host runs a write operation, DS6000 and DS8000 ports receive data from the host. Therefore, "write" metrics in DS6000 and DS8000 reports correspond to "receive" metrics in Tivoli Storage Productivity Center reports. When you view port Peer-to-Peer Remote Copy (PPRC) performance metrics, you must take into account the following additional differences between Tivoli Storage Productivity Center reports and native reports for storage systems:

- Metrics for PPRC reads in storage system native reports are represented as PPRC receives in Tivoli Storage Productivity Center (reads = receives).
- Metrics for PPRC writes in storage system native reports are represented as PPRC sends in Tivoli Storage Productivity Center (writes = sends).

Restriction: Tivoli Storage Productivity Center does not calculate volume-based metrics if thin-provisioned volumes are allocated in an extent pool that consists of multiple ranks. In this case, the columns for volume-based metrics display the value **N/A** in the Storage Subsystem Performance > By Array report for the arrays that are associated with that extent pool. However, if no thin-provisioned volumes are allocated in a multi-rank extent pool, or if the space efficient volumes are allocated in an extent pool that consists of a single rank, then this limitation does not apply and all volume-based metrics are displayed in the By Array report.

Metrics for XIV systems

To distinguish between metrics that were introduced in different versions of the XIV systems, the following conventions are used:

- [2] is displayed next to metrics that are available in the XIV system version 10.2.2 or later.
- [3] is displayed next to metrics that are available in the XIV system version 10.2.4 or later.

For example:

- The Read I/O Rate (overall) metric is available for the XIV systems version 10.2.2 and later. In the Resources: components column of the list of metrics, the entry for Read I/O Rate (overall) is displayed like this example: XIV[2]: volume, module, storage system
- The Small Transfers Response Time metric is available for the XIV systems version 10.2.4 and later. In the Resources: components column of the list of metrics, the entry for Small Transfers Response Time is displayed in the following format: XIV[3]: volume, module, storage system

Restriction: XIV systems do not track performance statistics for volumes that were never used. Because there are no performance statistics, Tivoli Storage Productivity Center does not display metrics for these volumes and their related components.

Metrics for SAN Volume Controller

Metrics that apply to SAN Volume Controller also apply to Storwize® V3500, Storwize V3700, Storwize V7000, and Storwize V7000 Unified. For example, the Read I/O Rate (overall) metric is available for SAN Volume Controller and Storwize storage system volumes, even though only SAN Volume Controller is shown in the Resources: components column of the following lists.

Volume metrics

The following metrics are available for the volumes in storage systems.

Metric	Resources: components[1]	Description
I/O Rates		
Read I/O Rate (normal)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of I/O operations per second for nonsequential read operations for a component over a specified time interval.
Read I/O rate (sequential)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of I/O operations per second for sequential read operations for a component over a specified time interval.
Read I/O Rate (overall)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller[1]: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of I/O operations per second for both sequential and nonsequential read operations for a component over a specified time interval.
Write I/O Rate (normal)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of I/O operations per second for nonsequential write operations for a component over a specified time interval.

Metric	Resources: components[1]	Description
Write I/O Rate (sequential)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of I/O operations per second for sequential write operations for a component over a specified time interval.
Write I/O Rate (overall)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of I/O operations per second for both sequential and nonsequential write operations for a component over a specified time interval.
Total I/O Rate (normal)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of I/O operations per second for nonsequential read and write operations for a component over a specified time interval.
Total I/O Rate (sequential)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of I/O operations per second for sequential read and write operations for a component over a specified time interval.
Total I/O Rate (overall)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of I/O operations per second for both sequential and nonsequential read and write operations for a component over a specified time interval.
Global Mirror Write I/O Rate	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of write operations per second issued to the Global Mirror secondary site for a component over a specified time interval.

Metric	Resources: components[1]	Description
Global Mirror Overlapping Write Percentage	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average percentage of write operations that are issued by the Global Mirror primary site and are serialized overlapping writes for a component over a specified time interval. For SAN Volume Controller 4.3.1 and later, some overlapping writes are processed in parallel (are not serialized) and are excluded. For earlier versions of SAN Volume Controller, all overlapping writes were serialized.
Global Mirror Overlapping Write I/O Rate	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of serialized overlapping write operations per second encountered by the Global Mirror primary site for a component over a specified time interval. For SAN Volume Controller 4.3.1 and later, some overlapping writes are processed in parallel (are not serialized) and are excluded. For earlier versions of SAN Volume Controller, all overlapping writes are serialized.
HPF Read I/O Rate	DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of read operations per second that were issued by the High Performance FICON® (HPF) feature of the storage system for a component over a specified time interval.
HPF Write I/O Rate	DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of write operations per second that were issued by the High Performance FICON (HPF) feature of the storage system for a component over a specified time interval.
Total HPF I/O Rate	DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of read and write operations per second that were issued by the High Performance FICON (HPF) feature of the storage system for a component over a specified time interval.
HPF I/O Percentage	DS8000: volume, RAID array, pool, controller, host connection, storage system	The percentage of all I/O operations that were issued by the High Performance FICON (HPF) feature of the storage system for a component over a specified time interval.
PPRC Transfer Rate	ESS/DS6000/DS8000: volume, RAID array, pool, controller, host connection, storage system	Average number of track transfer operations per second for PPRC usage for a component over a specified time interval. This metric shows the activity for the source of the PPRC relationship, but shows no activity for the target.
Small Transfers I/O Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of I/O operations over a specified interval. Applies to data transfer sizes that are <= 8 KB.
Medium Transfers I/O Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of I/O operations over a specified interval. Applies to data transfer sizes that are > 8 KB and <= 64 KB.
Large Transfers I/O Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of I/O operations over a specified interval. Applies to data transfer sizes that are > 64 KB and <= 512 KB.
Very Large Transfers I/O Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of I/O operations over a specified interval. Applies to data transfer sizes that are > 512 KB.
Cache hit percentages		

