



# Configuring MPLS-aware NetFlow

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This module contains information about and instructions for configuring Multiprotocol Label Switching (MPLS)-aware NetFlow. MPLS-aware NetFlow is an extension of the NetFlow accounting feature that provides highly granular traffic statistics for Cisco routers.

NetFlow is a Cisco IOS application that provides statistics on packets flowing through the router. It is emerging as a primary network accounting and security technology.

## Module History

This module was first published on June 19th, 2006, and last updated on June 19th, 2006.

## Finding Feature Information in This Module

*Your Cisco IOS software release may not support all features.* To find information about feature support and configuration, use the [“Feature Information for Configuring MPLS-aware NetFlow”](#) section on page 22.

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# Prerequisites for Configuring MPLS-aware NetFlow

Before you can configure the MPLS-aware NetFlow feature, you must:

- Configure NetFlow on the label switch router (LSR)
- Configure MPLS on the LSR
- Configure Cisco Express Forwarding (CEF) or Distributed CEF (dCEF) enabled on the LSR and the interfaces that you want to enable NetFlow on.

If you are exporting data to a Cisco NetFlow collector, the following requirements apply:

- NetFlow Version 9 export format configured on the LSR
- NetFlow collector and analyzer capable of using MPLS-aware NetFlow export packets in Version 9 format

Table 1 describes the Cisco 12000 Series Internet Router line card support for Cisco IOS 12.0 S releases of MPLS-aware NetFlow.

**Table 1** Cisco 12000 Series Line Card Support for MPLS-aware NetFlow in Cisco IOS 12.0 S Releases

Type	Line Card
Ethernet	1-Port GE <sup>1</sup> 8-Port FE <sup>1</sup> 3-Port GE 1-Port 10-GE Modular GE
Packet Over Sonet (POS)	4-Port OC-3 POS <sup>2</sup> 1-Port OC-12 POS <sup>2</sup> 1-Port OC-48 POS 4-Port OC-12 POS 4-Port OC-12 POS ISE 1-Port OC-48 POS ISE 4-Port OC-3 POS ISE 8-Port OC-3 POS ISE 16-Port OC-3 POS ISE 1-Port OC-192 POS ES (Edge Release) 4-Port OC-48 POS ES (Edge Release)
Channelized interfaces	1-Port CHOC-12 (DS3) <sup>2</sup> 1-Port CHOC-12 (OC-3) <sup>2</sup> 6-Port Ch T3 (DS1) <sup>2</sup> 2-Port CHOC-3 <sup>2</sup> 1-Port CHOC-48 ISE 4-Port CHOC-12 ISE
Electrical interface	6-Port DS3 <sup>2</sup> 12-Port DS3 <sup>2</sup> 6-Port E3 <sup>2</sup> 12-Port E3 <sup>2</sup>

**Table 1 Cisco 12000 Series Line Card Support for MPLS-aware NetFlow in Cisco IOS 12.0 S Releases (continued)**

Type	Line Card
Dynamic packet transport	1-Port OC-12 DPT <sup>1</sup> 1-Port OC-48 DPT 4-Port OC-48 DPT 1-Port OC-192 DPT
Asynchronous Transfer Mode (ATM)	4-Port OC-3 ATM <sup>2</sup> 1-Port OC-12 ATM <sup>2</sup> 8-Port OC-3 STM-1 ATM <sup>2</sup>

1. This Cisco 12000 Series Internet Router line card does *not* support MPLS-aware NetFlow.
2. This Cisco 12000 Series Internet Router line card supports MPLS-aware NetFlow enabled in either full or sampled mode. Line cards not marked with a footnote character support MPLS-aware NetFlow in sampled mode only. In general, Cisco 12000 line cards support MPLS-aware NetFlow in the same mode as they support NetFlow.

## Restrictions for Configuring MPLS-aware NetFlow

### Cisco IOS Releases 12.2(14)S, 12.0(22)S, or 12.2(15)T

If your router is running a version of Cisco IOS prior to releases 12.2(14)S, 12.0(22)S, or 12.2(15)T the **ip route-cache flow** command is used to enable NetFlow on an interface.

If your router is running Cisco IOS release 12.2(14)S, 12.0(22)S, 12.2(15)T, or later the **ip flow ingress** command is used to enable NetFlow on an interface.

