Cisco ASR 9000 Series Aggregation Services Router Netflow Configuration Guide

Cisco IOS XR Software Release 4.0

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CONTENTS

Preface

The *Cisco ASR 9000 Series Aggregation Services Router Netflow Configuration Guide* preface contains the following sections:

Changes to This Document

Table 1 lists the technical changes made to this document since it was first printed.

Table 1 Changes to This Document

Revision	Date	Change Summary
OL-23343-01	September 2010	Initial release of this document.

Obtaining Documentation and Submitting a Service Request

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Configuring NetFlow on Cisco ASR 9000 Series Aggregation Services Router

This module describes the configuration of NetFlow on the Cisco ASR 9000 Series Aggregation Services Router.

A NetFlow flow is a unidirectional sequence of packets that arrive on a single interface (or subinterface), and have the same values for key fields.

NetFlow is useful for the following:

- Accounting/Billing—NetFlow data provides fine grained metering for highly flexible and detailed resource utilization accounting.
- Network Planning and Analysis—NetFlow data provides key information for strategic network planning.
- Network Monitoring—NetFlow data enables near real-time network monitoring capabilities.

Feature History for Configuring NetFlow on Cisco IOS XR Software

Release	Modification
Release 3.3.0	• Information was added about using the **bgp attribute-download** command to enable the NetFlow BGP data export function. •
Release 3.3.1	• The **mpls** keyword was added to the **flow** command to support MPLS-aware NetFlow. • The **mpls** keyword was added to the **record** command to support MPLS-aware NetFlow.
Release 3.4.0	• The following commands were moved to flow exporter map configuration mode: – **destination** – **dscp** – **source** – **transport udp** • NetFlow was updated so that a single flow monitor map supports up to 8 exporters. • NetFlow was updated so that users could specify the number of MPLS labels to use as keys.

Release 3.5.0	•
Release 3.9.1	This feature was introduced.
Release 4.0	• IPv6 Multicast Netflow support was added on Cisco ASR 9000's A9K-SIP-700. •

Contents

This module includes the following sections:

Prerequisites for Configuring NetFlow

To perform these configuration tasks, your Cisco IOS XR software system administrator must assign you to a user group associated with a task group that includes the corresponding command task IDs. If you need assistance with your task group assignment, contact your system administrator.

Restrictions for Configuring NetFlow

Consider the following restrictions when configuring NetFlow in Cisco IOS XR software:

- You must configure a source interface. If you do not configure a source interface, the exporter will remain in a disabled state.
- Cisco IOS XR software supports export format Version 9 only.
- You must configure a valid record map name for every flow monitor map.

Tip We recommend that you do not use the management interface to export NetFlow packets. Exporting the management interface does not work efficiently.

Information About Configuring NetFlow

To implement NetFlow, you must understand the following concepts:

NetFlow Overview

A flow is exported as part of a NetFlow export User Datagram Protocol (UDP) datagram under the following circumstances:

- The flow has been inactive or active for too long.
- The flow cache is getting full.
- One of the counters (packets and or bytes) has wrapped.
- The user forces the flow to export.

NetFlow export UDP datagrams are sent to an external flow collector device that provides NetFlow export data filtering and aggregation. The export of data consists of expired flows and control information.

The NetFlow infrastructure is based on the configuration and use of the following maps:

- Monitor map
- Sampler map
- Exporter map

These maps are described in the sections that follow.

Monitor Map Overview

A monitor map contains name references to the flow record map and flow exporter map. Monitor maps are applied to an interface. You can configure the following monitor map attributes:

- Number of entries in the flow cache
- Type of cache (permanent or normal). Permanent caches do not have their entries removed from the cache unless they are explicitly cleared by the user
- Active flow timeout
- Inactive flow timeout
- Update timeout
- Default timeouts
- Record type of packets sampled and collected

Note The record name specifies the type of packets that NetFlow samples as they pass through the router. Currently, MPLS, IPv4, and IPv6 packet sampling is supported.

Note The active flow and inactive flow timeouts are associated with a normal cache type. The update timeout is associated with the permanent cache type.

Sampler Map Overview

The sampler map specifies the rate at which packets (one out of n packets) are sampled. On high bandwidth interfaces, applying NetFlow processing to every single packet can result in significant CPU utilization. Sampler map configuration is typically geared towards such high speed interfaces.

The Policer rate is based on the network processor (NP). If netflow is applied on 1 NP, the aggregated maximum flow packet processing rate per line card (LC) is 100k flow packets per second (irrespective of the direction and the number of interface netflow that is applied in that NP). However, depending on the Netflow monitor configuration distribution among NPs in an LC, policing of flow packet can take effect with an aggregated rate that is less than 100k. For example, if Netflow is applied to 1 interface per NP in a 4 NP LC, then the Policer rate per NP is 25K packets per second.

Exporter Map Overview

An exporter map contains user network specification and transport layer details for the NetFlow export packet. The **flow exporter-map** command allows you to configure collector and version attributes. You can configure the following collector information:

- Export destination IP address
- DSCP value for export packet
- Source interface
- UDP port number (This is where the collector is listening for NetFlow packets.)
- Transport protocol for export packets

Note In Cisco IOS XR software, UDP is the only supported transport protocol for export packets.

Note NetFlow export packets use the IP address that is assigned to the source interface. If the source interface does not have an IP address assigned to it, the exporter will be inactive.

You can also configure the following export version attributes:

- Template timeout
- Template data timeout
- Template options timeout
- Interface table timeout
- Sampler table timeout

Note A single flow monitor map can support up to eight exporters.

