Configuring SAN Analytics

This chapter provides information about the SAN Analytics feature and how to configure it:

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Feature History for Configuring SAN Analytics

Table 1: Feature History for Configuring SAN Analytics

Feature Name	Release	Feature Information
Virtual Machine Identifier (VMID) Analytics	8.5(1)	The VMID Analytics feature was introduced to monitor, analyze, identify, and troubleshoot performance issues at VM level. The **analytics vm-tag veid** command was introduced.
SAN Analytics	8.5(1)	Analysis of NVMe traffic was changed to count only IO frames. Previously, admin frames were also included.
ShowAnalytics Overlay CLI	8.5(1)	Added the **--appendfile** and **--outfile** options for the **ShowAnalytics** command. The **ShowAnalytics --help** command output was modified.

Feature Name	Release	Feature Information
ShowAnalytics Overlay CLI	8.4(2)	Added the option to list the command keywords and variables for the **ShowAnalytics** command and its options. Added support for the Non-Volatile Memory Express (NVMe) metrics in the **ShowAnalytics** command.
ShowAnalytics Overlay CLI	8.4(1a)	Added the **--alias** argument for the **--top** option of the **ShowAnalytics** command.
SAN Analytics	8.4(1)	Added support for NVMe analytics type. New NVMe view instances and flow metrics were added. For more information, see Flow Metrics. The following commands were modified: • Added the **fc-all** and **fc-nvme** keywords to the [**no**] **analytics type** {**fc-all** | **fc-nvme** | **fc-scsi**} command. • Removed the **type fc-scsi** keyword from the **show analytics flow congestion-drops** [**vsan** *number*] [**module** *number* **port** *number*] command. • Added the **--errorsonly**, **--evaluate-npuload**, **--minmax**, **--outstanding-io**, **--top**, **--vsan-thput**, **--alias**, **--limit**, **--key**, **--module**, **--progress**, and **--refresh** options to the **ShowAnalytics** command. The **show analytics schema** {**fc-nvme** | **fc-scsi**} {**view-instance** *instance-name* | **views**} command was introduced to display schema for the SCSI and NVMe analytics types.
Query Syntax	8.4(1)	Added support for NVMe analytics type. The following query syntax supports *fc-nvme* analytics type: **select all** | *column1*[, *column2*, *column3*, …] **from** *analytics_type.view_type* [**where** *filter_list1* [**and** *filter_list2* …]] [**sort** *column* [**asc** | **desc**]] [**limit** *number*]
SAN Analytics	8.4(1)	The following command outputs were modified: • **show analytics port-sampling module** *number* • **show analytics system-load** • **ShowAnalytics**
SAN Analytics	8.4(1)	Added the Cisco MDS 9396T 32-Gbps 96-Port Fibre Channel Fabric Switch and Cisco MDS 9148T 32-Gbps 48-Port Fibre Channel Fabric Switch to the list of supported hardware.

Feature Name	Release	Feature Information
Query Syntax	8.3(2)	Added support for sorting the metrics and metadata fields in ascending or descending order. The **asc** and **desc** options were added to the query syntax: **select all** | *column1*[, *column2*, *column3*, …] **from** *analytics_type.view_type* [**where** *filter_list1* [**and** *filter_list2* …]] [**sort** *column* [**asc** | **desc**]] [**limit** *number*] The **show analytics system-load** command was introduced.
SAN Analytics	8.3(1)	The following command was introduced: **no analytics name** *query_name* See the Table 3: Command Changes, on page 8 for commands that have changed from Cisco MDS NX-OS Release 8.2(1) to Cisco MDS NX-OS Release 8.3(1).
Port Sampling	8.3(1)	The Port Sampling feature allows you to gather data from a subset of ports in a module that is being monitored, cycle through multiple subsets of ports, and stream data from these ports at a regular port-sampling interval. The following commands were introduced: • **analytics port-sampling module** *number* **size** *number* **interval** *seconds* • **show analytics port-sampling module** *number*
SAN Analytics	8.3(1)	Some flow metrics were introduced. For more information, see Flow Metrics.
SAN Analytics Support for Cisco MDS 9132T 32-Gbps 32-Port Fibre Channel Switch	8.3(1)	Added the Cisco MDS 9132T 32-Gbps 32-Port Fibre Channel switch to the list of supported hardware.
SAN Analytics Support for Cisco N-Port Virtualizer (Cisco NPV) switches	8.3(1)	Added guidelines and limitations for using the SAN Analytics feature on Cisco NPV switches.
SAN Analytics	8.2(1)	Added the Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module to the list of supported hardware.

Feature Name	Release	Feature Information
SAN Analytics	8.2(1)	The SAN Analytics feature allows you to monitor, analyze, identify, and troubleshoot performance issues on Cisco MDS 9000 Series Multilayer Switches. The following commands were introduced: • **analytics type fc-scsi** • **analytics query** *"query_string"* **type timer** *timer_val* • **clear analytics** *"query_string"* • **feature analytics** • **purge analytics** *"query_string"* • **ShowAnalytics** • **show analytics** {**query** {*"query_string"* | *id* **result**} | **type fc-scsi flow congestion-drops** [**vsan** *number*] [**module** *number* **port** *number*]}

SAN Analytics Overview

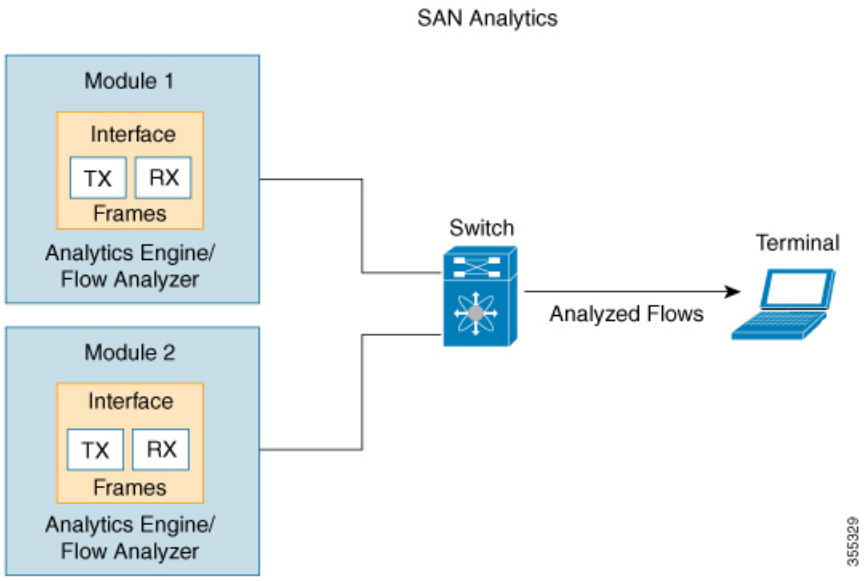
Note We recommended that you use the SAN Analytics feature in Cisco MDS NX-OS Release 8.3(1) or later releases.

The SAN Analytics feature allows you to monitor, analyze, identify, and troubleshoot performance issues on Cisco MDS switches. For a list of supported switches, see the Hardware Requirements for SAN Analytics, on page 5.

In a Fibre Channel SAN environment, it is important to provision and monitor the performance of all devices to be able to resolve any issues that can hinder the performance of such devices. The SAN Analytics feature monitors flows bidirectionally, correlates the flows in a network processing unit (NPU) within a module or individual switch, and provides the fully analyzed network data to the user.

The following figure shows the functionality of the SAN Analytics feature:

Figure 1: SAN Analytics Overview



Hardware Requirements for SAN Analytics

The following table lists the Cisco MDS hardware that supports the SAN Analytics feature:

Table 2: List of Supported Hardware

Switch	Module
Cisco MDS 9700 Series Multilayer Directors	• Cisco MDS 9700 48-Port 32-Gbps Fibre Channel Switching Module (DS-X9648-1536K9)
Cisco MDS 9396T 32-Gbps 96-Port Fibre Channel Fabric Switch	• 96 x 32-Gbps Fixed Ports • 32-Gbps Fibre Channel Expansion Module (M9XT-FC1632)
Cisco MDS 9148T 32-Gbps 48-Port Fibre Channel Fabric Switch	• 48 x 32-Gbps Fixed Ports
Cisco MDS 9132T 32-Gbps 32-Port Fibre Channel Fabric Switch	• 16 x 32-Gbps Fixed Ports • 16-Port 32-Gbps Fibre Channel Expansion Module (M9XT-FC1632)

Guidelines and Limitations for SAN Analytics

- This feature is not supported on VSANs where:

  - The default zone permit is configured.
  - The Inter-VSAN Routing (IVR) or Cisco MDS 9000 Input/Output Accelerator (IOA) feature is enabled.
  - Interoperability mode is enabled.
  - In-Order Delivery (IOD) is enabled.

- This feature has the following restriction about queries:
  - The maximum number of push queries is eight. For information about push queries, see Information About SAN Analytics, on page 9.
  - Does not support clearing and purging of individual metrics. For information about clearing and purging metrics, see Information About SAN Analytics, on page 9.
  - The where condition in the query syntax can accept only the equal (=) operator. For more information, see Query Syntax, on page 28.

- We recommend that you do not configure the **analytics type** command on ports that are members of port channels that are connected to Cisco Nexus switches and Cisco UCS Fabric Interconnects (SAN port channels) to avoid seeing missing and erroneous metrics.
- For a switch operating in Cisco NPV mode, when server logins move from one uplink to another, either via automatic load balancing by NX-OS or manual rebalancing by the user, the **show analytics system-load** command output may display an incorrect ITL count on that switch. This occurs if any auto load balanced devices ever need to log in again and do so via a different upstream link. If they do so, then they are assigned a new FCID. Because old analytics device FCID metrics are not automatically removed these stale entries result in additional ITL counts. You must purge the metrics first using the **purge analytics** *"query_string"* command before using the **show analytics system-load** command to get the correct data.
- The **show analytics system-load** command output displays incorrect ITL count after the VMID Analytics feature is initially enabled. To get the correct ITL count, you must first purge the metrics using the **purge analytics "select all from fc-scsi.port"** command before using the **show analytics system-load** command to get the correct data.
- The **select all** option in the query syntax does not display VMID metrics. To view VMID metrics, you must specify one or more individual metrics in the query string and include the *vmid* key. For example, **show analytics query "select port,vsan,app_id,vmid,target_id,initiator_id,lun, active_io_read_count,active_io_write_count from fc-scsi.scsi_initiator_itl_flow"**.
- When this feature is used along with Cisco DCNM (or third-party devices or applications), the Network Time Protocol (NTP) must be synchronized. For information on NTP, see the "Configuring NTP" section in the Cisco MDS 9000 Series Fundamentals Configuration Guide.
- This feature is not supported on Switched Port Analyzer (SPAN) Destination ports, more commonly known as SD ports, and NP (N-Port) ports. If you are enabling this feature on a range of interfaces, ensure that there are no SD or NP ports in that range of interfaces. Otherwise, this feature will not get enabled on any interface.
- This feature only analyzes frames containing standards-based commands. In Cisco MDS NX-OS Releases 8.2(x) and Release 8.3(x), Fibre Channel Protocol (FCP) SCSI read and write commands are supported. From Cisco MDS NX-OS Release 8.4(1), both Fibre Channel SCSI and Fibre Channel Non-Volatile

Memory Express (NVMe) read and write commands are supported. This feature does not analyze any frames containing proprietary commands; these are typically used by storage replication technologies.

- If the **feature analytics** command is enabled in Cisco MDS NX-OS Release 8.2(1) or Release 8.3(1), upgrading or downgrading between Cisco MDS NX-OS Release 8.2(1) and Release 8.3(1) is supported only after this feature is disabled using the **no feature analytics** command before upgrading or downgrading, and then re-enabling this feature using the **feature analytics** command.

  After downgrading from Cisco MDS NX-OS Release 8.3(1) or later releases to Release 8.2(1), this feature works only after you perform the workarounds mentioned in the caveat CSCvm19337.

- After upgrading, downgrading, reloading a switch, or reloading a module, all the flow metrics will be purged.
- This feature is not supported when the switch is in soft zoning mode.
- We recommend that the streaming-sample interval (**snsr-grp** *id* **sample-interval** *interval*), port-sampling interval (**analytics port-sampling module** *number* **size** *number* **interval** *seconds*), and push-query interval (**analytics query** *"query_string"* **name** *query_name* **type periodic** [**interval** *seconds*] [**clear**] [**differential**]) be configured with the same value. We also recommend that you change or configure the push-query interval first, then the port-sampling interval, and finally, the streaming-sample interval.

Caution

- We recommend that you set the streaming-sample interval, port-sampling interval, and push-query interval to be equal to or more than the minimum recommended value of 30 seconds. Configuring intervals below the minimum value may result in undesirable system behavior.
- See the Cisco MDS NX-OS Configuration Limits, Release 8.x document for information on the maximum number of Initiator-Target-LUNs (ITLs) supported per module.

  If the active ITL count exceeds the documented limit, a syslog message is logged. If the limit is exceeded for a significant amount of time, the stability of the switch may be impacted. Use the **show analytics system-load** command to check the ITL count and NPU load. For more information, see the Cisco MDS 9000 Family and Nexus 7000 Series NX-OS System Messages Reference Guide and the Cisco MDS NX-OS Configuration Limits, Release 8.x document.

- To avoid exceeding the network processing unit (NPU) capacity and its consequences, use the Port Sampling feature to analyze the flow metrics. For more information, see Port Sampling, on page 14.
- After you purge a view instance and its associated metrics, we recommend that you wait for few seconds before executing a pull query, because some fields in the flow metrics may contain irrelevant values until the purge operation is complete.
- NVMe analytics is compatible with the Fibre Channel Non-Volatile Memory Express - 1 (FC-NVMe-1) and FC-NVMe-2 standards.
- This feature tracks every flow metric on a per-port basis. Flow requests and responses spanning different physical ports on a switch may result in some flow metrics not being accurately computed. This condition specifically occurs when this feature is enabled on Inter-Switch Link (ISL) ports (E ports).

  The following is a lists the scenarios where a request response can be seen on different ISL ports:

- The load-balancing scheme is changed to Source ID (SID)-Destination ID (DID) by the user using the **vsan** *ID* **loadbalancing src-dst-id** command.
- ISLs (E ports) are configured to nontrunking mode by the user using the **switchport trunk mode off** command.
- ISLs (E ports) that are part of a port channel, and the port-channel is not configured to the active mode using the **no channel mode active** command.
- This feature does not work on nontrunk ISL or port channel. For this feature to work on an E port, the E port should have the trunk mode on.
- ISLs are not bundled together to be part of a port channel; that is, ECMP ISLs and ECMP port-channels are not supported.
- There is a port channel between the Cisco MDS 9250i Multiservice Fabric Switch or Cisco MDS 9148S 16-G Multilayer Fabric Switch and the Cisco MDS 9700 48-Port 32 Gbps Fibre Channel Switching Module (DS-X9648-1536K9).

- This feature is not supported on a FICON enabled Cisco MDS 9000 switches.

Command Changes

Some commands have undergone changes in Cisco MDS NX-OS Release 8.3(1). This document displays commands that are introduced or changed in Cisco MDS NX-OS Release 8.3(1). See the Table 3: Command Changes, on page 8 for the commands that are equivalent to the ones used in Cisco MDS NX-OS Release 8.2(1).

We recommended that you use the SAN Analytics feature in Cisco MDS NX-OS Release 8.3(1) and later releases.

Table 3: Command Changes, on page 8 lists the changes made to the commands in Cisco MDS NX-OS Release 8.3(1):

Table 3: Command Changes

Cisco MDS NX-OS Release 8.2(1)	Cisco MDS NX-OS Release 8.3(1)
analytics query *“query_string”* **type timer** *timer_val*	**analytics query** *“query_string”* **name** *query_name* **type periodic** [**interval** *seconds*] [**clear**] [**differential**]
clear analytics *“query_string”*	**clear analytics query** *“query_string”*
purge analytics *“query_string”*	**purge analytics query** *“query_string”*
show analytics query {*“query_string”* | *id* **result**}	**show analytics query** {*“query_string”* [**clear**] [**differential**] | **all** | **name** *query_name* **result**}

Information About SAN Analytics

The SAN Analytics feature collects flow metrics using frames of interest, for data analysis, and includes the following components:

- Data Collection—The flow data is collected from NPU and eventually sent and stored on the supervisor of a switch. The data that is displayed is the real time view of the data and does not display historical data.
- On-board Querying—The data that is stored in a database can be extracted using a pull query, a push query, or overlay CLIs. Queries are used to extract the flow metrics of interest from the database. The frames of interest are used to monitor, analyze, and troubleshoot performance issues on a switch. For more information, see Constructing and Using Queries, on page 48.

  The following are the different ways of querying the database:

  - The pull query is a one-time query that is used to extract the flow information that is stored in the database at the instant the query is executed. The output is in JSON format. Pull queries are NX-API compliant.

    The overlay CLI **ShowAnalytics** command is a python script that issues a predefined pull query that displays the flow metrics in a user-friendly tabular format. It is a CLI wrapper that is written in Python and stored in the bootflash for execution.

    From Cisco MDS NX-OS Release 8.3(1), the following options are supported in a pull query:

    - Clear—Clears all minimum, maximum, and peak flow metrics.
    - Differential—Returns the absolute value of only the ITL or ITN flow metrics that were updated between the last and the present streaming intervals. We recommend that you use the differential query to improve scale values of your switch.

  - Push query—A recurring query that is installed to periodically extract the flow metrics that are stored in the database and send them to a destination. The output is in JSON format.

    From Cisco MDS NX-OS Release 8.3(1), the following options are available in a push query:

    - Clear—Clears all minimum, maximum, and peak flow metrics.
    - Differential—Returns the absolute value of only the ITL or ITN flow metrics that were updated between the last and the present streaming intervals. We recommend that you use the differential query to improve scale values of your switch.

    Push query supports the following modes for extracting flow metrics:

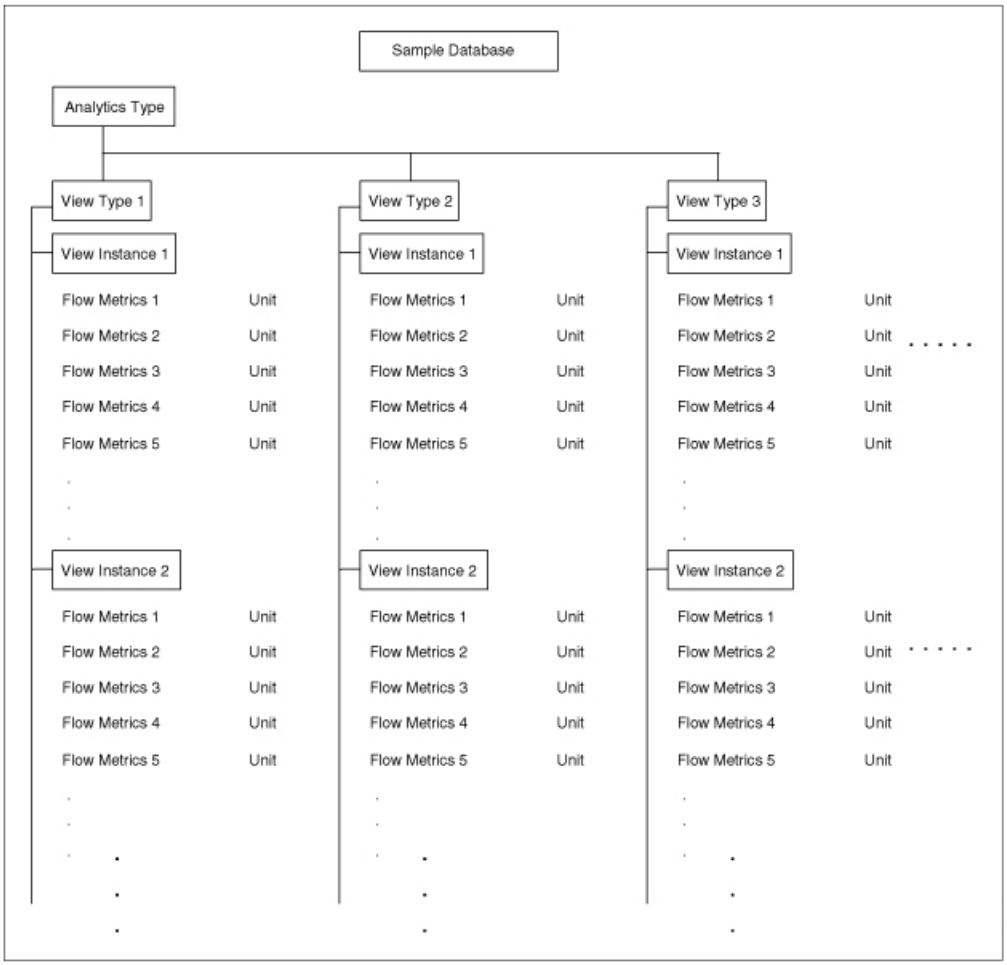
    - Continuous mode—Data is gathered continuously on all analytics-enabled ports.
    - Sampling mode—Data is gathered on a subset of analytics-enabled ports at a configured port-sampling interval, and then the data-gathering mechanism is cycled through the next subset of ports. For example, data is gathered on a group of 6 ports from the 24 analytics-enabled ports with a port sampling interval of 30 seconds. For more information, see Port Sampling, on page 14.

The database that is used for storing the flow metrics is organized according to the following hierarchy:

- Analytics Type—The protocol type to analyze. *fc-scsi* analytics type is supported in Cisco MDS NX-OS Release 8.2(x) and Cisco MDS NX-OS Release 8.3(x). *fc-scsi* and *fc-nvme* analytics types are supported from Cisco MDS NX-OS Release 8.4(1).
- View—A view is a selection of flow metrics in the database defined by any valid combination of port, VSAN, initiator, target, LUN, and namespace ID parameters.
- View Type—Views are defined based on components that constitute a flow, for example, port view, initiator_IT view, target_ITL view, and so on. The query syntax is used to run queries on a view type. The syntax supports only one query on a single view type. For a list of view types that are supported, see List of Supported View Types, on page 29.
- View Instance—An instance of a given view type. View instance has its own flow metrics. For example, for port view type, fc1/1 is one instance, fc1/2 is another instance, and so on.
- Flow Metrics—The flow metrics that are used for analysis. From Cisco MDS NX-OS 8.5(1) NVMe traffic metrics include only IO frames as classified by the NVMe frame's *Category* field. Prior to this release both IO and admin frames were included. For information about the list of flow metrics that are supported, see the view profiles in the Flow Metrics section in Appendix.

The following image shows the various components of a sample database:

Figure 2: Sample Database



For sample examples on configuring a query syntax, see the Examples: Configuring Query Syntax, on page 43.

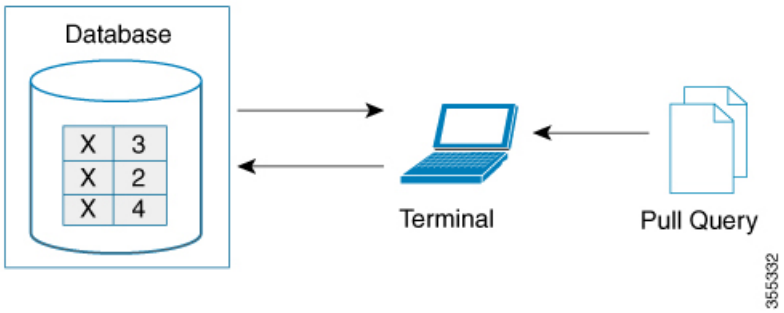
The following is the flow data collection workflow:

1. Feature Enablement—Enable the SAN Analytics feature on switches for which flow metrics have to be analyzed.
2. Interface Enablement—Enable collection of flow metrics on interfaces. We recommend that you enable the SAN Analytics feature on host interfaces, as seen in the images in Deployment Modes, on page 16.
3. Executing and Installing Queries—The following queries are used to retrieve flow metrics from the database:
   - Pull Query—Provides near real-time flow metrics for troubleshooting issues directly on a switch. Data from a pull query is extracted from the database at that instant and responded to the query. Pull query can be executed using CLI or via NX-API. Cisco DCNM can use the NX-API to gather data for visualization.

     Overlay CLI—A predefined pull query that displays the flow metrics in a user-friendly tabular format. It provides near real-time flow metrics for troubleshooting issues directly on a switch.

The following image shows the functionality of a pull query:

Figure 3: Pull Query



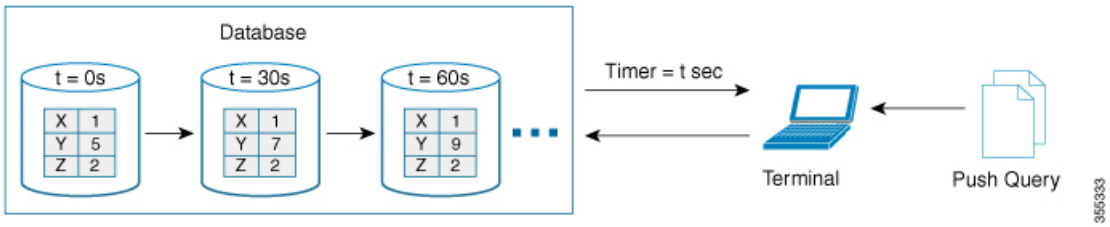
- Push Query—Provides flow metrics at regular intervals. You can specify a time interval, in seconds. After the time interval expires, the flow metrics that are of interest to the user are refreshed and pushed from the database. When multiple queries are installed, each of the push queries pushes the flow metrics independent of each other, which is the expected behavior.

Note

- Pull query, push query, and overlay CLI are applicable only on the interfaces on which the SAN Analytics feature is enabled.
- Push query timer fetches flow metrics from the NPU and stores them in the database on the supervisor at a specified push query interval.

The following image shows the functionality of a push query where only certain metrics are set to be updated at specific intervals:

Figure 4: Push Query

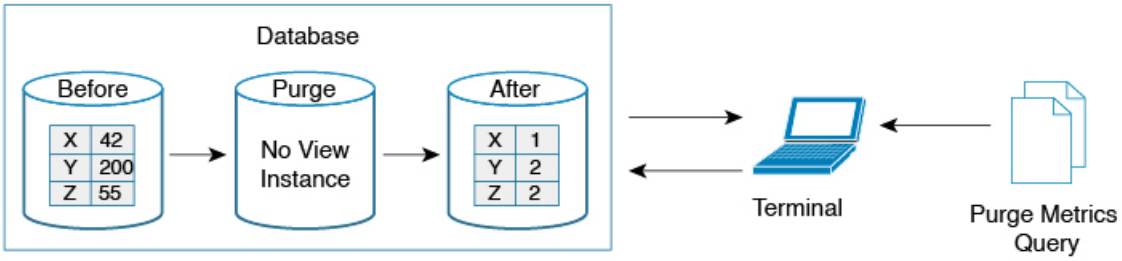


4. Clearing and Resetting Metrics—The following features allow you to clear or reset the flow metrics that are collected in a database:

   - Purge—Deletes a specified view instance and all the metrics that are associated with this view instance. The view instance is immediately rebuilt with the new IO and all view metrics start counting from zero. Use this option to flush any stale metrics from a view, such as when an initiator or target is no longer active or present.

     The following image shows the purge metrics query functionality:

Figure 5: Purge Metrics Query

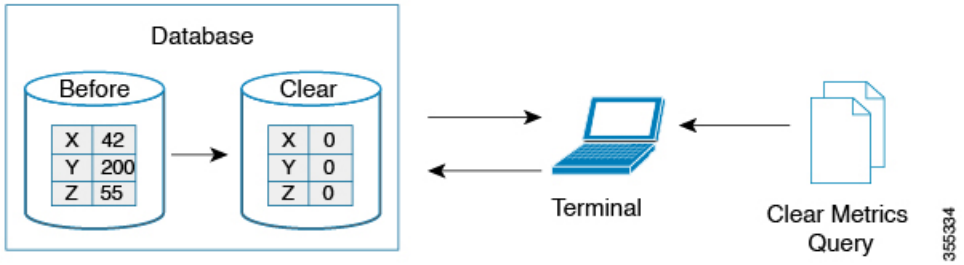


- Clear—Resets all the metrics that match the specified query string to zero except the flow metrics of the type *key*. After clearing, the database continues to collect the flow metrics for the specified query.

Note The **clear analytics query** command is different from the **clear** option that is used in a push query. The **clear analytics query** command resets all the metrics that meet the query syntax and the **clear** option that is used in a push query resets the minimum, maximum, and peak flow metrics.

The following image shows the clear metrics query functionality:

Figure 6: Clear Metrics Query



VMID Analytics

Note The VMID Analytics feature is currently in beta status for use in non-production environment only. Contact your account teams or Cisco MDS marketing team to understand the use case before enabling this feature. This beta status and restriction will change to regular production status in an upcoming release.

The SAN Analytics feature provides Fibre Channel traffic information at a device (per FCID) level. However, end devices can host multiple virtual entities (virtual machines [VMs]) and each VM can cause a varying load on the Fibre Channel fabric. Therefore, it becomes crucial to monitor the Fibre Channel performance of each VM. The VMID Analytics feature can be used to monitor, analyze, identify, and troubleshoot Fibre Channel performance issues at a VM level.

Individual VMs within a given device use the same FCID for their SCSI and NVMe IO exchanges. The NX-OS Virtual Machine Identifier (VMID) server feature enables resolving traffic sources from a per-FCID device level to an individual VM level. For more information on this feature, see the "VMID" section in the "Managing FLOGI, Name Server, FDMI, and RSCN Databases" chapter of the Cisco MDS 9000 Series Fabric Configuration Guide, Release 8.x.

After the VMID server feature is enabled, the VMID Analytics feature can subsequently be enabled to resolve performance metrics for initiators. When enabled, analytics views that used to report the initiator level metrics will also report VMID level metrics. Only the view types which include the *scsi-initiator-id* or *nvme-initiator-id* key are monitored. An additional *vmid* key is supported for these view types. You must specify the *vmid* key as part of the "selected fields" list along with the initiator ID in the query syntax to collect the VMID-specific analytics. If VMID is not specified in the "selected fields" list and only the initiator ID is specified then the aggregated metrics are collected for the initiator.

Disabling the VMID Server feature cause attached devices to stop inserting VMID information into Fibre Channel frames. Also, when the VMID Analytics feature is disabled the frames are counted against the source FCID and not the VMID. However, the Analytics database continues to retain the previously collected per-VMID metrics. You must purge the metrics or perform a nondisruptive module upgrade to reset the database. If you do not purge the metrics, then the output of the pull or push query with and without using the differential option will be as follows:

- When you use the differential option in a pull or push query after the VMID Analytics feature is disabled, only the first pull or push query will contain the stale per-VMID metrics.
- When you do not use the differential option in a pull or push query after the VMID Analytics feature is disabled, every pull or push query will fetch the stale per-VMID metrics.

The VMID Analytics feature was introduced in Cisco MDS NX-OS Release 8.5(1).

Port Sampling

The Port Sampling feature that is introduced in Cisco MDS NX-OS Release 8.3(1) allows you to gather data from a subset of ports in a module that is already being monitored, cycle through the various subsets of ports, and stream data from these ports at a regular port-sampling interval.

This feature is useful when the NPU load is high and you cannot reduce the number of ports that are being monitored on a module. In such a situation, the load on the NPU can be reduced by sampling a subset of the monitored ports at a specified port-sampling interval. Use the **show analytics system-load** command to check the NPU load.

In Cisco MDS NX-OS Release 8.3(2), system messages were introduced to alert you if the NPU load is high when the ITL count exceeds a module limit, when the ITL count exceeds the system limit, and when there is no response from NPU for analytics data. For more information, see the Cisco MDS 9000 Family and Nexus 7000 Series NX-OS System Messages Reference document.

Any I/O and errors that occur on a monitored port, when it is not being sampled, are not seen and not included in the analytics data.

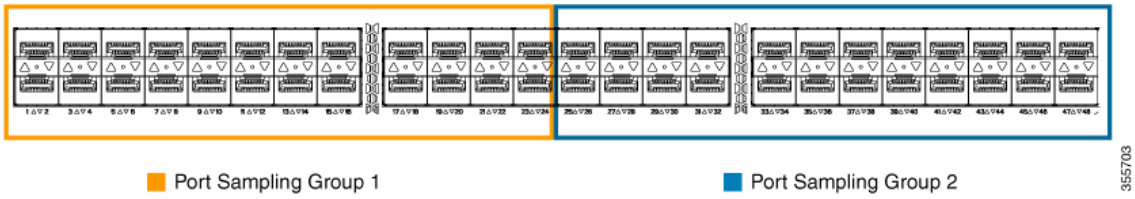
The port sampling interval that is used in this feature is independent of the streaming sample interval. We recommend that you set the streaming-sample interval, port-sampling interval, and push query interval to be equal to or more than the minimum recommended value of 30 seconds.