### MPLS-aware NetFlow

The following restrictions apply to the MPLS-aware NetFlow feature for this release:

- No more than three MPLS labels are allowed to be captured and exported for this implementation.
- MPLS-aware NetFlow reports the following fields in MPLS flows as 0: IP next-hop, source and destination Border Gateway Protocol (BGP) autonomous system (AS) numbers, and source and destination prefix masks.
- For MPLS packets that contain non-IP packets under the MPLS label stack, MPLS-aware NetFlow reports the following flow fields as 0: source and destination IP addresses, protocol, ToS, ports, and TCP flags.
- The IP addresses associated with the top label for traffic engineering (TE) tunnel midpoints and Any Transport over MPLS (AToM) are reported as 0.0.0.0.
- The top label type and IP address are obtained at the moment of flow export. Either can be incorrect if the top label was deleted or reassigned after the creation of the flow in the NetFlow cache.
- The following points hold true for the Cisco 12000 1-Port 10-GE, Modular GE, 1-Port OC-192 POS ES (Edge Release), and 4-Port OC-48 POS ES (Edge Release) line cards:
  - MPLS-aware NetFlow samples both IP and MPLS packets, but reports only MPLS packets that have one label per packet, ignoring all other packets (that is, IP and MPLS packets with more than one label).
  - MPLS-aware NetFlow does not report application (TCP/UDP) port numbers.
  - MPLS-aware NetFlow reports experimental bits in MPLS labels as 0.

- The Cisco 12000 1-Port OC-48 POS, 4-Port OC-12 POS, 16-Port OC-3 POS, 3-Port GE, and 1-Port OC-48 DPT line cards support MPLS-aware NetFlow in sampled mode in all microcode bundles that include IP-sampled NetFlow.

## Information About Configuring MPLS-aware NetFlow

The following sections contain useful information for understanding how to configure and use the MPLS-aware NetFlow feature:

- [MPLS-aware NetFlow Overview, page 4](#)
- [MPLS Label Stack, page 4](#)
- [MPLS-aware NetFlow Capture of MPLS Labels, page 6](#)
- [MPLS-aware NetFlow Display of MPLS Labels, page 7](#)
- [Information Captured and Exported by MPLS-aware NetFlow, page 8](#)
- [Full and Sampled MPLS-aware NetFlow Support, page 9](#)

## MPLS-aware NetFlow Overview

MPLS-aware NetFlow is an extension of the NetFlow accounting feature that provides highly granular traffic statistics for Cisco routers. MPLS-aware NetFlow collects statistics on a per-flow basis just as NetFlow does.

A flow is a unidirectional set of packets (IP or MPLS) that arrive at the router on the same subinterface, have the same source and destination IP addresses, the same Layer 4 protocol, the same TCP/UDP source and destination ports, and the same type of service (TOS) byte in the IP header.

An MPLS flow contains up to three of the same incoming MPLS labels of interest with experimental bits and end-of-stack bits in the same positions in the packet label stack. MPLS-aware NetFlow captures MPLS traffic that contains both IP and non-IP packets. It reports non-IP packets, but sets the IP NetFlow fields to 0. It can also be configured to capture and report IP packets, setting to 0 the IP NetFlow fields. MPLS-aware NetFlow uses the NetFlow Version 9 export format. MPLS-aware NetFlow exports up to three labels of interest from the incoming label stack, the IP address associated with the top label, and traditional NetFlow data.

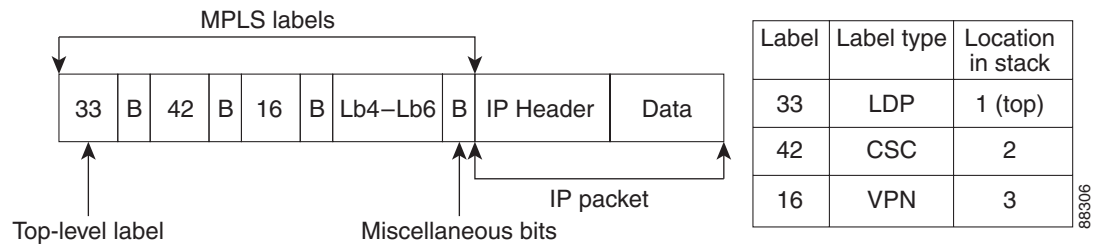
MPLS-aware NetFlow statistics can be used for detailed MPLS traffic studies and analysis that can provide information for a variety of purposes such as MPLS network management, network planning, and enterprise accounting.

A network administrator can turn on MPLS-aware NetFlow inside an MPLS cloud on a subset of provider backbone (P) routers. These routers can export MPLS-aware NetFlow data to an external NetFlow collection device for further processing and analysis or you can display NetFlow cache data on a router terminal.