Metric	Resources: components[1]	Description
Read Cache Hits Percentage (normal)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Percentage of cache hits for nonsequential read operations for a component over a specified time interval.
Read Cache Hits Percentage (sequential)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Percentage of cache hits for sequential read operations for a component over a specified time interval.
Read Cache Hits Percentage (overall)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[1]: volume, pool, module, host connection, storage system	Percentage of cache hits for both sequential and nonsequential read operations for a component over a specified time interval.
Write Cache Hits Percentage (normal)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Percentage of cache hits for nonsequential write operations for a component over a specified time interval.
Write Cache Hits Percentage (sequential)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Percentage of cache hits for sequential write operations for a component over a specified time interval.
Write Cache Hits Percentage (overall)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Percentage of cache hits for both sequential and nonsequential write operations for a component over a specified time interval.

Metric	Resources: components[1]	Description
Total Cache Hits Percentage (normal)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Percentage of cache hits for nonsequential read and write operations for a component over a specified time interval.
Total Cache Hits Percentage (sequential)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system	Percentage of cache hits for sequential read and write operations for a component over a specified time interval.
Total Cache Hits Percentage (overall)	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV: volume, pool, module, host connection, storage system	Percentage of cache hits for both sequential and nonsequential read and write operations for a component over a specified time interval.
Readahead Percentage of Cache Hits	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Percentage of all read cache hits, which occurred on prestaged data.
Dirty Write Percentage of Cache Hits	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Percentage of all write cache hits, which occurred on already dirty data in the cache.
Read Data Cache Hit Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of read data that was read from the cache over a specified time interval.
Write Data Cache Hit Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of write data that was written to the cache over a specified time interval.
Total Data Cache Hit Percentage	XIV[3]: module, pool, volume, host connection, storage system	Percentage of all data that was read from or written to the cache for a component over a specified time interval.

Metric	Resources: components[1]	Description
SSD Read Cache Hit Percentage	XIV[3]: module, pool, volume, host connection, storage system	The percentage of all read operations for a component that accessed SSD cache memory during a specified time interval. This metric is only available for XIV systems that use SSD drives as an additional layer of caching. The value for this metric is also included in the value for the Read Cache Hit Percentage (overall) metric.
SSD Read Data Cache Hit Percentage	XIV[3]: module, pool, volume, host connection, storage system	The percentage of all read data for a component that was read from SSD cache memory during a specified time interval. This metric is only available for XIV systems that use SSD drives as an additional layer of caching. The value for this metric is also included in the value for the Read Data Cache Hit Percentage (overall) metric.
Data rates		
Read Data Rate	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of megabytes (2^20 bytes) per second that were transferred for read operations for a component over a specified time interval.
Write Data Rate	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of megabytes (2^20 bytes) per second that were transferred for write operations for a component over a specified time interval.

Metric	Resources: components[1]	Description
Total Data Rate	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: controller, volume, storage system XIV[2]: module, pool, volume, host connection, storage system	Average number of megabytes (2^20 bytes) per second that were transferred for read and write operations for a component over a specified time interval.
Small Transfers Data Percentage	XIV[3]: module, volume, host connection, storage system	Percentage of data that was transferred over a specified interval. Applies to I/O operations with data transfer sizes that are <= 8 KB.
Medium Transfers Data Percentage	XIV[3]: module, volume, host connection, storage system	Percentage of data that was transferred over a specified interval. Applies to I/O operations with data transfer sizes that are > 8 KB and <= 64 KB.
Large Transfers Data Percentage	XIV[3]: module, volume, host connection, storage system	Percentage of data that was transferred over a specified interval. Applies to I/O operations with data transfer sizes that are > 64 KB and <= 512 KB.
Very Large Transfers Data	XIV[3]: module, volume, host connection, storage system	Percentage of data that was transferred over a specified interval. Applies to I/O operations with data transfer sizes that are > 512 KB.
Response times		
Read Response Time	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of milliseconds that it took to service each read operation for a component over a specified time interval.

Metric	Resources: components[1]	Description
Write Response Time	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of milliseconds that it took to service each write operation for a component over a specified time interval.
Overall Response Time	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of milliseconds that it took to service each I/O operation (read and write) for a component over a specified time interval.
Peak Read Response Time	SAN Volume Controller: volume, node, I/O group, host connection, storage system	The peak (worst) response time among all read operations.
Peak Write Response Time	SAN Volume Controller: volume, node, I/O group, host connection, storage system	The peak (worst) response time among all write operations.
Global Mirror Write Secondary Lag	SAN Volume Controller: volume, node, I/O group, host connection, storage system	The average number of additional milliseconds it takes to service each secondary write operation for Global Mirror, beyond the time that is required to service primary writes.