NetFlow Configuration Submodes

In Cisco IOS XR, NetFlow map configuration takes place in map-specific submodes. Cisco IOS XR supports the following NetFlow map configuration submodes:

- Flow Exporter Map Configuration Submode, page RC-5
- Flow Exporter Map Version Configuration Submode, page RC-6
- Flow Monitor Map Configuration Submode, page RC-6
- Sampler Map Configuration Submode, page RC-6

Tip The Cisco IOS XR software allows you to issue most commands available under submodes as one single command string from global configuration mode. For example, you can issue the **record ipv4** command from the flow monitor map configuration submode as follows:

```
RP/0/RSP0/CPU0router(config)# flow monitor-map fmm
RP/0/RSP0/CPU0:router(config-fmm)# record ipv4
```

Alternatively, you can issue the same command from global configuration mode, as shown in the following example:

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map fmm record ipv4
```

Flow Exporter Map Configuration Submode

When you issue the **flow exporter-map** *fem-name* command in global configuration mode, the command-line interface (CLI) prompt changes to "config-fem," indicating that you have entered the flow exporter map configuration submode.

In the following sample output, the question mark (**?**) online help function displays all the commands available under the flow exporter map configuration submode:

```
RP/0/RSP0/CPU0:router(config)# flow exporter-map fem

RP/0/RP0/CPU0:router(config-fem)# ?

clear        Clear the uncommitted configuration
clear        Clear the configuration
commit       Commit the configuration changes to running
describe     Describe a command without taking real actions
destination  Export destination configuration
do           Run an exec command
dscp         Specify DSCP value for export packets
exit         Exit from this submode
no           Negate a command or set its defaults
pwd          Commands used to reach current submode
root         Exit to the global configuration mode
show         Show contents of configuration
source       Source interface
transport    Specify the transport protocol for export packets
version      Specify export version parameters
```

Note If you enter the **version** command, you enter the flow exporter map version configuration submode.

Note A single flow monitor map can support up to eight exporters.

Flow Exporter Map Version Configuration Submode

When you issue the **version v9** command in the flow exporter map configuration submode, the CLI prompt changes to "config-fem-ver," indicating that you have entered the flow exporter map version configuration submode.

In the following sample output, the question mark (**?**) online help function displays all the commands available under the flow exporter map version configuration submode:

```
RP/0/RSP0/CPU0:router(config-fem)# version v9

RP/0/RP0/CPU0:router(config-fem-ver)# ?

commit    Commit the configuration changes to running
describe  Describe a command without taking real actions
do        Run an exec command
exit      Exit from this submode
no        Negate a command or set its defaults
options   Specify export of options template
show      Show contents of configuration
template  Specify template export parameters
```

Flow Monitor Map Configuration Submode

When you issue the **flow monitor-map** *map_name* command in global configuration mode, the CLI prompt changes to "config-fmm," indicating that you have entered the flow monitor map configuration submode.

In the following sample output, the question mark (**?**) online help function displays all the commands available under the flow monitor map configuration submode:

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map fmm

RP/0/RSP0/CPU0:router(config-fmm)# ?

cache     Specify flow cache attributes
commit    Commit the configuration changes to running
describe  Describe a command without taking real actions
do        Run an exec command
exit      Exit from this submode
exporter  Specify flow exporter map name
no        Negate a command or set its defaults
record    Specify a flow record map name
show      Show contents of configuration

RP/0/RSP0/CPU0:router(config-fmm)#
```

Sampler Map Configuration Submode

When you issue the **sampler-map** *map_name* command in global configuration mode, the CLI prompt changes to "config-sm," indicating that you have entered the sampler map configuration submode.

In the following sample output, the question mark (**?**) online help function displays all the commands available under the sampler map configuration submode:

```
RP/0/RSP0/CPU0(config)# sampler-map fmm
```

```
RP/0/RSP0/CPU0:router(config-sm)# ?
clear     Clear the uncommitted configuration
clear     Clear the configuration
commit    Commit the configuration changes to running
describe  Describe a command without taking real actions
do        Run an exec command
exit      Exit from this submode
no        Negate a command or set its defaults
pwd       Commands used to reach current submode
random    Use random mode for sampling packets
root      Exit to the global configuration mode
show      Show contents of configuration
RP/0/RSP0/CPU0(config-sm)#RP/0/RP0/CP0:router(config-sm)#
```

Enabling the NetFlow BGP Data Export Function

Use the **bgp attribute-download** command to enable NetFlow BGP routing attribute collection. The routing attributes are then exported. When no routing attributes are collected, zeroes (0) are exported.

When BGP attribute download is enabled, BGP downloads the attribute information for prefixes (community, extended community, and as-path) to the Routing Information Base (RIB) and Forwarding Information Base (FIB). This enables FIB to associate the prefixes with attributes and send the NetFlow statistics along with the associated attributes.

MPLS Flow Monitor with IPv4 and IPv6 Support

Cisco IOS XR Software Release supports the NetFlow collection of MPLS packets. It also supports the NetFlow collection of MPLS packets carrying IPv4, IPv6, or both IPv4 and IPv6 payloads.

MPLS Cache Reorganization to Support Both IPv4 and IPv6

In Cisco IOS XR Software Release , at a time, you can have only one MPLS flow monitor running on an interface. If you apply an additional MPLS flow monitor to the interface, the new flow monitor overwrites the existing one.