Note When this feature is enabled on a module and then the SAN Analytics feature is enabled on new ports on the module, the port-sampling data for the new ports are streamed only after the next port-sampling interval.

Port-Sampling Scenarios

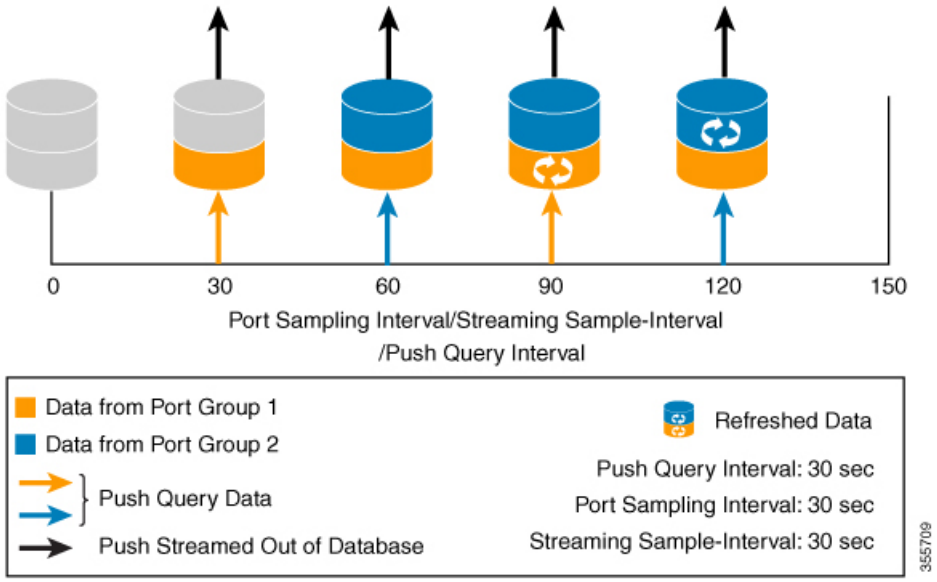
Let us consider a module consisting of 48 ports and group them into two subsets of 24 ports. Depending on the port-sampling intervals that are configured for these subsets of ports and the streaming-sample interval that is configured, flow metrics can be captured at different intervals as seen in the following examples:

Figure 7: Port-Sampling Groups



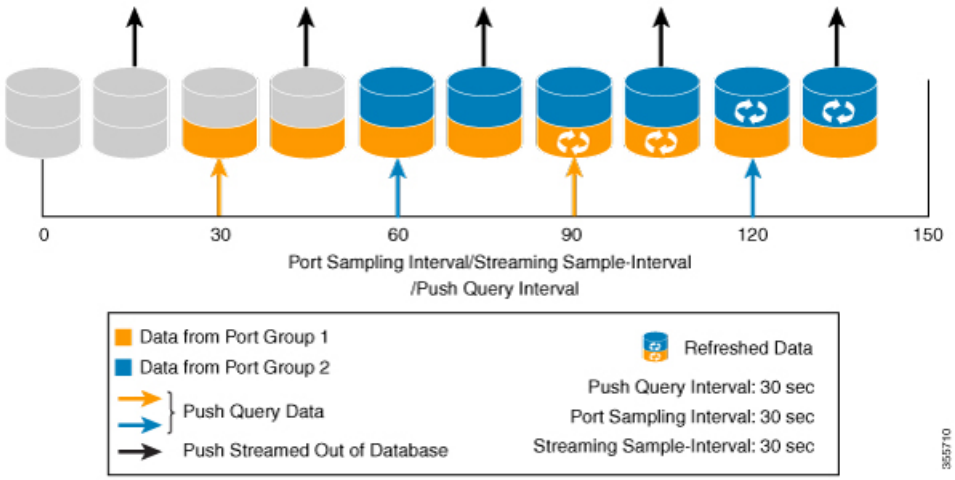
- When the port-sampling interval and the streaming-sample interval start at the same time:

Figure 8: Port Sampling Interval and Streaming Sample Interval Starting at the Same Time



- When the port-sampling interval and the streaming-sample interval start at a different time:

Figure 9: Port Sampling Interval and Streaming Sample Interval Starting at a Different Time



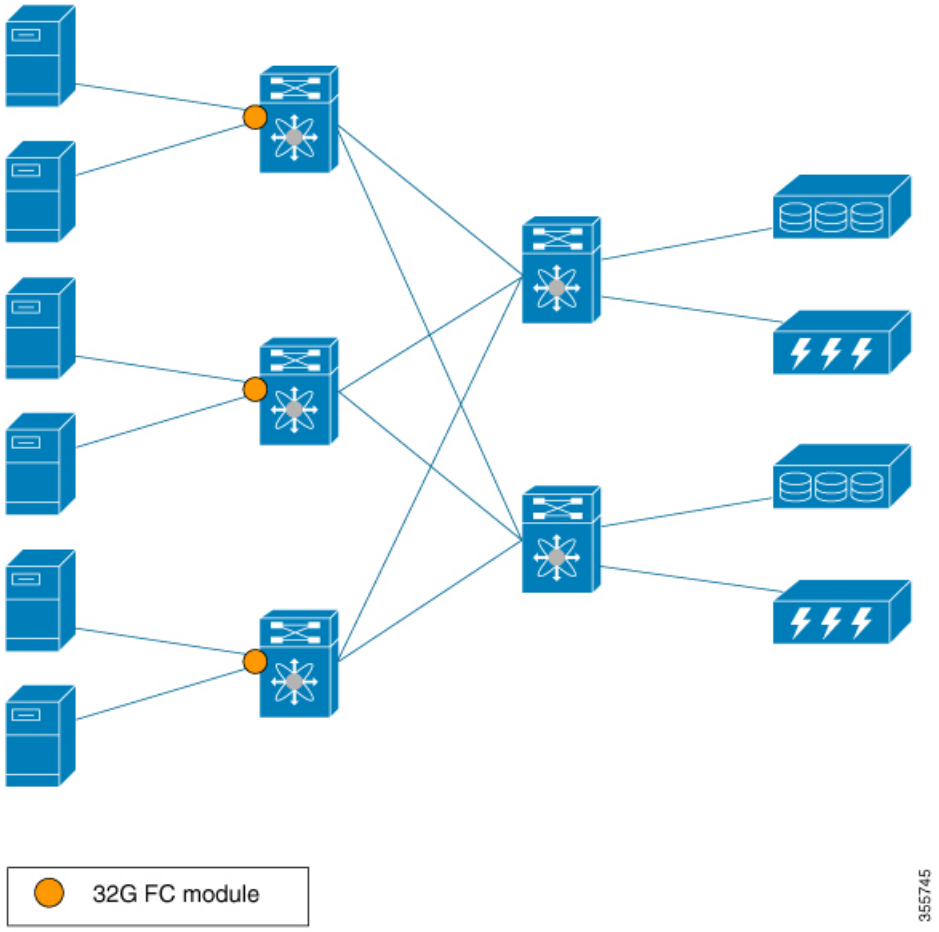
Deployment Modes

Depending on where the switches that support the SAN Analytics feature are deployed in a SAN fabric, the following deployment modes are possible:

Host Edge Deployment Mode

The SAN Analytics feature is enabled on all Cisco MDS core switches and on interfaces that are connected to hosts.

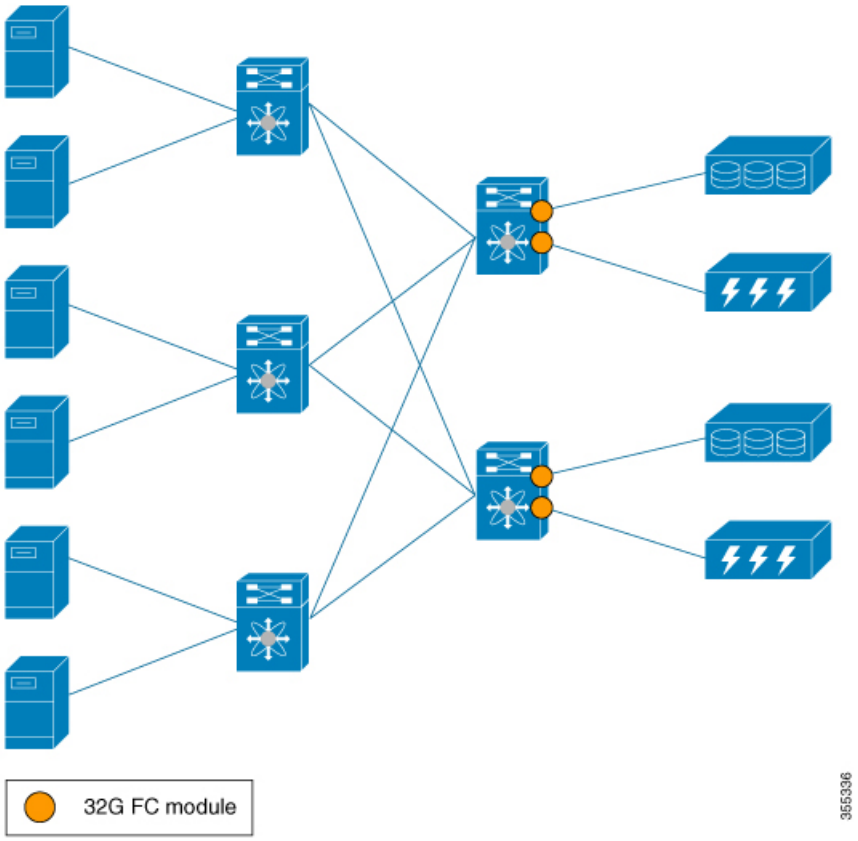
Figure 10: Host Edge Deployment Mode



Storage Edge Deployment Mode

The SAN Analytics feature is enabled on all the Cisco MDS core switches and on the interfaces that are connected to storage arrays.

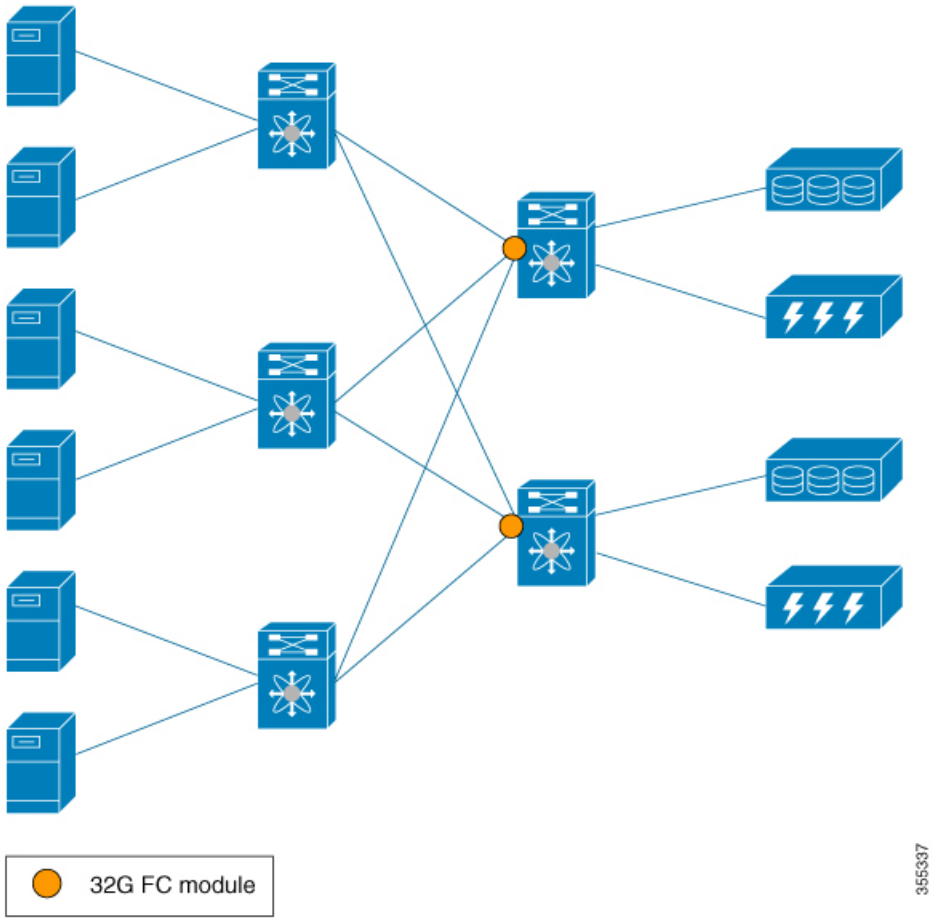
Figure 11: Storage Edge Deployment Mode



ISL Deployment Mode

The SAN Analytics feature is enabled on all the Cisco MDS switches and on the interfaces that are on any one side of ISLs.

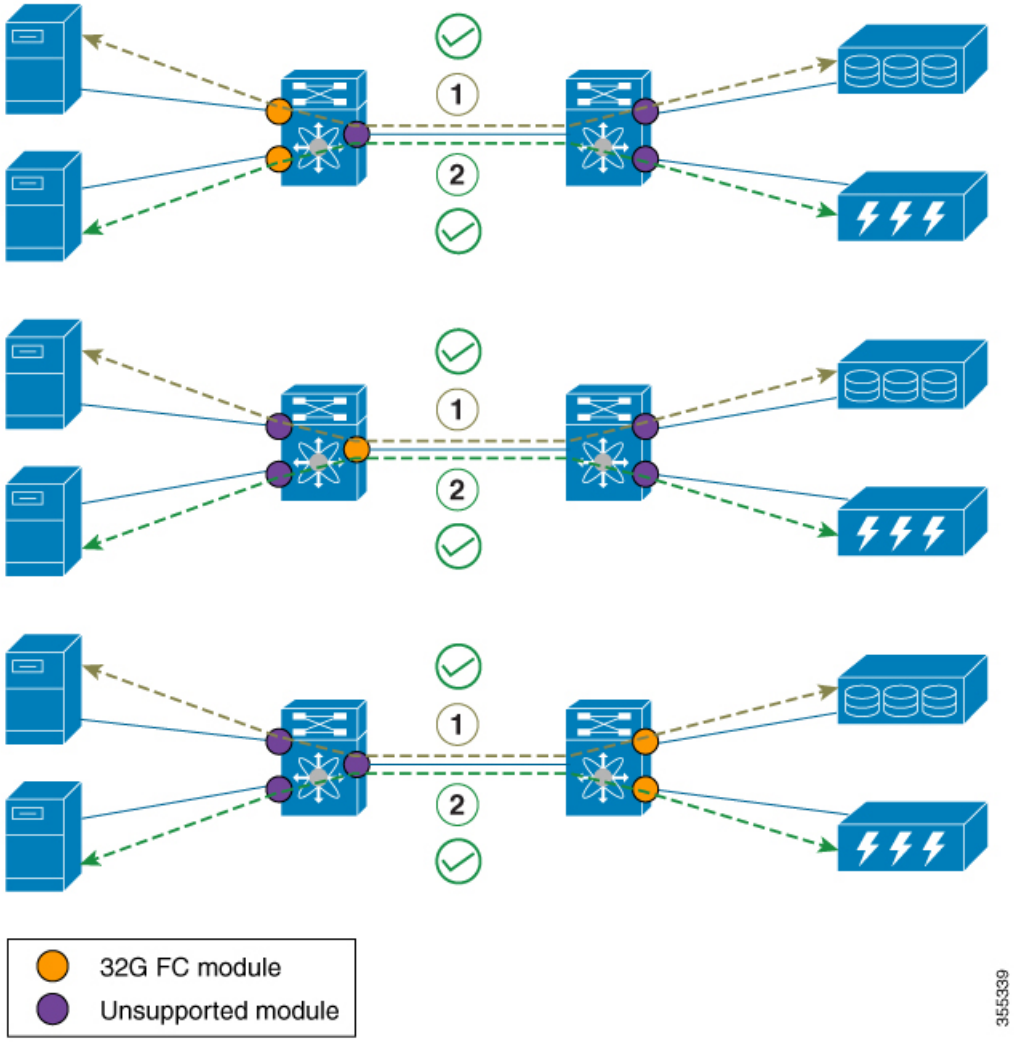
Figure 12: ISL Deployment Mode

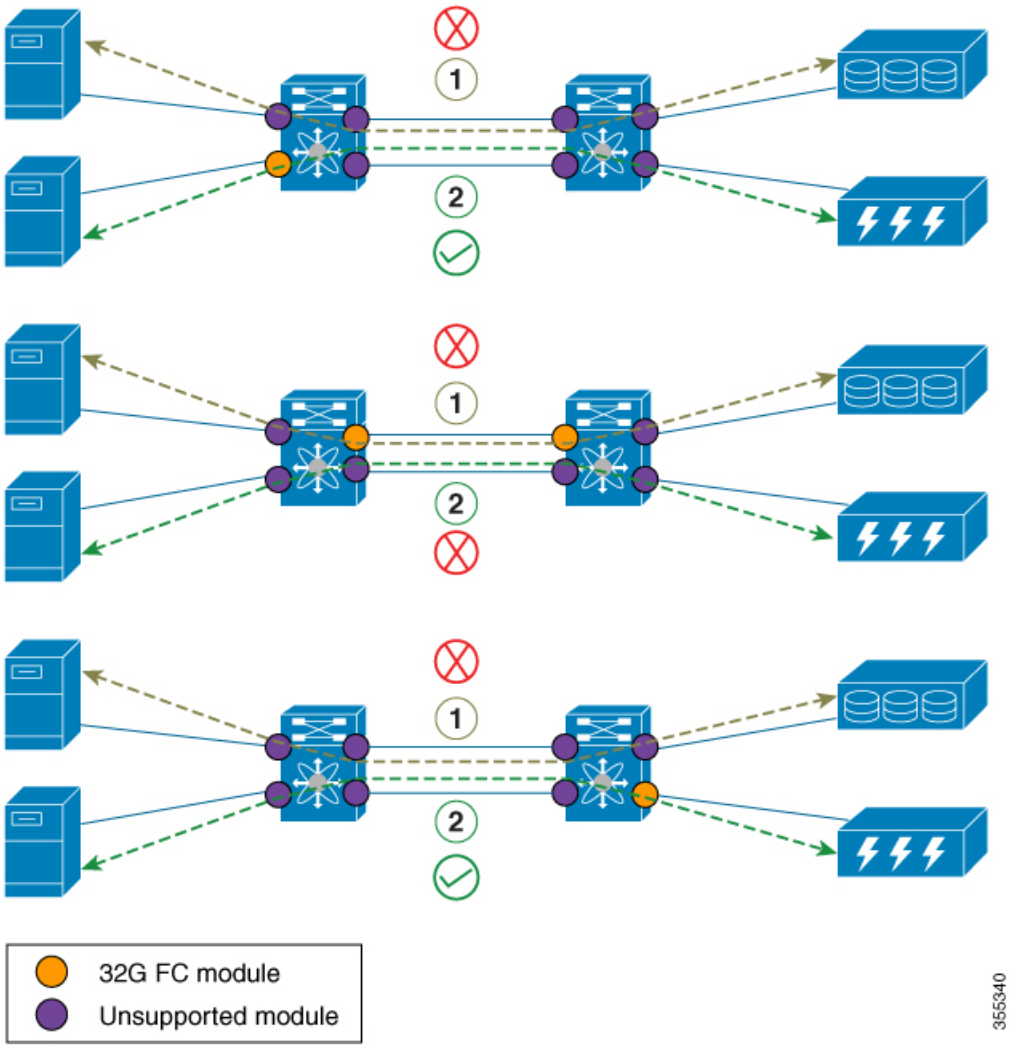


The following image shows the functionality of the SAN Analytics feature when supported and unsupported modules (16-Gbps Fibre Channel, Cisco MDS 9700 40-Gbps 24-Port FCoE Module (DS-X9824-960K9), Cisco MDS 24/10-Port SAN Extension Module (DS-X9334-K9), and so on) are used in SAN.

Note The numbers 1 and 2 in the Figure 13: Functionality of The SAN Analytics Feature When Supported and Unsupported Modules are Used represent two different flows from initiators to targets respectively.

Figure 13: Functionality of The SAN Analytics Feature When Supported and Unsupported Modules are Used

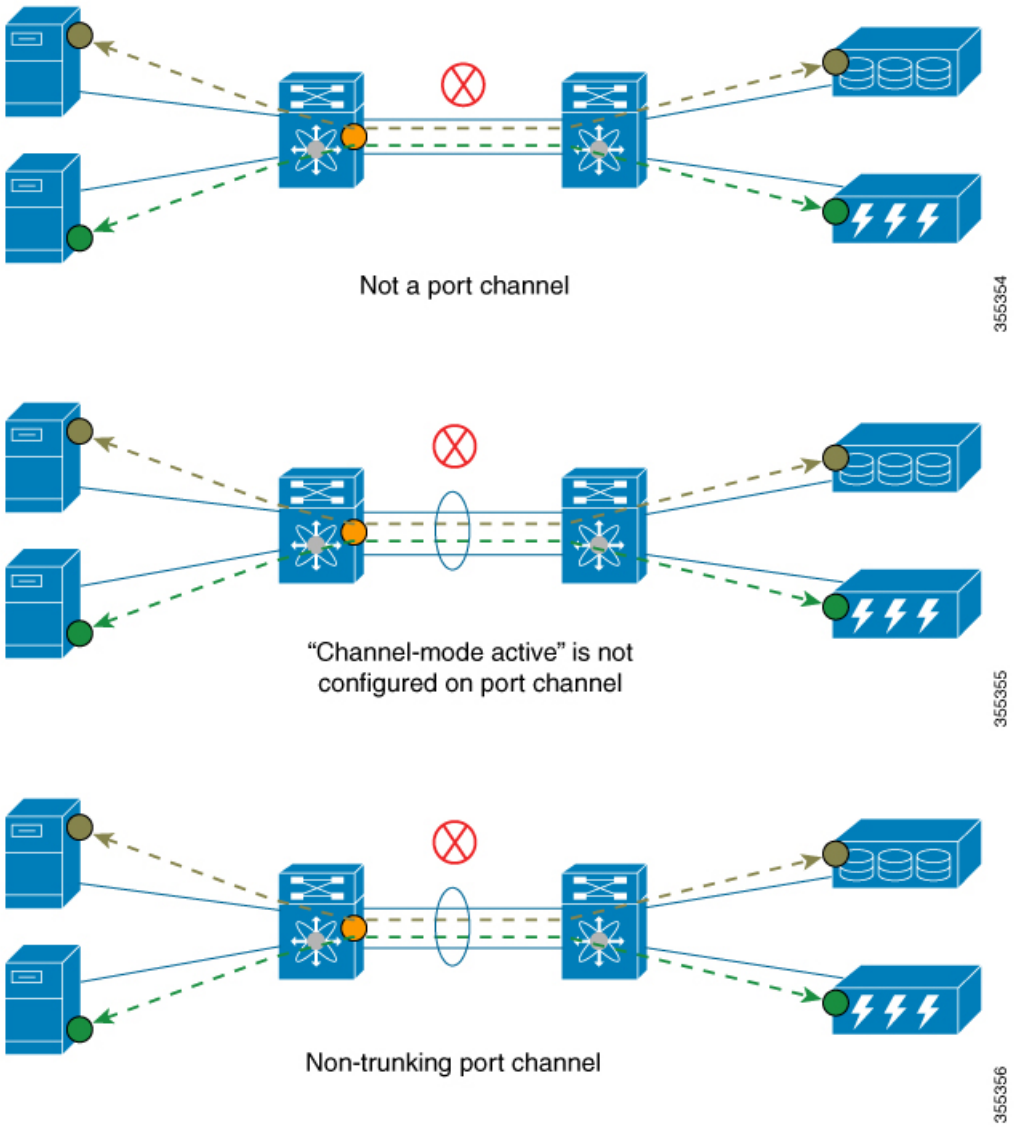




Note

- In the above ISL mode scenarios, the request responses can be seen on different members of port channel.
- When supported and unsupported modules are used on ISL, the analytics data that is analyzed on the ISL may not be accurate. Hence, we recommend that you do not analyze data on ISL where supported and unsupported modules are used.

Configuring SAN Analytics



Configuring SAN Analytics

Enable the SAN Analytics feature on both a switch and its interfaces in order to enable flow metric collection from the interfaces.

Note

- To use the SAN Analytics feature, you must install an appropriate license package using the **install license** command. For more information, see the Cisco MDS 9000 Series Licensing Guide.
- If you are using Cisco DCNM SAN Insights, you can configure the SAN Analytics feature in Cisco DCNM SAN Insights and there is no need to configure this feature on the switch. For more information, see the "Configuring SAN Insights" section in the Cisco DCNM SAN Management Configuration Guide.

Enabling SAN Analytics

Note
- The SAN Analytics feature is disabled by default.
- When the active ITL count exceeds the documented limit, a syslog message will be logged..

To enable the SAN Analytics feature on a switch, perform these steps:

Procedure

Step 1 Enter global configuration mode:
switch# **configure terminal**

Step 2 Enable the SAN Analytics feature on the switch:
switch(config)# **feature analytics**

Disabling SAN Analytics

To disable the SAN Analytics feature on a switch, perform these steps:

Procedure

Step 1 Enter global configuration mode:
switch# **configure terminal**

Step 2 Disable the SAN Analytics feature on the switch:
switch(config)# **no feature analytics**

Enabling SAN Analytics on an Interface

To enable the SAN Analytics feature on an interface, perform these steps:

Before you begin

Note The SAN Analytics feature is disabled by default on all interfaces.

- Enable the SAN Analytics feature on the switch. See the Enabling SAN Analytics, on page 23 section.

- In port channels, enable the SAN Analytics feature on all the interfaces.

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Select a Fibre Channel interface or a range of interfaces and enter interface configuration submode:

switch(config)# **interface fc** *slot number/port number*

Note You can also specify the range for interfaces using the **interface fc** *slot number/port number - port number ,* **fc** *slot number/port number - port number* command. The spaces are required before and after the dash (-) and before and after the comma (,).

Step 3 Enable the SAN Analytics feature on the selected interface:

switch(config-if)# **analytics type** {**fc-all** | **fc-nvme** | **fc-scsi**}

Note Only the **fc-scsi** analytics type was supported in Cisco MDS NX-OS Release 8.2(x) and Cisco MDS NX-OS Release 8.3(x). From Cisco MDS NX-OS Release 8.4(1), the **fc-scsi**, **fc-nvme**, and **fc-all** analytics types are supported.

Disabling SAN Analytics on an Interface

To disable the SAN Analytics feature on an interface, perform these steps:

Before you begin

In port channels, disable the SAN Analytics feature on all the interfaces.

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Select a Fibre Channel interface or a range of interfaces and enter interface configuration submode:

switch(config)# **interface fc** *slot number/port number*

Note You can also specify the range for interfaces using the **interface fc** *slot number/port number - port number ,* **fc** *slot number/port number - port number* command. The spaces are required before and after the dash (-) and before and after the comma (,).

Step 3 Disable the SAN Analytics feature on the selected interface:

switch(config-if)# **no analytics type** {**fc-all** | **fc-nvme** | **fc-scsi**}

Enabling VMID Analytics

To enable the VMID Analytics feature on a switch, perform these steps:

Before you begin

1. Ensure that the attached HBAs have firmware that supports VMID capability and that the capability is enabled on the HBA.
2. Enable the SAN Analytics feature on the switch. See the Enabling SAN Analytics, on page 23 section.
3. Enable SAN Analytics on an interface. See the Enabling SAN Analytics on an Interface, on page 23 section.
4. Enable the VMID Server feature. See the "Enabling the VMID Server" section in the "Managing FLOGI, Name Server, FDMI, and RSCN Databases" chapter of the Cisco MDS 9000 Series Fabric Configuration Guide, Release 8.x.

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Enable the VMID Analytics feature on the switch:

switch(config)# **analytics vm-tag veid**

Disabling VMID Analytics

To disable the VMID Analytics feature on a switch, perform these steps:

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Disable the VMID Analytics feature on the switch:

switch(config)# **no analytics vm-tag veid**

Enabling Port Sampling

Note

- Port sampling is supported only in Cisco MDS NX-OS Release 8.3(1) and later releases.
- Port sampling is disabled by default, and continuous monitoring is enabled on all the analytics-enabled ports. For more information on port sampling, see Port Sampling, on page 14.

To enable port sampling on a module, perform these steps:

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Enable port sampling on a module:

switch# **analytics port-sampling module** *number* **size** *number* **interval** *seconds*

Disabling Port Sampling

To disable port sampling on a module, perform these steps:

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Disable port sampling on a module and go back to the default mode of monitoring all analytics-enabled ports with the configured streaming-sample interval:

switch# **no analytics port-sampling module** *number*

Example: Configuring SAN Analytics

This example shows how to enable the SAN Analytics feature on a switch:

```
switch# configure terminal
switch(config)# feature analytics
```

This example shows how to disable the SAN Analytics feature on a switch:

```
switch# configure terminal
switch(config)# no feature analytics
```

This example shows how to enable the SAN Analytics feature on an interface for the SCSI analytics type when the NVMe analytics type is already enabled:

- This example displays that the NVMe analytics type is already enabled:

```
switch# show running-config analytics

!Command: show running-config analytics
!Running configuration last done at: Wed Mar 13 09:01:56 2019
!Time: Wed Mar 13 09:02:52 2019

version 8.4(1)
feature analytics


interface fc1/1
  analytics type fc-nvme
```

- This example displays how to enable the SCSI analytics type on a single port:

```
switch# configure terminal
switch(config)# interface fc 1/1
switch(config-if)# analytics type fc-scsi
```

- This example displays that the SCSI analytics type is enabled:

```
switch# show running-config analytics

!Command: show running-config analytics
!Running configuration last done at: Wed Mar 13 09:01:56 2019
!Time: Wed Mar 13 09:02:52 2019

version 8.4(1)
feature analytics


interface fc1/1
  analytics type fc-scsi
  analytics type fc-nvme
```

Querying Metrics on a Switch

When you run a pull query CLI, the specified metrics are collected from the NPU of a module, stored in the metric database on the supervisor, and then displayed in the user session.

Schema for Querying Metrics

A schema is used to display the data of interest that is stored in a database to a user. Use the **show analytics schema** command for more information on schema. Metrics are maintained in a database in the form of various view instances. These view instances can be retrieved using queries. See Views, on page 29 for more information.

Query Syntax

The following is the *query syntax* that is used in the pull query, push query, clearing metrics, and purging views:

select all | *column1*[, *column2*, *column3*, …] **from** *analytics_type.view_type* [**where** *filter_list1* [**and** *filter_list2* …]] [**sort** *column* [**asc** | **desc**]] [**limit** *number*]

The following are the elements of the query syntax:

- *analytics_type*—Specifies the analytics type. Only the *fc-scsi* type is supported in Cisco MDS NX-OS Release 8.2(1) and Cisco MDS NX-OS Release 8.3(1). From Cisco MDS NX-OS Release 8.4(1), *fc-nvme* analytics type is supported.
- *view_type*—Specifies the view type of a metric database. The syntax is used to run queries on it. The syntax supports only one query on a single view type. For the list of supported view types and their descriptions, see List of Supported View Types, on page 29.
- *column*—Specifies the flow metrics. A view instance contains multiple columns.
- *filter_list*—Specifies the filters to extract specific metrics of a view instance. You can use the filter conditions on a flow metric column whose type is a *key* value or on a view instance column. You can also use the AND operator for filtering. For a list of view types that are supported, see List of Supported View Types, on page 29.
- **sort**—Specifies to sort the results in a column. Sorting is performed before the limit operation is performed.
- **asc**—Sorts the results in a column in ascending order. By default, sorting is done in ascending order if no order is specified.
- **desc**—Sorts the results in a column in descending order.
- **limit**—Limits the number of metrics that are returned in a result.

For examples on configuring query syntax, see the Examples: Configuring Query Syntax, on page 43.