Metric	Resources: components[1]	Description
Overall Host Attributed Response Time Percentage	SAN Volume Controller: volume, node, I/O group, host connection, storage system	The percentage of the average response time, both read response time and write response time, that can be attributed to delays from host systems. This metric is provided to help diagnose slow hosts and poorly performing fabrics. The value is based on the time that is taken for hosts to respond to transfer-ready notifications from the SAN Volume Controller nodes (for read) and the time that is taken for hosts to send the write data after the node responds to a transfer-ready notification (for write).
Read Cache Hit Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each read cache hit operation over a specified time interval.
Write Cache Hit Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each write cache hit operation over a specified time interval.
Overall Cache Hit Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each read cache hit operation and each write cache hit operation over a specified time interval.
Read Cache Miss Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each read cache miss operation over a specified time interval.
Write Cache Miss Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each write cache miss operation over a specified time interval.
Overall Cache Miss Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each read cache miss operation and each write cache miss operation over a specified time interval.
Small Transfers Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each I/O operation. Applies to data transfer sizes that are <= 8 KB.
Medium Transfers Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each I/O operation. Applies to data transfer sizes that are > 8 KB and <= 64 KB.
Large Transfers Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each I/O operation. Applies to data transfer sizes that are > 64 KB and <= 512 KB.
Very Large Transfers Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that it takes to service each I/O operation. Applies to data transfer sizes that are > 512 KB.

Metric	Resources: components[1]	Description
SSD Read Cache Hit Response Time	XIV[3]: volume, pool, module, host connection, storage system	Average number of milliseconds that was required to service each hit operation of SSD read memory for a component over a specified time interval. This metric is only available for XIV systems that use SSD drives as an additional layer of caching. The value for this metric is also included in the value for the Read Cache Hit Response Time metric.
Transfer sizes		
Read Transfer Size	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of KB per I/O for read operations.
Write Transfer Size	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of KB per I/O for write operations.

Metric	Resources: components[1]	Description
Overall Transfer Size	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, pool, node, I/O group, host connection, storage system SMI-S BSP: volume, controller, storage system XIV[2]: volume, pool, module, host connection, storage system	Average number of KB per I/O for read and write operations.
Write-cache constraints		
Write-Cache Delay Percentage	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, node, I/O group, host connection, storage system	Percentage of I/O operations that were delayed because of write-cache space constraints or other conditions for a component over a specified time interval. (The ratio of delayed operations to total I/Os.)
Write-Cache Delay I/O Rate	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection, storage system SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of I/O operations per second that were delayed because of write-cache space constraints or other conditions for a component over a specified time interval.
Write-Cache Overflow Percentage	SAN Volume Controller: volume, node, I/O group, host connection, storage system	The percentage of write operations that are delayed because there is not enough space in the write cache for a component over a specified time interval.
Write-Cache Overflow I/O Rate	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of write operations per second that are delayed because there is not enough space in the write cache for a component over a specified time interval.
Write-Cache Flush-through Percentage	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Percentage of tracks that is written to disk in flush-through mode for a component over a specified time interval.
Write-Cache Flush-through I/O Rate	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of tracks per second that are written to disk in flush-through mode for a component over a specified time interval.

Metric	Resources: components[1]	Description
Write-Cache Write-through Percentage	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Percentage of tracks that is written to disk in write-through mode for a component over a specified time interval.
Write-Cache Write-through I/O Rate	SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of tracks per second that are written to disk in write-through mode for a component over a specified time interval.
Record mode reads		
Record Mode Read I/O Rate	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection	Average number of I/O operations per second for record mode read operations for a component over a specified time interval.
Record Mode Read Cache Hit Percentage	ESS, DS6000, DS8000: volume, RAID array, pool, controller, host connection	Percentage of cache hits for record mode read operations for a component over a specified time interval.
Cache transfers		
Disk to Cache I/O Rate	ESS/DS6000/DS8000: volume, RAID array, pool, controller, host connection SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of I/O operations (track transfers) per second for disk to cache transfers for a component over a specified time interval.
Cache to Disk I/O Rate	ESS/DS6000/DS8000: volume, RAID array, pool, controller, host connection SAN Volume Controller: volume, node, I/O group, host connection, storage system	Average number of I/O operations (track transfers) per second for cache to disk transfers for a component over a specified time interval.
Miscellaneous computed values		
Cache Holding Time	ESS, DS6000, DS8000: controller, storage system	Average cache holding time, in seconds, for I/O data in this storage system controller (cluster). Shorter time periods indicate adverse performance.
CPU Utilization	SAN Volume Controller: node, I/O group, storage system	Average utilization percentage of the processors.
Non-Preferred Node Usage Percentage	SAN Volume Controller: volume, I/O group, host connection	The overall percentage of I/O performed or data transferred through the non-preferred nodes of the volumes, for a component over a specified time interval.

Metric	Resources: components[1]	Description
Volume Utilization	ESS, DS6000, DS8000: volume SAN Volume Controller: volume SMI-S BSP: volume XIV[2]: volume	The approximate utilization percentage of a volume over a specified time interval (the average percent of time that the volume was busy).
Pool Utilization	DS6000, DS8000: pool SAN Volume Controller: pool XIV[2]: pool	The approximate utilization percentage for the most active pools in the storage system. This utilization metric represents the average percent of time that a pool was busy. The value is based on an estimate of the workload for resources such as controllers, device adapters, volumes, and hard disks.
Important: • [1] The "Resource: components" column shows the resources and components that are measured by a metric. Metrics that apply to SAN Volume Controller also apply to Storwize V3500, Storwize V3700, Storwize V7000, and Storwize V7000 Unified. • [2] This metric is available in the XIV system version 10.2.2 or later. • [3] This metric is available in the XIV system version 10.2.4 or later.		