At a time, you can apply only one flow monitor on an interface per direction. You can apply either the same flow monitor to an interface in both directions, or each direction can have its own flow monitor.

You can configure the MPLS flow monitor to collect IPv4 fields, IPv6 fields, or IPv4-IPv6 fields. IPv4-IPv6 configuration collects both IPv4 and IPv6 addresses using one MPLS flow monitor. IPv4 configuration collects only IPv4 addresses. IPv6 configuration collects only IPv6 addresses.

The MPLS flow monitor supports up to 1,000,000 cache entries. NetFlow entries include the following types of fields:

- IPv4 fields
- IPv6 fields
- MPLS with IPv4 fields
- MPLS with IPv6 fields

The maximum number of bytes per NetFlow cache entry is as follows:

- IPv4–88 bytes per entry
- MPLS–88 bytes per entry
- IPv6–108 bytes per entry

- MPLS with IPv4 fields–108 bytes per entry
- MPLS with IPv6 fields–128 bytes per entry

Note The different types of NetFlow entries are stored in separate caches. Consequently, the number of NetFlow entries on a line card can significantly impact the amount of available memory on the line card. Also, even though the sampling rate for IPv6 is the same as the sampling rate for IPv4, the CPU utilization for IPv6 is higher due to the longer keys used by the IPv6 fields.

MPLS Packets with IPv6 Flows

The collection of IPv6 flows in MPLS packets is an option. The CPU uses 128 bytes for each IPv6 field. IPv6 flows may contain the following types of information:

- Source IP address
- Destination IP address
- Traffic class value
- Layer 4 protocol number
- Layer 4 source port number
- Layer 4 destination port number
- Flow ID
- Header option mask

To collect the IPv6 fields in MPLS packets, you must activate the MPLS record type, ipv6-fields by running the **record mpls ipv6-fields** command. You can also specify the number of labels to be used for aggregation with this command.

How to Configure NetFlow on Cisco IOS XR Software

The steps that follow provide a general overview of NetFlow configuration:

Step 1 Create and configure an exporter map.

Step 2 Create and configure a monitor map and a sampler map.

Note The monitor map must reference the exporter map you created in Step 1. If you do not apply an exporter-map to the monitor-map, the flow records are not exported, and aging is done according to the cache parameters specified in the monitor-map.

Step 3 Apply the monitor map and sampler map to an interface.

These steps are described in detail in the following sections:

- Configuring an Exporter Map, page RC-9
- Configuring a Sampler Map, page RC-11
- Configuring a Monitor Map, page RC-13
- Applying a Monitor Map and a Sampler Map to an Interface, page RC-16

- Clearing NetFlow Data, page RC-17
- Configuring NetFlow Collection of MPLS Packets with IPv6 Fields, page RC-18

Configuring an Exporter Map

Configure an exporter map and apply it to the monitor map with the **flow monitor-map** *map_name* **exporter** *map_name* command. You can configure the exporter map prior to configuring the monitor map, or you can configure the monitor map first and then configure and apply an exporter map later on.

Note Cisco IOS XR software supports the configuration of a single collector only in the exporter map.

The steps that follow describe how to create and configure an exporter map.

SUMMARY STEPS

1. **configure**
2. **flow exporter-map** *map_name*
3. **destination** *hostname_or_IP_address*
4. **dscp** *dscp_value*
5. **source** *type interface-path-id*
6. **transport udp** *port*
7. **version v9**
8. **options** {**interface-table** | **sampler-table**} [**timeout** *seconds*]
9. **template** [**data** | **options**] **timeout** *seconds*
10. **end**
    or
    commit
11. **exit**
12. **exit**
13. **show flow exporter-map** *map_name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**flow exporter-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router(config)# flow exporter-map fem`	Creates an exporter map, configures the exporter map name, and enters flow exporter map configuration mode.

	Command or Action	Purpose
Step 3	**destination** *hostname_or_IP_address* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# destination nnn.nnn.nnn.nnn`	Configures the export destination for the flow exporter map. The destination can be a hostname or an IP address.
Step 4	**dscp** *dscp_value* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# dscp 55`	(Optional) Specifies the differentiated services codepoint (DSCP) value for export packets. Replace the *dscp_value* argument with a value in the range from 0 through 63.
Step 5	**source** *type interface-path-id* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# source gigabitEthernet 0/0/0/0`	Specifies a source interface, in the format *type interface-path-id*.
Step 6	**transport udp** *port* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# transport udp 9991`	(Optional) Specifies the destination port for UDP packets. Replace *port* with the destination UDP port value, in the range from 1024 through 65535.
Step 7	**version v9** **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# version v9`	(Optional) Enters flow exporter map version configuration submode.
Step 8	**options** {**interface-table** | **sampler-table**} [**timeout** seconds] **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# options sampler-table timeout 2000`	(Optional) Configures the export timeout value for the sampler table. Replace *seconds* with the export timeout value, in the range from 1 through 604800 seconds. Default is 1800 seconds.
Step 9	**template** [**data** | **options**] **timeout** *seconds* **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# template data timeout 10000`	(Optional) Configures the export period for data packets. Replace *seconds* with the export timeout value, in the range from 1 through 604800 seconds.