Note

- The *limit* and *where* options in the *"query_string"* can only be used on the *key* fields.
- Prior to Cisco MDS NX-OS, Release 8.3(2), the sort option in the *"query_string"* could only be used on the *key* fields and the metrics were sorted only in ascending order. From Cisco MDS NX-OS, Release 8.3(2), the *sort* option in the *"query_string"* can be used on all the *metrics* and *metadata* fields and can be sorted in ascending or descending order using the **asc** or **desc** options respectively. By default, sorting is performed in ascending order if no order is specified.

  If you have configured push queries with the **sort asc** or **sort desc** option, make sure that you remove these sort options before downgrading from Cisco MDS NX-OS, Release 8.3(2) to Cisco MDS NX-OS, Release 8.3(1) or earlier releases.

Query Rules

The following are the rules for constructing queries:

- The **select**, **from**, **where**, **sort**, and **limit** conditions should be used in the same order as described in Query Syntax, on page 28.
- The list of columns under the **select** condition should belong to the schema that corresponds to the *view_type* under the **from** condition.
- The **where** condition is allowed only on flow metric fields whose type is a *key* value. For information about the flow metric fields whose type is a key value, see List of Supported View Types, on page 29.
- Before Cisco MDS NX-OS, Release 8.3(2), the **sort** condition must be a *metric* field and should be present among the columns that are listed under the **select** condition. From Cisco MDS NX-OS, Release 8.3(2), the **sort** condition must be a *metric* or *metadata* field and should be present among the columns that are listed under the **select** condition.

Views

A view is a representation of the flow metrics about a port, initiator, target, LUN, or any valid combination of these. Each view type supports specific flow metrics. To optimize resource utilization, long names in the flow metrics are used for OnBoard queries and short names are used for SAN Telemetry Streaming. For more information, see Flow Metrics.

List of Supported View Types

The following table lists the supported view types:

Table 4: Supported View Types

View Type	Description	Keys
port	A port's view contains metadata and IO metrics for ports on a switch.	port
logical_port	A logical port view contains metadata and IO metrics for VSANs configured for ports on a switch.	port and vsan
app	An application view contains metadata and IO metrics for the concerned applications hosted behind various ports that are performing IO operations.	port and app-id
scsi_target	A target view contains metadata and IO metrics for SCSI targets that are deployed behind various ports on a switch that execute IO operations.	port, vsan, and scsi-target-id

View Type	Description	Keys
nvme_target	A target view contains metadata and IO metrics for NVMe targets that are deployed behind various ports on a switch that execute IO operations.	port, vsan, and nvme-target-id
scsi_initiator	An initiator view contains metadata and IO metrics for initiators that are deployed behind various ports on a switch that initiate IO operations.	port, vsan, scsi-initiator-id, and vmid
nvme_initiator	An initiator view contains metadata and IO metrics for initiators that are deployed behind various ports on a switch that initiate IO operations.	port, vsan, nvme-initiator-id, and vmid
scsi_target_app	A target app view contains metadata and IO metrics for the applications whose data is hosted on various targets.	port, vsan, scsi-target-id, and app-id
nvme_target_app	A target app view contains metadata and IO metrics for the applications whose data is hosted on various targets.	port, vsan, nvme-target-id, and app-id
scsi_initiator_app	An initiator app view contains metadata and IO metrics for the applications for which initiators initiate IO operations.	port, vsan, scsi-initiator-id, app-id, and vmid
nvme_initiator_app	An initiator app view contains metadata and IO metrics for the applications for which initiators initiate IO operations.	port, vsan, nvme-initiator-id, app-id, and vmid
scsi_target_it_flow	A target initiator-target (IT) flow view contains metadata and IO metrics for IT flows associated with various targets.	port, vsan, scsi-target-id, scsi-initiator-id, and vmid
nvme_target_it_flow	A target initiator-target (IT) flow view contains metadata and IO metrics for IT flows associated with various targets.	port, vsan, nvme-target-id, nvme-initiator-id, and vmid
scsi_initiator_it_flow	An initiator IT flow view contains metadata and IO metrics for the IT flows associated with various initiators.	port, vsan, scsi-initiator-id, scsi-target-id, and vmid

View Type	Description	Keys
nvme_initiator_it_flow	An initiator IT flow view contains metadata and IO metrics for the IT flows associated with various initiators.	port, vsan, nvme-initiator-id, nvme-target-id, and vmid
scsi_target_tl_flow	A target target-LUN (TL) flow view contains metadata and IO metrics for the LUNs associated with various SCSI targets.	port, vsan, scsi-target-id, and lun-id
nvme_target_tn_flow	A target target-namespace ID (TN) flow view contains metadata and IO metrics for the namespace IDs associated with various NVMe targets.	port, vsan, nvme-target-id, and namespace-id
scsi_target_itl_flow	A target initiator-target-LUN (ITL) flow view contains metadata and IO metrics for the ITL flows associated with various SCSI targets.	port, vsan, scsi-target-id, scsi-initiator-id, lun-id, and vmid
nvme_target_itn_flow	A target initiator-target-namespace ID (ITN) flow view contains metadata and IO metrics for the ITN flows associated with various NVMe targets.	port, vsan, nvme-target-id, nvme-initiator-id, namespace-id, and vmid
scsi_initiator_itl_flow	An initiator ITL flow view contains metadata and IO metrics for the ITL flows associated with various SCSI initiators.	port, vsan, scsi-initiator-id, scsi-target-id, lun-id, and vmid
nvme_initiator_itn_flow	An initiator ITN flow view contains metadata and IO metrics for the ITN flows associated with various NVMe initiators.	port, vsan, nvme-initiator-id, nvme-target-id, namespace-id, and vmid
scsi_target_io	A target IO view contains IO transaction details for the active IOs that various targets execute.	port, vsan, scsi-target-id, scsi-initiator-id, ox-id, and vmid
nvme_target_io	A target IO view contains IO transaction details for the active IOs that various targets execute.	port, vsan, nvme-target-id, nvme-initiator-id, ox-id, and vmid
scsi_initiator_io	An initiator IO view records IO transaction details for the active IOs that various initiators initiate.	port, vsan, scsi-initiator-id, scsi-target-id, ox-id, and vmid

View Type	Description	Keys
nvme_initiator_io	An initiator IO view records IO transaction details for the active IOs that various initiators initiate.	port, vsan, nvme-initiator-id, nvme-target-id, ox-id, and vmid

View Types Representation

Note The examples provided in this section are for SCSI analytics type and can be extended to the NVMe analytics type as well.

We have considered a sample topology to explain the different view types. In the following image:

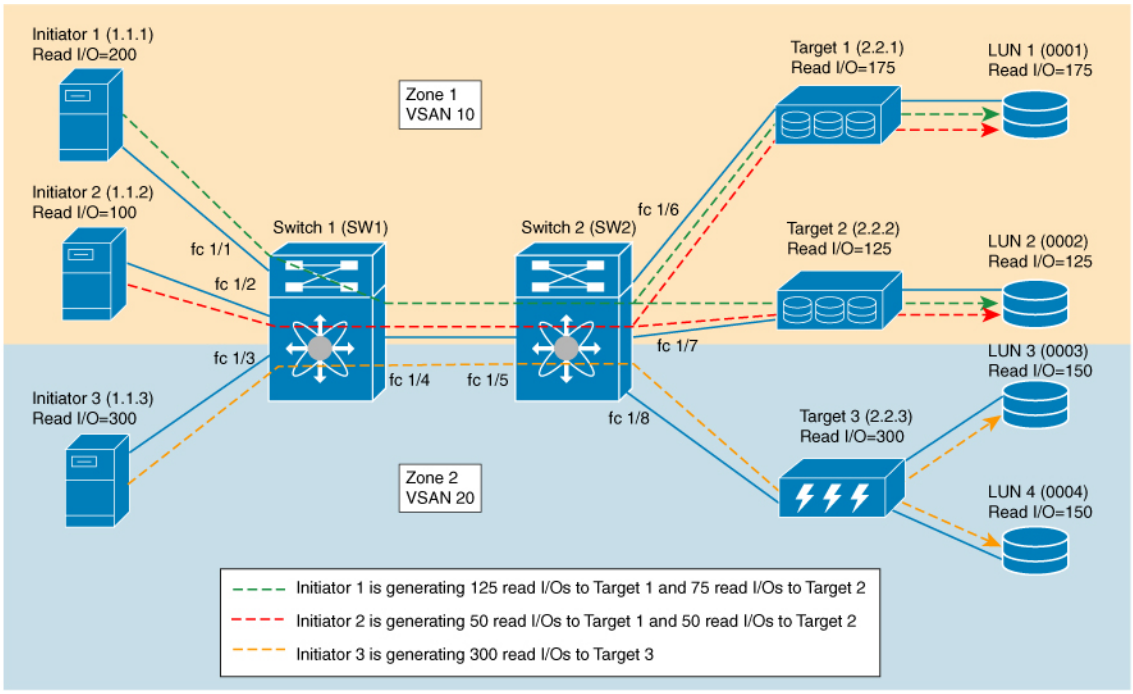
- Initiator 1 and Initiator 2 are configured in VSAN 1 and are communicating with Target 1, Target 2, LUN 1, and LUN 2 in zone 1.
  - Initiator 1 generates 125 read I/Os to Target 1 and 75 read I/Os to Target 2.
  - Initiator 2 generates 50 read I/Os to Target 1 and Target 2 respectively.
- Initiator 3 is configured in VSAN 2 and communicates with Target 3, LUN 3, and LUN 4 in zone 2.

  Initiator 3 generates 300 read I/Os to Target 3. Target 3 is generating 150 read I/Os to LUN 3 and LUN 4 respectively.

Note The information that is provided in brackets in the following images are the Fibre Channel IDs (FCIDs) of the devices.

For the list of supported view types and their descriptions, see List of Supported View Types, on page 29.

Figure 14: Sample Topology for View Types Representation



The following image shows the flow metrics as viewed from a port view type:

Figure 15: Port View Type

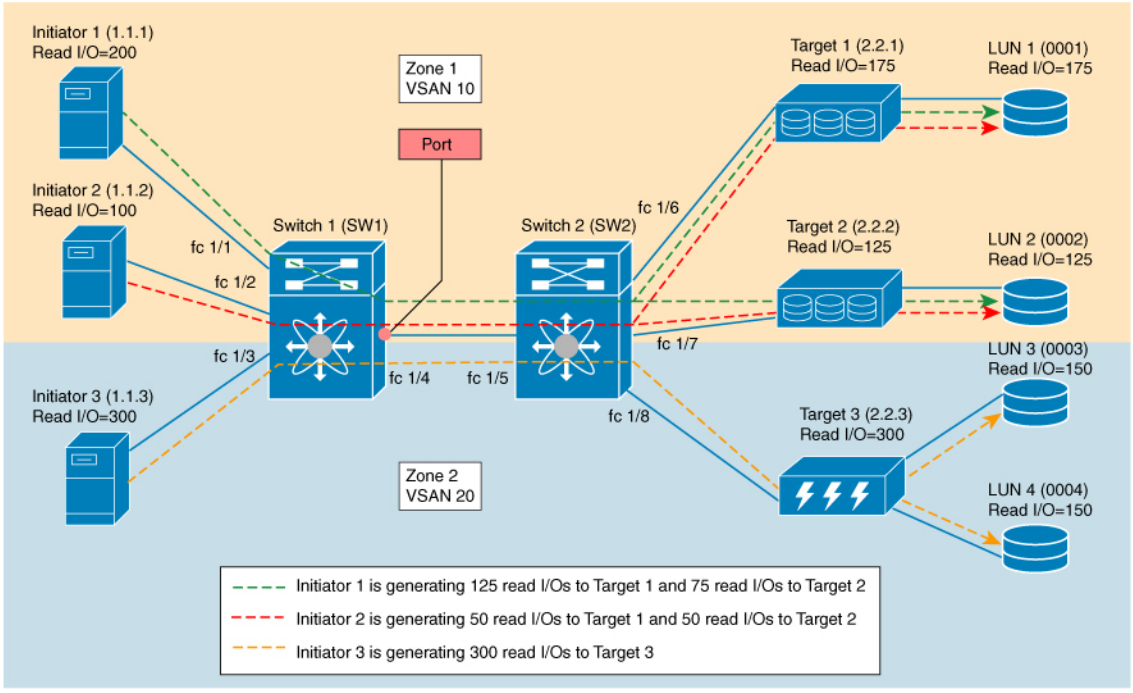


Table 5: Port View Type

Port View	Flow Metrics
Port view, where port = fc 1/4	total_read_io_count = 600 (read I/Os of all the initiators that are seen on the port)

The following image shows the flow metrics as viewed from a logical port view type:

Figure 16: Logical Port View Type

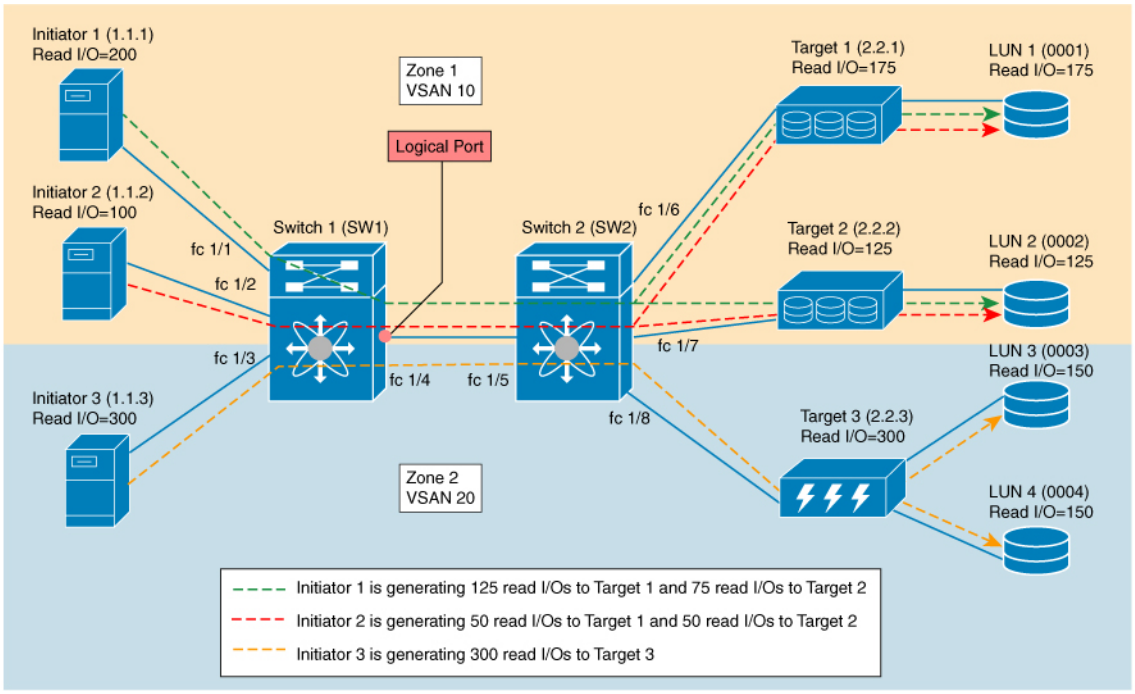


Table 6: Logical Port View Type

Logical Port View	Flow Metrics
Logical port, view where port = fc 1/4 and VSAN =1	total_read_io_count = 300 (read I/Os of all the initiators in VSAN 1)

The following image shows the flow metrics as viewed from a scsi_initiator view type:

Figure 17: scsi_initiator View Type

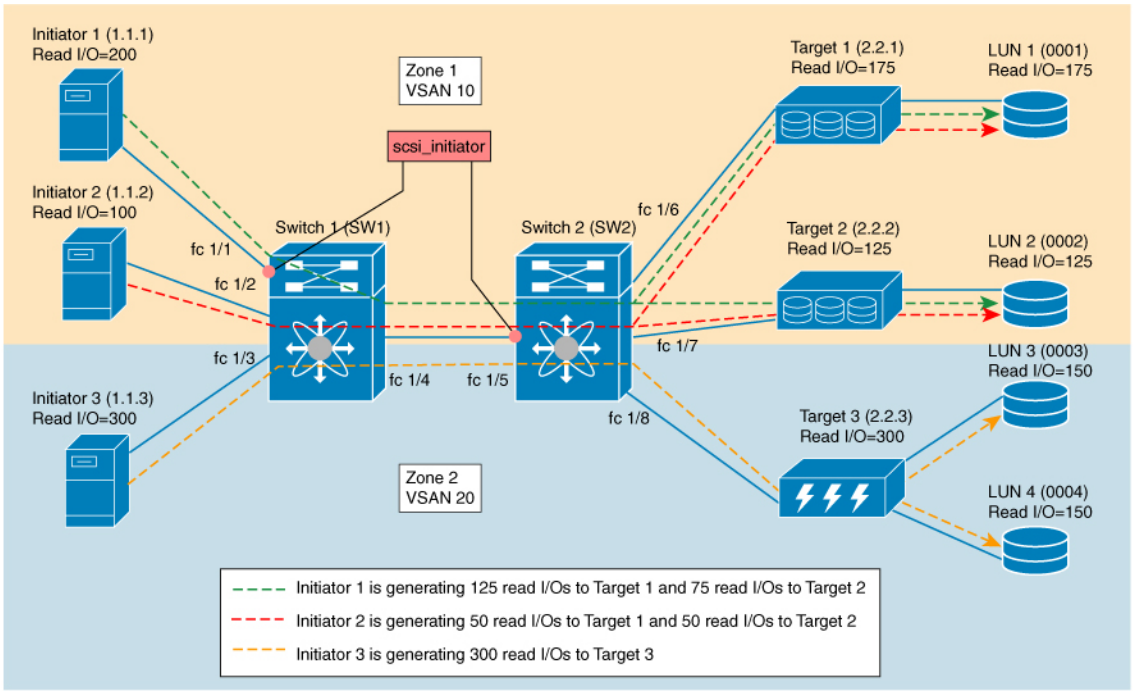


Table 7: scsi_initiator View Type

scsi_initiator View	Flow Metrics
scsi_initiator view, where port = fc 1/1, VSAN = 1, and initiator ID = 1.1.1 scsi_initiator view where port = fc 1/5, VSAN = 1, and initiator ID = 1.1.1	total_read_io_count = 200 (read I/Os of the initiator ID 1.1.1)
scsi_initiator view, where port = fc 1/5, VSAN = 1, and initiator ID = 1.1.2	total_read_io_count = 100 (read I/Os of the initiator ID 1.1.2)
scsi_initiator view, where port = fc 1/5, VSAN = 2, and initiator ID = 1.1.3	total_read_io_count = 300 (read I/Os of the initiator ID 1.1.3)

The following image shows the flow metrics as viewed from a scsi_target view type:

Figure 18: scsi_target View Type

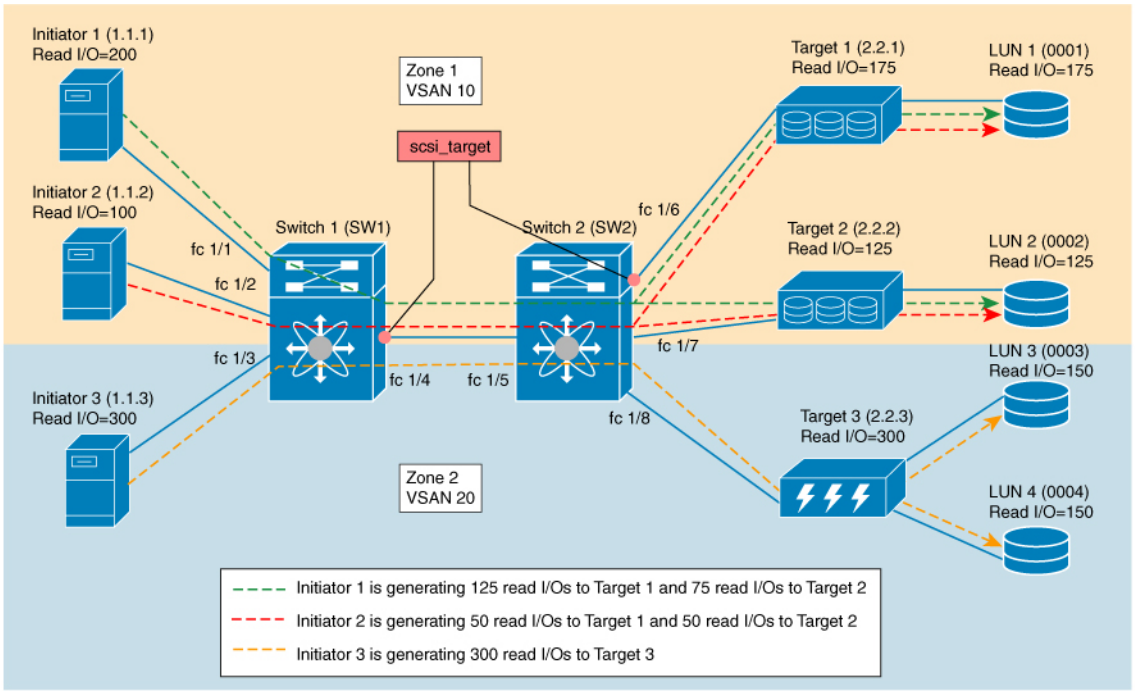


Table 8: scsi_target View Type

scsi_target View	Flow Metrics
scsi_target view, where port = fc 1/6, VSAN = 1, and target ID = 2.2.1 scsi_target view, where port = fc 1/4, VSAN = 1, and target ID = 2.2.1	total_read_io_count = 175 (read I/Os of the target ID 2.2.1)
scsi_target view, where port = fc 1/4, VSAN = 1, and target ID = 2.2.2	total_read_io_count = 125 (read I/Os of the target ID 2.2.2)
scsi_target view, where port = fc 1/4, VSAN = 2, and target ID = 2.2.3	total_read_io_count = 300 (read I/Os of the target ID 2.2.3)

The following image shows the flow metrics as viewed from a scsi_initiator_it_flow view type:

Figure 19: scsi_initiator_it_flow View Type

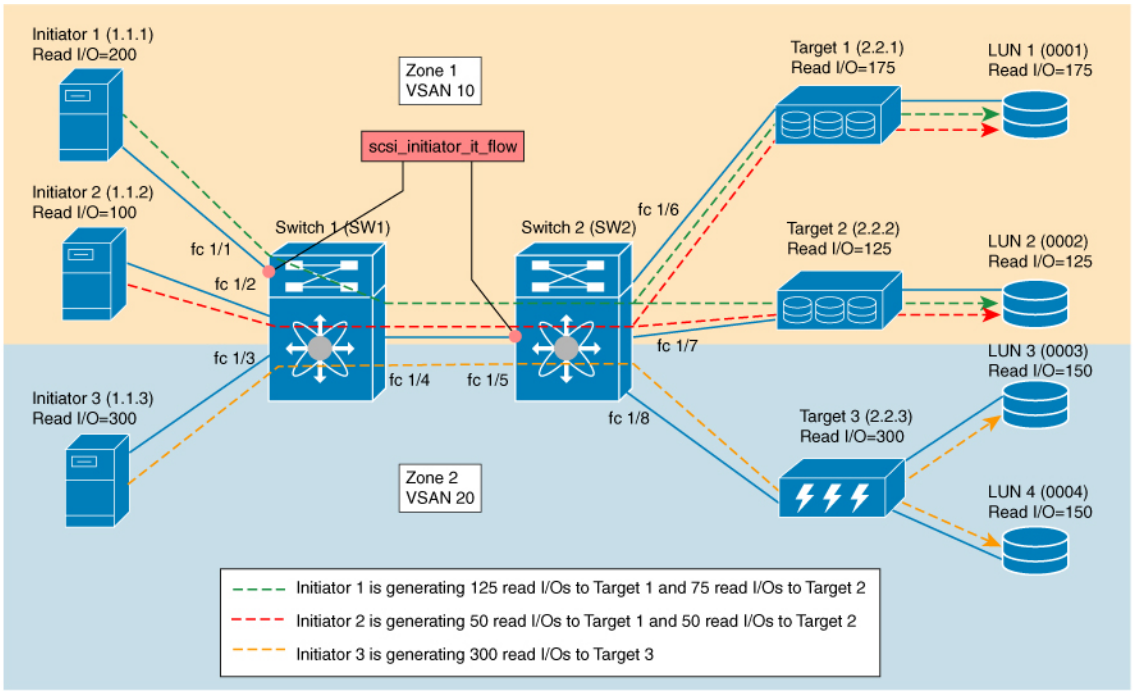


Table 9: scsi_initiator_it_flow View Type

scsi_initiator_it_flow View	Flow Metrics
scsi_initiator_it_flow view, where port = fc 1/1, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.1 scsi_initiator_it_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.1	total_read_io_count = 125 (read I/Os only between initiator ID 1.1.1 and target ID 2.2.1)
scsi_initiator_it_flow view, where port = fc 1/1, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.2 scsi_initiator_it_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.2	total_read_io_count = 75 (read I/Os only between initiator ID 1.1.1 and target ID 2.2.2)
scsi_initiator_it_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.2, and target ID = 2.2.1	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2 and target ID 2.2.1)
scsi_initiator_it_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.2, and target ID = 2.2.2	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2 and target ID 2.2.2)
scsi_initiator_it_flow view, where port = fc 1/5, VSAN = 2, initiator ID = 1.1.3, and target ID = 2.2.3	total_read_io_count = 300 (read I/Os only between initiator ID 1.1.3 and target ID 2.2.3)

The following image shows the flow metrics as viewed from a scsi_target_it_flow view type:

Figure 20: scsi_target_it_flow View Type

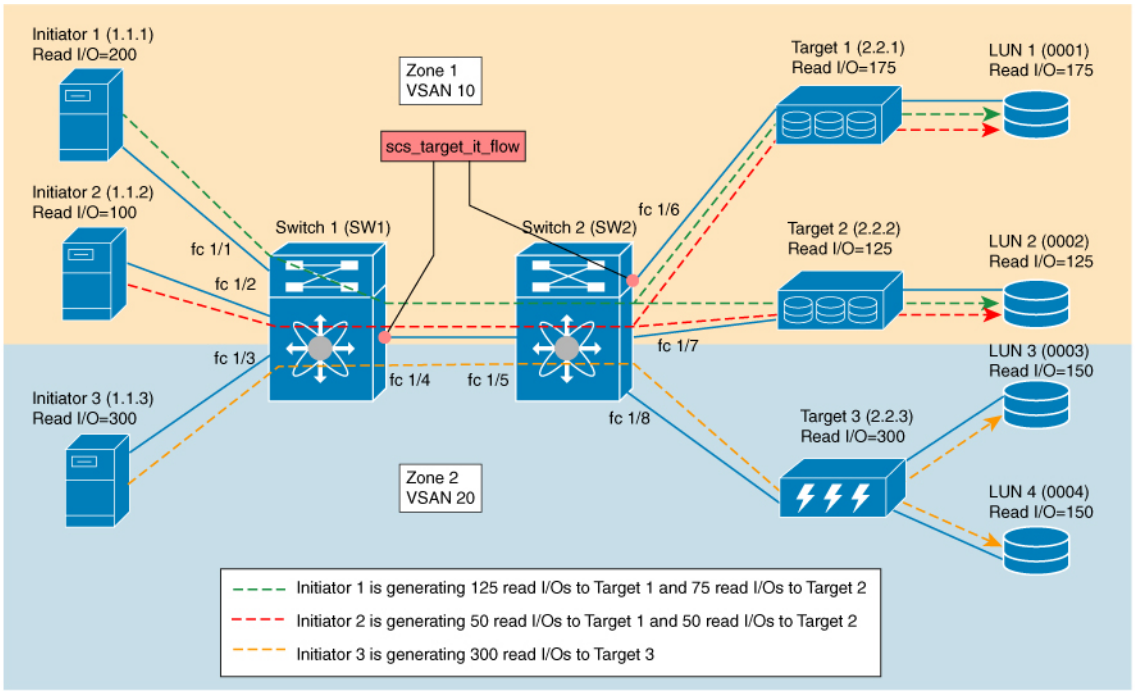


Table 10: scsi_target_it_flow View Type

scsi_target_it_flow View	Flow Metrics
scsi_target_it_flow view, where port = fc 1/6, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.1 scsi_target_it_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.1	total_read_io_count = 125 (read I/Os only between initiator ID 1.1.1 and target ID 2.2.1)
scsi_target_it_flow view, where port = fc 1/6, VSAN = 1, initiator ID = 1.1.2, and target ID = 2.2.1 scsi_target_it_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.2, and target ID = 2.2.1	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2 and target ID 2.2.1)
scsi_target_it_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.1, and target ID = 2.2.2	total_read_io_count = 75 (read I/Os only between initiator ID 1.1.1 and target ID 2.2.2)
scsi_target_it_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.2, and target ID = 2.2.2	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2 and target ID 2.2.2)
scsi_target_it_flow view, where port = fc 1/4, VSAN = 2, initiator ID = 1.1.3, and target ID = 2.2.3	total_read_io_count = 300 (read I/Os only between initiator ID 1.1.3 and target ID 2.2.3)

The following image shows the flow metrics as viewed from a scsi_initiator_itl_flow view type:

Figure 21: scsi_initiator_itl_flow View Type

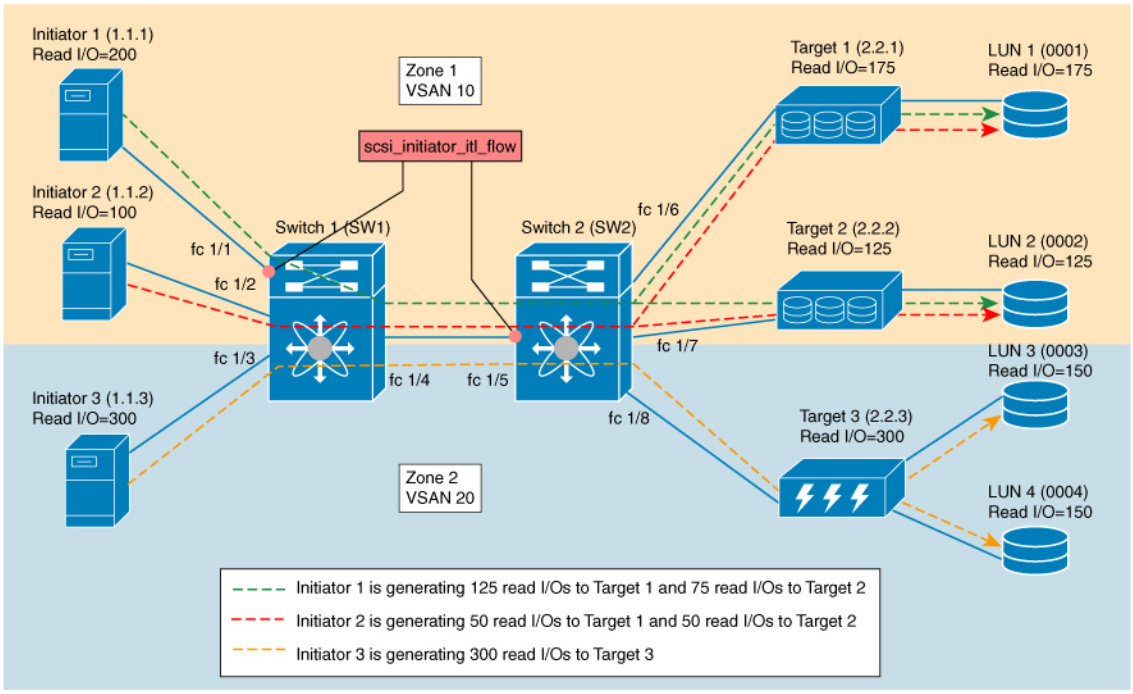


Table 11: scsi_initiator_itl_flow View Type

scsi_initiator_itl_flow View	Flow Metrics
scsi_initiator_itl_flow view, where port = fc 1/1, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.1, and LUN ID = 0001 scsi_initiator_itl_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.1, and LUN ID = 0001	total_read_io_count = 125 (read I/Os only between initiator ID 1.1.1, target ID 2.2.1, and LUN ID 0001)
scsi_initiator_itl_flow view, where port = fc 1/1, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.2, and LUN ID = 0002 scsi_initiator_itl_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.2, and LUN ID = 0002	total_read_io_count = 75 (read I/Os only between initiator ID 1.1.1, target ID 2.2.2, and LUN ID 0002)
scsi_initiator_itl_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.2, target ID = 2.2.1, and LUN ID = 0001 scsi_initiator_itl_flow view, where port = fc 1/5, VSAN = 1, initiator ID = 1.1.2, target ID = 2.2.2, and LUN ID = 0002	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2, target ID 2.2.1, and LUN ID 0001 and initiator ID 1.1.2, target ID 2.2.2, and LUN ID 0002)

scsi_initiator_itl_flow view, where port = fc 1/5, VSAN = 2, initiator ID = 1.1.3, target ID = 2.2.3, and LUN ID = 0003 scsi_initiator_itl_flow view, where port = fc 1/5, VSAN = 2, initiator ID = 1.1.3, target ID = 2.2.3, and LUN ID = 0004	total_read_io_count = 150 (read I/Os only between initiator ID 1.1.3, target ID 2.2.3, and LUN ID 0003, and initiator ID 1.1.3, target ID 2.2.3, and LUN ID 0004)