Disk metrics

The following table describes the metrics for the disks on storage systems.

Column	Resources: components[1]	Description
I/O rates		
Backend Read I/O Rate	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller[1]: volume, pool, node, I/O group, storage system	Average number of I/O operations per second for read operations.
Backend Write I/O Rate	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: volume, pool, node, I/O group, storage system	Average number of I/O operations per second for write operations.

Column	Resources: components[1]	Description
Total Backend I/O Rate	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: volume, pool, node, I/O group, storage system	Average number of I/O operations per second for read and write operations.
Data rates		
Backend Read Data Rate	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of megabytes (2^20 bytes) that were transferred for read operations.
Backend Write Data Rate	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of megabytes (2^20 bytes) that were transferred for write operations.
Total Backend Data Rate	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of megabytes (2^20 bytes) that were transferred for read and write operations.
Response times		
Backend Read Response Time	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of milliseconds that it took to respond to each read operation. For SAN Volume Controller models, this time is the external response time of the managed disks (MDisks).
Backend Write Response Time	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of milliseconds that it took to respond to each write operation. For SAN Volume Controller models, this time is the external response time of the managed disks (MDisks).

Column	Resources: components[1]	Description
Overall Backend Response Time	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of milliseconds that it took to respond to each I/O operation (read and write). For SAN Volume Controller models, this time is the external response time of the managed disks (MDisks).
Backend Read Queue Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of milliseconds that each read operation was in the queue before it was issued to the back-end resource.
Backend Write Queue Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of milliseconds that each write operation was in the queue before it was issued to the back-end resource.
Overall Backend Queue Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of milliseconds that read and write operations were in the queue before they were issued to the back-end resource.
Peak Back-end Read Response Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	The peak (worst) response time among all read operations for a component over a specified time interval. For SAN Volume Controller, it represents the external response time of the managed disks.
Peak Back-end Write Response Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	The peak (worst) response time among all write operations for a component over a specified time interval. For SAN Volume Controller, it represents the external response time of the managed disks.
Peak Back-end Read Queue Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	The lower bound on the peak (worst) queue time for read operations for a component over a specified time interval. The queue time is the amount of time that the read operation was in the queue before it was issued to the back-end resource.
Peak Back-end Write Queue Time	SAN Volume Controller: managed disk, pool, node, I/O group, storage system	The lower bound on the peak (worst) queue time for write operations for a component over a specified time interval. The queue time is the amount of time that the write operation was in the queue before it was issued to the back-end resource.
Transfer sizes		
Back-end Read Transfer Size	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of KB per I/O for read operations for a component over a specified time interval.

Column	Resources: components[1]	Description
Back-end Write Transfer Size	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of KB per I/O for write operations for a component over a specified time interval.
Overall Back-end Transfer Size	ESS, DS6000, DS8000: rank, RAID array, pool, controller, storage system SAN Volume Controller: managed disk, pool, node, I/O group, storage system	Average number of KB per I/O for read and write operations for a component over a specified time interval.
Disk utilization		
Disk Utilization Percentage	ESS, DS6000, DS8000: RAID array	The approximate utilization percentage of a rank over a specified time interval (the average percent of time that the disks associated with the array were busy). **Note:** Tivoli Storage Productivity Center does not calculate a value for this column if there are multiple ranks in the extent pool where thin-provisioned volumes are allocated. This column displays value of **N/A** for the reports in which it is displayed. However, if there is only a single rank in the extent pool, Tivoli Storage Productivity Center does calculate the value for this column regardless of the thin-provisioned volumes.
Sequential I/O Percentage	ESS, DS6000, DS8000: RAID array	Percentage of all I/O operations that were completed for a RAID array over a specified time interval that were sequential operations.
Important: [1] The "Resource: components" column shows the resources and components that are measured by a metric. Metrics that apply to Storwize V3500, Storwize V3700, Storwize V7000, and Storwize V7000 Unified.		

Port metrics

The following table describes the metrics for the ports on storage systems and switches.

Column	Resources: components[1]	Description
I/O or frame rates		
Port Send I/O Rate	ESS, DS6000, DS8000: port, storage system SAN Volume Controller[1]: port, node, I/O group, storage system SMI-S BSP: port XIV[3]: port	Average number of I/O operations per second for send operations for a port over a specified time interval.
Port Receive I/O Rate	ESS, DS6000, DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system SMI-S BSP: port XIV[3]: port	Average number of I/O operations per second for receive operations for a port over a specified time interval.
Total Port I/O Rate	ESS, DS6000, DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system SMI-S BSP: port XIV[3]: port	Average number of I/O operations per second for send and receive operations for a port over a specified time interval.
Port Send Frame Rate	switch port, switch	Average number of frames per second that are sent through the port.
Port Receive Frame Rate	switch port, switch	Average number of frames per second that are received by the port.
Total Port Frame Rate	switch port, switch	Average number of frames per second that are transferred. This value includes frames that are sent and frames that are received by the port.
Port to Host Send I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second sent to host computers by a component over a specified time interval.
Port to Host Receive I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second received from host computers by a component over a specified time interval.
Total Port to Host I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second transmitted between host computers and a component over a specified time interval.