	Command or Action	Purpose

Step 10	**end**
	or
	commit
	
	Example:
	`RP/0/RSP0/CPU0:router (config-fem-ver)# end`
	or
	`RP/0/RSP0/CPU0:router(config-fem-ver)# commit`
		Saves configuration changes.
		• When you issue the **end** command, the system prompts you to commit changes:
		`Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:`
		– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Step 11	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# exit`	Exits flow exporter map version configuration submode.
Step 12	**exit** **Example:** `RP/0/RSP0/CPU0:router(config)# exit`	Enters EXEC mode.
Step 13	**show flow exporter-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router# show flow exporter-map fem`	Displays exporter map data.

Configuring a Sampler Map

The steps that follow describe how to create and configure a sampler map.

SUMMARY STEPS

1. **configure**
2. **sampler-map** *map_name*
3. **random 1 out-of** *sampling_interval*
4. **end**
   or
   commit
5. **exit**

6. **exit**
7. **show sampler-map** *map_name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.

Step 2	**sampler-map** *map_name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# sampler-map fsm`
	`RP/0/RSP0/CPU0:router(config-sm)#f`
		Creates a sampler map and enters sampler map configuration mode.
		Keep the following in mind when configuring a sampler map:
		•

Step 3	**random 1 out-of** *sampling_interval* **Example:** `RP/0/RSP0/CPU0:router(config-sm)# random 1 out-of 65535`	Configures the sampling interval to use random mode for sampling packets. Replace the *sampling_interval* argument with a number, in the range from1 through 65535 units.

Step 4	**end**
	or
	commit
	
	Example:
	`RP/0/RSP0/CPU0:router (config-sm)# end`
	or
	`RP/0/RSP0/CPU0:router (config-sm)# commit`
		Saves configuration changes.
		• When you issue the **end** command, the system prompts you to commit changes:
		`Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:`
		– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Step 5	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-sm)# exit`	Exits sampler map configuration mode and enters global configuration mode.

	Command or Action	Purpose
Step 6	**exit** **Example:** `RP/0/RSP0/CPU0:router(config)# exit`	Exits global configuration mode and enters EXEC mode.
Step 7	**show sampler-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router# show sampler-map fsm`	Displays sampler map data.

Configuring a Monitor Map

The steps that follow describe how to create and configure a monitor map.

SUMMARY STEPS

1. **configure**
2. **flow monitor-map** *map_name*
3. **record ipv4**
   or
   record ipv4 [peer as]
   or
   record ipv6
   or
   record mpls
   or
   record mpls [**ipv4-fields**] [**labels** *number*]
   or
   record mpls [**ipv6-fields**] [**labels** *number*]
   or
   record mpls [**ipv4-ipv6-fields**] [**labels** *number*]
4. **cache entries** *number*
5. **cache permanent**
6. **cache timeout** {**active** | **inactive** | **upate**} *timeout_value*
7. **exporter** *map_name*
8. **end**
   or
   commit
9. **exit**
10. **exit**
11. **show flow monitor-map** *map_name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.

Step 2	**flow monitor-map** *map_name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# flow monitor-map fmm`
	`RP/0/RSP0/CPU0:router(config-fmm)#`
		Creates a monitor map and configures a monitor map name and enters flow monitor map configuration submode.

Step 3	**record ipv4** or **record ipv4 [peer as]** or **record ipv6** or **record mpls** [**labels** *number*] or **record mpls** [**ipv4-fields**] [**labels** *number*] or **record mpls** [**ipv6-fields**] [**labels** *number*] or **record mpls** [**ipv4-ipv6-fields**] [**labels** *number*] **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# record ipv4`	Configures the flow record map name for IPv4, IPv6, or MPLS. • Use the **record ipv4** command to configure the flow record map name for IPv4. By default, you collect and export the originating autonomous system (AS) numbers. • Use the **record ipv4 [peer as]** command to record peer AS. Here, you collect and export the peer AS numbers. **Note** Ensure that the **bgp attribute-download** command is configured. Else, no AS is collected when the **record ipv4 [peer-as]** command is configured. • Use the **record ipv6** command to configure the flow record map name for IPv6. • Use the **record mpls labels** command with the *number* argument to specify the number of labels that you want to aggregate. By default, MPLS-aware NetFlow aggregates the top six labels of the MPLS label stack. The maximum value is 6. • Use the **record mpls ipv4-fields** command to collect IPv4 fields in the MPLS-aware NetFlow. • Use the **record mpls ipv6-fields** command to collect IPV6 fields in the MPLS-aware NetFlow. • Use the **record mpls ipv4-ipv6-fields** command to collect IPv4 and IPv6 fields in the MPLS-aware NetFlow.
Step 4	**cache entries** *number* **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# cache entries 10000`	(Optional) Configures the number of entries in the flow cache. Replace the *number* argument with the number of flow entries allowed in the flow cache, in the range from 4096 through 1000000. The default number of cache entries is 65535.

	Command or Action	Purpose
Step 5	**cache permanent** **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# flow monitor-map fmm cache permanent`	(Optional) Disables removal of entries from flow cache.
Step 6	**cache timeout** {**active** *timeout_value* | **inactive** *timeout_value* | **upate** *timeout_value*} **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# cache timeout inactive 1000`	(Optional) Configures the active, inactive, or update flow cache timeout value. • The default timeout value for the inactive flow cache is 15 seconds. • The default timeout value for the active flow cache is 1800 seconds. • The default timeout value for the update flow cache is 1800 seconds. **Note** The **update** *timeout_value* keyword argument is used for permanent caches only. It specifies the timeout value that is used to export entries from permanent caches. In this case, the entries are exported but remain the cache.
Step 7	**exporter** *map_name* **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# exporter fem`	Associates an exporter map with a monitor map. **Note** A single flow monitor map can support up to eight exporters.