The following image shows the flow metrics as viewed from a scsi_target_itl_flow view type:

Figure 22: scsi_target_itl_flow View Type

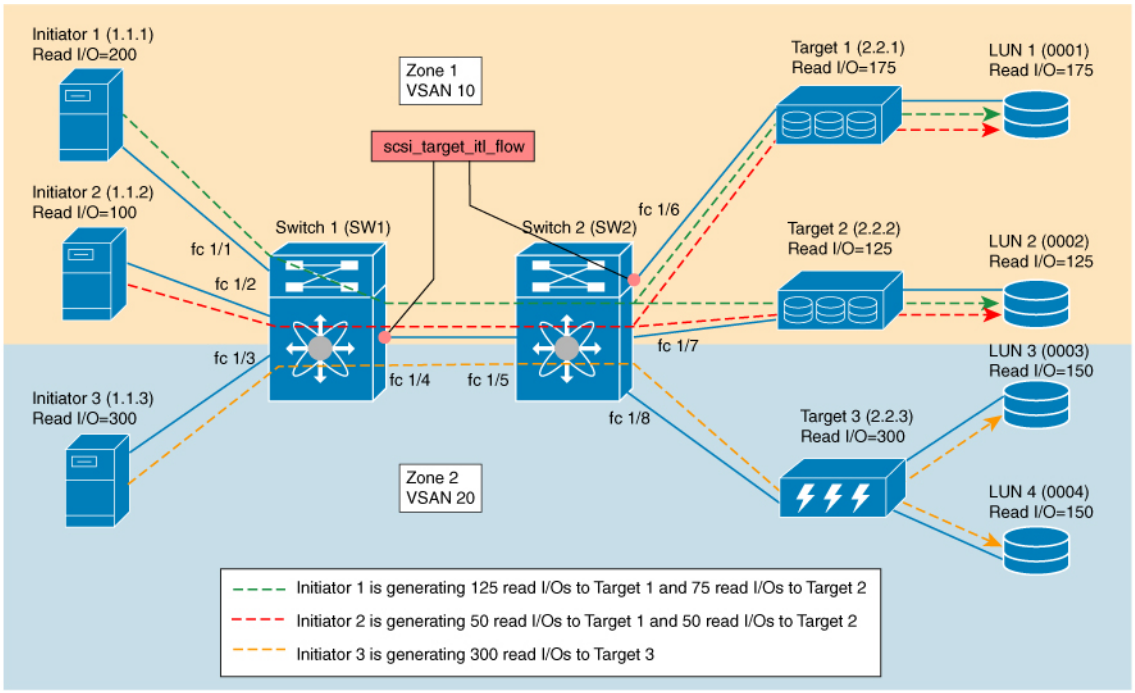


Table 12: scsi_target_itl_flow View Type

scsi_target_itl_flow View	Flow Metrics
scsi_target_itl_flow view, where port = fc 1/6, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.1, and LUN ID = 0001 scsi_target_itl_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.1, and LUN ID = 0001	total_read_io_count = 125 (read I/Os only between initiator ID 1.1.1, target ID 2.2.1, and LUN ID 0001)
scsi_target_itl_flow view, where port = fc 1/6, VSAN = 1, initiator ID = 1.1.2, target ID = 2.2.1, and LUN ID = 0001 scsi_target_itl_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.2, target ID = 2.2.1, and LUN ID = 0001	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2, target ID 2.2.1, and LUN ID 0001)

scsi_target_itl_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.1, target ID = 2.2.2, and LUN ID = 0002	total_read_io_count = 75 (read I/Os only between initiator ID 1.1.1, target ID 2.2.2, and LUN ID 0002)
scsi_target_itl_flow view, where port = fc 1/4, VSAN = 1, initiator ID = 1.1.2, target ID = 2.2.2, and LUN ID = 0002	total_read_io_count = 50 (read I/Os only between initiator ID 1.1.2, target ID 2.2.2, and LUN ID 0002)
scsi_target_itl_flow view, where port = fc 1/4, VSAN = 2, initiator ID = 1.1.3, target ID = 2.2.3, and LUN ID = 0003 scsi_target_itl_flow view, where port = fc 1/4, VSAN = 2, initiator ID = 1.1.3, target ID = 2.2.3, and LUN ID = 0004	total_read_io_count = 150 (read I/Os only between initiator ID 1.1.3, target ID 2.2.3, and LUN ID 0003, and initiator ID 1.1.3, target ID 2.2.3, and LUN ID 0004)

The following image shows the flow metrics as viewed from a scsi_target_tl_flow view type:

Figure 23: scsi_target_tl_flow View Type

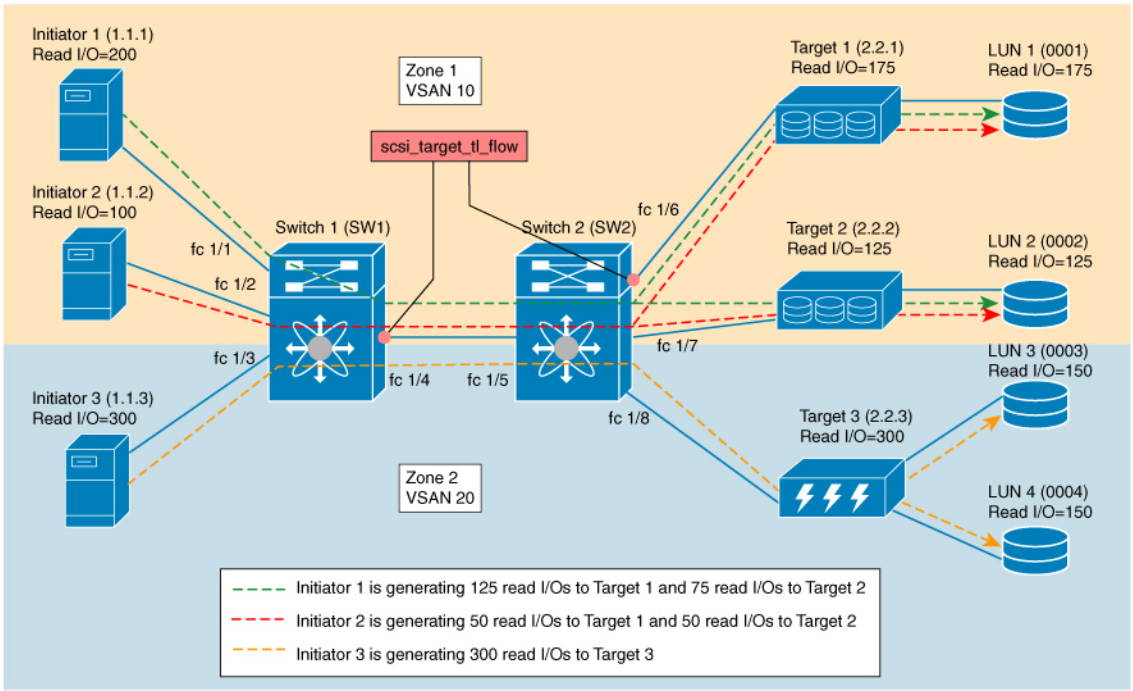


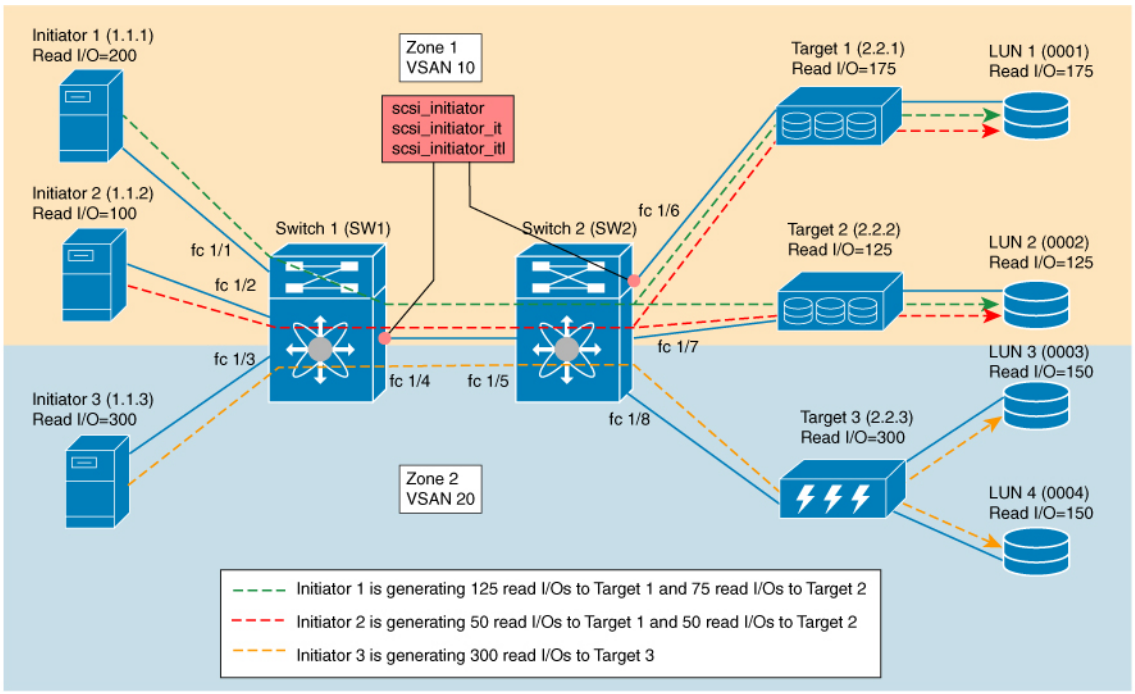
Table 13: scsi_target_tl_flow View Type

scsi_target_tl_flow View	Flow Metrics
scsi_target_tl_flow view, where port = fc 1/6, VSAN = 1, target ID = 2.2.1, and LUN ID = 0001 scsi_target_tl_flow view, where port = fc 1/4, VSAN = 1, target ID = 2.2.1, and LUN ID = 0001	total_read_io_count = 175 (read I/Os only between target ID 2.2.1 and LUN ID 0001)

scsi_target_tl_flow view, where port = fc 1/4, VSAN = 1, target ID = 2.2.2, and LUN ID = 0002	total_read_io_count = 125 (read I/Os only between target ID 2.2.2 and LUN ID 0002)
scsi_target_tl_flow view, where port = fc 1/4, VSAN = 2, target ID = 2.2.3, and LUN ID = 0003 scsi_target_tl_flow view, where port = fc 1/4, VSAN = 2, target ID = 2.2.3, and LUN ID = 0004	total_read_io_count = 150 (read I/Os only between target ID 2.2.3 and LUN ID 0003 and target ID 2.2.3 and LUN ID 0004)

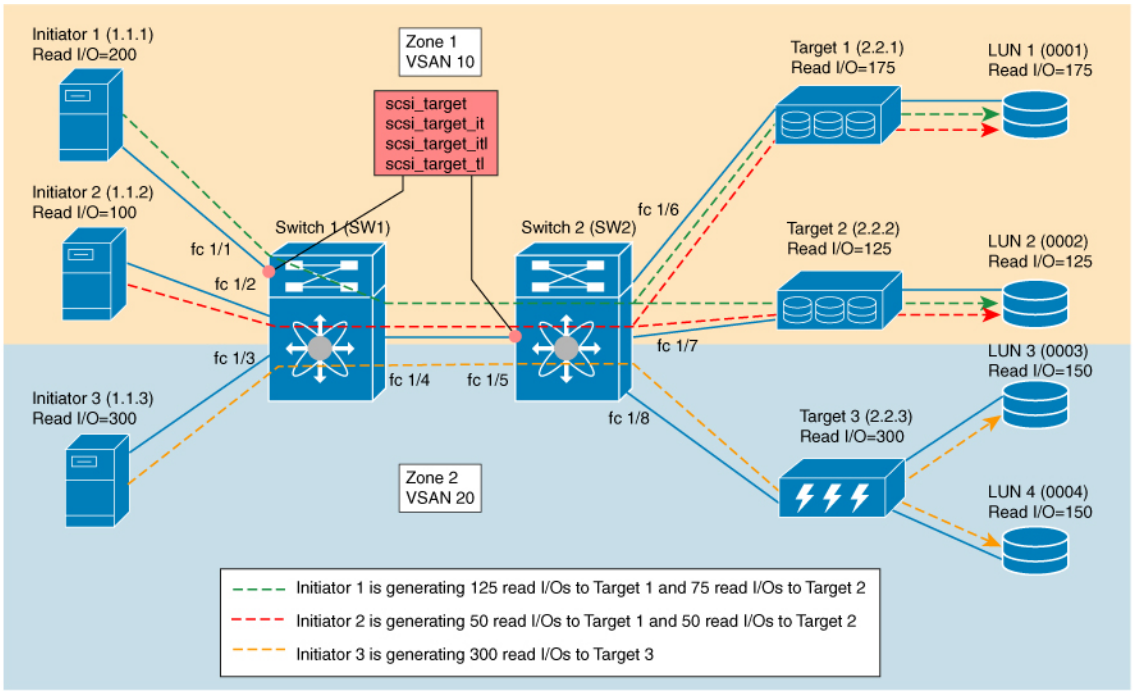
The following image shows initiator views where the total_read_io_count is 0.

Figure 24: Initiator Views Where the total_read_io_count is Zero



The following image shows target views where the total_read_io_count is 0.

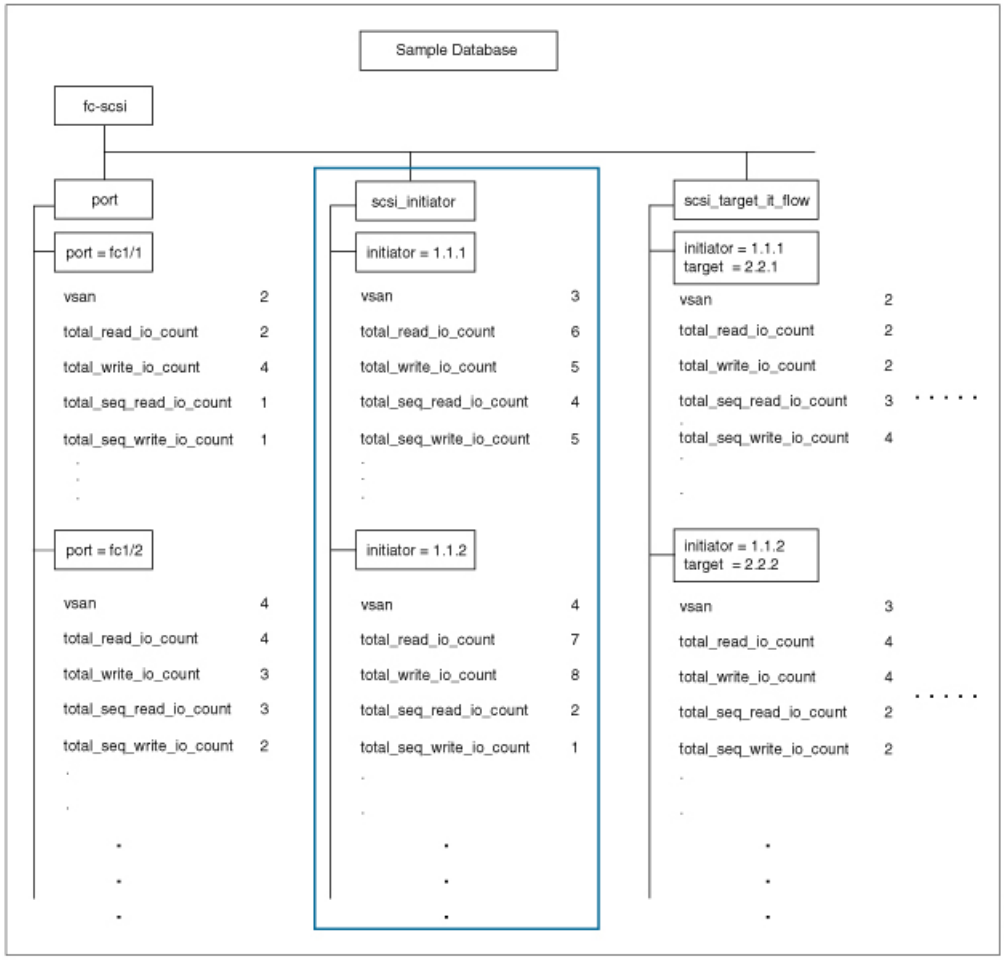
Figure 25: Target Views Where the total_read_io_count is Zero



Examples: Configuring Query Syntax

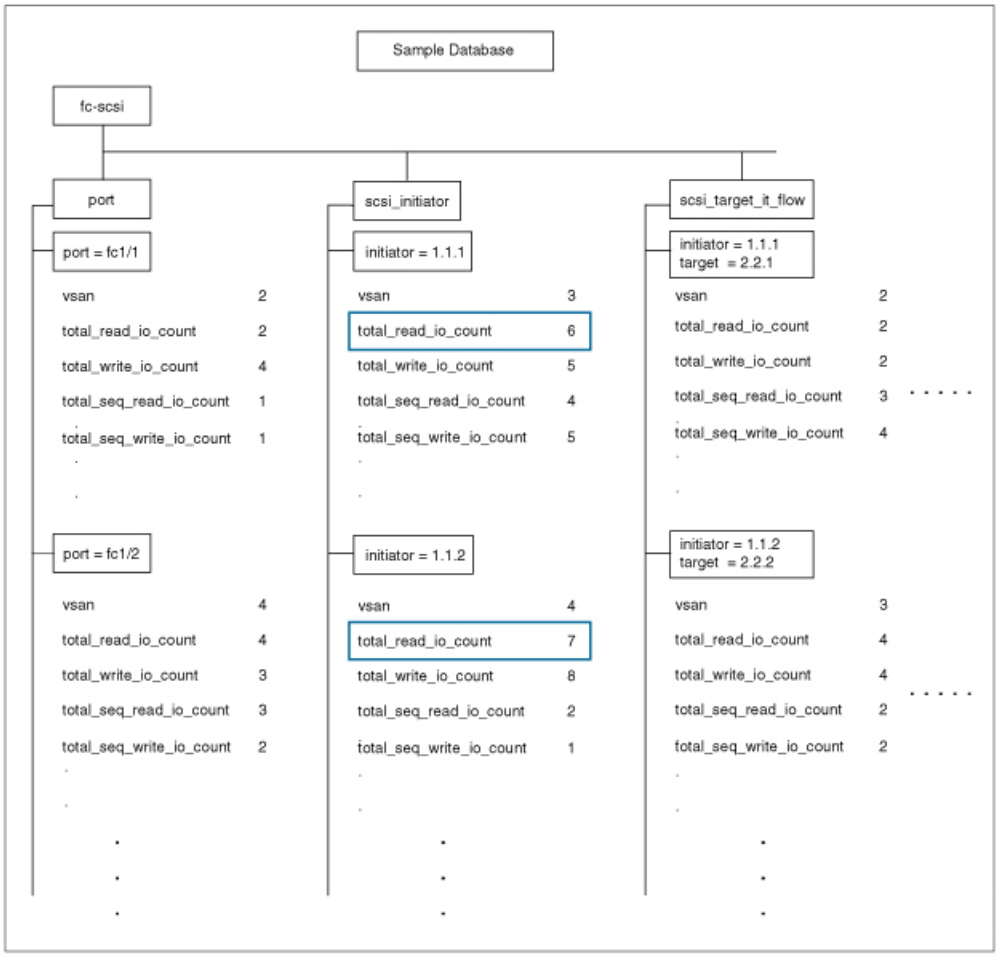
The **show analytics query 'select all from fc-scsi.scsi_initiator'** command provides an output of the flow metrics of all the initiators, as seen in the sample database shown in the following image:

Figure 26: Flow Metrics of all the Initiators



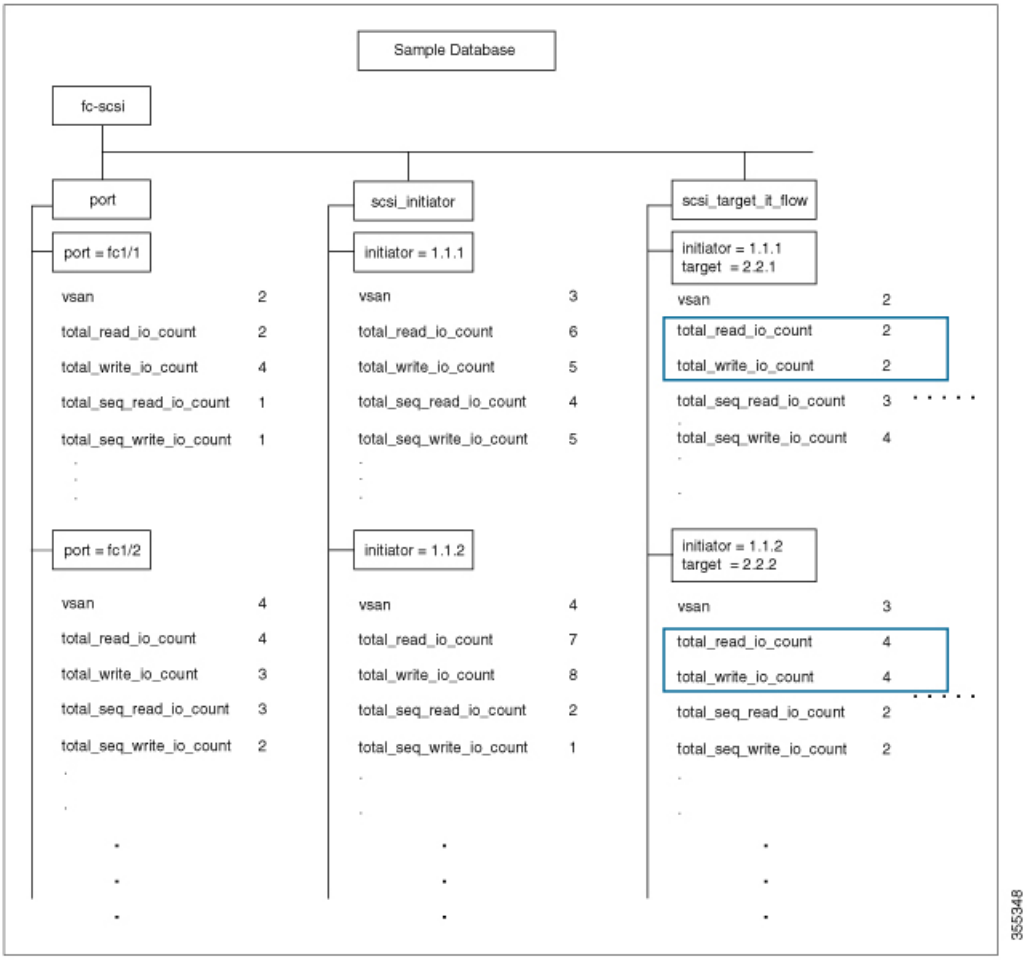
The **show analytics query 'select total_read_io_count from fc-scsi.scsi_initiator'** command provides an output of a target's total_read_io_count flow metrics, as seen in the sample database in the following image:

Figure 27: Flow Metrics of a Target's Total Read IO Count



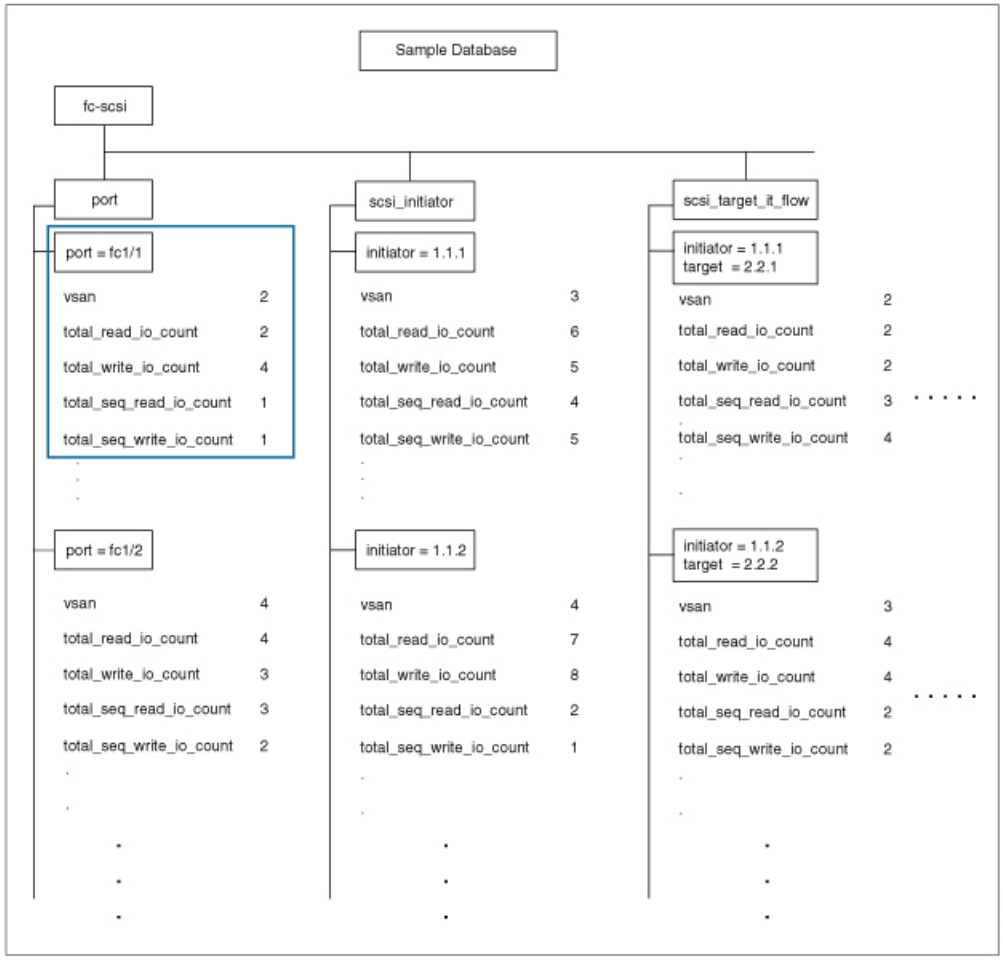
The **show analytics query 'select total_read_io_count,total_write_io_count from fc-scsi.scsi_target_it_flow'** command provides an output of an initiator's and a target's total_read_io_count and total_write_io_count flow metrics viewed from the target, as seen in the sample database in the following image:

Figure 28: Flow Metrics of an Initiator's and Target's Total Read IO Count and Total Write IO Count



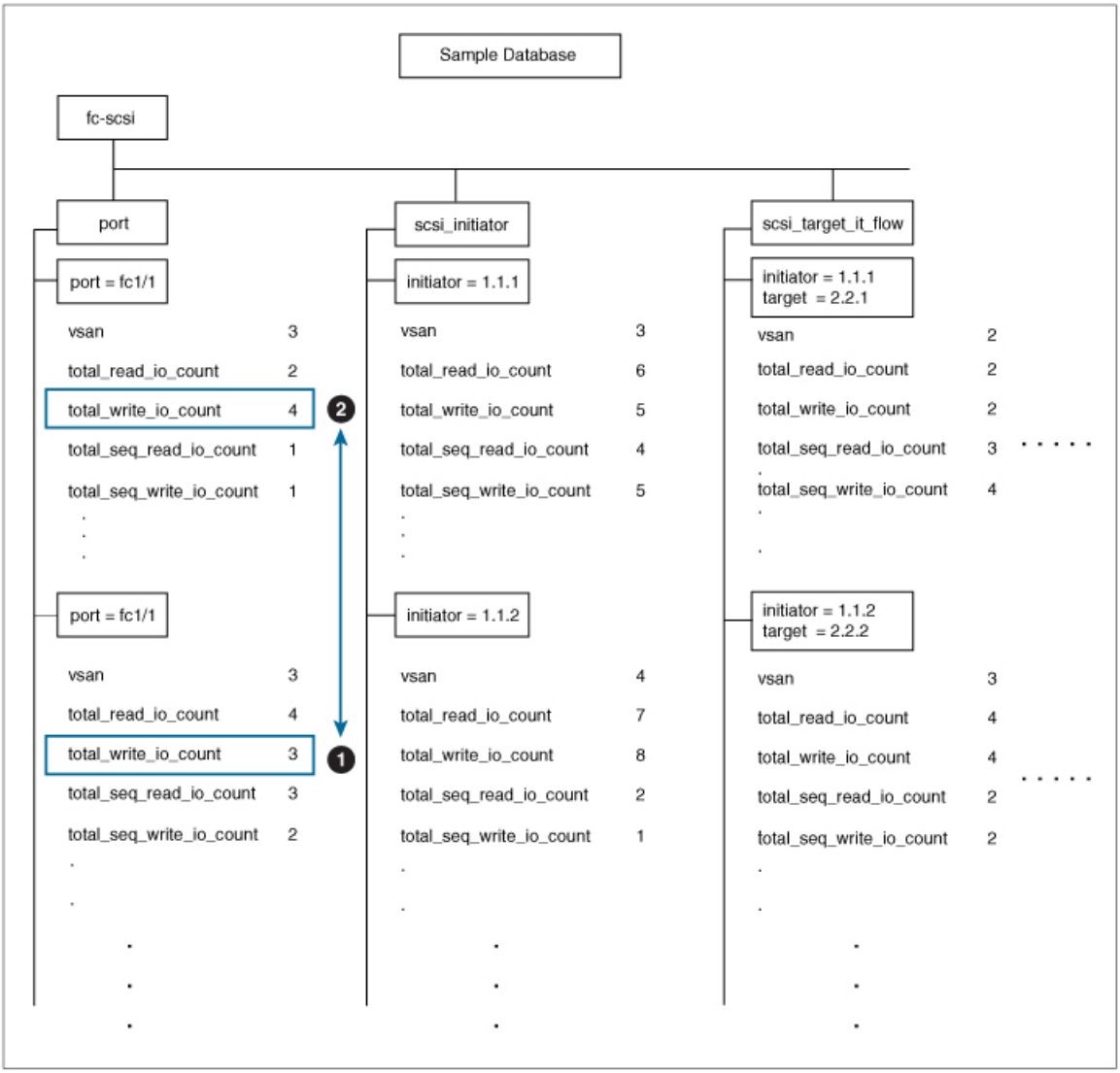
The **show analytics query 'select all from fc-scsi.port where port=fc1/1 and vsan=2 limit 1'** command provides an output of a port's flow metrics that are a part of port fc1/1, VSAN 2, with the number of records is limited to one, as seen in the sample database in the following image:

Figure 29: Flow Metrics of the Port FC 1/1 That Belongs to VSAN 2 With the Number of Records Limited to One



The **show analytics query 'select all from fc-scsi.scsi_initiator where port=fc1/1 and vsan=3 sort total_write_io_count'** command provides an output of an initiator's total_write_io_count flow metrics that are a part of port fc1/1 and VSAN 3, and the output is sorted, as seen in the sample database in the following image:

Figure 30: Flow Metrics of an Initiator's Total Write IO Count That Belongs to Port FC1/1 and VSAN 3 With the Output Sorted



Constructing and Using Queries

Flow metrics are analyzed by using a *query_string* that is in the form of a query syntax.

Displaying the Installed Push Queries

To display the installed push queries, run this command:

switch# **show analytics query** {**all** | **name** *query_name*}

Displaying the Results of a Push Query

To display the results of a push query, run this command:

switch# **show analytics query name** *query_name* **result**

Executing a Pull Query

To execute a pull query, run this command:

switch# **show analytics query** *"query_string"* [**clear**] [**differential**]

Note Use the *"query_string"* to specify query semantics, such as **select**, **table**, **limit**, and so on, for example, *"select all from fc-scsi.port"*.