Column	Resources: components[1]	Description
I/O or frame rates		
Port to Disk Send I/O Rate A	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second sent to storage systems by a component over a specified time interval.
Port to Disk Receive I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second received from storage systems by a component over a specified time interval.
Total Port to Disk I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second transmitted between storage systems and a component over a specified time interval.
Port to Local Node Send I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second sent to other nodes in the local SAN Volume Controller cluster by a component over a specified time interval.
Port to Local Node Receive I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second received from other nodes in the local SAN Volume Controller cluster by a component over a specified time interval.
Total Port to Local Node I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second transmitted between other nodes in the local SAN Volume Controller cluster and a component over a specified time interval.
Port to Remote Node Send I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second sent to nodes in the remote SAN Volume Controller cluster by a component over a specified time interval.
Port to Remote Node Receive I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second received from nodes in the remote SAN Volume Controller cluster.
Total Port to Remote Node I/O Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of exchanges (I/Os) per second transmitted between nodes in the remote SAN Volume Controller cluster and a component over a specified time interval.
Port FCP Send I/O Rate	ESS, DS6000, DS8000: port	Average number of send operations per second using the FCP protocol, for a port over a specified time interval.
Port FCP Receive I/O Rate	ESS, DS6000, DS8000: port	Average number of receive operations per second using the FCP protocol for a port over a specified time interval.
Total Port FCP I/O Rate	ESS, DS6000, DS8000: port	Average number of send and receive operations per second using the FCP protocol for a port over a specified time interval.
Port FICON Send I/O Rate	ESS, DS6000, DS8000: port	Average number of send operations per second using the FICON protocol for a port over a specified time interval.

Column	Resources: components[1]	Description
I/O or frame rates		
Port FICON Receive I/O Rate	ESS, DS6000, DS8000: port	Average number of receive operations per second using the FICON protocol for a port over a specified time interval.
Total Port FICON I/O Rate	ESS, DS6000, DS8000: port	Average number of send and receive operations per second using the FICON protocol for a port over a specified time interval.
Port PPRC Send I/O Rate	ESS, DS6000, DS8000:: port, storage system	Average number of send operations per second for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Port PPRC Receive I/O Rate	ESS, DS6000, DS8000: port, storage system	Average number of receive operations per second for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Total Port PPRC I/O Rate	ESS, DS6000, DS8000: port, storage system	Average number of send and receive operations per second for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Data rates		
Port Send Data Rate	ESS, DS6000, DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system SMI-S BSP: port switch port, switch XIV[3]: port	Average number of megabytes (2^20 bytes) per second that were transferred for send (read) operations for a port over a specified time interval.
Port Receive Data Rate	ESS, DS6000, DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system SMI-S BSP: port switch port, switch XIV[3]: port	Average number of megabytes (2^20 bytes) per second that were transferred for receive (write) operations for a port over a specified time interval.
Total Port Data Rate	ESS, DS6000, DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system SMI-S BSP: port switch port, switch XIV[3]: port	Average number of megabytes (2^20 bytes) per second that were transferred for send and receive operations for a port over a specified time interval.

Column	Resources: components[1]	Description
I/O or frame rates		
Port Peak Send Data Rate	switch port	Peak number of megabytes (2^20 bytes) per second that were sent by a port over a specified time interval
Port Peak Receive Data Rate	switch port	Peak number of megabytes (2^20 bytes) per second that were received by a port over a specified time interval.
Port to Host Send Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second sent to host computers by a component over a specified time interval.
Port to Host Receive Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second received from host computers by a component over a specified time interval.
Total Port to Host Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second transmitted between host computers and a component over a specified time interval.
Port to Disk Send Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second sent to storage systems by a component over a specified time interval.
Port to Disk Receive Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second received from storage systems by a component over a specified time interval.
Total Port to Disk Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second transmitted between storage systems and a component over a specified time interval.
Port to Local Node Send Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second sent to other nodes in the local SAN Volume Controller cluster by a component over a specified time interval.
Port to Local nNode Receive Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second received from other nodes in the local SAN Volume Controller cluster by a component over a specified time interval.
Total Port to Local Node Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second transmitted between other nodes in the local SAN Volume Controller cluster and a component over a specified time interval.
Port to Remote Node Send Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second sent to nodes in the remote SAN Volume Controller cluster by a component over a specified time interval.
Port to Remote Node Receive Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second received from nodes in the remote SAN Volume Controller cluster by a component over a specified time interval.