## MPLS Label Stack

As packets move through an MPLS network, LSRs can add labels to the MPLS label stack. LSRs in an MPLS cloud can add up to six labels to the MPLS label stack. An LSR adds the MPLS labels to the top of the IP packet. [Figure 1](#) shows an example of an incoming MPLS label stack that LSRs added to an IP packet as it traversed an MPLS cloud.

**Figure 1 Example of an MPLS Label Stack Added to an IP Packet in an MPLS Cloud**

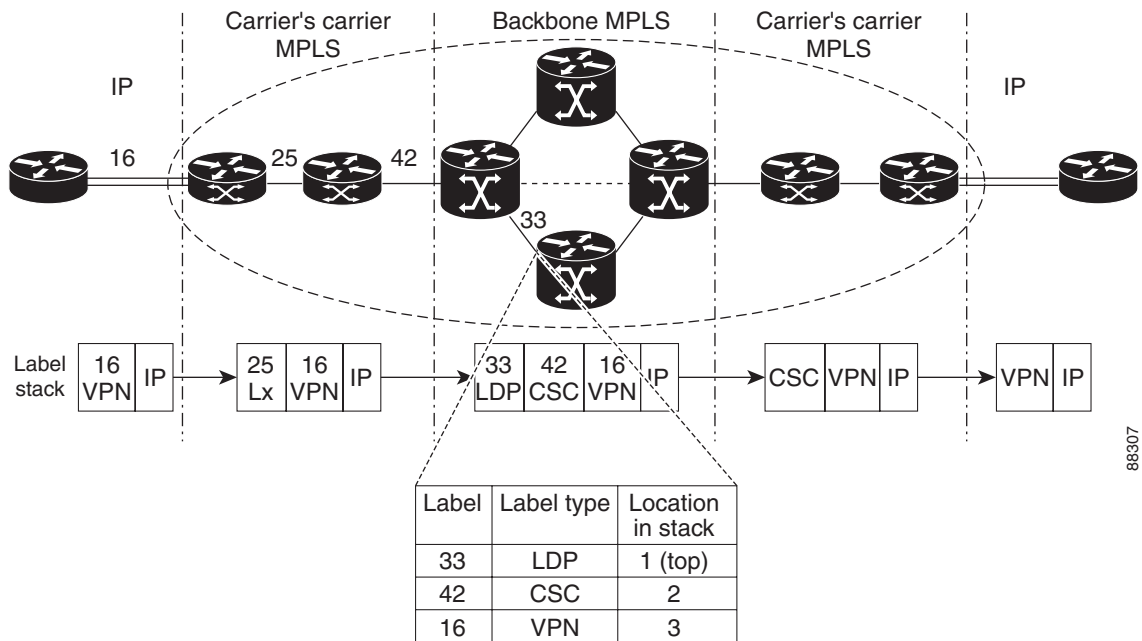


In the example of an MPLS label stack in [Figure 1](#):

- The 33 represents the top label of this packet.  
This label was the last label added to the MPLS label stack and the label that MPLS-aware NetFlow captures if you indicate the label of interest as 1.
- The 42 represents the second label in the MPLS stack.  
MPLS-aware NetFlow captures this label if you indicate 2 (second from the top) as a label of interest.
- The 16 represents the third label in the MPLS label stack.  
MPLS-aware NetFlow captures this label if you indicate 3 (third from the top) as a label of interest.
- Lb4–Lb6 represents the fourth to sixth labels in the MPLS stack. LSRs in an MPLS cloud add up to six labels to the MPLS label stack.  
MPLS-aware NetFlow captures these labels if you indicate 4, 5, or 6 as labels of interest.
- The B represents miscellaneous bits. These include the following:
  - Exp—Three bits reserved for experimental use
  - S—End-of-stack bits, set to 1 for the last entry in the stack and to 0 for every other entry
  - Time To Live (TTL)—Eight bits used to encode a hop count (or time to live) value

[Figure 2](#) shows a sample Carrier Supporting Carrier (CSC) topology and the incoming MPLS label stack on multiple LSRs as the packet travels through the network. [Figure 2](#) shows what the stack might look like at a provider core LSR.

**Figure 2** Provider and Customer Networks and MPLS Label Imposition



In the example in [Figure 2](#), a hierarchical VPN is set up between two customer edge (CE) routers.