Configuring a Push Query

To configure a push query, perform these steps:

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Specify a query string and a timer value for the flow metrics to be displayed at specific intervals:

switch(config)# **analytics query** *"query_string"* **name** *query_name* **type periodic** [**interval** *seconds*] [**clear**] [**differential**]

Only one push query using a *"query_string"* is allowed at a time. If you try to configure a duplicate push query name, a message is returned stating that the current configuration is a duplicate.

Note Pull query, push query, and overlay CLI are applicable only on interfaces where the SAN Analytics feature is enabled.

Removing a Configured Push Query

To remove a configured push query, perform these steps:

Procedure

Step 1 Enter global configuration mode:

switch# **configure terminal**

Step 2 Remove a configured push query:

switch(config)# **no analytics name** *query_name*

Clearing Metrics

To reset all the flow metrics for a view instance that match the query string, run this command:

switch# **clear analytics query** *"query_string"*

Note

- The *"query_string"* must have the format *"select all from <view-name>"*.
- You can clear the flow metrics without installing a push query.
- The **clear analytics query** command is different from the **clear** option that is used in a push query. The **clear analytics query** command resets all the metrics that meet the query syntax and the **clear** option that is used in a push query resets the minimum, maximum, and peak flow metrics.

Purging Views

To delete a specific view instance and its associated metrics, run this command:

switch# **purge analytics query** *"query_string"*

Note

- The *"query_string"* must have the format *"select all from <view-name>"*.
- You can clear the flow metrics without installing a push query.
- The **where** clause in the purge query can accept only the *port* key field.

Displaying the Results of a Configured Push Query

The flow metrics that are displayed using the **show analytics query name** *query_name* **result** command are the refreshed metrics at the time interval when this command was executed. For example, if a push query is configured to refresh at an interval of every 30 seconds, and the **show analytics query name** *query_name* **result** command is executed after 35 seconds, the push query displays the flow metrics that were refreshed when the time interval was 30 seconds.

To display the flow metrics of a configured push query, run this command:

switch# **show analytics query name** *query_name* **result**

Example: Constructing and Using Queries

Note

- The number after *"values"* in the output indicates the corresponding number of a record.
- New metrics are added in Cisco MDS NX-OS Release 8.3(1) because of which the query results may vary slightly between Cisco MDS NX-OS Release 8.3(1) and later releases and Cisco MDS NX-OS Release 8.2(1).

This example shows the output of all the flow metrics of the SCSI initiator ITL flow view instance:

```
switch#  show analytics query 'select all from fc-scsi.scsi_initiator_itl_flow'
{ "values": {
        "1": {
                "port": "fc1/1",
                "vsan": "10",
                "app_id": "255",
                "initiator_id": "0xe80041",
                "target_id": "0xd60200",
                "lun": "0000-0000-0000-0000",
                "active_io_read_count": "0",
                "active_io_write_count": "1",
                "total_read_io_count": "0",
                "total_write_io_count": "1162370362",
                "total_seq_read_io_count": "0",
                "total_seq_write_io_count": "1",
                "total_read_io_time": "0",
                "total_write_io_time": "116204704658",
                "total_read_io_initiation_time": "0",
                "total_write_io_initiation_time": "43996934029",
                "total_read_io_bytes": "0",
                "total_write_io_bytes": "595133625344",
                "total_read_io_inter_gap_time": "0",
                "total_write_io_inter_gap_time": "41139462314556",
                "total_time_metric_based_read_io_count": "0",
                "total_time_metric_based_write_io_count": "1162370358",
                "total_time_metric_based_read_io_bytes": "0",
                "total_time_metric_based_write_io_bytes": "595133623296",
                "read_io_rate": "0",
                "peak_read_io_rate": "0",
                "write_io_rate": "7250",
                "peak_write_io_rate": "7304",
                "read_io_bandwidth": "0",
                "peak_read_io_bandwidth": "0",
                "write_io_bandwidth": "3712384",
                "peak_write_io_bandwidth": "3739904",
                "read_io_size_min": "0",
                "read_io_size_max": "0",
                "write_io_size_min": "512",
                "write_io_size_max": "512",
                "read_io_completion_time_min": "0",
                "read_io_completion_time_max": "0",
                "write_io_completion_time_min": "89",
                "write_io_completion_time_max": "416",
                "read_io_initiation_time_min": "0",
                "read_io_initiation_time_max": "0",
                "write_io_initiation_time_min": "34",
                "write_io_initiation_time_max": "116",
                "read_io_inter_gap_time_min": "0",
```

```
            "read_io_inter_gap_time_max": "0",
            "write_io_inter_gap_time_min": "31400",
            "write_io_inter_gap_time_max": "118222",
            "peak_active_io_read_count": "0",
            "peak_active_io_write_count": "5",
            "read_io_aborts": "0",
            "write_io_aborts": "0",
            "read_io_failures": "0",
            "write_io_failures": "0",
            "read_io_scsi_check_condition_count": "0",
            "write_io_scsi_check_condition_count": "0",
            "read_io_scsi_busy_count": "0",
            "write_io_scsi_busy_count": "0",
            "read_io_scsi_reservation_conflict_count": "0",
            "write_io_scsi_reservation_conflict_count": "0",
            "read_io_scsi_queue_full_count": "0",
            "write_io_scsi_queue_full_count": "0",
            "sampling_start_time": "1528535447",
            "sampling_end_time": "1528697457"
    },
.
.
.
    "5": {
            "port": "fc1/8",
            "vsan": "10",
            "app_id": "255",
            "initiator_id": "0xe80001",
            "target_id": "0xe800a1",
            "lun": "0000-0000-0000-0000",
            "active_io_read_count": "0",
            "active_io_write_count": "1",
            "total_read_io_count": "0",
            "total_write_io_count": "1138738309",
            "total_seq_read_io_count": "0",
            "total_seq_write_io_count": "1",
            "total_read_io_time": "0",
            "total_write_io_time": "109792480881",
            "total_read_io_initiation_time": "0",
            "total_write_io_initiation_time": "39239145641",
            "total_read_io_bytes": "0",
            "total_write_io_bytes": "583034014208",
            "total_read_io_inter_gap_time": "0",
            "total_write_io_inter_gap_time": "41479779998852",
            "total_time_metric_based_read_io_count": "0",
            "total_time_metric_based_write_io_count": "1138738307",
            "total_time_metric_based_read_io_bytes": "0",
            "total_time_metric_based_write_io_bytes": "583034013184",
            "read_io_rate": "0",
            "peak_read_io_rate": "0",
            "write_io_rate": "7074",
            "peak_write_io_rate": "7903",
            "read_io_bandwidth": "0",
            "peak_read_io_bandwidth": "0",
            "write_io_bandwidth": "3622144",
            "peak_write_io_bandwidth": "4046336",
            "read_io_size_min": "0",
            "read_io_size_max": "0",
            "write_io_size_min": "512",
            "write_io_size_max": "512",
            "read_io_completion_time_min": "0",
            "read_io_completion_time_max": "0",
            "write_io_completion_time_min": "71",
            "write_io_completion_time_max": "3352",
```

```
                    "read_io_initiation_time_min": "0",
                    "read_io_initiation_time_max": "0",
                    "write_io_initiation_time_min": "26",
                    "write_io_initiation_time_max": "2427",
                    "read_io_inter_gap_time_min": "0",
                    "read_io_inter_gap_time_max": "0",
                    "write_io_inter_gap_time_min": "25988",
                    "write_io_inter_gap_time_max": "868452",
                    "peak_active_io_read_count": "0",
                    "peak_active_io_write_count": "5",
                    "read_io_aborts": "0",
                    "write_io_aborts": "0",
                    "read_io_failures": "0",
                    "write_io_failures": "0",
                    "read_io_scsi_check_condition_count": "0",
                    "write_io_scsi_check_condition_count": "0",
                    "read_io_scsi_busy_count": "0",
                    "write_io_scsi_busy_count": "0",
                    "read_io_scsi_reservation_conflict_count": "0",
                    "write_io_scsi_reservation_conflict_count": "0",
                    "read_io_scsi_queue_full_count": "0",
                    "write_io_scsi_queue_full_count": "0",
                    "sampling_start_time": "1528535447",
                    "sampling_end_time": "1528697457"
            }
}}
```


This example shows the output of all the flow metrics of the NVMe initiator ITN flow view instance:


```
switch# show analytics query 'select all from fc-nvme.nvme_initiator_itn_flow'
{ "values": {
        "1": {
                    "port": "fc1/9",
                    "vsan": "5",
                    "app_id": "255",
                    "initiator_id": "0xa40160",
                    "target_id": "0xa4018c",
                    "connection_id": "0000-0000-0000-0000",
                    "namespace_id": "1",
                    "active_io_read_count": "0",
                    "active_io_write_count": "0",
                    "total_read_io_count": "414106348",
                    "total_write_io_count": "0",
                    "total_seq_read_io_count": "0",
                    "total_seq_write_io_count": "0",
                    "total_read_io_time": "204490863437",
                    "total_write_io_time": "0",
                    "total_read_io_initiation_time": "132775579977",
                    "total_write_io_initiation_time": "0",
                    "total_read_io_bytes": "16226866588672",
                    "total_write_io_bytes": "0",
                    "total_read_io_inter_gap_time": "19198018763772",
                    "total_write_io_inter_gap_time": "0",
                    "total_time_metric_based_read_io_count": "414106244",
                    "total_time_metric_based_write_io_count": "0",
                    "total_time_metric_based_read_io_bytes": "16226860198912",
                    "total_time_metric_based_write_io_bytes": "0",
                    "read_io_rate": "0",
                    "peak_read_io_rate": "16826",
                    "write_io_rate": "0",
                    "peak_write_io_rate": "0",
                    "read_io_bandwidth": "0",
                    "peak_read_io_bandwidth": "656438400",
```

```
            "write_io_bandwidth": "0",
            "peak_write_io_bandwidth": "0",
            "read_io_size_min": "1024",
            "read_io_size_max": "262144",
            "write_io_size_min": "0",
            "write_io_size_max": "0",
            "read_io_completion_time_min": "16",
            "read_io_completion_time_max": "7057",
            "write_io_completion_time_min": "0",
            "write_io_completion_time_max": "0",
            "read_io_initiation_time_min": "16",
            "read_io_initiation_time_max": "5338",
            "write_io_initiation_time_min": "0",
            "write_io_initiation_time_max": "0",
            "read_io_inter_gap_time_min": "32",
            "read_io_inter_gap_time_max": "83725169",
            "write_io_inter_gap_time_min": "0",
            "write_io_inter_gap_time_max": "0",
            "peak_active_io_read_count": "11",
            "peak_active_io_write_count": "0",
            "read_io_aborts": "24",
            "write_io_aborts": "0",
            "read_io_failures": "80",
            "write_io_failures": "0",
            "read_io_timeouts": "0",
            "write_io_timeouts": "0",
            "read_io_nvme_lba_out_of_range_count": "0",
            "write_io_nvme_lba_out_of_range_count": "0",
            "read_io_nvme_ns_not_ready_count": "0",
            "write_io_nvme_ns_not_ready_count": "0",
            "read_io_nvme_reservation_conflict_count": "0",
            "write_io_nvme_reservation_conflict_count": "0",
            "read_io_nvme_capacity_exceeded_count": "0",
            "write_io_nvme_capacity_exceeded_count": "0",
            "sampling_start_time": "1512847422",
            "sampling_end_time": "1513166516"
        },
.
.
.
        "5": {
            "port": "fc1/9",
            "vsan": "5",
            "app_id": "255",
            "initiator_id": "0xa40165",
            "target_id": "0xa40190",
            "connection_id": "0000-0000-0000-0000",
            "namespace_id": "1",
            "active_io_read_count": "0",
            "active_io_write_count": "0",
            "total_read_io_count": "33391955",
            "total_write_io_count": "643169087",
            "total_seq_read_io_count": "0",
            "total_seq_write_io_count": "0",
            "total_read_io_time": "13005795783",
            "total_write_io_time": "131521212441",
            "total_read_io_initiation_time": "5696099596",
            "total_write_io_initiation_time": "71938348902",
            "total_read_io_bytes": "1309083368448",
            "total_write_io_bytes": "329302572544",
            "total_read_io_inter_gap_time": "19175084866843",
            "total_write_io_inter_gap_time": "19182318062480",
            "total_time_metric_based_read_io_count": "33391919",
            "total_time_metric_based_write_io_count": "643168808",
```

```
                "total_time_metric_based_read_io_bytes": "1309074355200",
                "total_time_metric_based_write_io_bytes": "329302429696",
                "read_io_rate": "0",
                "peak_read_io_rate": "574",
                "write_io_rate": "0",
                "peak_write_io_rate": "9344",
                "read_io_bandwidth": "0",
                "peak_read_io_bandwidth": "19122176",
                "write_io_bandwidth": "0",
                "peak_write_io_bandwidth": "4784384",
                "read_io_size_min": "1024",
                "read_io_size_max": "262144",
                "write_io_size_min": "512",
                "write_io_size_max": "512",
                "read_io_completion_time_min": "16",
                "read_io_completion_time_max": "5123",
                "write_io_completion_time_min": "27",
                "write_io_completion_time_max": "2254",
                "read_io_initiation_time_min": "16",
                "read_io_initiation_time_max": "3650",
                "write_io_initiation_time_min": "12",
                "write_io_initiation_time_max": "1377",
                "read_io_inter_gap_time_min": "32",
                "read_io_inter_gap_time_max": "3234375975",
                "write_io_inter_gap_time_min": "32",
                "write_io_inter_gap_time_max": "38886219",
                "peak_active_io_read_count": "6",
                "peak_active_io_write_count": "16",
                "read_io_aborts": "6",
                "write_io_aborts": "18",
                "read_io_failures": "30",
                "write_io_failures": "261",
                "read_io_timeouts": "0",
                "write_io_timeouts": "0",
                "read_io_nvme_lba_out_of_range_count": "0",
                "write_io_nvme_lba_out_of_range_count": "0",
                "read_io_nvme_ns_not_ready_count": "0",
                "write_io_nvme_ns_not_ready_count": "0",
                "read_io_nvme_reservation_conflict_count": "0",
                "write_io_nvme_reservation_conflict_count": "0",
                "read_io_nvme_capacity_exceeded_count": "0",
                "write_io_nvme_capacity_exceeded_count": "0",
                "sampling_start_time": "1512847422",
                "sampling_end_time": "1513166516"
        }
}}
```

This example shows the output of specific flow metrics for a specific initiator ID of an initiator ITL flow view instance:

```
switch#   show analytics query 'select
port,initiator_id,target_id,lun,total_read_io_count,total_write_io_count,read_io_rate,write_io_rate
 from fc-scsi.scsi_initiator_itl_flow where initiator_id=0xe80001'
{ "values": {
        "1": {
                "port": "fc1/8",
                "initiator_id": "0xe80001",
                "target_id": "0xe800a1",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1139010960",
```

```
                "read_io_rate": "0",
                "write_io_rate": "7071",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697495"
        }
}}
```

This example shows the output of specific flow metrics for a specific initiator ID and LUN of an initiator ITL flow view instance:

```
switch#   show analytics query 'select
port,initiator_id,target_id,lun,total_read_io_count,total_write_io_count,read_io_rate,write_io_rate
 from fc-scsi.scsi_initiator_itl_flow where initiator_id=0xe80001 and lun=0000-0000-0000-0000'
{ "values": {
        "1": {
                "port": "fc1/8",
                "initiator_id": "0xe80001",
                "target_id": "0xe800a1",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1139453979",
                "read_io_rate": "0",
                "write_io_rate": "7070",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697559"
        }
}}
```

This example shows the output of specific flow metrics for a specific LUN, with the output sorted for the write_io_rate metrics of a target ITL flow view instance:

```
switch#   show analytics query 'select
port,initiator_id,target_id,lun,total_read_io_count,total_write_io_count,read_io_rate,write_io_rate
 from fc-scsi.scsi_target_itl_flow where lun=0000-0000-0000-0000 sort write_io_rate'
{ "values": {
        "1": {
                "port": "fc1/6",
                "initiator_id": "0xe80020",
                "target_id": "0xd60040",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1103394068",
                "read_io_rate": "0",
                "write_io_rate": "6882",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697630"
        },
        "2": {
                "port": "fc1/6",
                "initiator_id": "0xe80021",
                "target_id": "0xe80056",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1119199742",
                "read_io_rate": "0",
                "write_io_rate": "6946",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697630"
        },
        "3": {
                "port": "fc1/8",
```

```
                "initiator_id": "0xe80000",
                "target_id": "0xe80042",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1119506589",
                "read_io_rate": "0",
                "write_io_rate": "6948",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697630"
        },
        "4": {
                "port": "fc1/8",
                "initiator_id": "0xe80001",
                "target_id": "0xe800a1",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1139953183",
                "read_io_rate": "0",
                "write_io_rate": "7068",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697630"
        },
        "5": {
                "port": "fc1/1",
                "initiator_id": "0xe80041",
                "target_id": "0xd60200",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1163615698",
                "read_io_rate": "0",
                "write_io_rate": "7247",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697630"
        }
}}
```

This example shows the output of specific flow metrics for a specific LUN, with the output limited to three records and sorted for the write_io_rate metrics of an initiator ITL flow view instance:

```
switch#   show analytics query 'select
port,initiator_id,target_id,lun,total_read_io_count,total_write_io_count,read_io_rate,write_io_rate
 from fc-scsi.scsi_initiator_itl_flow where lun=0000-0000-0000-0000 sort write_io_rate limit
 3'
{ "values": {
        "1": {
                "port": "fc1/6",
                "initiator_id": "0xe80020",
                "target_id": "0xd60040",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1103901828",
                "read_io_rate": "0",
                "write_io_rate": "6885",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697704"
        },
        "2": {
                "port": "fc1/8",
                "initiator_id": "0xe80000",
                "target_id": "0xe80042",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
```

```
                "total_write_io_count": "1120018575",
                "read_io_rate": "0",
                "write_io_rate": "6940",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697704"
        },
        "3": {
                "port": "fc1/6",
                "initiator_id": "0xe80021",
                "target_id": "0xe80056",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1119711583",
                "read_io_rate": "0",
                "write_io_rate": "6942",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697704"
        }
}}
```

This example shows the output of specific flow metrics for a specific LUN and target ID of an initiator ITL flow view instance:

```
switch#   show analytics query 'select
port,initiator_id,target_id,lun,total_read_io_count,total_write_io_count,read_io_rate,write_io_rate
 from fc-scsi.scsi_initiator_itl_flow where lun=0000-0000-0000-0000 and target_id=0xe800a1'
{ "values": {
        "1": {
                "port": "fc1/8",
                "initiator_id": "0xe80001",
                "target_id": "0xe800a1",
                "lun": "0000-0000-0000-0000",
                "total_read_io_count": "0",
                "total_write_io_count": "1139010960",
                "read_io_rate": "0",
                "write_io_rate": "7071"
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697495"
        }
}}
```

This example shows the output of specific flow metrics for VMID 4 and initiator ID 0x0900e0 for initiator ITL flow view instance:

```
switch#   show analytics query "select port,vsan,initiator_id,vmid from
fc-scsi.scsi_initiator_itl_flow where initiator_id=0x0900e0 and vmid=4"
{ "values": {
        "1": {
                "port": "fc2/9",
                "vsan": "1",
                "initiator_id": "0x0900e0",
                "vmid": "4",
                "sampling_start_time": "1589269530",
        }
}}
```

This example shows how to configure a push query when the duration to refresh the flow metrics is set to the default duration of 30 seconds:

```
switch# configure terminal
switch(config)# analytics query 'select all from fc-scsi.scsi_initiator_itl_flow' name
initiator_itl_flow type periodic
switch(config)# show analytics query name initiator_itl_flow result
{ "values": {
        "1": {
                "port": "fc1/1",
                "vsan": "10",
                "app_id": "255",
                "initiator_id": "0xe80041",
                "target_id": "0xd60200",
                "lun": "0000-0000-0000-0000",
                "active_io_read_count": "0",
                "active_io_write_count": "1",
                "total_read_io_count": "0",
                "total_write_io_count": "1162370362",
                "total_seq_read_io_count": "0",
                "total_seq_write_io_count": "1",
                "total_read_io_time": "0",
                "total_write_io_time": "116204704658",
                "total_read_io_initiation_time": "0",
                "total_write_io_initiation_time": "43996934029",
                "total_read_io_bytes": "0",
                "total_write_io_bytes": "595133625344",
                "total_read_io_inter_gap_time": "0",
                "total_write_io_inter_gap_time": "41139462314556",
                "total_time_metric_based_read_io_count": "0",
                "total_time_metric_based_write_io_count": "1162370358",
                "total_time_metric_based_read_io_bytes": "0",
                "total_time_metric_based_write_io_bytes": "595133623296",
                "read_io_rate": "0",
                "peak_read_io_rate": "0",
                "write_io_rate": "7250",
                "peak_write_io_rate": "7304",
                "read_io_bandwidth": "0",
                "peak_read_io_bandwidth": "0",
                "write_io_bandwidth": "3712384",
                "peak_write_io_bandwidth": "3739904",
                "read_io_size_min": "0",
                "read_io_size_max": "0",
                "write_io_size_min": "512",
                "write_io_size_max": "512",
                "read_io_completion_time_min": "0",
                "read_io_completion_time_max": "0",
                "write_io_completion_time_min": "89",
                "write_io_completion_time_max": "416",
                "read_io_initiation_time_min": "0",
                "read_io_initiation_time_max": "0",
                "write_io_initiation_time_min": "34",
                "write_io_initiation_time_max": "116",
                "read_io_inter_gap_time_min": "0",
                "read_io_inter_gap_time_max": "0",
                "write_io_inter_gap_time_min": "31400",
                "write_io_inter_gap_time_max": "118222",
                "peak_active_io_read_count": "0",
                "peak_active_io_write_count": "5",
                "read_io_aborts": "0",
                "write_io_aborts": "0",
                "read_io_failures": "0",
                "write_io_failures": "0",
                "read_io_scsi_check_condition_count": "0",
                "write_io_scsi_check_condition_count": "0",
                "read_io_scsi_busy_count": "0",
```

```
        "write_io_scsi_busy_count": "0",
        "read_io_scsi_reservation_conflict_count": "0",
        "write_io_scsi_reservation_conflict_count": "0",
        "read_io_scsi_queue_full_count": "0",
        "write_io_scsi_queue_full_count": "0",
        "sampling_start_time": "1528535447",
        "sampling_end_time": "1528697457"
},
.
.
.
"5": {
        "port": "fc1/8",
        "vsan": "10",
        "app_id": "255",
        "initiator_id": "0xe80001",
        "target_id": "0xe800a1",
        "lun": "0000-0000-0000-0000",
        "active_io_read_count": "0",
        "active_io_write_count": "1",
        "total_read_io_count": "0",
        "total_write_io_count": "1138738309",
        "total_seq_read_io_count": "0",
        "total_seq_write_io_count": "1",
        "total_read_io_time": "0",
        "total_write_io_time": "109792480881",
        "total_read_io_initiation_time": "0",
        "total_write_io_initiation_time": "39239145641",
        "total_read_io_bytes": "0",
        "total_write_io_bytes": "583034014208",
        "total_read_io_inter_gap_time": "0",
        "total_write_io_inter_gap_time": "41479779998852",
        "total_time_metric_based_read_io_count": "0",
        "total_time_metric_based_write_io_count": "1138738307",
        "total_time_metric_based_read_io_bytes": "0",
        "total_time_metric_based_write_io_bytes": "583034013184",
        "read_io_rate": "0",
        "peak_read_io_rate": "0",
        "write_io_rate": "7074",
        "peak_write_io_rate": "7903",
        "read_io_bandwidth": "0",
        "peak_read_io_bandwidth": "0",
        "write_io_bandwidth": "3622144",
        "peak_write_io_bandwidth": "4046336",
        "read_io_size_min": "0",
        "read_io_size_max": "0",
        "write_io_size_min": "512",
        "write_io_size_max": "512",
        "read_io_completion_time_min": "0",
        "read_io_completion_time_max": "0",
        "write_io_completion_time_min": "71",
        "write_io_completion_time_max": "3352",
        "read_io_initiation_time_min": "0",
        "read_io_initiation_time_max": "0",
        "write_io_initiation_time_min": "26",
        "write_io_initiation_time_max": "2427",
        "read_io_inter_gap_time_min": "0",
        "read_io_inter_gap_time_max": "0",
        "write_io_inter_gap_time_min": "25988",
        "write_io_inter_gap_time_max": "868452",
        "peak_active_io_read_count": "0",
        "peak_active_io_write_count": "5",
        "read_io_aborts": "0",
        "write_io_aborts": "0",
```

```
                "read_io_failures": "0",
                "write_io_failures": "0",
                "read_io_scsi_check_condition_count": "0",
                "write_io_scsi_check_condition_count": "0",
                "read_io_scsi_busy_count": "0",
                "write_io_scsi_busy_count": "0",
                "read_io_scsi_reservation_conflict_count": "0",
                "write_io_scsi_reservation_conflict_count": "0",
                "read_io_scsi_queue_full_count": "0",
                "write_io_scsi_queue_full_count": "0",
                "sampling_start_time": "1528535447",
                "sampling_end_time": "1528697457"
        }
}}
```


These examples show how to clear all the minimum, maximum, and peak flow metrics:

- This example shows the output before clearing all the minimum, maximum, and peak flow metrics:


```
switch# show analytics query "select all from  fc-scsi.scsi_target_itl_flow where
port=fc1/17" clear
{ "values": {
        "1": {
                "port": "fc1/17",
                "vsan": "1",
                "app_id": "255",
                "target_id": "0xef0040",
                "initiator_id": "0xef0000",
                "lun": "0000-0000-0000-0000",
                "active_io_read_count": "0",
                "active_io_write_count": "1",
                "total_read_io_count": "0",
                "total_write_io_count": "84701",
                "total_seq_read_io_count": "0",
                "total_seq_write_io_count": "1",
                "total_read_io_time": "0",
                "total_write_io_time": "7007132",
                "total_read_io_initiation_time": "0",
                "total_write_io_initiation_time": "2421756",
                "total_read_io_bytes": "0",
                "total_write_io_bytes": "86733824",
                "total_read_io_inter_gap_time": "0",
                "total_write_io_inter_gap_time": "2508109021",
                "total_time_metric_based_read_io_count": "0",
                "total_time_metric_based_write_io_count": "84701",
                "total_time_metric_based_read_io_bytes": "0",
                "total_time_metric_based_write_io_bytes": "86733824",
                "read_io_rate": "0",
                "peak_read_io_rate": "0",
                "write_io_rate": "8711",
                "peak_write_io_rate": "8711",
                "read_io_bandwidth": "0",
                "peak_read_io_bandwidth": "0",
                "write_io_bandwidth": "8920576",
                "peak_write_io_bandwidth": "8920576",
                "read_io_size_min": "0",
                "read_io_size_max": "0",
                "write_io_size_min": "1024",
                "write_io_size_max": "1024",
                "read_io_completion_time_min": "0",
                "read_io_completion_time_max": "0",
                "write_io_completion_time_min": "74",
                "write_io_completion_time_max": "844",
```

```
                "read_io_initiation_time_min": "0",
                "read_io_initiation_time_max": "0",
                "write_io_initiation_time_min": "24",
                "write_io_initiation_time_max": "775",
                "read_io_inter_gap_time_min": "0",
                "read_io_inter_gap_time_max": "0",
                "write_io_inter_gap_time_min": "26903",
                "write_io_inter_gap_time_max": "287888",
                "peak_active_io_read_count": "0",
                "peak_active_io_write_count": "3",
                "read_io_aborts": "0",
                "write_io_aborts": "0",
                "read_io_failures": "0",
                "write_io_failures": "0",
                "read_io_scsi_check_condition_count": "0",
                "write_io_scsi_check_condition_count": "0",
                "read_io_scsi_busy_count": "0",
                "write_io_scsi_busy_count": "0",
                "read_io_scsi_reservation_conflict_count": "0",
                "write_io_scsi_reservation_conflict_count": "0",
                "read_io_scsi_queue_full_count": "0",
                "write_io_scsi_queue_full_count": "0",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530684301"
        },
}}
```


Note The **show analytics query** *"query_string"* **clear** command is a clear-on-push or clear-on-pull command. Therefore, this command is not applicable when this command is executed for the first time.