Column	Resources: components[1]	Description
I/O or frame rates		
Total Port to Remote Node Data Rate	SAN Volume Controller: port, node, I/O group, storage system	Average number of megabytes (2^20 bytes) per second transmitted between nodes in the remote SAN Volume Controller cluster and a component over a specified time interval.
Port FCP Send Data Rate	ESS, DS6000, DS8000: port	Average number of megabytes (2^20 bytes) per second sent over the FCP protocol for a port over a specified time interval.
Port FCP Receive Data Rate	ESS, DS6000, DS8000: port	Average number of megabytes (2^20 bytes) per second received over the FCP protocol for a port over a specified time interval.
Total Port FCP Data Rate	ESS, DS6000, DS8000: port	Average number of megabytes (2^20 bytes) per second sent or received over the FCP protocol for a port over a specified time interval.
Port FICON Send Data Rate	ESS, DS6000, DS8000: port	Average number of megabytes (2^20 bytes) per second sent over the FICON protocol for a port over a specified time interval.
Port FICON Receive Data Rate	ESS, DS6000, DS8000: port	Average number of megabytes (2^20 bytes) per second received over the FICON protocol, for a port over a specified time interval.
Total Port FICON Data Rate	ESS, DS6000, DS8000: port	Average number of megabytes (2^20 bytes) per second sent or received over the FICON protocol for a port over a specified time interval.
Port PPRC Send Data Rate	ESS, DS6000, DS8000: port, storage system	Average number of megabytes (2^20 bytes) per second sent for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Port PPRC Receive Data Rate	ESS, DS6000, DS8000: port, storage system	Average number of megabytes (2^20 bytes) per second received for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Total Port PPRC Data Rate	ESS, DS6000, DS8000: port, storage system	Average number of megabytes (2^20 bytes) per second transferred for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Response times		
Port Send Response Time	ESS, DS6000, DS8000: port, storage system XIV[3]: port	Average number of milliseconds that it took to service each send (read) operation for a port over a specified time interval.
Port Receive Response Time	ESS, DS6000, DS8000: port, storage system XIV[3]: port	Average number of milliseconds that it took to service each receive (write) operation for a port over a specified time interval.
Overall Port Response Time	ESS, DS6000, DS8000: port, storage system XIV[3]: port	Average number of milliseconds that it took to service each operation (send and receive) for a port over a specified time interval.
Port to Local Node Send Response Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds it took to service each send operation to another node in the local SAN Volume Controller cluster for a component over a specified time interval. This value is the external response time of the transfers.

Column	Resources: components[1]	Description
I/O or frame rates		
Port to Local Node Receive Response Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds it took to service each receive operation from another node in the local SAN Volume Controller cluster for a component over a specified time interval. This value is the external response time of the transfers.
Total Port to Local Node Response Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds it took to service each send or receive operation between another node in the local SAN Volume Controller cluster and a component over a specified time interval. This value is the external response time of the transfers.
Port to Local Node Send Queued Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds that each send operation issued to another node in the local SAN Volume Controller cluster spent on the queue before being issued for a component over a specified time interval.
Port to Local Node Receive Queued Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds that each receive operation from another node in the local SAN Volume Controller cluster spent on the queue before being issued for a component over a specified time interval.
Total Port to Local Node Queued Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds that each operation issued to another node in the local SAN Volume Controller cluster spent on the queue before being issued for a component over a specified time interval.
Port to Remote Node Send Response Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds it took to service each send operation to a node in the remote SAN Volume Controller cluster for a component over a specified time interval. This is the external response time of the transfers.
Port to Remote Node Receive Response Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds it took to service each receive operation from a node in the remote SAN Volume Controller cluster for a component over a specified time interval. This value is the external response time of the transfers.
Total Port to Remote Node Response Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds it took to service each send or receive operation between a node in the remote SAN Volume Controller cluster and a component over a specified time interval. This value is the external response time of the transfers.
Port to Remote Node Send Queued Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds that each send operation issued to a node in the remote SAN Volume Controller cluster spent on the queue before being issued for a component over a specified time interval.

Column	Resources: components[1]	Description
I/O or frame rates		
Port to Remote Node Receive Queued Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds that each receive operation from a node in the remote SAN Volume Controller cluster spent on the queue before being issued for a component over a specified time interval.
Total Port to Remote Node Queued Time	SAN Volume Controller: node, I/O group, storage system	Average number of milliseconds that each operation issued to a node in the remote SAN Volume Controller cluster spent on the queue before being issued for a component over a specified time interval.
Port FCP Send Response Time	ESS, DS6000, DS8000: port	Average number of milliseconds it took to service all send operations over the FCP protocol for a port over a specified time interval.
Port FCP Receive Response Time	ESS, DS6000, DS8000: port	Average number of milliseconds it took to service all receive operations over the FCP protocol for a port over a specified time interval.
Overall Port FCP Response Time	ESS, DS6000, DS8000: port	Average number of milliseconds it took to service all I/O operations over the FCP protocol for a port over a specified time interval.
Port FICON Send Response Time	ESS, DS6000, DS8000: port	Average number of milliseconds it took to service all send operations over the FICON protocol for a port over a specified time interval.
Port FICON Receive Response Time	ESS, DS6000, DS8000: port	Average number of milliseconds it took to service all receive operations over the FICON protocol for a port over a specified time interval.
Overall Port FICON Response Time	ESS, DS6000, DS8000: port	Average number of milliseconds it took to service all I/O operations over the FICON protocol for a port over a specified time interval.
Port PPRC Send Response Time	ESS, DS6000, DS8000: port, storage system	Average number of milliseconds it took to service all send operations for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Port PPRC Receive Response Time	ESS, DS6000, DS8000: port, storage system	Average number of milliseconds it took to service all receive operations for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Overall Port PPRC Response Time	ESS, DS6000, DS8000: port, storage system	Average number of milliseconds it took to service all I/O operations for Peer-to-Peer Remote Copy usage for a port over a specified time interval.
Transfer sizes		