- Traffic flows from the CE router to a provider edge (PE) router, possibly one belonging to an Internet service provider (ISP). Here, a VPN label (16) is imposed on the inbound IP packet.
- The ISP network eventually connects to an Internet backbone provider where a CSC label (42) is imposed on the label stack.
- As packets traverse the backbone network, a Label Distribution Protocol (LDP) label (33) is imposed on the label stack.

At the inbound interface shown in [Figure 2](#), MPLS-aware NetFlow captures the MPLS label stack and reports that the top label (33) is an LDP label, the second label (42) is a CSC label, and the third label (16) is a VPN label.

With NetFlow and MPLS-aware NetFlow enabled on the P router, you can determine the label type for the specified labels, and the IP address associated with the top label on the incoming interface (see the [“MPLS-aware NetFlow Capture of MPLS Labels”](#) section on page 6). Thus, you can track specific types of MPLS traffic, such as TE, LDP, or Virtual Private Networks (VPNs).

## MPLS-aware NetFlow Capture of MPLS Labels

When you configure the MPLS-aware NetFlow feature, you select the MPLS label positions in the incoming label stack that you are interested in monitoring. You can capture up to three labels from positions 1 to 6 in the MPLS label stack. Label positions are counted from the top of the stack. For example, the position of the top label is 1, the position of the next label is 2, and so on. You enter the stack location value as an argument to the following command:

```
ip flow-cache mpls label-positions [label-position-1 [label-position-2
[label-position-3]]]
```

The *label-position-n* argument represents the position of the label on the incoming label stack. For example, the **ip flow-cache mpls label-positions 1 3 4** command configures MPLS-aware NetFlow to capture and export the first (top), third, and fourth labels. If you enter this command and the label stack consists of two MPLS labels, MPLS-aware NetFlow captures only the first (top) label. If some of the labels you requested are not available, they are not captured or reported.

**Note**

For this implementation, MPLS-aware NetFlow allows the capture of up to three labels.

In addition to capturing MPLS labels from the label stack, MPLS-aware NetFlow records the following MPLS label information:

- Type of top label—The type can be any of the following: unknown, TE tunnel midpoint, AToM, VPN, BGP, or LDP.
- The IP address associated with the top label—The route prefix to which the label maps.

**Note**

For this implementation, the IP address for any TE tunnel midpoint or AToM top label is reported as 0.0.0.0.

MPLS-aware NetFlow is enabled globally on the router. However, NetFlow is enabled per interface and must be enabled in either full or sampled mode on the interfaces where you choose to capture and export MPLS and IP NetFlow data.

**Note**

See [Table 1 on page 2](#) for information on Cisco 12000 Series Internet Router line card support for NetFlow (full and sampled modes).

## MPLS-aware NetFlow Display of MPLS Labels

The MPLS-aware NetFlow feature allows the display of a snapshot of the NetFlow cache, including MPLS flows, on a terminal through the use of the **show ip cache verbose flow** command. For example, output like the following from a provider core router (P router) shows position, value, experimental bits, and end-of-stack bit for each MPLS label of interest. It also shows the type of the top label and the IP address associated with the top label.

```

SrcIf          SrcIPAddress  DstIf          DstIPAddress  Pr TOS Flgs Pkts
Port Msk AS    Port Msk AS    NextHop       B/Pk Active
PO3/0         10.1.1.1      PO5/1         10.2.1.1      01 00 10    9
0100 /0 0      0200 /0 0      0.0.0.0       100    0.0
Pos:Lbl-Exp-S 1:12305-6-0 (LDP/10.10.10.10) 2:12312-6-1

```

In this example from a P router:

- The value of the top label is 12305.
- The experimental bits value is 6 and the end-of-stack bit is 0.
- The label type is LDP and the IP address associated with the label is 10.10.10.10.
- The value of the second label is 12312, the experimental bits value is 6, and the end-of-stack bit is 1.

To fully understand and use the information gathered on the P router, you need information from the label forwarding information base (LFIB) on the PE router.

**Note**

The MPLS application owner for a label is not reported by MPLS-aware NetFlow for any MPLS label except for the top label. IP information, the label number, and the MPLS application are reported for the top label. Only IP information and the label number are reported for labels other than the top label. Therefore, you need to understand your network if you are interested in identifying the MPLS application owner for labels other than the top MPLS label.

Using MPLS-aware NetFlow, you can monitor various labels in the MPLS label stack. You can also export this information to a NetFlow collector for further processing with a data analyzer and look at MPLS traffic patterns in your network.