- This example shows the output after clearing all the minimum, maximum, and peak flow metrics. The metrics that were cleared are highlighted in the output.

```
switch# show analytics query "select all from  fc-scsi.scsi_target_itl_flow where
port=fc1/17" clear
```


```
{ "values": {
        "1": {
                "port": "fc1/17",
               "vsan": "1",
                "app_id": "255",
                "target_id": "0xef0040",
                "initiator_id": "0xef0000",
                "lun": "0000-0000-0000-0000",
                "active_io_read_count": "0",
                "active_io_write_count": "0",
                "total_read_io_count": "0",
                "total_write_io_count": "800615",
                "total_seq_read_io_count": "0",
                "total_seq_write_io_count": "1",
                "total_read_io_time": "0",
                "total_write_io_time": "66090290",
                "total_read_io_initiation_time": "0",
                "total_write_io_initiation_time": "22793874",
                "total_read_io_bytes": "0",
                "total_write_io_bytes": "819829760",
                "total_read_io_inter_gap_time": "0",
                "total_write_io_inter_gap_time": "23702347887",
```

```
                "total_time_metric_based_read_io_count": "0",
                "total_time_metric_based_write_io_count": "800615",
                "total_time_metric_based_read_io_bytes": "0",
                "total_time_metric_based_write_io_bytes": "819829760",
                "read_io_rate": "0",
                "peak_read_io_rate": "0",
                "write_io_rate": "0",
                "peak_write_io_rate": "0",
                "read_io_bandwidth": "0",
                "peak_read_io_bandwidth": "0",
                "write_io_bandwidth": "0",
                "peak_write_io_bandwidth": "0",
                "read_io_size_min": "0",
                "read_io_size_max": "0",
                "write_io_size_min": "0",
                "write_io_size_max": "0",
                "read_io_completion_time_min": "0",
                "read_io_completion_time_max": "0",
                "write_io_completion_time_min": "0",
                "write_io_completion_time_max": "0",
                "read_io_initiation_time_min": "0",
                "read_io_initiation_time_max": "0",
                "write_io_initiation_time_min": "0",
                "write_io_initiation_time_max": "0",
                "read_io_inter_gap_time_min": "0",
                "read_io_inter_gap_time_max": "0",
                "write_io_inter_gap_time_min": "0",
                "write_io_inter_gap_time_max": "0",
                "peak_active_io_read_count": "0",
                "peak_active_io_write_count": "0",
                "read_io_aborts": "0",
                "write_io_aborts": "0",
                "read_io_failures": "0",
                "write_io_failures": "0",
                "read_io_scsi_check_condition_count": "0",
                "write_io_scsi_check_condition_count": "0",
                "read_io_scsi_busy_count": "0",
                "write_io_scsi_busy_count": "0",
                "read_io_scsi_reservation_conflict_count": "0",
                "write_io_scsi_reservation_conflict_count": "0",
                "read_io_scsi_queue_full_count": "0",
                "write_io_scsi_queue_full_count": "0",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530684428"
        },
}}
```

These examples show how to stream only the ITL flow metrics that have changed between streaming-sample intervals:

- This example shows the output before using the differential option:

```
switch# show analytics query "select port, target_id,
initiator_id,lun,total_write_io_count from fc-scsi.scsi_target_itl_flow where port=fc1/17"
 differential
{ "values": {
        "1": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0000",
                "lun": "0001-0000-0000-0000",
```

```
                "total_write_io_count": "1515601",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530683484"
        },
        "2": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0020",
                "lun": "0000-0000-0000-0000",
                "total_write_io_count": "1515601",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530683484"
        },
        "3": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0020",
                "lun": "0001-0000-0000-0000",
                "total_write_io_count": "1515600",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530683484"
        },
        "4": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0000",
                "lun": "0000-0000-0000-0000",
                "total_write_io_count": "1515600",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530683484"
        }
}}
```

- This example shows the output with the differential option and only the records that have changed:

```
switch# show analytics query "select port, target_id,
initiator_id,lun,total_write_io_count from fc-scsi.scsi_target_itl_flow where port=fc1/17"
 differential
{ "values": {
       "1": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0000",
                "lun": "0001-0000-0000-0000",
                "total_write_io_count": "1892021",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530683534"
        },
        "2": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0020",
                "lun": "0000-0000-0000-0000",
                "total_write_io_count": "1892021",
                "sampling_start_time": "1530683133",
                "sampling_end_time": "1530683534"
        },
        "3": {
                "port": "fc1/17",
                "target_id": "0xef0040",
                "initiator_id": "0xef0000",
                "lun": "0000-0000-0000-0000",
                "total_write_io_count": "1892021",
```

```
                    "sampling_start_time": "1530683133",
                    "sampling_end_time": "1530683534"
            }
    }}
```

This example shows how to remove an installed query name:

```
switch(config)# no analytics name initiator_itl_flow
```

The following example show how to clear the flow metrics:

1. This example show the output before clearing the flow metrics:

```
switch# show analytics query "select port,target_id,total_write_io_count,
total_write_io_bytes,total_time_metric_based_write_io_count,write_io_rate,
peak_write_io_rate,write_io_bandwidth,peak_write_io_bandwidth,
write_io_size_min,write_io_size_max,write_io_completion_time_min,
write_io_completion_time_max,write_io_initiation_time_min,
write_io_initiation_time_max,write_io_inter_gap_time_min,write_io_inter_gap_time_max
from fc-scsi.scsi_target where
target_id=0x650060"
{ "values": {
        "1": {
                "port": "fc3/17",
                "target_id": "0x650060",
                "total_write_io_count": "67350021",
                "total_write_io_bytes": "17655403905024",
                "total_time_metric_based_write_io_count": "67349761",
                "write_io_rate": "0",
                "peak_write_io_rate": "6300",
                "write_io_bandwidth": "0",
                "peak_write_io_bandwidth": "1651572736",
                "write_io_size_min": "262144",
                "write_io_size_max": "262144",
                "write_io_completion_time_min": "192",
                "write_io_completion_time_max": "9434",
                "write_io_initiation_time_min": "21",
                "write_io_initiation_time_max": "199",
                "write_io_inter_gap_time_min": "2553",
                "write_io_inter_gap_time_max": "358500",
                "sampling_start_time": "1531204359",
                "sampling_end_time": "1531215327"
        }
```

2. This example shows how to clear the flow metrics:

Note Clearing metrics is allowed only on view instances and not on individual flow metrics.

```
switch# clear analytics query "select all from fc-scsi.scsi_target where
target_id=0x650060"
```

3. This example shows the output after clearing the flow metrics:

```
switch# show analytics query "select port,target_id,total_write_io_count,
total_write_io_bytes,total_time_metric_based_write_io_count,write_io_rate,
```

```
peak_write_io_rate,write_io_bandwidth,peak_write_io_bandwidth,
write_io_size_min,write_io_size_max,write_io_completion_time_min,
write_io_completion_time_max,write_io_initiation_time_min,
write_io_initiation_time_max,write_io_inter_gap_time_min,write_io_inter_gap_time_max
from fc-scsi.scsi_target where target_id=0x650060"
{ "values": {
        "1": {
                "port": "fc3/17",
                "target_id": "0x650060",
                "total_write_io_count": "0",
                "total_write_io_bytes": "0",
                "total_time_metric_based_write_io_count": "0",
                "write_io_rate": "0",
                "peak_write_io_rate": "0",
                "write_io_bandwidth": "0",
                "peak_write_io_bandwidth": "0",
                "write_io_size_min": "0",
                "write_io_size_max": "0",
                "write_io_completion_time_min": "0",
                "write_io_completion_time_max": "0",
                "write_io_initiation_time_min": "0",
                "write_io_initiation_time_max": "0",
                "write_io_inter_gap_time_min": "0",
                "write_io_inter_gap_time_max": "0",
                "sampling_start_time": "1531204359",
                "sampling_end_time": "1531215464"
        }
```

This example shows the output after purging the flow metrics:

Note Only the *port* key value is allowed with the **where** clause for purging metrics.

```
switch# purge analytics query "select all from fc-scsi.scsi_target where port=fc3/17"
switch# show analytics query "select all from fc-scsi.scsi_target where port=fc3/17"
Table is empty for query "select all from fc-scsi.scsi_target where port=fc3/17"
```

Using the ShowAnalytics Overlay CLI

The **ShowAnalytics** overlay CLI is used to interpret the analytics data that is in JSON format in a user-friendly tabular format. The **ShowAnalytics** overlay CLI has a "Linux like" syntax and uses the inbuilt NX-OS Python interpreter to execute a script to convert the JSON output of the pull query into a tabular format. Currently, only a small subset of the flow metrics is displayed.

Note

- To execute Overlay CLIs, you must login as **network-admin**.
- The **ShowAnalytics** overlay command displays cumulative data about the Exchange Completion Time (ECT) for the *--initiator-itl* and *--target-itl* options under the *--info* option. However, it displays instantaneous data for rate and bandwidth metrics.
- If the active ITL count exceeds the documented limit, the **ShowAnalytics** overlay command displays a warning and exits. For information on the ITL count limit, see the Cisco MDS NX-OS Configuration Limits, Release 8.x document.
- If you configure a push query with the **clear** keyword as recommended by Virtual Instruments or Cisco DCNM, the minimum and maximum flow metrics will not have accurate values.
- The options under the ShowAnalytics command support only the SCSI analytics type, except the **--evaluate-npuload** option that supports both SCSI and NVMe analytics types.
- Run the **--evaluate-npuload** option before configuring the *analytics type* on interfaces. The **--evaluate-npuload** option does not work on a module even if one of the interface on the module is configured with an analytic type.
- The **--outstanding-io** option works only on F ports.

To display the analytics information in a tabular format, run this command:

switch# **ShowAnalytics** *–help*.

For more information, see the Cisco MDS 9000 Series Command Reference, Release 8.x.

Examples: Using the ShowAnalytics Overlay CLI

This example shows the options under the overlay CLI:

Note The option to display the available keywords and variables under the overlay CLI and its options that are added from Cisco MDS NX-OS Release 8.4(2) and later.

```
switch# ShowAnalytics ?
  ShowAnalytics              Aliased to 'source sys/analytics.py'
  ShowAnalyticsConsistency   Aliased to 'source sys/analytics_pss_consistency_checker.py'
  --errors                   To display errors stats in all IT(L/N) pairs
  --errorsonly               To display IT(L/N) flows with errors
  --evaluate-npuload         To evaluate npuload on system
  --help                     To display help and exit
  --info                     To display information about IT(L/N) flows
  --minmax                   To display min max and peak info about IT(L/N) flows
  --outstanding-io           To display outstanding io for an interface
  --top                      To display top 10 IT(L/N) Flow
  --version                  To display version of utility and exit
  --vsan-thput               To display per vsan throughput for interface
```

This example shows how to display the overlay CLI version:

```
switch# ShowAnalytics --version
ShowAnalytics 4.0.0
```

This example shows how to display the flow metrics of an initiator ITL:

```
switch# ShowAnalytics --info --initiator-itl
2021-02-09 09:01:39.714290

Interface fc3/1
+-----------------------------------------------------------------------------------------------------------------------------------------------------------+
| VSAN |Initiator|VMID| Target |       LUN         |Avg IOPS| Avg Throughput  |  Avg ECT   |Avg Data Access Latency|  Avg IO Size  |
+-----------------------------------------------------------------------------------------------------------------------------------------------------------+
|                                                  |Read|Write|Read |   Write |Read| Write |   Read    |   Write   |Read | Write   |
|                                                  |    |     |     |         |    |       |           |           |     |         |
| 2200 |0x641547|  1  |0x641227|0006-0000-0000-0000|  0 | 19  |0 B/s|76.0 KB/s|0 ns|17.7 ms|   0 ns    |   4.7 ms  |0 B/s|9.1 KB/s |
| 2200 |0x64154a|  6  |0x64122a|003b-0000-0000-0000|  0 | 20  |0 B/s|83.0 KB/s|0 ns|13.2 ms|   0 ns    |   4.4 ms  |0 B/s|10.1 KB/s|
| 2200 |0x641542|  2  |0x641222|0013-0000-0000-0000|  0 | 22  |0 B/s|88.0 KB/s|0 ns|15.2 ms|   0 ns    |   4.5 ms  |0 B/s|10.1 KB/s|
| 2200 |0x641545|  3  |0x641225|001c-0000-0000-0000|  0 | 23  |0 B/s|93.0 KB/s|0 ns|18.7 ms|   0 ns    |   4.9 ms  |0 B/s|7.5 KB/s |
| 2200 |0x641543|  1  |0x641223|0003-0000-0000-0000|  0 | 13  |0 B/s|53.0 KB/s|0 ns|13.6 ms|   0 ns    |   4.5 ms  |0 B/s|7.0 KB/s |
| 2200 |0x641546|  4  |0x641226|0027-0000-0000-0000|  0 | 24  |0 B/s|99.0 KB/s|0 ns|18.1 ms|   0 ns    |   4.7 ms  |0 B/s|7.6 KB/s |
| 2200 |0x641545|  4  |0x641225|0021-0000-0000-0000|  0 | 20  |0 B/s|82.0 KB/s|0 ns|15.2 ms|   0 ns    |   5.1 ms  |0 B/s|7.9 KB/s |
| 2200 |0x641548|  5  |0x641228|002d-0000-0000-0000|  0 | 21  |0 B/s|84.0 KB/s|0 ns|16.0 ms|   0 ns    |   4.5 ms  |0 B/s|9.9 KB/s |
| 2200 |0x641547|  5  |0x641227|002f-0000-0000-0000|  0 | 24  |0 B/s|96.0 KB/s|0 ns|14.3 ms|   0 ns    |   3.7 ms  |0 B/s|9.1 KB/s |
| 2200 |0x641545|  6  |0x641225|003a-0000-0000-0000|  0 | 15  |0 B/s|61.0 KB/s|0 ns|17.0 ms|   0 ns    |   4.2 ms  |0 B/s|9.4 KB/s |
+-----------------------------------------------------------------------------------------------------------------------------------------------------------+
```

This example shows how to display the flow metrics of a target ITL:

```
switch# ShowAnalytics --info --target-itl
2021-02-09 12:14:59.285397

Interface fc1/1
+-----------------------------------------------------------------------------------------------------------------------------------------+
|VSAN|Initiator|VMID| Target |       LUN         | Avg IOPS | Avg Throughput |  Avg ECT  |Avg Data Access Latency|  Avg IO Size   |
+-----------------------------------------------------------------------------------------------------------------------------------------+
|                                                |Read|Write|Read | Write    |Read|Write |   Read    |   Write   | Read| Write    |
|                                                |    |     |     |          |    |      |           |           |     |          |
| 20| 0x1c0020 | 89 |0x1c0000|0000-0000-0000-0000| 0  |1761 |0 B/s|220.2 MB/s|0 ns|5.5 ms|   0 ns    |  2.5 ms   |0 B/s|128.0 KB/s|
+-----------------------------------------------------------------------------------------------------------------------------------------+
```

This example shows how to display all target ITLs and limit the output to 10 random records:

```
switch# ShowAnalytics --info --target-itl --interface fc8/15 --limit 10
2019-04-09 11:11:24.652190

 Interface fc8/15
+-----------------------------------------+-------------+------------------+----------------+
|         VSAN|Initiator|Target|LUN          |  Avg IOPS    |  Avg Throughput  |   Avg ECT      |
+-----------------------------------------+-------------+------------------+----------------+
|                                         | Read | Write |  Read |   Write  | Read |  Write  |
|                                         |      |       |       |          |      |         |
| 3300|0x040001|0x030033|0000-0000-0000-0000 |   0   | 4047  |  0    |15.8 MB/s |  0   | 84.0 us |
| 3300|0x040003|0x030035|0000-0000-0000-0000 |   0   | 4045  |  0    |15.8 MB/s |  0   | 85.0 us |
| 3300|0x040005|0x030037|0000-0000-0000-0000 |   0   | 4033  |  0    |15.8 MB/s |  0   | 85.0 us |
| 3300|0x040007|0x030039|0000-0000-0000-0000 |   0   | 4041  |  0    |15.8 MB/s |  0   | 86.0 us |
| 3300|0x040009|0x03003b|0000-0000-0000-0000 |   0   | 4048  |  0    |15.8 MB/s |  0   | 86.0 us |
| 3300|0x04000b|0x03003d|0000-0000-0000-0000 |   0   | 4040  |  0    |15.8 MB/s |  0   | 86.0 us |
| 3300|0x04000d|0x03003f|0000-0000-0000-0000 |   0   | 4055  |  0    |15.8 MB/s |  0   | 86.0 us |
| 3300|0x04000f|0x030041|0000-0000-0000-0000 |   0   | 4052  |  0    |15.8 MB/s |  0   | 86.0 us |
| 3300|0x040011|0x030043|0000-0000-0000-0000 |   0   | 4055  |  0    |15.8 MB/s |  0   | 86.0 us |
| 3300|0x040013|0x030045|0000-0000-0000-0000 |   0   | 4056  |  0    |15.8 MB/s |  0   | 86.0 us |
+-----------------------------------------+-------------+------------------+----------------+
```

This example shows how to display the flow metrics of VSAN 3300 of an initiator ITN for NVMe:

```
switch# ShowAnalytics --info --initiator-itn --vsan 3300
2019-04-08 11:26:23.074904

Interface fc16/12
+-------------------------------+-----------+-------------------+---------------+---------------+---------------+-------------+-------------+
|VSAN | Initiator |  Target   | Namespace |   Avg IOPS   |      Avg Throughput      |       Avg ECT       |       Avg DAL       |     Avg IO Size
      | Avg Host Delay | Avg Array Delay |
+-------------------------------+-----------+-------------------+---------------+---------------+---------------+-------------+-------------+
|                                 | Read | Write |     Read    |    Write     |   Read    |   Write   |   Read    |   Write   |   Read    |
Write   |     Write      |      Write      |
|                                 |      |       |             |              |           |           |           |           |           |
       |                |                 |
|3300 | 0xc80002  | 0xed0002  |  1        | 2466 | 2458  | 154.2 MB/s | 153.6 MB/s  | 782.0 us |   2.1 ms | 635.0 us | 620.0 us |  64.0 KB |
64.0 KB  |    714.0 us    |     567.0 us    |
|3300 | 0xc80007  | 0xed0007  |  1        | 2466 | 2470  | 154.1 MB/s | 154.4 MB/s  | 786.0 us |   2.0 ms | 641.0 us | 620.0 us |  64.0 KB |
64.0 KB  |    712.0 us    |     561.0 us    |
|3300 | 0xc80005  | 0xed0005  |  1        | 2432 | 2484  | 152.0 MB/s | 155.3 MB/s  | 775.0 us |   2.1 ms | 629.0 us | 623.0 us |  64.0 KB |
64.0 KB  |    714.0 us    |     564.0 us    |
|3300 | 0xc80001  | 0xed0001  |  1        | 2066 | 2031  | 129.2 MB/s | 126.9 MB/s  | 723.0 us |   1.7 ms | 580.0 us | 569.0 us |  64.0 KB |
64.0 KB  |    470.0 us    |     507.0 us    |
|3300 | 0xc80000  | 0xed0000  |  1        | 339  | 347   |  21.2 MB/s |  21.7 MB/s  |  15.3 ms |  16.1 ms |  15.2 ms |  15.2 ms |  64.0 KB |
64.0 KB  |    190.0 us    |     518.0 us    |
|3300 | 0xc80008  | 0xed0008  |  1        | 2436 | 2480  | 152.2 MB/s | 155.0 MB/s  | 777.0 us |   2.0 ms | 632.0 us | 623.0 us |  64.0 KB |
64.0 KB  |    708.0 us    |     563.0 us    |
|3300 | 0xc80009  | 0xed0009  |  1        | 2475 | 2459  | 154.7 MB/s | 153.7 MB/s  | 772.0 us |   2.1 ms | 625.0 us | 630.0 us |  64.0 KB |
```

```
64.0 KB  |    700.0 us    |     569.0 us    |
|3300 | 0xc80004  | 0xed0004  |  1        | 2508 | 2448  | 156.8 MB/s | 153.0 MB/s  | 775.0 us |   2.0 ms | 630.0 us | 626.0 us |  64.0 KB |
64.0 KB  |    704.0 us    |     568.0 us    |
|3300 | 0xc80006  | 0xed0006  |  1        | 2427 | 2485  | 151.7 MB/s | 155.3 MB/s  | 778.0 us |   2.0 ms | 634.0 us | 623.0 us |  64.0 KB |
64.0 KB  |    713.0 us    |     561.0 us    |
|3300 | 0xc80000  | 0xed0001  |  1        | 2246 | 2218  | 140.4 MB/s | 138.7 MB/s  | 744.0 us |   1.8 ms | 600.0 us | 591.0 us |  64.0 KB |
64.0 KB  |    561.0 us    |     530.0 us    |
|3300 | 0xc80003  | 0xed0003  |  1        | 2439 | 2478  | 152.4 MB/s | 154.9 MB/s  | 776.0 us |   2.1 ms | 630.0 us | 628.0 us |  64.0 KB |
64.0 KB  |    711.0 us    |     564.0 us    |
+----------------------------------+-----------+-------------------+-------------------+-------------------+-------------------+-------------+-------------+
Total number of ITNs: 11
```

This example shows how to display the flow metrics of VSAN 2200 of an initiator ITL for SCSI:

```
switch# ShowAnalytics --info --initiator-itl --vsan 2200
2019-04-08 11:26:23.074904

Interface fc2/22
+-----------------------------------------+-----------+-------------------+-------------------+-------------------+-------------------+-------------+-------------+
|VSAN | Initiator | VMID |  Target   |         LUN          |   Avg IOPS   |      Avg Throughput       |      Avg ECT       |      Avg DAL       |
     Avg IO Size      | Avg Host Delay | Avg Array Delay |
+-----------------------------------------+-----------+-------------------+-------------------+-------------------+-------------------+-------------+-------------+
|                                         |           |                   | Read | Write |     Read    |    Write    |  Read   |   Write   |  Read   |   Write   |
|   Read    |   Write   |     Write      |      Write      |
|                                         |           |                   |      |       |             |             |         |           |         |           |
                          |                |                 |
|2200 | 0xe80ee0  |   - | 0xe80622  | 0007-0000-0000-0000  |    0 | 0     |      0 B/s |     0 B/s   |   0 ns  |    0 ns   |   0 ns  |    0 ns   |
      0 B |    0 B    |       0 ns     |       0 ns      |
|2200 | 0xe80ee0  |   - | 0xc809a0  | 0003-0000-0000-0000  |    0 | 0     |      0 B/s |     0 B/s   |   0 ns  |    0 ns   |   0 ns  |    0 ns   |
      0 B |    0 B    |       0 ns     |       0 ns      |
|2200 | 0xe80ee0  |   - | 0xe80622  | 0002-0000-0000-0000  |    0 | 0     |      0 B/s |     0 B/s   |   0 ns  |    0 ns   |   0 ns  |    0 ns   |
      0 B |    0 B    |       0 ns     |       0 ns      |
|2200 | 0xe80ee0  |  18 | 0xc809a0  | 0003-0000-0000-0000  |    0 | 0     |      0 B/s |   2.0 KB/s  |   0 ns  |  843.0 us |   0 ns  |  179.0 us |
      0 B |  4.0 KB   |     7.0 us     |     656.0 us    |
|2200 | 0xe80ee0  |   - | 0xe80622  | 0000-0000-0000-0000  |    0 | 0     |      0 B/s |     0 B/s   |   0 ns  |    0 ns   |   0 ns  |    0 ns   |
      0 B |    0 B    |       0 ns     |       0 ns      |
+-----------------------------------------+-----------+-------------------+-------------------+-------------------+-------------------+-------------+-------------+
Total number of ITLs: 5
```

This example shows how to display the flow metrics of interface fc3/15 of a target ITN for NVMe:

```
switch# ShowAnalytics --info --target-itn --interface fc3/15
2019-04-09 11:11:17.974991

 Interface fc3/15
+----------------------------------+-----------+-------------------+-----------+-------------------+-------------------+-------------------+-------------+-------------+
|VSAN | Initiator |  Target   | Namespace |   Avg IOPS   |      Avg Throughput       |       Avg ECT      |      Avg DAL       |     Avg IO Size
      | Avg Host Delay | Avg Array Delay |
+----------------------------------+-----------+-------------------+-----------+-------------------+-------------------+-------------------+-------------+-------------+
|                                  |           |                   | Read | Write |     Read    |    Write    |  Read   |   Write   |  Read   |   Write   |  Read   |
Write   |     Write      |      Write      |
|                                  |           |                   |      |       |             |             |         |           |         |           |         |
     |                |                 |
|3300 | 0xc80005  | 0xed0005  |  1        | 2475 | 2531  | 154.7 MB/s | 158.2 MB/s  | 112.0 us |   1.5 ms | 45.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80000  | 0xed0001  |  1        | 2137 | 2158  | 133.6 MB/s | 134.9 MB/s  | 112.0 us |   1.4 ms | 46.0 us |  39.0 us |  64.0 KB |  64.0
 KB  |     1.2 ms     |      5.0 us     |
|3300 | 0xc80004  | 0xed0004  |  1        | 2465 | 2530  | 154.1 MB/s | 158.2 MB/s  | 115.0 us |   1.5 ms | 46.0 us |  39.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80001  | 0xed0001  |  1        | 1785 | 1796  | 111.6 MB/s | 112.2 MB/s  | 112.0 us |   1.3 ms | 45.0 us |  38.0 us |  64.0 KB |  64.0
 KB  |     1.1 ms     |      5.0 us     |
|3300 | 0xc80003  | 0xed0003  |  1        | 2512 | 2506  | 157.0 MB/s | 156.6 MB/s  | 113.0 us |   1.5 ms | 45.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80000  | 0xed0000  |  1        | 355  | 329   |  22.2 MB/s |  20.6 MB/s  |  14.8 ms |  15.5 ms | 14.8 ms |  14.6 ms |  64.0 KB |  64.0
 KB  |    753.0 us    |      5.0 us     |
|3300 | 0xc80007  | 0xed0007  |  1        | 2465 | 2532  | 154.1 MB/s | 158.2 MB/s  | 115.0 us |   1.5 ms | 47.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80008  | 0xed0008  |  1        | 2488 | 2520  | 155.5 MB/s | 157.5 MB/s  | 115.0 us |   1.5 ms | 47.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80002  | 0xed0002  |  1        | 2548 | 2497  | 159.3 MB/s | 156.1 MB/s  | 113.0 us |   1.5 ms | 46.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80006  | 0xed0006  |  1        | 2476 | 2523  | 154.8 MB/s | 157.7 MB/s  | 113.0 us |   1.5 ms | 46.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
|3300 | 0xc80009  | 0xed0009  |  1        | 2487 | 2525  | 155.4 MB/s | 157.8 MB/s  | 114.0 us |   1.5 ms | 46.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
+----------------------------------+-----------+-------------------+-----------+-------------------+-------------------+-------------------+-------------+-------------+
Total number of ITNs: 11
```

This example shows how to display the flow metrics of interface fc5/21 of a target ITL for SCSI:

```
switch# ShowAnalytics --info --target-itl --interface fc5/21
2019-04-09 11:11:17.974991

  Interface fc5/21
+-----------------------------------------+-----------+-------------------+-------------------+-------------------+-------------------+-------------+-------------+
|VSAN | Initiator | VMID |  Target   |         LUN          |   Avg IOPS   |      Avg Throughput       |      Avg ECT       |      Avg DAL       |
     Avg IO Size      | Avg Host Delay | Avg Array Delay |
+-----------------------------------------+-----------+-------------------+-------------------+-------------------+-------------------+-------------+-------------+
|                                         |           |                   | Read | Write |     Read    |    Write    |  Read   |   Write   |  Read   |   Write   |
|   Read    |   Write   |     Write      |      Write      |
|                                         |           |                   |      |       |             |             |         |           |         |           |
                          |                |                 |
|2200 | 0xe902e0  |   - | 0xe805a0  | 0002-0000-0000-0000  |  0   | 9231  |      0 B/s |   4.5 MB/s  |   0 ns  |   75.0 us |   0 ns  |   25.0 us |
      0 B |  512.0 B  |       0 ns     |       0 ns      |
|2200 | 0xe902e0  |   - | 0xe805a0  | 0003-0000-0000-0000  |  0   | 9231  |      0 B/s |   4.5 MB/s  |   0 ns  |   75.0 us |   0 ns  |   25.0 us |
      0 B |  512.0 B  |       0 ns     |       0 ns      |
|2200 | 0xe902e0  |   - | 0xe805a0  | 0001-0000-0000-0000  |  0   | 9230  |      0 B/s |   4.5 MB/s  |   0 ns  |   75.0 us |   0 ns  |   25.0 us |
```

```
      0 B |  512.0 B  |      0 ns      |       0 ns      |
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
Total number of ITLs: 3
```

This example shows how to display the flow metrics and device alias information of interface fc3/15 of a target ITN and limit the output to 10 random records for NVMe:

```
switch# ShowAnalytics --info --target-itn --alias  --interface fc3/15  --limit 10
2019-04-09 12:04:07.032501

 Interface fc3/15
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
|VSAN |      Initiator       |        Target        | Namespace |   Avg IOPS   |      Avg Throughput      |       Avg ECT       |      Avg DAL
     |     Avg IO Size      | Avg Host Delay | Avg Array Delay |
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
|                                                                          | Read | Write |     Read    |    Write     |    Read    |   Write   |  Read   |
Write  |   Read   |   Write   |     Write      |      Write      |
|                                                                          |              |                              |                   |
     |                    |                |                 |
|3300 |       0xc80005       |       0xed0005       |  1        | 2488 | 2514  | 155.5 MB/s | 157.1 MB/s  | 113.0 us |   1.5 ms | 46.0 us |  39.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
|3300 |       0xc80000       |       0xed0001       |  1        | 2122 | 2154  | 132.6 MB/s | 134.7 MB/s  | 111.0 us |   1.4 ms | 45.0 us |  40.0
 us |  64.0 KB |  64.0 KB  |     1.2 ms     |      5.0 us     |
|3300 |       0xc80004       |       0xed0004       |  1        | 2492 | 2509  | 155.8 MB/s | 156.8 MB/s  | 113.0 us |   1.5 ms | 46.0 us |  40.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
|3300 |       0xc80001       |       0xed0001       |  1        | 1847 | 1752  | 115.4 MB/s | 109.5 MB/s  | 112.0 us |   1.3 ms | 45.0 us |  39.0
 us |  64.0 KB |  64.0 KB  |     1.1 ms     |      5.0 us     |
|3300 |       0xc80003       |       0xed0003       |  1        | 2523 | 2495  | 157.7 MB/s | 155.9 MB/s  | 114.0 us |   1.5 ms | 46.0 us |  41.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
|3300 |       0xc80000       |       0xed0000       |  1        | 340  | 355   |  21.3 MB/s |  22.2 MB/s  |  14.3 ms |  15.3 ms | 14.2 ms |  14.4
 ms |  64.0 KB |  64.0 KB  |    801.0 us    |      5.0 us     |
|3300 |       0xc80007       |       0xed0007       |  1        | 2495 | 2510  | 156.0 MB/s | 156.9 MB/s  | 114.0 us |   1.5 ms | 47.0 us |  40.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
|3300 |       0xc80008       |       0xed0008       |  1        | 2515 | 2496  | 157.2 MB/s | 156.0 MB/s  | 114.0 us |   1.5 ms | 47.0 us |  40.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
|3300 |       0xc80002       |       0xed0002       |  1        | 2537 | 2484  | 158.6 MB/s | 155.3 MB/s  | 114.0 us |   1.5 ms | 46.0 us |  41.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
|3300 |       0xc80006       |       0xed0006       |  1        | 2502 | 2510  | 156.4 MB/s | 156.9 MB/s  | 113.0 us |   1.5 ms | 46.0 us |  41.0
 us |  64.0 KB |  64.0 KB  |     1.3 ms     |      5.0 us     |
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
Total number of ITNs: 10
```

This example shows how to display the flow metrics and device alias information of interface fc5/21 of a target ITL and limit the output to 10 random records for SCSI:

```
switch# ShowAnalytics --info --target-itl --alias  --interface fc5/21  --limit 10
2019-04-09 12:04:07.032501

 Interface fc5/21
+-----------------------------------------+-----------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
|VSAN |      Initiator       | VMID |        Target        |         LUN          |   Avg IOPS   |      Avg Throughput      |       Avg ECT       |
|      Avg DAL       |     Avg IO Size      | Avg Host Delay | Avg Array Delay |
+-----------------------------------------+-----------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
|                                                                                    | Read | Write |     Read    |    Write     |    Read    |   Write
|  Read   |   Write  |   Read   |   Write   |     Write      |      Write      |
|                                                                                    |              |                              |
|                  |                    |                 |                 |
|2200 |       0xe902e0       |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000  |  0   | 5796  |      0 B/s |  2.8 MB/s   |   0 ns  |  84.0 us
|   0 ns  |  29.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
|2200 |       0xe902e0       |   - | Tgt_9706_206_fc5_21_ | 0003-0000-0000-0000  |  0   | 5797  |      0 B/s |  2.8 MB/s   |   0 ns  |  84.0 us
|   0 ns  |  29.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
|2200 |       0xe902e0       |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000  |  0   | 5797  |      0 B/s |  2.8 MB/s   |   0 ns  |  84.0 us
|   0 ns  |  29.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
|2200 |       0xe90440       |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000  |  0   | 5797  |      0 B/s |  2.8 MB/s   |   0 ns  | 122.0 us
|   0 ns  |  44.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
|2200 |       0xe90440       |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000  |  0   | 5796  |      0 B/s |  2.8 MB/s   |   0 ns  | 124.0 us
|   0 ns  |  44.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
|2200 |       0xe906c0       |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000  |  0   | 5797  |      0 B/s |  2.8 MB/s   |   0 ns  | 130.0 us
|   0 ns  |  47.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
|2200 |       0xe906c0       |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000  |  0   | 5796  |      0 B/s |  2.8 MB/s   |   0 ns  | 131.0 us
|   0 ns  |  48.0 us |      0 B |  512.0 B  |      0 ns       |       0 ns      |
+-----------------------------------------+-----------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
Total number of ITLs: 7
```

This example shows how to display the flow metrics of target ID 0xed0001 of a target ITN for NVMe:

```
switch# ShowAnalytics --info --target-itn --target 0xed0001
2019-04-09 11:16:26.246741

 Interface fc3/15
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
|VSAN | Initiator |  Target   | Namespace |   Avg IOPS   |      Avg Throughput      |       Avg ECT       |      Avg DAL        |     Avg IO Size
      | Avg Host Delay | Avg Array Delay |
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
|                                      | Read | Write |     Read    |    Write     |    Read    |   Write  |  Read   |   Write   |   Read   |
Write   |     Write      |      Write      |
|                                      |              |                              |                  |                   |
     |                |                 |
|3300 | 0xc80000  | 0xed0001  |  1        | 2100 | 2173  | 131.2 MB/s | 135.8 MB/s  | 110.0 us |   1.4 ms | 44.0 us |  38.0 us |  64.0 KB |  64.0
 KB  |     1.2 ms     |      5.0 us     |
|3300 | 0xc80001  | 0xed0001  |  1        | 1964 | 1943  | 122.8 MB/s | 121.4 MB/s  | 109.0 us |   1.2 ms | 43.0 us |  38.0 us |  64.0 KB |  64.0
 KB  |     1.0 ms     |      5.0 us     |
+-----------------------------------------+-----------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
Total number of ITNs: 2
```

This example shows how to display the flow metrics of target ID 0xe80b40 of a target ITL for SCSI:

```
switch# ShowAnalytics --info --target-itl --target 0xe80b40
2019-04-09 11:16:26.246741

 Interface fc5/21
+----------------------------------------------+----------+--------------------+---------------+----------------+-------------+------------+
|VSAN | Initiator | VMID |  Target    |        LUN         |  Avg IOPS   |     Avg Throughput     |      Avg ECT       |      Avg DAL       |
     Avg IO Size      | Avg Host Delay | Avg Array Delay |
+----------------------------------------------+----------+--------------------+---------------+----------------+-------------+------------+
|                                                          | Read | Write |     Read    |    Write     |  Read   |   Write  |  Read   |    Write  |
   Read    |   Write    |      Write      |      Write       |
|                                                          |             |                          |                    |                    |
                      |                 |                  |
|2200 | 0xe90440   |    - | 0xe80b40   | 0001-0000-0000-0000  |  0    | 5809  |      0 B/s |  2.8 MB/s    |   0 ns   | 128.0 us |   0 ns   |  48.0 us |
      0 B |  512.0 B  |      0 ns       |       0 ns       |
|2200 | 0xe90440   |    - | 0xe80b40   | 0002-0000-0000-0000  |  0    | 5809  |      0 B/s |  2.8 MB/s    |   0 ns   | 132.0 us |   0 ns   |  48.0 us |
      0 B |  511.0 B  |      0 ns       |       0 ns       |
+----------------------------------------------+----------+--------------------+---------------+----------------+-------------+------------+
Total number of ITLs: 2
```