Step 8	**end**
	or
	commit
	
	Example:
	`RP/0/RSP0/CPU0:router(config-fmm)# end`
	or
	`RP/0/RSP0/CPU0:router(config-fmm)# commit`
		Saves configuration changes.
		• When you issue the **end** command, the system prompts you to commit changes:
		`Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:`
		– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Step 9	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# exit`	Exits flow monitor map configuration submode.

	Command or Action	Purpose
Step 10	**exit** **Example:** `RP/0/RSP0/CPU0:router(config)# exit`	Exits global configuration mode.
Step 11	**show flow monitor-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router# show flow monitor-map fmm`	Displays flow monitor map data.

Applying a Monitor Map and a Sampler Map to an Interface

SUMMARY STEPS

The steps that follow describe how to apply a monitor map and a sampler map to an interface.

1. **configure**
2. **interface** *type number*
3. **flow** [**ipv4 | ipv6 | mpls**] **monitor** *monitor_map* **sampler** *sampler_map* {**egress | ingress**}
4. **end**
   or
   commit

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.

Step 2	**interface** *type number*
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/0/0/0`
	`RP/0/RSP0/CPU0:router(config-if)#`
		Enters interface configuration mode.

	Command or Action	Purpose
Step 3	**flow** [**ipv4** | **ipv6** | **mpls**] **monitor** *monitor_map* **sampler** *sampler_map* {**egress** | **ingress**} **Example:** `RP/0/RSP0/CPU0:router(config-if)# flow ipv4 monitor fmm sampler fsm egress`	Associates a monitor map and a sampler map with an interface. Enter **ipv4** to enable IPV4 NetFlow on the specified interface. Enter **ipv6** to enable IPV6 NetFlow on the specified interface. Enter **mpls** to enable MPLS-aware NetFlow on the specified interface.

Step 4	**end**
	or
	commit
	
	Example:
	`RP/0/RSP0/CPU0:router(config-if)# end`
	or
	`RP/0/RSP0/CPU0:router(config-if)# commit`
		Saves configuration changes.
		• When you issue the **end** command, the system prompts you to commit changes:
		`Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:`
		– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Clearing NetFlow Data

The steps that follow describe how to clear flow exporter map and flow monitor map data.

SUMMARY STEPS

1. **clear flow exporter** [*exporter_name*] {**restart** | **statistics**} **location** *node-id*
2. **clear flow monitor** [*monitor_name*] **cache** [**force-export** | **statistics**] **location** *node-id*}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**clear flow exporter** [*exporter_name*] {**restart** | **statistics**} **location** *node-id* **Example:** `RP/0/RSP0/CPU0:router# clear flow exporter statistics location 0/0/CPU0`	Clears the flow exporter data. Specify the **statistics** option to clear exporter statistics. Specify the **restart** option to export all of the templates that are currently configured on the specified node.
Step 2	**clear flow monitor** [*monitor_name*] **cache** [**force-export** | **statistics**] **location** *node-id*} **Example:** `RP/0/RSP0/CPU0:router# clear flow monitor cache force-export location 0/0/CPU0`	Clears the flow monitor data. Specify the **statistics** option to clear cache statistics. Specify the **force-export** option to export the data from cache to server first and then clear the entries from cache.

Configuring NetFlow Collection of MPLS Packets with IPv6 Fields

The following steps show how to configure NetFlow collection of MPLS packets with IPv6 fields.

SUMMARY STEPS

1. **configure**
2. **flow exporter-map** *map_name*
3. **version v9**
4. **options** {**interface-table** | **sampler-table**} [**timeout** *seconds*]
5. **template** [**data** | **options**] **timeout** *seconds*
6. **exit**
7. **transport udp** *port*
8. **source** *type interface-path-id*
9. **destination** *hostname_or_IP_address*
10. **exit**
11. **flow monitor-map** *map_name*
12. **record mpls** [**ipv4-ipv6-fields**] [**labels** *number*]
13. **exporter** *map_name*
14. **cache entries** *number*
15. **cache timeout** {**active** *timeout_value* | **inactive** *timeout_value* | **upate** *timeout_value*}
16. **cache permanent**
17. **sampler-map** *map_name*
18. **random 1 out-of** *sampling_interval*
19. **interface** *type number*
20. **flow** [**ipv4** | **ipv6** | **mpls**] **monitor** *monitor_map* **sampler** *sampler_map* {**egress** | **ingress**}

21. **end**
    or
    commit
22. **exit**
23. **exit**
24. **show flow monitor-map** *map_name*
25. **show flow exporter-map** *map_name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# config`	Enters global configuration mode.
Step 2	**flow exporter-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router(config)# flow exporter-map exp1`	Creates an exporter map, configures the exporter map name, and enters flow exporter map configuration mode.
Step 3	**version v9** **Example:** `RP/0/RSP0/CPU0:router(config-fem)# version v9`	(Optional) Enters flow exporter map version configuration submode.
Step 4	**options** {**interface-table** | **sampler-table**} [**timeout** *seconds*] **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# options interface-table timeout 300`	(Optional) Configures the export timeout value for the interface table or the sampler table. Replace *seconds* with the export timeout value, in the range from 1 through 604800 seconds. The default is 1800 seconds for both the interface table and the sample table. You must perform this step twice to configure the export timeout value for both an interface table and a sample table.
Step 5	**template** [**data** | **options**] **timeout** *seconds* **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# template data timeout 300`	(Optional) Configures the export period for data packets or options packets. Replace *seconds* with the export timeout value, in the range from 1 through 604800 seconds. You must perform this step twice to configure the export period for both data packets and options packets.
Step 6	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-fem-ver)# exit`	Exits flow exporter map version configuration mode, and enters flow exporter map configuration mode.