Column	Resources: components[1]	Description
I/O or frame rates		
Port Send Transfer Size	ESS, DS6000, DS8000: port, storage system SMI-S BSP: port	Average number of KB sent per I/O by a port over a specified time interval.
Port Receive Transfer Size	ESS, DS6000, DS8000: port, storage system SMI-S BSP: port	Average number of KB received per I/O by a port over a specified time interval.
Overall Port Transfer Size	ESS, DS6000, DS8000: port, storage system SMI-S BSP: port	Average number of KB transferred per I/O by a port over a specified time interval.
Port Send Frame Size	switch port, switch	The average size of a frame that is sent out through a port.
Port Receive Frame Size	switch port, switch	The average size of a frame that is received in through a port.
Overall Port Frame Size	switch port, switch	The average frame transfer size. This value includes frames that are sent and frames that are received by a port.
Special computed values		
Port Send Utilization Percentage	ESS, DS6000, DS8000: port	Average amount of time that the port was busy sending data over a specified time interval.
Port Receive Utilization Percentage	ESS, DS6000, DS8000: port	Average amount of time that the port was busy receiving data over a specified time interval.
Overall Port Utilization Percentage	ESS, DS6000, DS8000: port	Average amount of time that the port was busy sending or receiving data over a specified time interval.
Port Send Bandwidth Percentage	ESS, DS8000: port SAN Volume Controller: port switch, port XIV[3]: port	The approximate bandwidth utilization percentage for send operations by a port, based on its current negotiated speed.
Port Receive Bandwidth Percentage	ESS, DS8000: port SAN Volume Controller: port switch, port XIV[3]: port	The approximate bandwidth utilization percentage for receive operations by this port, based on its current negotiated speed.
Overall Port Bandwidth Percentage	ESS, DS8000: port SAN Volume Controller: port switch, port XIV[3]: port	The approximate bandwidth utilization percentage for send and receive operations by this port.

Column	Resources: components[1]	Description
I/O or frame rates		
Error rates		
Error Frame Rate	switch port, switch DS8000: port, storage system	Average number of error frames per second that are received. An error frame is a frame that violates the Fibre Channel Protocol.
Discarded Frame Rate	switch port, switch	Average number of frames per second that are discarded because host buffers are unavailable for the port.
Link Failure Rate	switch port, switch DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system	Number of link errors per second.
Loss of Sync Rate	switch port, switch DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system	Average number of times per second that synchronization is lost. Synchronization is assumed lost after a timeout interval expires.
Loss of Signal Rate	switch port, switch DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system	Average number of times per second that the signal is lost.
CRC Error Rate	switch port, switch DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system	Average number of frames per second that are received in which a cyclic redundancy check (CRC) error is detected. A CRC error is detected when the CRC in the transmitted frame does not match the CRC computed by the receiver.
Short Frame Rate	switch port, switch	Average number of frames that are received per second that are shorter than 28 octets. This number excludes start-of-frame bytes and end-of-frame bytes. The 28 octet limit is calculated based on the assumption that a frame has 24 header bytes, and 4 CRC bytes.

Column	Resources: components[1]	Description
I/O or frame rates		
Long Frame Rate	switch port, switch	Average number of frames that are received per second that are longer than 2140 octets. This number excludes start-of-frame bytes and end-of-frame bytes. The 2140 octet limit is calculated based on the assumption that a frame has 24 header bytes, 4 CRC bytes, and 2112 data bytes.
Encoding Disparity Error Rate	switch port, switch	Average number of disparity errors per second that are received.
Discarded Class 3 Frame Rate	switch port, switch	Average number of class 3 frames per second that are discarded.
Class 3 Send Timeout Frame Rate	switch port, switch	Average number of class 3 frames per second that were discarded before transmission because of a timeout condition. The timeout condition occurred while waiting for buffer credit from the receiving port at the other end of the fibre. When you troubleshoot a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected. Available only for Brocade switches.
Class 3 Receive Timeout Frame Rate	switch port, switch	Average number of class 3 frames per second that were discarded after reception because of a timeout condition. The timeout condition occurred while a transmitting port waited for buffer credit from a port at the other end of the fibre. When you troubleshoot a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected. Available only for Brocade switches.
F-BSY Frame Rate	switch port, switch	Average number of F-BSY frames per second that are generated. An F-BSY frame is issued by the fabric to indicate that a frame cannot be delivered because the fabric or destination N_port is busy.
F-RJT Frame Rate	switch port, switch	Average number of F-RJT frames per second that are generated. An F-RJT frame is issued by the fabric to indicate that delivery of a frame was denied.
Primitive Sequence Protocol Error Rate	switch port, switch DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system	Average number of primitive sequence protocol errors per second that are detected. This error occurs when there is a link failure for a port.