This example shows how to display the flow metrics of initiator ID 0xed0500, target ID 0xef0720, and LUN ID 0001-0000-0000-0000 of a target ITL:

```
switch# ShowAnalytics --info --target-itl --initiator 0xed0500 --target 0xef0720 --lun 0001-0000-0000-0000
2019-04-09 11:17:24.643292

B: Bytes, s: Seconds, Avg: Average, Acc: Accumulative,
ns: Nano Seconds, ms: Milli Seconds, us: Micro Seconds,
GB: Giga Bytes, MB: Mega Bytes, KB: Killo Bytes,
ECT: Exchange Completion Time, DAL: Data Access Latency


Interface : fc8/17
+--------------------------------+---------+---------+-----------+
| Metric                         |   Min   |   Max   |    Avg    |
+--------------------------------+---------+---------+-----------+
| Read  IOPS         (4sec Avg) |      NA |      NA |        39 |
| Write IOPS         (4sec Avg) |      NA |      NA |         0 |
| Read  Throughput   (4sec Avg) |      NA |      NA | 39.8 KB/s |
| Write Throughput   (4sec Avg) |      NA |      NA |         0 |
| Read  Size         (Acc Avg)  |  1024 B |  1024 B |    1024 B |
| Write Size         (Acc Avg)  |       0 |       0 |         0 |
| Read  DAL          (Acc Avg)  | 28.0 us | 30.0 ms |   23.8 ms |
| Write DAL          (Acc Avg)  |    0    |    0    |     0     |
| Read  ECT          (Acc Avg)  | 28.0 us | 30.0 ms |   23.8 ms |
| Write ECT          (Acc Avg)  |    0    |    0    |     0     |
| Read  Inter-IO-Gap (Acc Avg)  | 73.2 us |   2.0 s |   25.0 ms |
| Write Inter-IO-Gap (Acc Avg)  |    0    |    0    |     0     |
+--------------------------------+---------+---------+-----------+
```

This example shows how to display the flow metrics of initiator ID 0xc80005 and namespace 1 of a target ITN for NVMe:

```
switch# ShowAnalytics --info --target-itn --initiator 0xc80005  --namespace 1
2019-04-09 11:18:40.132828

 Interface fc3/15
+-------------------------------------+-----------+-----------------------+-------------------+----------------+------------------+-------------+-------------+
|VSAN | Initiator |  Target    | Namespace |   Avg IOPS    |      Avg Throughput       |       Avg ECT       |      Avg DAL       |     Avg IO Size
      | Avg Host Delay | Avg Array Delay |
+-------------------------------------+-----------+-----------------------+-------------------+----------------+------------------+-------------+-------------+
|                                          | Read | Write |     Read    |    Write     |   Read    |    Write  |  Read   |    Write  |   Read    |
Write   |     Write      |      Write      |
|                                          |               |                         |                   |                  |
      |                 |                  |
|3300 | 0xc80005   | 0xed0005   |  1       | 2451 | 2478   | 153.2 MB/s | 154.9 MB/s  | 114.0 us |    1.5 ms | 45.0 us |  40.0 us |  64.0 KB |  64.0
 KB  |     1.3 ms     |      5.0 us     |
+-------------------------------------+-----------+-----------------------+-------------------+----------------+------------------+-------------+-------------+
Total number of ITNs: 1
```

This example shows how to display the flow metrics of initiator ID 0xe90440 and LUN ID 0001-0000-0000-0000 of a target ITL for SCSI:

```
switch# ShowAnalytics --info --target-itl --initiator 0xe90440  --lun 0001-0000-0000-0000
2019-04-09 11:18:40.132828

 Interface fc5/21
+----------------------------------------------+----------+--------------------+---------------+----------------+-------------+------------+
|VSAN | Initiator | VMID |  Target    |        LUN         |  Avg IOPS   |     Avg Throughput     |      Avg ECT       |      Avg DAL       |
     Avg IO Size      | Avg Host Delay | Avg Array Delay |
+----------------------------------------------+----------+--------------------+---------------+----------------+-------------+------------+
|                                                          | Read | Write |     Read    |    Write     |  Read   |   Write  |  Read   |    Write  |
   Read    |   Write    |      Write      |      Write       |
|                                                          |             |                          |                    |                    |
                      |                 |                  |
|2200 | 0xe90440   |    - | 0xe80b40   | 0001-0000-0000-0000  |  0    | 5816  |      0 B/s |  2.8 MB/s    |   0 ns   | 131.0 us |   0 ns   |  48.0 us |
      0 B |  512.0 B  |      0 ns       |       0 ns       |
+----------------------------------------------+----------+--------------------+---------------+----------------+-------------+------------+
Total number of ITLs: 1
```

For information on flow metrics, see Flow Metrics.

This example shows how to display the top ITNs for I/O operations per second (IOPS) for NVMe:

```
switch# ShowAnalytics  --top  --nvme

2019-06-13 10:56:49.099069

+--------+-----------------------------------------+------------------+
|  PORT  | VSAN | Initiator |  Target   | Namespace  |      Avg IOPS     |
+--------+-----------------------------------------+------------------+
|        |                                         |   Read  |  Write  |
| fc3/15 | 3300 | 0xc80004  | 0xed0004  |   1        |   2547  |  2474   |
| fc3/15 | 3300 | 0xc80002  | 0xed0002  |   1        |   2521  |  2486   |
| fc3/15 | 3300 | 0xc80008  | 0xed0008  |   1        |   2506  |  2499   |
| fc3/15 | 3300 | 0xc80009  | 0xed0009  |   1        |   2516  |  2483   |
| fc3/15 | 3300 | 0xc80006  | 0xed0006  |   1        |   2516  |  2482   |
| fc3/15 | 3300 | 0xc80007  | 0xed0007  |   1        |   2508  |  2484   |
| fc3/15 | 3300 | 0xc80005  | 0xed0005  |   1        |   2481  |  2505   |
| fc3/15 | 3300 | 0xc80003  | 0xed0003  |   1        |   2469  |  2517   |
| fc3/15 | 3300 | 0xc80000  | 0xed0001  |   1        |   2057  |  2021   |
| fc3/15 | 3300 | 0xc80001  | 0xed0001  |   1        |   1893  |  1953   |
+--------+-----------------------------------------+------------------+
```

This example shows how to display the top ITLs for I/O operations per second (IOPS):

```
switch# ShowAnalytics  --top

2019-06-13 10:56:49.099069

+--------+-----------------------------------------+------------------+
|  PORT  |        VSAN|Initiator|Target|LUN        |      Avg IOPS     |
+--------+-----------------------------------------+------------------+
|        |                                         |   Read  |  Write  |
| fc8/10 | 5|0xed04b2|0xef0680|0001-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0003-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0002-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0005-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0006-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0007-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0008-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|0009-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|000a-0000-0000-0000 |   118   |   0     |
| fc8/10 | 5|0xed04b2|0xef0680|000b-0000-0000-0000 |   118   |   0     |
+--------+-----------------------------------------+------------------+
```

This example shows how to display the top ITNs for throughput progressively for NMVe:

```
switch# ShowAnalytics  --top --key thput  --progress --nvme

2019-06-13 10:58:16.015546

+--------+-----------------------------------------+-------------------------+
|  PORT  | VSAN | Initiator |  Target   | Namespace  |      Avg Throughput     |
+--------+-----------------------------------------+-------------------------+
|        |                                         |     Read    |   Write   |
| fc3/15 | 3300 | 0xc80003  | 0xed0003  |   1        | 159.1 MB/s | 154.6 MB/s |
| fc3/15 | 3300 | 0xc80002  | 0xed0002  |   1        | 157.4 MB/s | 155.0 MB/s |
| fc3/15 | 3300 | 0xc80006  | 0xed0006  |   1        | 157.7 MB/s | 154.3 MB/s |
| fc3/15 | 3300 | 0xc80004  | 0xed0004  |   1        | 157.1 MB/s | 154.8 MB/s |
| fc3/15 | 3300 | 0xc80007  | 0xed0007  |   1        | 155.5 MB/s | 155.4 MB/s |
| fc3/15 | 3300 | 0xc80009  | 0xed0009  |   1        | 153.8 MB/s | 156.6 MB/s |
| fc3/15 | 3300 | 0xc80008  | 0xed0008  |   1        | 152.2 MB/s | 157.1 MB/s |
| fc3/15 | 3300 | 0xc80005  | 0xed0005  |   1        | 150.9 MB/s | 158.1 MB/s |
| fc3/15 | 3300 | 0xc80000  | 0xed0001  |   1        | 133.7 MB/s | 133.3 MB/s |
| fc3/15 | 3300 | 0xc80001  | 0xed0001  |   1        | 118.4 MB/s | 120.2 MB/s |
+--------+-----------------------------------------+-------------------------+
```

This example shows how to display the top ITLs for throughput progressively:

```
switch# ShowAnalytics  --top --key thput  --progress

2019-06-13 10:58:16.015546

+--------+-----------------------------------------+-------------------------+
|  PORT  |        VSAN|Initiator|Target|LUN        |      Avg THROUGHPUT     |
+--------+-----------------------------------------+-------------------------+
|        |                                         |     Read    |   Write   |
| fc8/10 | 5|0xed04b2|0xef0680|000f-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b3|0xef0681|000a-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b3|0xef0681|0014-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b4|0xef0682|000f-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b5|0xef0683|000a-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b5|0xef0683|000f-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b5|0xef0683|0013-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b6|0xef0684|0013-0000-0000-0000 | 133.8 KB/s |     0      |
| fc8/10 | 5|0xed04b2|0xef0680|0004-0000-0000-0000 | 133.5 KB/s |     0      |
| fc8/10 | 5|0xed04b3|0xef0681|0009-0000-0000-0000 | 133.5 KB/s |     0      |
+--------+-----------------------------------------+-------------------------+
```

This example shows how to display the ITNs with the highest I/O operations per second (IOPS) for NVMe. The **--alias** option causes initiator and target device alias information is displayed.

```
switch# ShowAnalytics --top --alias --nvme

2021-02-09 09:15:25.445815

+--------+------+-----------------------+-----------------------+-----------+-----------------+
|  PORT  | VSAN |      Initiator        |        Target         | Namespace |     Avg IOPS    |
+--------+------+-----------------------+-----------------------+-----------+-----------------+
|        |      |                       |                       |           |  Read  |  Write |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2518  |  2459  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2499  |  2470  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2491  |  2472  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2491  |  2471  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2457  |  2487  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2445  |  2496  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2440  |  2495  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2434  |  2499  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  2197  |  2199  |
| fc3/15 | 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1       |  1987  |  1982  |
+--------+------+-----------------------+-----------------------+-----------+-----------------+
```

This example shows how to display the ITLs with the highest I/O operations per second (IOPS) for SCSI. The **--alias** option causes initiator and target device alias information is displayed.

```
switch# ShowAnalytics --top --alias

2021-02-09 09:15:25.445815

+--------+------+-----------------------+------+-----------------------+-----------------------+-----------------+
|  PORT  | VSAN |      Initiator        | VMID |        Target         |          LUN          |     Avg IOPS    |
+--------+------+-----------------------+------+-----------------------+-----------------------+-----------------+
|        |      |                       |      |                       |                       |  Read  |  Write |
| fc5/22 | 2200 |       0xe90460        |   - |       0xe80b60        | 0002-0000-0000-0000   |    0   |  9124  |
| fc5/22 | 2200 |       0xe90460        |   - |       0xe80b60        | 0003-0000-0000-0000   |    0   |  9124  |
| fc5/22 | 2200 |       0xe90460        |   - |       0xe80b60        | 0001-0000-0000-0000   |    0   |  9123  |
| fc5/21 | 2200 |       0xe902e0        |   - | Tgt_9706_206_fc5_21_ | 0003-0000-0000-0000   |    0   |  5718  |
| fc5/21 | 2200 |       0xe902e0        |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000   |    0   |  5718  |
| fc5/21 | 2200 |       0xe906c0        |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000   |    0   |  5718  |
| fc5/21 | 2200 |       0xe902e0        |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000   |    0   |  5717  |
| fc5/21 | 2200 |       0xe90440        |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000   |    0   |  5717  |
| fc5/21 | 2200 |       0xe90440        |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000   |    0   |  5717  |
| fc5/21 | 2200 |       0xe906c0        |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000   |    0   |  5717  |
+--------+------+-----------------------+------+-----------------------+-----------------------+-----------------+
```

This example shows how to display the ITLs with the highest I/O operations per second (IOPS). The **--alias** option causes initiator and target device alias information is displayed.

```
switch# ShowAnalytics --top --alias

2021-02-09 09:15:25.445815

+-------+------+-----------------------+------+-----------------------+-----------------------+-----------------+
|  PORT | VSAN |      Initiator        | VMID |        Target         |          LUN          |     Avg IOPS    |
+-------+------+-----------------------+------+-----------------------+-----------------------+-----------------+
|       |      |                       |      |                       |                       |  Read  |  Write |
| fc1/2 |   20 | tie-2000012341newdev |  89 | tie-200001234lnewdev | 0000-0000-0000-0000   |    0   |  1769  |
| fc1/1 |   20 | tie-2000012341newdev |  89 | tie-200001234lnewdev | 0000-0000-0000-0000   |    0   |  1769  |
+-------+------+-----------------------+------+-----------------------+-----------------------+-----------------+
```

This example shows how to display the errors for all target ITNs and limit the output to ten random records for NVMe:

```
switch# ShowAnalytics --errors --target-itn --limit 10
2019-05-23 11:28:34.926267

 Interface fc3/15
+-----------------------------------------+---------------------+-----------------+
| VSAN | Initiator |  Target   | Namespace  | Total NVMe Failures | Total FC Aborts |
+-----------------------------------------+---------------------+-----------------+
|                                         |     Read | Write    |   Read | Write  |
|                                         |          |          |        |        |
| 3300 | 0xc80005  | 0xed0005  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80000  | 0xed0001  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80004  | 0xed0004  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80001  | 0xed0001  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80003  | 0xed0003  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80000  | 0xed0000  |   1        |        0 | 0        |   1260 | 1210   |
| 3300 | 0xc80007  | 0xed0007  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80008  | 0xed0008  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80002  | 0xed0002  |   1        |        0 | 0        |    0   |  0     |
| 3300 | 0xc80006  | 0xed0006  |   1        |        0 | 0        |    0   |  0     |
+-----------------------------------------+---------------------+-----------------+
```

This example shows how to display the errors for all target ITLs and limit the output to ten random records:

```
switch# ShowAnalytics --errors --target-itl --limit 10
2019-05-23 11:28:34.926267
```

```
 Interface fc8/7
+----------------------------------------+--------------------+-----------------+
|        VSAN|Initiator|Target|LUN        | Total SCSI Failures | Total FC Aborts |
+----------------------------------------+--------------------+-----------------+
|                                        |     Read | Write    |   Read | Write  |
|                                        |                     |                 |
| 5|0xed0332|0xef0592|000f-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed0342|0xef05a2|000a-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed0332|0xef0592|0008-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed0340|0xef05a0|0010-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed0322|0xef0582|0008-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed032c|0xef058c|0014-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed033a|0xef059a|000d-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed034a|0xef05aa|0005-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed033a|0xef059a|0007-0000-0000-0000 |        0 | 0        |      0 | 0      |
| 5|0xed034a|0xef05aa|0013-0000-0000-0000 |        0 | 0        |      0 | 0      |
+----------------------------------------+--------------------+-----------------+
```

This example shows how to display all ITNs with nonzero NVMe failure and revert counts:

```
switch# ShowAnalytics --errorsonly --initiator-itn
2019-04-09 11:27:42.496294

 Interface fc16/12
+-----------------------------------------+--------------------+-----------------+
| VSAN | Initiator |  Target   | Namespace  | Total NVMe Failures | Total FC Aborts |
+-----------------------------------------+--------------------+-----------------+
|                                         |     Read | Write    |   Read | Write  |
|                                         |                     |                 |
| 3300 | 0xc80000  | 0xed0000  |   1        |        0 | 0        |   1635 | 1631   |
+-----------------------------------------+--------------------+-----------------+
```

This example shows how to display all ITLs with nonzero SCSI failure and revert counts:

```
switch# ShowAnalytics --errorsonly --initiator-itl
2019-04-09 11:27:42.496294

 Interface fc8/27
+-----------------------------------------+--------------------+-----------------+
|         VSAN|Initiator|Target|LUN         | Total SCSI Failures | Total FC Aborts |
+-----------------------------------------+--------------------+-----------------+
|                                         |     Read | Write    |   Read | Write  |
|                                         |                     |                 |
| 311|0x900000|0xc90000|0000-0000-0000-0000 |       0  | 42       |      0 | 0      |
+-----------------------------------------+--------------------+-----------------+
```

This example shows how to display 10 random ITNs with nonzero NVMe failure and revert counts. The device-alias (if any) is included for both the initiator and target.

```
switch# ShowAnalytics --errorsonly --initiator-itn --alias --limit 10
2019-04-09 12:06:19.847350
 Interface fc16/12
+-------------------------------------------------------------+--------------------+-----------------+
| VSAN |      Initiator       |        Target        | Namespace  | Total NVMe Failures | Total FC Aborts |
+-------------------------------------------------------------+--------------------+-----------------+
|                                                             |     Read | Write    |   Read | Write  |
|                                                             |                     |                 |
| 3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |   1        |        0 | 0        |   1635 | 1631   |
+-------------------------------------------------------------+--------------------+-----------------+
```

This example shows how to display 10 random ITLs with nonzero SCSI failure and terminate counts. The device-alias (if any) is included for both the initiator and target.

```
switch# ShowAnalytics --errorsonly --initiator-itl --alias --limit 10
2019-04-09 12:06:19.847350

 Interface fc7/16
+-------------------------------------------------------------------------------+--------------------+-----------------+
| VSAN |      Initiator       |        Target        |         LUN          | Total SCSI Failures | Total FC Aborts |
+-------------------------------------------------------------------------------+--------------------+-----------------+
|                                                                               |     Read | Write    |   Read | Write  |
|                                                                               |                     |                 |
| 2200 |       0xe90440       | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000 |      0   | 5928     |      0 | 0      |
| 2200 |       0xe90440       | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000 |      0   | 5926     |      0 | 0      |
+-------------------------------------------------------------------------------+--------------------+-----------------+
```

This example shows how to display the minimum, maximum, and peak flow metrics of target ID 0xef0720 of a target ITL:

```
switch# ShowAnalytics --minmax --target-itl --target 0xef0720
2019-04-09 11:22:08.652598

 Interface fc8/17
+----------------------------------------+---------------+------------------+-------------------+--------------+
|        VSAN|Initiator|Target|LUN        |   Peak IOPS*  | Peak Throughput* |   Read ECT*       |   Write ECT* |
+----------------------------------------+---------------+------------------+-------------------+--------------+
|                                        |  Read | Write |   Read   | Write |   Min   |  Max    |  Min |  Max  |
```

```
|                                          |             |                |                  |             |
| 5|0xed0500|0xef0720|0001-0000-0000-0000 | 11106 |  0    |10.8 MB/s |   0   | 28.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0002-0000-0000-0000 |  9232 |  0    | 9.0 MB/s |   0   | 28.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0003-0000-0000-0000 |  7421 |  0    | 7.2 MB/s |   0   | 28.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0004-0000-0000-0000 |  5152 |  0    | 5.0 MB/s |   0   | 29.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0005-0000-0000-0000 |  5163 |  0    | 5.0 MB/s |   0   | 30.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0006-0000-0000-0000 |  5154 |  0    | 5.0 MB/s |   0   | 30.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0007-0000-0000-0000 |  4801 |  0    | 4.7 MB/s |   0   | 29.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0008-0000-0000-0000 |  3838 |  0    | 3.7 MB/s |   0   | 64.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0009-0000-0000-0000 |  3053 |  0    | 3.0 MB/s |   0   | 40.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|000a-0000-0000-0000 |  3061 |  0    | 3.0 MB/s |   0   | 33.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|000b-0000-0000-0000 |  3053 |  0    | 3.0 MB/s |   0   | 30.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|000c-0000-0000-0000 |  3058 |  0    | 3.0 MB/s |   0   | 37.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|000d-0000-0000-0000 |  3058 |  0    | 3.0 MB/s |   0   | 29.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|000e-0000-0000-0000 |  2517 |  0    | 2.5 MB/s |   0   | 29.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|000f-0000-0000-0000 |  2405 |  0    | 2.3 MB/s |   0   | 29.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0010-0000-0000-0000 |  2410 |  0    | 2.4 MB/s |   0   | 36.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0011-0000-0000-0000 |  2405 |  0    | 2.3 MB/s |   0   | 33.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0012-0000-0000-0000 |  2411 |  0    | 2.4 MB/s |   0   | 30.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0013-0000-0000-0000 |  2408 |  0    | 2.4 MB/s |   0   | 37.0 us | 30.0 ms |   0  |   0   |
| 5|0xed0500|0xef0720|0014-0000-0000-0000 |  2284 |  0    | 2.2 MB/s |   0   | 29.0 us | 30.0 ms |   0  |   0   |
+------------------------------------------+-------------+----------------+------------------+-------------+
*These values are calculated since the metrics were last cleared.
```

This example shows how to display the device alias information, minimum, maximum, and peak flow metrics of interface fc3/15 of a target ITN and limit the output to 10 random records for NVMe:

```
switch# ShowAnalytics --minmax --target-itn --alias  --interface fc3/15 --limit 10
2019-04-09 12:01:40.609197

 Interface fc3/15
+-------------------------------------------------------------+-------------------+-------------------+-------------+-------------+-------------+-------------+-------------+-------------+-------------+
|VSAN |      Initiator       |        Target        | Namespace |       Peak IOPS*      |     Peak Throughput*      |     Read ECT*      |      Write ECT*     |    Host Delay*
    |    Array Delay*    | Write IO sequence* |
+-------------------------------------------------------------+-------------------+-------------------+-------------+-------------+-------------+-------------+-------------+-------------+-------------+
|                                                             |   Read    |   Write   |     Read    |    Write    |   Min   |   Max   |   Min   |   Max   |   Min   |   Max
   |  Min    |    Max   |  Min    |    Max   |
|                                                             |           |           |             |             |         |         |         |         |         |
    |                      |                      |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2674    |   2595    | 167.1 MB/s | 162.2 MB/s  | 38.0 us |   2.3 ms |  69.0 us |   3.9 ms | 12.0 us |   3.7
 ms |   NA     |  36.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   10199   |   10163   | 637.4 MB/s | 635.2 MB/s  |  9.0 us |   2.4 ms |  65.0 us |   3.9 ms | 12.0 us |   3.7
 ms |   NA     |  32.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2618    |   2587    | 163.6 MB/s | 161.7 MB/s  | 39.0 us |   2.4 ms |  69.0 us |   3.8 ms | 12.0 us |   3.6
 ms |   NA     |  34.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2288    |   2287    | 143.0 MB/s | 143.0 MB/s  | 37.0 us |   2.4 ms |  69.0 us |   4.0 ms | 12.0 us |   3.7
 ms |   NA     |  35.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2624    |   2583    | 164.0 MB/s | 161.4 MB/s  | 38.0 us |   2.5 ms | 108.0 us |   3.6 ms | 12.0 us |   3.4
 ms |   NA     |  33.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |    383    |    379    |  24.0 MB/s |  23.7 MB/s  |  2.6 ms |  27.0 ms |   3.5 ms |  28.7 ms | 12.0 us |   3.1
 ms |   NA     |   1.4 ms |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2624    |   2587    | 164.0 MB/s | 161.7 MB/s  | 38.0 us |   2.4 ms |  69.0 us |   3.7 ms | 12.0 us |   3.5
 ms |   NA     |  39.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2621    |   2597    | 163.8 MB/s | 162.3 MB/s  | 38.0 us |   2.4 ms |  77.0 us |   3.9 ms | 12.0 us |   3.5
 ms |   NA     |  31.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2646    |   2590    | 165.4 MB/s | 161.9 MB/s  | 38.0 us |   2.6 ms |  69.0 us |   3.8 ms | 12.0 us |   3.6
 ms |   NA     |  33.0 us |    0     |    0     |
|3300 | sanblaze-147-port7-p | sanblaze-147-port6-p |  1        |   2651    |   2594    | 165.7 MB/s | 162.2 MB/s  | 39.0 us |   2.6 ms |  69.0 us |   3.6 ms | 12.0 us |   3.5
 ms |   NA     |  32.0 us |    0     |    0     |
+-------------------------------------------------------------+-------------------+-------------------+-------------+-------------+-------------+-------------+-------------+-------------+-------------+
Total number of ITNs: 10
*These values are calculated since the metrics were last cleared.
```

This example shows how to display the device alias information, minimum, maximum, and peak flow metrics of interface fc5/21 of a target ITL and limit the output to 10 random records for SCSI:

```
switch# ShowAnalytics --minmax --target-itl --alias  --interface fc5/21 --limit 10
2019-04-09 12:01:40.609197

 Interface fc5/21
+-------------------------------------------------------------+-----------+-----------------------+-----------------+-------------+-------------+-------------+-------------+-------------+-------------+-------------+
|VSAN |      Initiator       | VMID |        Target         |         LUN          |  Peak IOPS* |     Peak Throughput*      |     Read ECT*      |     Write ECT*     |    Host
Delay*     |    Array Delay*    | Write IO sequence* |
+-------------------------------------------------------------+-----------+-----------------------+-----------------+-------------+-------------+-------------+-------------+-------------+-------------+-------------+
|                                                             |           |                       |                 |Read | Write |     Read    |    Write    |   Min   |   Max   |   Min   |   Max   |   Min   |
   Max   |  Min    |    Max   |  Min    |    Max   |
|                                                             |           |                       |                 |     |       |             |             |         |         |         |         |         |
        |                      |                      |
|2200 |      0xe902e0        |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000  |  0   | 9242 |      0 B/s |  4.5 MB/s  |   0 ns  |   0 ns  | 66.0 us |  2.6 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
|2200 |      0xe902e0        |   - | Tgt_9706_206_fc5_21_ | 0003-0000-0000-0000  |  0   | 9243 |      0 B/s |  4.5 MB/s  |   0 ns  |   0 ns  | 66.0 us |  2.6 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
|2200 |      0xe902e0        |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000  |  0   | 9242 |      0 B/s |  4.5 MB/s  |   0 ns  |   0 ns  | 66.0 us |  2.6 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
|2200 |      0xe90440        |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000  |  0   | 8361 |      0 B/s |  4.1 MB/s  |   0 ns  |   0 ns  | 68.0 us |  2.6 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
|2200 |      0xe90440        |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000  |  0   | 7814 |      0 B/s |  3.8 MB/s  |   0 ns  |   0 ns  | 69.0 us |  2.6 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
|2200 |      0xe906c0        |   - | Tgt_9706_206_fc5_21_ | 0001-0000-0000-0000  |  0   | 7779 |      0 B/s |  3.8 MB/s  |   0 ns  |   0 ns  | 69.0 us |  2.7 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
|2200 |      0xe906c0        |   - | Tgt_9706_206_fc5_21_ | 0002-0000-0000-0000  |  0   | 7779 |      0 B/s |  3.8 MB/s  |   0 ns  |   0 ns  | 69.0 us |  2.6 ms |   0 ns  |
   0 ns  |   NA     |   0 ns  |    0     |    0     |
+-------------------------------------------------------------+-----------+-----------------------+-----------------+-------------+-------------+-------------+-------------+-------------+-------------+-------------+
Total number of ITLs: 7
*These values are calculated since the metrics were last cleared.
```

This example shows how to display the NPU load for a range of interfaces:

```
switch# ShowAnalytics --evaluate-npuload --interface fc8/7-8
2019-05-09 10:56:54.021234
There are 2 interfaces to be evaluated. Expected time is 2 minutes 0 seconds
Do you want to continue [Yes|No]? [n]y
+-----------+--------+--------+---------+------+------+-------+------------+----------+
| Interface |        ITL/N Count         |      NPU Load %     |  Analyis   | Analysis |
|           |  SCSI  |  NVMe  |  Total  | SCSI | NVMe | Total | Start Time | End Time |
+-----------+--------+--------+---------+------+------+-------+------------+----------+
|   fc8/7   |  1000  |   0    |   1000  | 8.1  | 0.0  |  8.1  |  10:57:20  | 10:57:52 |
|   fc8/8   |  1000  |   0    |   1000  | 8.1  | 0.0  |  8.1  |  10:58:20  | 10:58:51 |
|           |        |        |         |      |      |       |            |          |
|   *Total  |  2000  |   0    |   2000  | 16.2 | 0.0  |  16.2 |            |          |
+-----------+--------+--------+---------+------+------+-------+------------+----------+
* This total is an indicative reference based on evaluated ports
```

Note Evaluating NPU load takes some time. If the connection to the switch is lost during the evaluation process, the process continues to run in the background until completion and the output is saved in a file. A syslog message is generated after the process is complete with the filename and the location of the file where the output is saved.