	Command or Action	Purpose
Step 7	**transport udp** *port* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# transport udp 12515`	(Optional) Specifies the destination port for UDP packets. Replace *port* with the destination UDP port value, in the range from 1024 through 65535.
Step 8	**source** *type interface-path-id* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# source Loopback0`	Specifies a source interface, in the format *type interface-path-id*. For example: POS 0/1/0/1 or Loopback0
Step 9	**destination** *hostname_or_IP_address* **Example:** `RP/0/RSP0/CPU0:router(config-fem)# destination 170.1.1.11`	Configures the export destination for the flow exporter map. The destination can be a hostname or an IP address.
Step 10	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-fem)# exit`	Exits flow exporter map configuration mode, and enters flow exporter map configuration mode.
Step 11	**flow monitor-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router(config)# flow monitor-map MPLS-IPv6-fmm`	Creates a monitor map and configures a monitor map name and enters flow monitor map configuration submode.
Step 12	**record mpls** [**ipv4-ipv6-fields**] [**labels** *number*] **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# record mpls ipv6-fields labels 3`	Configures the flow record map name for IPv4, IPv6, or MPLS. Use the **ipv4-ipv6-fields** keyword to collect IPv4 and IPv6 fields in an MPLS-aware NetFlow.
Step 13	**exporter** *map_name* **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# exporter exp1`	Associates an exporter map with a monitor map. **Note** A single flow monitor map can support up to eight exporters.
Step 14	**cache entries** *number* **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# cache entries 10000`	(Optional) Configures the number of entries in the flow cache. Replace the *number* argument with the number of flow entries allowed in the flow cache, in the range from 4096 through 1000000. The default number of cache entries is 65535.

	Command or Action	Purpose
Step 15	**cache timeout** {**active** *timeout_value* | **inactive** *timeout_value* | **upate** *timeout_value*} **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# cache timeout inactive 1800`	(Optional) Configures the active, inactive, or update flow cache timeout value. • The default timeout value for the inactive flow cache is 15 seconds. • The default timeout value for the active flow cache is 1800 seconds. • The default timeout value for the update flow cache is 1800 seconds. **Note** The **inactive** and **active** keywords are not applicable to permanent caches. **Note** The **update** keyword is used for permanent caches only. It specifies the timeout value that is used to export entries from permanent caches. In this case, the entries are exported but remain the cache.
Step 16	**cache permanent** **Example:** `RP/0/RSP0/CPU0:router(config-fmm)# flow monitor-map fmm cache permanent`	(Optional) Disables the removal of entries from flow cache.
Step 17	**exit** **Example:** `RP/0/RP0/CPU0:router(config-fmm)# exit`	Exits flow monitor map configuration submode.

Step 18	**sampler-map** *map_name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# sampler-map fsm`
	`RP/0/RSP0/CPU0:router(config-sm)#`
		Creates a sampler map and enters sampler map configuration mode.
		Keep the following in mind when configuring a sampler map:
		•

Step 19	**random 1 out-of** *sampling_interval* **Example:** `RP/0/RSP0/CPU0:router(config-sm)# random 1 out-of 65535`	Configures the sampling interval to use random mode for sampling packets. Replace the *sampling_interval* argument with a number, in the range from1 through 65535 units.
Step 20	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-sm)# exit`	Exits sampler map configuration mode and enters global configuration mode.

Step 21	**interface** *type number*
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/0/0/0`
	`RP/0/RSP0/CPU0:router(config-if)#`
		Enters interface configuration mode.

	Command or Action	Purpose
Step 22	**flow** [**ipv4** | **ipv6** | **mpls**] **monitor** *monitor_map* **sampler** *sampler_map* {**egress** | **ingress**} **Example:** `RP/0/RSP0/CPU0:router(config-if)# flow ipv4 monitor MPLS-IPv6-fmm sampler fsm egress`	Associates a monitor map and a sampler map with an interface. Enter **ipv4** to enable IPV4 NetFlow on the specified interface. Enter **ipv6** to enable IPV6 NetFlow on the specified interface. Enter **mpls** to enable MPLS-aware NetFlow on the specified interface.

Step 23	**end**
	or
	commit
	
	Example:
	`RP/0/RSP0/CPU0:router (config-fem-ver)# end`
	or
	`RP/0/RSP0/CPU0:router(config-fem-ver)# commit`
		Saves configuration changes.
		• When you issue the **end** command, the system prompts you to commit changes:
		`Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:`
		– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Step 24	**exit** **Example:** `RP/0/RSP0/CPU0:router(config-if)# exit`	Exits interface configuration submode for the Ethernet interface.
Step 25	**exit** **Example:** `RP/0/RSP0/CPU0:router(config)# exit`	Exits global configuration mode.
Step 26	**show flow monitor-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router# show flow monitor-map fmm`	Displays flow monitor map data.
Step 27	**show flow exporter-map** *map_name* **Example:** `RP/0/RSP0/CPU0:router# show flow exporter-map fem`	Displays exporter map data.

Trident Netflow

Trident Netflow exports using only the V9 (Version 9) format. V9 is the most flexible NetFlow export. This format is flexible and extensible. It provides the flexibility to support new fields and record types.