Column	Resources: components[1]	Description
I/O or frame rates		
Invalid Transmission Word Rate	switch port, switch DS8000: port, storage system SAN Volume Controller: port, node, I/O group, storage system	Average number of bit errors per second that are detected. Errors include an 8b10 code violation in one or more characters, a K28.5 in the second, third, or fourth character positions, or an ordered set that had an incorrect Beginning Running Disparity.
Zero Buffer-Buffer Credit Timer	SAN Volume Controller: port, node, I/O group, storage system	Number of microseconds that the port was unable to send frames because of a lack of buffer credit since the last node reset.
Zero Buffer-Buffer Credit Percentage	SAN Volume Controller: port, node, I/O group, storage system	Percentage of sampling time that the port was unable to send frames because of a lack of buffer credit since the last node reset.
Zero Buffer Credit Rate	switch port, switch	Average number of Zero Buffer Credit conditions per second that occurred. A Zero Buffer Credit condition occurs when a port is unable to send frames because of a lack of buffer credit since the last node reset. When you troubleshoot a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected. Available only for Brocade switches.
Link Reset Transmitted Rate	switch port, switch DS8000: port, storage system	Average number of times per second that the port changes from an active (AC) state to a Link Recovery (LR1) state.
Link Reset Received Rate	switch port, switch DS8000: port, storage system	Average number of times per second that the port changes from an active (AC) state to a Link Recovery (LR2) state.
Credit Recovery Link Reset Rate	switch port, switch DS8000: port, storage system	Estimated average number of link resets per second that were performed to recover buffer credits. This estimate attempts to disregard link resets that were caused by link initialization. When troubleshooting a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected.
Out of Order Data Rate	DS8000: port, storage system	Average number of times per second that an out of order frame was detected for a port over a specified time interval.
Out of Order ACK Rate	DS8000: port, storage system	Average number of times per second that an out of order ACK frame was detected for a port over a specified time interval.
Duplicate Frame Rate	DS8000: port, storage system	Average number of times per second that a frame was received and also was detected as previously processed for a port over a specified time interval.

Column	Resources: components[1]	Description
I/O or frame rates		
Invalid Relative Offset Rate	DS8000: port, storage system	Average number of times per second that a frame was received with invalid relative offset in the frame header for a port over a specific time interval.
Sequence Timeout Rate	DS8000: port, storage system	Average number of times per second the port detected a timeout condition on receiving sequence initiative for a Fibre Channel exchange for a port over a specified time interval.
RDY Priority Override Rate	switch port, switch	Average number of times per second that sending R_RDY or VC_RDY signals was a higher priority than sending frames. This condition occurs because of diminishing credit reserves in the transmitter at the other end of the fibre. When you troubleshoot a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected. Available only for Brocade switches.
Port State Change Rate	switch port, switch	Average number of times per second that the state of a port changed to offline, online, or faulty. When you troubleshoot a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected. Available only for Brocade switches.
Port Congestion Index	switch port, switch SAN Volume Controller: port	Estimated degree to which frame transmission was delayed due to a lack of buffer credits. This value is generally between 0 (no congestion) to 100, but can exceed 100 if buffer credit exhaustion persisted for an extended amount of time. When you troubleshoot a SAN, use this metric to view port conditions that might slow the performance of the resources to which those ports are connected.
Bad EOF CRC Error Rate	switch port	The average number of times per second that a cyclic redundancy check (CRC) error is detected in frames with a bad end-of-frame (EOF) indicator. In Brocade fabrics, a bad EOF in a frame can indicate that the frame has a known, previously detected CRC error. A good EOF in a frame with a CRC error indicates that the CRC error was not previously detected.
Link Quality Percentage	switch port	The estimated link quality of the switch port. The percentage is based on whether the port is an expansion port (E_port) or a fabric port (F_port), and on the error statistics for the port.
Invalid Link Transmission Rate	switch port	The average number of times per second that an invalid transmission word was detected by the port while the link did not experience any signal or synchronization loss.
Extreme I/O Concurrency Rate	DS8000: port	The average number of times per second that the port on DS8000 had more than 1500 concurrent I/O operations or exchanges. The number of concurrent I/O operations for a port on DS8000 cannot exceed 2000.

Column	Resources: components[1]	Description
I/O or frame rates		
Extreme I/O Concurrency Percentage	DS8000: port	The average percentage of I/O operations for which the port on DS8000 had more than 1500 concurrent I/O operations or exchanges. The number of concurrent I/O operations for ports on DS8000 cannot exceed 2000.
I/O Busy Rate	DS8000: port	The average number of times per second that the port on DS8000 returned a `SCSI Queue Full` or a `Busy` status to the server. Ports can return these statuses if the number of I/O operations or exchanges exceeds an internal DS8000 threshold.
I/O Busy Percentage	DS8000: port	The average percentage of I/O operations or exchanges for which the port on DS8000 returned a `SCSI Queue Full` or a `Busy` status to the server. Ports can return these statuses if the number of I/O operations exceeds an internal DS8000 threshold.
I/O Overrun Rate	DS8000: port	The average number of times per second that the port on DS8000 had to discard commands because the number of concurrent I/O operations or exchanges for the port exceeded 2000.
I/O Overrun Percentage	DS8000: port	The average percentage of I/O operations that the port on DS8000 had to discard because the number of concurrent I/O operations or exchanges for the port exceeded 2000.
Zero Send Buffer Credit Percentage	DS8000: port	The amount of time, as a percentage, that the port on DS8000 had depleted its send buffer credits. That is, the percentage of time that the receiving port had no credit to provide to the port on DS8000.
Zero Receive Buffer Credit Percentage	DS8000: port	The amount of time, as a percentage, that the port on DS8000 had depleted its receive buffer credits. That is, the percentage of time that the port on DS8000 had no credit to provide to the sending port.
Important: • [1] The "Resource: components" column shows the resources and components that are measured by a metric. Metrics that apply to Storwize V3500, Storwize V3700, Storwize V7000, and Storwize V7000 Unified. • [2] This metric is available in the XIV system version 10.2.2 or later. • [3] This metric is available in the XIV system version 10.2.4 or later.		