This example shows how to duplicate the output to a file named *output.txt* on bootflash:

Note You can use the **--outfile** option with all the **ShowAnalytics** command options to duplicate the command output to a file.

```
switch# ShowAnalytics --evaluate-npuload --outfile output.txt
2020-11-24 13:42:19.510351
There are 4 interfaces to be evaluated. Expected time is 4 minutes 0 seconds
Do you want to continue [Yes|No]? [n]y
Module 1
+-----------+-----------+--------+--------+---------+------+------+-------+------------+----------+
| Interface |    Type   |        ITL/N Count         |      NPU Load %     |  Analyis   | Analysis |
|           |           |  SCSI  |  NVMe  |  Total  | SCSI | NVMe | Total | Start Time | End Time |
+-----------+-----------+--------+--------+---------+------+------+-------+------------+----------+
|   fc1/1   |   Target  |   1    |   0    |    1    | 0.6  | 0.0  |  0.6  |  13:42:40  | 13:43:11 |
|   fc1/2   | Initiator |   1    |   0    |    1    | 0.6  | 0.0  |  0.6  |  13:43:40  | 13:44:11 |
|           |           |        |        |         |      |      |       |            |          |
|   *Total  |           |   2    |   0    |    2    | 1.2  | 0.0  |  1.2  |            |          |
+-----------+-----------+--------+--------+---------+------+------+-------+------------+----------+
Recommended port sampling size: 48

* This total is an indicative reference based on evaluated ports

Errors:
------

Traffic is not running on port fc1/47
Traffic is not running on port fc1/48
```

This example shows how to append the output to a file named *output.txt* on bootflash: that already contains some output:

```
switch# ShowAnalytics --evaluate-npuload --appendfile  output.txt
2020-11-24 13:45:07.535440
There are 4 interfaces to be evaluated. Expected time is 4 minutes 0 seconds
Do you want to continue [Yes|No]? [n]y
Module 1
+-----------+-----------+--------+--------+---------+------+------+-------+------------+----------+
| Interface |    Type   |        ITL/N Count         |      NPU Load %     |  Analyis   | Analysis |
|           |           |  SCSI  |  NVMe  |  Total  | SCSI | NVMe | Total | Start Time | End Time |
+-----------+-----------+--------+--------+---------+------+------+-------+------------+----------+
|   fc1/1   |   Target  |   1    |   0    |    1    | 0.6  | 0.0  |  0.6  |  13:45:40  | 13:46:11 |
|   fc1/2   | Initiator |   1    |   0    |    1    | 0.6  | 0.0  |  0.6  |  13:46:40  | 13:47:11 |
|           |           |        |        |         |      |      |       |            |          |
|   *Total  |           |   2    |   0    |    2    | 1.2  | 0.0  |  1.2  |            |          |
+-----------+-----------+--------+--------+---------+------+------+-------+------------+----------+
Recommended port sampling size: 48

* This total is an indicative reference based on evaluated ports

Errors:
------

Traffic is not running on port fc1/47
```

```
Traffic is not running on port fc1/48
```

This example shows how to display the VSAN throughput information for NVMe:

```
switch# ShowAnalytics --vsan-thput --nvme
2019-05-09 14:02:07.940600

 Interface fc16/12
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 3300 | 1605.8 | 1626.8 | 3232.6 |
+------+--------+--------+--------+
Note: This data is only for NVMe
```

This example shows how to display the VSAN throughput information for SCSI:

```
switch# ShowAnalytics --vsan-thput
2019-05-09 14:02:07.940600

Interface fc8/17
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 5    | 0.0    | 0.0    | 0.0    |
+------+--------+--------+--------+

Interface fc8/18
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 5    | 0.0    | 0.0    | 0.0    |
+------+--------+--------+--------+

Interface fc8/19
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 5    | 0.0    | 0.0    | 0.0    |
+------+--------+--------+--------+

Interface fc8/20
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 5    | 0.0    | 0.0    | 0.0    |
+------+--------+--------+--------+

Interface fc8/21
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 3500 | 301.9  | 302.8  | 604.7  |
+------+--------+--------+--------+

Interface fc8/22
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 3500 | 302.7  | 304.8  | 607.5  |
+------+--------+--------+--------+
Note: This data is only for SCSI
```

This example shows how to display the VSAN throughput information for a port channel:

```
switch# ShowAnalytics --vsan-thput --interface port-channel108
2019-05-09 15:01:32.538121

Interface port-channel108
+------+--------+--------+--------+
| VSAN |   Throughput (4s avg)    |
|      | Read   | Write  | Total  |
|      | (MBps) | (MBps) | (MBps) |
+------+--------+--------+--------+
| 1    | 0.0    | 0.0    | 0.0    |
| 5    | 145.9  | 0.0    | 145.9  |
| 3500 | 561.9  | 558.6  | 1120.5 |
+------+--------+--------+--------+
Note: This data is only for SCSI
```

This example shows how to display the outstanding IO per ITN for an interface for NVMe:

```
switch# ShowAnalytics --outstanding-io --interface fc16/12 --nvme
2019-05-20 11:59:48.306396
 Interface : fc16/12  VSAN : 3300  FCNS_type : Initiator

+-----------------------------------+----------------+
| Initiator |  Target   | Namespace  | Outstanding IO |
+-----------------------------------+----------------+
|                                   |  Read | Write  |
|                                   |                |
| 0xc80002  | 0xed0002  |   1        |    3  |  6     |
| 0xc80007  | 0xed0007  |   1        |    5  |  5     |
| 0xc80005  | 0xed0005  |   1        |    1  | 10     |
| 0xc80001  | 0xed0001  |   1        |    2  |  7     |
| 0xc80000  | 0xed0000  |   1        |    6  |  5     |
| 0xc80008  | 0xed0008  |   1        |    1  |  7     |
| 0xc80009  | 0xed0009  |   1        |    3  |  4     |
| 0xc80004  | 0xed0004  |   1        |    3  |  6     |
| 0xc80006  | 0xed0006  |   1        |    2  |  5     |
| 0xc80000  | 0xed0001  |   1        |    3  |  4     |
| 0xc80003  | 0xed0003  |   1        |    4  |  4     |
+-----------------------------------+----------------+
Instantaneous Qdepth : 96
```

This example shows how to display the outstanding IO per ITL for an interface for SCSI:

```
switch# ShowAnalytics --outstanding-io --interface fc8/7
2019-05-20 11:59:48.306396

Interface : fc8/7  VSAN : 5  FCNS_type : Target

+---------------------------------------+----------------+
|          Initiator|Target|LUN         | Outstanding IO |
+---------------------------------------+----------------+
|                                       |  Read | Write  |
|                                       |                |
| 0xed0320|0xef0580|0001-0000-0000-0000 |    2  |  0     |
| 0xed0320|0xef0580|0002-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0003-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0004-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0005-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0006-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0007-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0008-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0009-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|000a-0000-0000-0000 |    1  |  0     |
+---------------------------------------+----------------+
Instantaneous Qdepth : 11
```

Note The *Instantaneous Qdepth* value in the output represents the number of IOs that are currently active in the specified interface.

This example shows how to display the outstanding IO per ITN for an interface, limit the output to 10 records, and refresh the data periodically for NVMe:

```
switch# ShowAnalytics --outstanding-io --interface fc8/7  --limit 10 --refresh --nvme
2019-05-20 12:00:21.028228
 Interface : fc16/12  VSAN : 3300  FCNS_type : Initiator

+-----------------------------------+----------------+
| Initiator |  Target   | Namespace  | Outstanding IO |
+-----------------------------------+----------------+
|                                   |  Read | Write  |
|                                   |                |
| 0xc80002  | 0xed0002  |   1        |    2  |  7     |
| 0xc80007  | 0xed0007  |   1        |    3  |  5     |
| 0xc80005  | 0xed0005  |   1        |    1  |  8     |
| 0xc80001  | 0xed0001  |   1        |    1  |  0     |
| 0xc80000  | 0xed0000  |   1        |    5  |  6     |
+-----------------------------------+----------------+
```

This example shows how to display the outstanding IO per ITL for an interface, limit the output to 10 records, and refresh the data periodically for SCSI:

```
switch# ShowAnalytics --outstanding-io --interface fc8/7  --limit 10 --refresh
2019-05-20 12:00:21.028228

Interface : fc8/7  VSAN : 5  FCNS_type : Target

+---------------------------------------+----------------+
|          Initiator|Target|LUN         | Outstanding IO |
+---------------------------------------+----------------+
|                                       |  Read | Write  |
|                                       |                |
```

```
| 0xed0320|0xef0580|0001-0000-0000-0000 |    0  |  0     |
| 0xed0320|0xef0580|0002-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0003-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0004-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0005-0000-0000-0000 |    0  |  0     |
| 0xed0320|0xef0580|0006-0000-0000-0000 |    0  |  0     |
| 0xed0320|0xef0580|0007-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|0008-0000-0000-0000 |    0  |  0     |
| 0xed0320|0xef0580|0009-0000-0000-0000 |    1  |  0     |
| 0xed0320|0xef0580|000a-0000-0000-0000 |    1  |  0     |
+-------------------------------------+----------------+
Estimated Qdepth : 6
```

Displaying Congestion Drops Per Flow

The SAN Analytics feature displays packet timeout drops on a per-flow basis. The number of packets dropped along with the time stamp for ports is displayed.

To display the packet drops on a per-flow basis, run this command:

switch# **show analytics flow congestion-drops**

Examples: Displaying Congestion Drops Per Flow

This example shows flows where frames are dropped due to congestion. The source and destination FCID, differential frame drop count for the IT pair, and timestamp of the drops are displayed.

```
switch# show analytics flow congestion-drops
```

```
|=============================================================================================|
| Source       |Destination            | Congestion    |     Timestamp                  |
| INTF  | VSAN |  FCID     |  FCID     | Drops(delta)  |                                |
|=============================================================================================|
| fc2/13| 0002 | 0x9900E1  | 0x640000  |  00000105     | 1. 09/13/17 11:09:48.762     |
| fc2/13| 0002 | 0x9900E1  | 0x640000  |  00000002     | 2. 09/13/17 09:05:39.527     |
| fc2/13| 0002 | 0x990000  | 0x640020  |  00000002     | 3. 09/13/17 09:05:39.527     |
|=============================================================================================|
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000084     | 1. 09/12/17 08:17:11.905     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000076     | 2. 09/12/17 05:50:37.721     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000067     | 3. 09/12/17 03:24:03.319     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000088     | 4. 09/12/17 00:57:28.019     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000088     | 5. 09/11/17 22:30:53.723     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000086     | 6. 09/11/17 20:04:18.001     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000026     | 7. 09/11/17 17:37:24.273     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000076     | 8. 09/11/17 15:10:50.240     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000074     | 9. 09/11/17 12:44:15.866     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000087     |10. 09/11/17 10:17:41.402     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000086     |11. 09/11/17 07:51:10.412     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000084     |12. 09/11/17 05:24:35.981     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000083     |13. 09/11/17 02:58:01.067     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000086     |14. 09/11/17 00:31:26.709     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000079     |15. 09/10/17 22:04:51.399     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000084     |16. 09/10/17 19:38:17.217     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000082     |17. 09/10/17 17:11:42.594     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000086     |18. 09/10/17 14:44:52.786     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000089     |19. 09/10/17 12:18:18.394     |
| fc2/31| 0002 | 0x640000  | 0x9900E1  |  00000087     |20. 09/10/17 09:51:44.067     |
|=============================================================================================|
```

Verifying SAN Analytics

This example shows the list of interfaces that have the SAN Analytics feature enabled:

```
switch# show running-config analytics

!Command: show running-config analytics
!Running configuration last done at: Mon Apr  1 05:27:54 2019
!Time: Mon Apr  1 05:28:42 2019

version 8.4(0)SK(1)
feature analytics
analytics port-sampling module 4 size 12 interval 30

analytics query "select all from fc-scsi.scsi_target_itl_flow" name VI_scsi type periodic
interval 30  differential clear
analytics query "select all from fc-nvme.nvme_target_itn_flow" name nvme-184 type periodic
 interval 30  differential clear

interface fc4/25
  analytics type fc-scsi

interface fc4/26
  analytics type fc-nvme

interface fc12/44
  analytics type fc-scsi
  analytics type fc-nvme
```

This example shows the list of configured push queries that are installed on a switch:

```
switch# show analytics query all
Total queries:2
============================
Query Name      :VI_scsi
Query String    :select all from fc-scsi.scsi_target_itl_flow
Query Type      :periodic, interval 30
Query Options   :differential clear

Query Name      :nvme-184
Query String    :select all from fc-nvme.nvme_target_itn_flow
Query Type      :periodic, interval 30
Query Options   :differential clear
```

This example shows how to display the NPU load, ITL, and ITN count per module:

```
switch# show analytics system-load
 n/a - not applicable
 ---------------------------------- Analytics System Load Info -------------------------------
 | Module | NPU Load (in %) | ITLs   ITNs   Both  |        Hosts         |       Targets       |
 |        | SCSI NVMe Total | SCSI   NVMe   Total | SCSI   NVMe   Total | SCSI   NVMe   Total |
 ---------------------------------------------------------------------------------------------
 |   1    | 0    0    0     | 0      0      0     | 0      0      0     | 0      0      0     |
 |   4    | 64   0    64    | 20743  0      20743 | 0      0      0     | 346    0      346   |
 |   5    | 0    0    0     | 0      0      0     | 0      0      0     | 0      0      0     |
 |   8    | 0    0    0     | 0      0      0     | 0      0      0     | 0      0      0     |
 |   12   | 0    12   12    | 0      300    300   | 0      0      0     | 0      40     40    |
 |   13   | 0    0    0     | 0      0      0     | 0      0      0     | 0      0      0     |
 |   18   | 0    13   13    | 1      1      2     | 1      1      2     | 0      0      0     |
 | Total  | n/a  n/a  n/a   | 20744  301    21045 | 1      1      2     | 346    40     386   |
```

```
As of Mon Apr  1 05:31:10 2019
```

Note The **show analytics system-load** command provides the system load information based on all ITL counts, including active and inactive ITL counts. Hence, we recommend that you use the **purge analytics query** *"query_string"* command to remove the inactive ITL counts, and then run this command to get the active ITL counts.

This example displays the NPU load, ITL, and ITN of all active modules:

```
switch# ShowAnalytics --systemload-active

This will run differential query on scsi_initiator_itl_flow, scsi_target_itl_flow,
nvme_initiator_itn_flow, nvme_target_itn_flow, scsi_initiator, scsi_target,
nvme_initiator and nvme_target  or use the result of installed query if present
 Do you want to continue [Yes|No]? [n]y

Data collected at : Wed, 25 May 2022 16:29:24 +0530

Using result of installed queries: dcnmtgtITN,dcnmtgtITL

+--------+--------+--------+---------+------+------+-------+-------+-------+--------+
| Module |        ITL/N Count        |      Initiators     |        Targets         |
|        |  SCSI  |  NVMe  |  Total  | SCSI | NVMe | Total |  SCSI |  NVMe |  Total |
+--------+--------+--------+---------+------+------+-------+-------+-------+--------+
|   1    |  5571  |    0   |   5571  |   2  |   0  |    2  |   55  |    0  |   55   |
|   2    |  14904 |    1   |   14905 |  191 |   1  |   192 |   191 |    0  |   191  |
|   3    |  7588  |    0   |   7588  |  128 |   0  |   128 |   128 |    0  |   128  |
|   5    |    0   |    0   |     0   |  56  |   0  |   56  |    0  |    0  |    0   |
|   12   |    0   |    0   |     0   |   0  |   0  |    0  |    0  |    1  |    1   |
| Total  |  28063 |    1   |   28064 |  377 |   1  |   378 |   374 |    1  |   375  |
+--------+--------+--------+---------+------+------+-------+-------+-------+--------+
```

This example displays the NPU load, ITL, and ITN details for a particular active module:

```
switch# ShowAnalytics --systemload-active --module 1 --detail

This will run differential query on scsi_initiator_itl_flow, scsi_target_itl_flow,
nvme_initiator_itn_flow, nvme_target_itn_flow, scsi_initiator, scsi_target,
nvme_initiator and nvme_target  or use the result of installed query if present
 Do you want to continue [Yes|No]? [n]y

Data collected at : Wed, 25 May 2022 16:35:35 +0530

Using result of installed queries: dcnmtgtITN,dcnmtgtITL

+--------+--------+--------+---------+------+------+-------+-------+-------+--------+
| Module |        ITL/N Count        |      Initiators     |        Targets         |
|        |  SCSI  |  NVMe  |  Total  | SCSI | NVMe | Total |  SCSI |  NVMe |  Total |
+--------+--------+--------+---------+------+------+-------+-------+-------+--------+
|   1    |  5571  |    0   |   5571  |   2  |   0  |    2  |   55  |    0  |   55   |
| Total  |  5571  |    0   |   5571  |   2  |   0  |    2  |   55  |    0  |   55   |
+--------+--------+--------+---------+------+------+-------+-------+-------+--------+

Detailed output for DS-X9748-3072K9 modules
Module : 1
+-----------------------------+--------+--------+---------+------+------+-------+-------+-------+--------+
|            Ports            |        ITL/N Count        |      Initiators     |        Targets         |
|                             |  SCSI  |  NVMe  |  Total  | SCSI | NVMe | Total |  SCSI |  NVMe |  Total |
+-----------------------------+--------+--------+---------+------+------+-------+-------+-------+--------+
|   fc1/1,fc1/3,fc1/5,fc1/7   |  186   |   0    |   186   |  0   |  0   |   0   |   2   |   0   |   2    |
|   fc1/2,fc1/4,fc1/6,fc1/8   |  186   |   0    |   186   |  0   |  0   |   0   |   2   |   0   |   2    |
|  fc1/9,fc1/11,fc1/13,fc1/15 |  185   |   0    |   185   |  0   |  0   |   0   |   2   |   0   |   2    |
| fc1/10,fc1/12,fc1/14,fc1/16 |   93   |   0    |    93   |  0   |  0   |   0   |   1   |   0   |   1    |
| fc1/17,fc1/19,fc1/21,fc1/23 |  186   |   0    |   186   |  0   |  0   |   0   |   2   |   0   |   2    |
| fc1/18,fc1/20,fc1/22,fc1/24 |  186   |   0    |   186   |  0   |  0   |   0   |   2   |   0   |   2    |
| fc1/25,fc1/27,fc1/29,fc1/31 |  171   |   0    |   171   |  2   |  0   |   2   |   0   |   0   |   0    |
| fc1/33,fc1/35,fc1/37,fc1/39 |  2188  |   0    |   2188  |  0   |  0   |   0   |   22  |   0   |   22   |
| fc1/34,fc1/36,fc1/38,fc1/40 |  2190  |   0    |   2190  |  0   |  0   |   0   |   22  |   0   |   22   |
|            Total            |  5571  |   0    |   5571  |  2   |  0   |   2   |   55  |   0   |   55   |
+-----------------------------+--------+--------+---------+------+------+-------+-------+-------+--------+
```

This example shows how to check the port sampling status and the instantaneous NPU load:

```
switch# show analytics port-sampling module 1
Sampling Window Size: 12
Rotation Interval: 30
NPU LOAD : 64%      [SCSI 64%, NVMe 0%]
================================================================================
  Port                Monitored Start Time           Monitored End Time
================================================================================
  fc4/25              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/26              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/27              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/28              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/29              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/30              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/31              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/32              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/33              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/34              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/35              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/36              04/01/19 - 05:25:29            04/01/19 - 05:25:59
  fc4/37*             04/01/19 - 05:25:59            -
  fc4/38*             04/01/19 - 05:25:59            -
  fc4/39*             04/01/19 - 05:25:59            -
  fc4/40*             04/01/19 - 05:25:59            -
  fc4/41*             04/01/19 - 05:25:59            -
  fc4/42*             04/01/19 - 05:25:59            -
  fc4/43*             04/01/19 - 05:25:59            -
  fc4/44*             04/01/19 - 05:25:59            -
  fc4/45*             04/01/19 - 05:25:59            -
  fc4/46*             04/01/19 - 05:25:59            -
  fc4/47*             04/01/19 - 05:25:59            -
  fc4/48*             04/01/19 - 05:25:59            -
================================================================================
! - Denotes port is link down but analytics enabled.
* - Denotes port in active analytics port sampling window.
```

The star symbol (*) next to a port indicates that the port is currently being sampled.

This example shows the output of a push query that has already been configured:

```
switch# show analytics query name iniitl result
{ "values": {
        "1": {
                "port": "fc1/6",
                "vsan": "10",
                "app_id": "255",
                "initiator_id": "0xe800a0",
                "target_id": "0xd601e0",
                "lun": "0000-0000-0000-0000",
                "active_io_read_count": "0",
                "active_io_write_count": "7",
                "total_read_io_count": "0",
                "total_write_io_count": "1008608573",
                "total_seq_read_io_count": "0",
                "total_seq_write_io_count": "1",
                "total_read_io_time": "0",
                "total_write_io_time": "370765952314",
                "total_read_io_initiation_time": "0",
                "total_write_io_initiation_time": "52084968152",
                "total_read_io_bytes": "0",
                "total_write_io_bytes": "2065630357504",
                "total_read_io_inter_gap_time": "0",
```

```
            "total_write_io_inter_gap_time": "16171468343166",
            "total_time_metric_based_read_io_count": "0",
            "total_time_metric_based_write_io_count": "1008608566",
            "total_time_metric_based_read_io_bytes": "0",
            "total_time_metric_based_write_io_bytes": "2065630343168",
            "read_io_rate": "0",
            "peak_read_io_rate": "0",
            "write_io_rate": "16070",
            "peak_write_io_rate": "32468",
            "read_io_bandwidth": "0",
            "peak_read_io_bandwidth": "0",
            "write_io_bandwidth": "32912384",
            "peak_write_io_bandwidth": "66494976",
            "read_io_size_min": "0",
            "read_io_size_max": "0",
            "write_io_size_min": "2048",
            "write_io_size_max": "2048",
            "read_io_completion_time_min": "0",
            "read_io_completion_time_max": "0",
            "write_io_completion_time_min": "111",
            "write_io_completion_time_max": "9166",
            "read_io_initiation_time_min": "0",
            "read_io_initiation_time_max": "0",
            "write_io_initiation_time_min": "36",
            "write_io_initiation_time_max": "3265",
            "read_io_inter_gap_time_min": "0",
            "read_io_inter_gap_time_max": "0",
            "write_io_inter_gap_time_min": "100",
            "write_io_inter_gap_time_max": "1094718",
            "peak_active_io_read_count": "0",
            "peak_active_io_write_count": "23",
            "read_io_aborts": "0",
            "write_io_aborts": "0",
            "read_io_failures": "0",
            "write_io_failures": "0",
            "read_io_scsi_check_condition_count": "0",
            "write_io_scsi_check_condition_count": "0",
            "read_io_scsi_busy_count": "0",
            "write_io_scsi_busy_count": "0",
            "read_io_scsi_reservation_conflict_count": "0",
            "write_io_scsi_reservation_conflict_count": "0",
            "read_io_scsi_queue_full_count": "0",
            "write_io_scsi_queue_full_count": "0",
            "sampling_start_time": "1529993232",
            "sampling_end_time": "1529993260"
    },
    "2": {
            "port": "fc1/6",
            "vsan": "10",
            "app_id": "255",
            "initiator_id": "0xe800a1",
            "target_id": "0xd601e1",
            "lun": "0000-0000-0000-0000",
            "active_io_read_count": "0",
            "active_io_write_count": "8",
            "total_read_io_count": "0",
            "total_write_io_count": "1004271260",
            "total_seq_read_io_count": "0",
            "total_seq_write_io_count": "1",
            "total_read_io_time": "0",
            "total_write_io_time": "370004164726",
            "total_read_io_initiation_time": "0",
            "total_write_io_initiation_time": "51858511487",
            "total_read_io_bytes": "0",
```

```
                    "total_write_io_bytes": "2056747540480",
                    "total_read_io_inter_gap_time": "0",
                    "total_write_io_inter_gap_time": "16136686881766",
                    "total_time_metric_based_read_io_count": "0",
                    "total_time_metric_based_write_io_count": "1004271252",
                    "total_time_metric_based_read_io_bytes": "0",
                    "total_time_metric_based_write_io_bytes": "2056747524096",
                    "read_io_rate": "0",
                    "peak_read_io_rate": "0",
                    "write_io_rate": "16065",
                    "peak_write_io_rate": "16194",
                    "read_io_bandwidth": "0",
                    "peak_read_io_bandwidth": "0",
                    "write_io_bandwidth": "32901632",
                    "peak_write_io_bandwidth": "33165824",
                    "read_io_size_min": "0",
                    "read_io_size_max": "0",
                    "write_io_size_min": "2048",
                    "write_io_size_max": "2048",
                    "read_io_completion_time_min": "0",
                    "read_io_completion_time_max": "0",
                    "write_io_completion_time_min": "114",
                    "write_io_completion_time_max": "9019",
                    "read_io_initiation_time_min": "0",
                    "read_io_initiation_time_max": "0",
                    "write_io_initiation_time_min": "37",
                    "write_io_initiation_time_max": "3158",
                    "read_io_inter_gap_time_min": "0",
                    "read_io_inter_gap_time_max": "0",
                    "write_io_inter_gap_time_min": "101",
                    "write_io_inter_gap_time_max": "869035",
                    "peak_active_io_read_count": "0",
                    "peak_active_io_write_count": "19",
                    "read_io_aborts": "0",
                    "write_io_aborts": "0",
                    "read_io_failures": "0",
                    "write_io_failures": "0",
                    "read_io_scsi_check_condition_count": "0",
                    "write_io_scsi_check_condition_count": "0",
                    "read_io_scsi_busy_count": "0",
                    "write_io_scsi_busy_count": "0",
                    "read_io_scsi_reservation_conflict_count": "0",
                    "write_io_scsi_reservation_conflict_count": "0",
                    "read_io_scsi_queue_full_count": "0",
                    "write_io_scsi_queue_full_count": "0",
                    "sampling_start_time": "1529993232",
                    "sampling_end_time": "1529993260"
            }
}}
```


Note The output of these queries are in JSON format.

This example shows the list of view instances supported in the *fc-scsi* analytics type:

```
switch# show analytics schema fc-scsi views

fc-scsi db schema tables:
        port
        logical_port
```

```
        app
        scsi_target
        scsi_initiator
        scsi_target_app
        scsi_initiator_app
        scsi_target_tl_flow
        scsi_target_it_flow
        scsi_initiator_it_flow
        scsi_target_itl_flow
        scsi_initiator_itl_flow
        scsi_target_io
        scsi_initiator_io
```

This example shows the list of view instances supported in the *fc-nvme* analytics type:

```
switch# show analytics schema fc-nvme views

fc-nvme db schema tables:
        port
        logical_port
        app
        nvme_target
        nvme_initiator
        nvme_target_app
        nvme_initiator_app
        nvme_target_tn_flow
        nvme_target_it_flow
        nvme_initiator_it_flow
        nvme_target_itn_flow
        nvme_initiator_itn_flow
        nvme_target_io
        nvme_initiator_io
```

This example shows the list of flow metrics supported in the *fc-scsi.port* view instance:

Note The *exceed_count* counters in the output will be supported in a future Cisco MDS NX-OS Release.

```
switch# show analytics schema fc-scsi view-instance port

fc-scsi.port table schema columns:
        *port
         scsi_target_count
         scsi_initiator_count
         io_app_count
         logical_port_count
         scsi_target_app_count
         scsi_initiator_app_count
         active_io_read_count
         active_io_write_count
         scsi_target_it_flow_count
         scsi_initiator_it_flow_count
         scsi_target_itl_flow_count
         scsi_initiator_itl_flow_count
         scsi_target_tl_flow_count
         total_abts_count
         total_read_io_count
```

```
total_write_io_count
total_seq_read_io_count
total_seq_write_io_count
total_read_io_time
total_write_io_time
total_read_io_initiation_time
total_write_io_initiation_time
total_read_io_bytes
total_write_io_bytes
total_read_io_inter_gap_time
total_write_io_inter_gap_time
total_time_metric_based_read_io_count
total_time_metric_based_write_io_count
total_time_metric_based_read_io_bytes
total_time_metric_based_write_io_bytes
read_io_rate
peak_read_io_rate
write_io_rate
peak_write_io_rate
read_io_bandwidth
peak_read_io_bandwidth
write_io_bandwidth
peak_write_io_bandwidth
read_io_size_min
read_io_size_max
write_io_size_min
write_io_size_max
read_io_completion_time_min
read_io_completion_time_max
write_io_completion_time_min
write_io_completion_time_max
read_io_initiation_time_min
read_io_initiation_time_max
write_io_initiation_time_min
write_io_initiation_time_max
read_io_inter_gap_time_min
read_io_inter_gap_time_max
write_io_inter_gap_time_min
write_io_inter_gap_time_max
peak_active_io_read_count
peak_active_io_write_count
read_io_aborts
write_io_aborts
read_io_failures
write_io_failures
read_io_timeouts
write_io_timeouts
read_io_scsi_check_condition_count
write_io_scsi_check_condition_count
read_io_scsi_busy_count
write_io_scsi_busy_count
read_io_scsi_reservation_conflict_count
write_io_scsi_reservation_conflict_count
read_io_scsi_queue_full_count
write_io_scsi_queue_full_count
read_io_rate_exceed_count
write_io_rate_exceed_count
read_io_bandwidth_exceed_count
write_io_bandwidth_exceed_count
read_io_size_min_exceed_count
read_io_size_max_exceed_count
write_io_size_min_exceed_count
write_io_size_max_exceed_count
read_io_initiation_time_min_exceed_count
```

```
 read_io_initiation_time_max_exceed_count
 write_io_initiation_time_min_exceed_count
 write_io_initiation_time_max_exceed_count
 read_io_completion_time_min_exceed_count
 read_io_completion_time_max_exceed_count
 write_io_completion_time_min_exceed_count
 write_io_completion_time_max_exceed_count
 read_io_inter_gap_time_min_exceed_count
 read_io_inter_gap_time_max_exceed_count
 write_io_inter_gap_time_min_exceed_count
 write_io_inter_gap_time_max_exceed_count
 read_io_abort_exceed_count
 write_io_abort_exceed_count
 read_io_failure_exceed_count
 write_io_failure_exceed_count
 sampling_start_time
 sampling_end_time

(* - indicates the metric is a 'key' for the table)
```

This example shows the list of flow metrics supported in the *fc-nvme.port* view instance:

Note The *exceed_count* counters in the output will be supported in a future Cisco MDS NX-OS Release.

```
switch# show analytics schema fc-nvme view-instance port

fc-nvme.port table schema columns:
        *port
         nvme_target_count
         nvme_initiator_count
         io_app_count
         logical_port_count
         nvme_target_app_count
         nvme_initiator_app_count
         active_io_read_count
         active_io_write_count
         nvme_target_it_flow_count
         nvme_initiator_it_flow_count
         nvme_target_itn_flow_count
         nvme_initiator_itn_flow_count
         nvme_target_tn_flow_count
         total_abts_count
         total_read_io_count
         total_write_io_count
         total_seq_read_io_count
         total_seq_write_io_count
         total_read_io_time
         total_write_io_time
         total_read_io_initiation_time
         total_write_io_initiation_time
         total_read_io_bytes
         total_write_io_bytes
         total_read_io_inter_gap_time
         total_write_io_inter_gap_time
         total_time_metric_based_read_io_count
         total_time_metric_based_write_io_count
         total_time_metric_based_read_io_bytes
         total_time_metric_based_write_io_bytes
```

```
read_io_rate
peak_read_io_rate
write_io_rate
peak_write_io_rate
read_io_bandwidth
peak_read_io_bandwidth
write_io_bandwidth
peak_write_io_bandwidth
read_io_size_min
read_io_size_max
write_io_size_min
write_io_size_max
read_io_completion_time_min
read_io_completion_time_max
write_io_completion_time_min
write_io_completion_time_max
read_io_initiation_time_min
read_io_initiation_time_max
write_io_initiation_time_min
write_io_initiation_time_max
read_io_inter_gap_time_min
read_io_inter_gap_time_max
write_io_inter_gap_time_min
write_io_inter_gap_time_max
peak_active_io_read_count
peak_active_io_write_count
read_io_aborts
write_io_aborts
read_io_failures
write_io_failures
read_io_timeouts
write_io_timeouts
read_io_nvme_lba_out_of_range_count
write_io_nvme_lba_out_of_range_count
read_io_nvme_ns_not_ready_count
write_io_nvme_ns_not_ready_count
read_io_nvme_reservation_conflict_count
write_io_nvme_reservation_conflict_count
read_io_nvme_capacity_exceeded_count
write_io_nvme_capacity_exceeded_count
read_io_rate_exceed_count
write_io_rate_exceed_count
read_io_bandwidth_exceed_count
write_io_bandwidth_exceed_count
read_io_size_min_exceed_count
read_io_size_max_exceed_count
write_io_size_min_exceed_count
write_io_size_max_exceed_count
read_io_initiation_time_min_exceed_count
read_io_initiation_time_max_exceed_count
write_io_initiation_time_min_exceed_count
write_io_initiation_time_max_exceed_count
read_io_completion_time_min_exceed_count
read_io_completion_time_max_exceed_count
write_io_completion_time_min_exceed_count
write_io_completion_time_max_exceed_count
read_io_inter_gap_time_min_exceed_count
read_io_inter_gap_time_max_exceed_count
write_io_inter_gap_time_min_exceed_count
write_io_inter_gap_time_max_exceed_count
read_io_abort_exceed_count
write_io_abort_exceed_count
read_io_failure_exceed_count
write_io_failure_exceed_count
```

```
 sampling_start_time
 sampling_end_time

(* - indicates the metric is a 'key' for the table)
```

Troubleshooting SAN Analytics

Due to an ASIC issue, it is possible that the ITO table is not flushed, if the response to an exchange is received on another link (due to port channel flap or such rare occasions). This event itself does not affect analytics. But if this happens for a large number of ITLs and if there is a lot of churn in the fabric (such that the ITLs which had an ITO table hitare now quiet and a fresh set of ITLs are now active in the fabric), then scale can be affected. An error can occur in AMC when the scale limits are exceeded. On 64G modules and switches the analytics are collected via the AlertMgrCollector(AMC).

The AMC reset feature provides a non-disruptive recovery of analytics by resetting only the ASIC analytics. You can reset the AMC on the line card using the **analytics reset module** <*module-number*> command. For scale limits, see the *Cisco MDS NX-OS Configuration Limits, Release 9.x*.

This command resets only the AMC modules and flushes all the entries in the table and recover the AMC from ITO_HIT_ON_CMD.

For example:

```
switch # analytics reset module 6
switch # 2022 Jun 15 12:24:48 sw184-9706
%ANALYTICS_LC_MGR-SLOT6-5-ANALYTICS_LC_MGR_RESET_SUCCESS:
Analytics reset successful on module 6
```

On a successful reset, following syslog will be seen:

```
switch# 2022 Mar 13 22:35:54 switch
       %ANALYTICS_LC_MGR-SLOT6-5-ANALYTICS_LC_MGR_RESET_SUCCESS: Reset of Analytics engine

        succeeded.
```

On failure to reset, following syslog will be seen:

```
switch# 2022 Mar 13 22:35:54 switch
       %ANALYTICS_LC_MGR-SLOT6-3-ANALYTICS_LC_MGR_RESET_FAILURE: Reset of Analytics engine

        failed
```

If a failure syslog is seen, collect the tech-support and reload the module for recovery.