Supported features

- Flow monitor type of IPv4, IPv6, and MPLS can all be configured to an interface per direction.
- Sampled Netflow. There is no support for full mode sampling.
- Non-deterministic Random Sampling Algorithm.
- Different traffic types, including unicast and multicast traffic.

Punt path policer rate

In order to achieve the maximum flow processing without overloading the LC CPU, all flow packets that are punted from each Network Processor are policed. This is done to avoid overloading the CPU. The aggregate punt policer rate is 100 Kpps. To avoid having flow packets arrive at the CPU at a huge rate, the punt path policer needs to be applied on all NPs that have the netflow feature applied on them.

The Punt path policer rate can be calculated in following way:

Calculating Punt path policer rate

The policer rate of each NP_NetflowMonitor is 100k, where NP_NetflowMonitor is NP that has Netflow monitor configured to its associated interfaces; or any of its associated interfaces are member of a bundle interfaces or bundle sub-interfaces that has Netflow monitor applied.

Determining NP for NP_NetflowMonitor or non - NP_NetflowMonitor:

1. If any of its associated interface or sub-interface has any flow monitor applied, then it is NP_NetflowMonitor.
2. If any of its interfaces is a member of a bundle interface or bundle sub-interface that has Netflow monitor configured, the NP is considered as non- NP_NetflowMonitor.

Trident base line cards supported features

- Supports ingress and egress Netflow (IPv4, IPv6, MPLS) on L3 physical interface, L3-sub-interface, L3-Bundle interface, and L3 bundle sub-interface.
- Supports configurable Sampling Rate 1:1 ~ 1: 65535
- Supports only up to 4 Sampling Rates (or Intervals) per LC.
- Supports up to 8k (Large memory LC) or 4k (Small Memory LC) interfaces/subinterfaces
- Supports configuration with flow monitor per NP.
- Supports maximum aggregate Netflow processing rate of 50k flow packets per seconds per LC, enforced by Netflow Punt Policer on each NPs.
- Supports netflow processing of 100Kpps, with CPU utilization not exceeding 50%.
- Supports up to 4 flow exporters per flow monitor.
- Supports exporting packet rates of up to 100k flows per second.

Configuration Examples for NetFlow

The following examples show NetFlow configurations:

Sampler Map: Example

The following example shows how to create a new sampler map called “fsm1,” which samples 1 out of 65535 packets:

```
RP/0/RSP0/CPU0:router(config)# sampler-map fsm1
RP/0/RSP0/CPU0:router(config-sm)# random 1 out-of 65535
RP/0/RSP0/CPU0:router(config)# exit
```

Exporter Map: Example

The following example shows how to create a new flow exporter map called “fem1,” which uses the version 9 (V9) export format for NetFlow export packets. The data template flow-set is inserted into the V9 export packets once every 10 minutes, and the options interface table flow-set is inserted into the V9 export packet. The export packets are sent to the flow collector destination 10.1.1.1, where the source address is identical to the interface IP address of Loopback 0. The UDP destination port is 1024, and the DSCP value is 10:

```
RP/0/RSP0/CPU0router(config)# flow exporter-map fem1
RP/0/RSP0/CPU0:router(config-fem)# destination 10.1.1.1
RP/0/RSP0/CPU0:router(config-fem)# source Loopback 0
RP/0/RSP0/CPU0:router(config-fem)# transport udp 1024
RP/0/RSP0/CPU0:router(config-fem)# dscp 10
RP/0/RSP0/CPU0:router(config-fem)# exit
RP/0/RSP0/CPU0:router(config-fem)# version v9
RP/0/RSP0/CPU0router(config-fem-ver)# template data timeout 600
RP/0/RSP0/CPU0:router(config-fem-ver)# options interface-table
RP/0/RSP0/CPU0:router(config-fem-ver)# exit
```

Flow Monitor Map: Examples

The following example shows how to create a new flow monitor map with name “fmm1”. This flow monitor map references the flow exporter map “fem1,” and sets the flow cache attributes to 10000 cache entries. The active entries from the cache are aged every 30 seconds, while the inactive entries from the cache are aged every 15 seconds. The record map for this monitor map is IPv4:

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map fmm1
RP/0/RSP0/CPU0:router(config-fmm)# record ipv4
RP/0/RSP0/CPU0:router(config-fmm)# exporter fem1
RP/0/RSP0/CPU0:router(config-fmm)# cache entries 10000
RP/0/RSP0/CPU0:router(config-fmm)# cache timeout active 30
RP/0/RSP0/CPU0:router(config-fmm)# cache timeout inactive 15
RP/0/RSP0/CPU0:router(config-fmm)# exit
```

The following example shows how to apply the flow monitor “fmm1”and the sampler “fsm1” to the TenGigE 0/0/0/0 interface in the ingress direction:

```
RP/0/RSP0/CPU0:router(config)# interface TenGigE 0/0/0/0
RP/0/RSP0/CPU0:router(config-if)# flow ipv4 monitor fmm1 sampler fsm1 ingress
RP/0/RSP0/CPU0:router(config-if)# exit
```

The following example shows how to configure the NetFlow monitor to collect MPLS packets with IPv6 fields:

```
RP/0/RSP0/CPU0:router# config
RP/0/RSP0/CPU0:routerconfig)# flow exporter-map exp1
RP/0/RSP0/CPU0:router(config-fem)# version v9
RP/0/RSP0/CPU0:router(config-fem-ver)# options interface-table timeout 300
RP/0/RSP0/CPU0:router(config-fem-ver)# options sampler-table timeout 300
RP/0/RSP0/CPU0:router(config-fem-ver)# template data timeout 300
RP/0/RSP0/CPU0:router(config-fem-ver)# template options timeout 300
RP/0/RSP0/CPU0:router(config-fem-ver)# exit
RP/0/RSP0/CPU0:router(config-fem)# transport udp 12515
RP/0/RSP0/CPU0:router(config-fem)# source Loopback0
RP/0/RSP0/CPU0:router(config-fem)# destination 170.1.1.11
RP/0/RSP0/CPU0:router(config-fmm)# exit
RP/0/RSP0/CPU0:router(config)# flow monitor-map MPLS-IPv6-fmm
RP/0/RSP0/CPU0:router(config-fmm)# record mpls ipv6-fields labels 3
RP/0/RSP0/CPU0:router(config-fmm)# exporter exp1
RP/0/RSP0/CPU0:router(config-fmm)# cache entries 10000
RP/0/RSP0/CPU0:router(config-fmm)# cache permanent
RP/0/RSP0/CPU0:router(config-fmm)# exit

RP/0/RSP0/CPU0:router(config)# sampler-map FSM
RP/0/RSP0/CPU0:router(config-sm)# random 1 out-of 65535
RP/0/RSP0/CPU0:router(config-sm)# exit
RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/0/0/0
RP/0/RSP0/CPU0:router(config-if)# flow mpls monitor MPLS-IPv6-fmm sampler FSM ingress
```

MPLS Flow Monitor with IPv4 and IPv6 Support: Examples

The following configuration collects MPLS traffic, but no payload information is collected.

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map MPLS-fmm
RP/0/RSP0/CPU0:router(config-fmm)# record mpls labels 3
RP/0/RSP0/CPU0:router(config-fmm)# cache permanent
RP/0/RSP0/CPU0:router(config)# exit
RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/0/0/0

RP/0/RSP0/CPU0:router(config-if)# flow mpls monitor MPLS-fmm sampler fsm ingress
```

The following configuration collects MPLS traffic with IPv4 payloads. It also collects MPLS traffic without IPv4 payloads, but it populates the IPv4 fields with zeros (0).

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map MPLS-IPv4-fmm
RP/0/RSP0/CPU0:router(config-fmm)# record mpls IPv4-fields labels 3
RP/0/RSP0/CPU0:router(config-fmm)# cache permanent
RP/0/RSP0/CPU0:router(config-fmm)# exit
RP/0/RSP0/CPU0:routerrouter(config)# interface gigabitEthernet 0/0/0/0
RP/0/RSP0/CPU0:router(config-if)# flow mpls monitor MPLS-IPv4-fmm sampler fsm ingress
```

The following configuration collects MPLS traffic with IPv6 payloads. It also collects MPLS traffic without IPv6 payloads, but it populates the IPv6 fields with zeros (0).

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map MPLS-IPv6-fmm
RP/0/RSP0/CPU0:router(config-fmm)# record mpls IPv6-fields labels 3
RP/0/RSP0/CPU0:router(config-fmm)# cache permanent
RP/0/RSP0/CPU0:router(config-fmm)# exit
RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/0/0/0
RP/0/RSP0/CPU0:router(config-if)# flow mpls monitor MPLS-IPv6-fmm sampler fsm ingress
```

The following configuration collects MPLS traffic with both IPv6 and IPv4 fields. It also collects MPLS traffic without IPv4 or IPv6 payloads, but it populates the IPv6 and IPv4 fields with zeros (0).

```
RP/0/RSP0/CPU0:router(config)# flow monitor-map MPLS-IPv4-IPv6-fmm
RP/0/RSP0/CPU0:router(config-fmm)# record mpls IPv4-IPv6-fields labels 3
RP/0/RSP0/CPU0:router(config-fmm)# cache permanent
RP/0/RSP0/CPU0:router(config-fmm)# exit
RP/0/RSP0/CPU0:router(config)# interface gigabitEthernet 0/0/0/0
RP/0/RSP0/CPU0:router(config-if)# flow mpls monitor MPLS-IPv4-IPv6-fmm sampler fsm ingress
```

Note Flow records are exported using the Version 9 format.

Additional References

The following sections provide references related to interface configuration.

Related Documents

Related Topic	Document Title
Cisco IOS XR master command reference	*Cisco IOS XR Master Commands List*
Cisco IOS XR interface configuration commands	*Cisco IOS XR Interface and Hardware Component Command Reference*
Initial system bootup and configuration information for a router using the Cisco IOS XR software.	*Cisco IOS XR Getting Started Guide*
Information about user groups and task IDs	*Cisco IOS XR Interface and Hardware Component Command Reference*
Information about configuring interfaces and other components on the Cisco CRS-1 Router from a remote Craft Works Interface (CWI) client management application.	*Cisco Craft Works Interface User Guide*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
—	To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

RFCs

RFCs	Title
3954	NetFlow services export protocol Version 9.

Technical Assistance

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HC	Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide
IC	Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Configuration Guide
MCC	Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide
MNC	Cisco ASR 9000 Series Aggregation Services Router System Monitoring Configuration Guide
MPC	Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide
NFC	Cisco ASR 9000 Series Aggregation Services Router NetFlow Configuration Guide
QC	Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide
RC	Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide
SC	Cisco ASR 9000 Series Aggregation Services Router System Security Configuration Guide
SMC	Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide
VPC	Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide

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