## Information Captured and Exported by MPLS-aware NetFlow

MPLS-aware NetFlow captures and reports on other information in addition to MPLS labels. It provides per-flow statistics for both incoming IP and MPLS traffic.

- For MPLS traffic, MPLS-aware NetFlow captures and reports up to three labels of interest and the label type and associated IP address of the top label, along with a subset of NetFlow data.
- For IP traffic, MPLS-aware NetFlow provides the regular NetFlow data.

MPLS-aware NetFlow uses Version 9 format to export both IP and MPLS NetFlow data.

MPLS-aware NetFlow provides the following traditional NetFlow per-flow statistics:

- Number of packets
- Number of bytes, counting either MPLS payload size only or MPLS payload size plus MPLS label stack size
- Time stamp of the first packet
- Time stamp of the last packet

In addition to these statistics, MPLS-aware NetFlow exports values for the following fields for each flow, using Version 9 NetFlow export format:

- Regular NetFlow fields:
  - Source IP address
  - Destination IP address
  - Transport layer protocol
  - Source application port number
  - Destination application port number
  - IP type of service (ToS)
  - TCP flags
  - Input interface
  - Output interface

**Note**

With the exception of the input interface and output interface fields, these regular NetFlow fields are not included in a flow if the **no-ip-fields** keyword is specified in the **ip flow-cache mpls label-positions** command.

- Additional fields:
  - Up to three incoming MPLS labels with experimental bits and an end-of-stack bit
  - Positions of the above labels in the label stack
  - Type of the top label
  - An address prefix associated with the top label specific to the label type:
    - TE—This is always set to "0.0.0.0" because tunnel label addresses are not supported.
    - LDP—The address prefix is the IP address of the next-hop.
    - VPN—If the VRFs do not have overlapping IP addresses, the address prefix is the destination prefix. If the VRFs have overlapping IP addresses the destination prefix given may be ambiguous.

**Note**

Unlike NetFlow, MPLS-aware NetFlow reports a 0 value for IP next-hop, source and destination BGP autonomous system numbers, or source and destination prefix masks for MPLS packets.

**Note**

If you are exporting MPLS data to a NetFlow collector or a data analyzer, the collector must support NetFlow Version 9 flow export format, and you must configure NetFlow export in Version 9 format on the router.

## Full and Sampled MPLS-aware NetFlow Support

Table 2 shows MPLS-aware NetFlow full and sampled NetFlow support. Information in the table is based on the Cisco IOS release and includes the commands to implement the functionality on a supported platform.

**Table 2** *MPLS-aware NetFlow Full and Sampled NetFlow Support*

Cisco IOS Release	Full or Sampled NetFlow	Cisco 12000 Series Commands to Implement	Cisco 7500/7200 Series Commands to Implement <sup>1</sup>
12.0(24)S	Sampled	<b>ip route-cache flow sampled</b>	—
	Full	—	—
12.0(26)S	Sampled	<b>ip route-cache flow sampled</b>	<b>flow-sampler-map</b> <i>sampler-map-name</i> <b>mode random one-of</b> <i>packet-interval</i> <b>interface</b> <i>type number</i> <b>flow-sampler</b> <i>sampler-map-name</i>
	Full	—	<b>ip route-cache flow</b>

1. NetFlow sampling on the Cisco 7500/7200 platforms is performed by a feature called Random Sampled NetFlow.

# How to Configure MPLS-aware NetFlow

This section contains the following procedures for configuring MPLS-aware NetFlow:

- [Configuring MPLS-aware NetFlow on a Router, page 10](#) (required)
- [Configuring Sampling for MPLS-aware NetFlow, page 12](#) (optional)
- [Verifying the NetFlow Sampler Configuration, page 14](#) (optional)
- [Displaying MPLS-aware NetFlow Information on a Router, page 14](#) (optional)

## Configuring MPLS-aware NetFlow on a Router


Perform the steps in this required task to configure MPLS-aware NetFlow on a router.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *interface-type interface-number*
4. **ip flow** {ingress}
5. **exit**
6. Repeat Steps 3 through 5 for each interface you want to configure NetFlow on.
7. **ip flow-export version 9** [origin-as | peer-as] [bgp-next-hop]
8. **ip flow-cache mpls label-positions** [*label-position-1* [*label-position-2* [*label-position-3*]]] [no-ip-fields] [mpls-length]
9. **exit**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	(Required) Enables privileged EXEC mode.  • Enter your password if prompted.
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	(Required) Enters global configuration mode.
Step 3	<b>interface</b> <i>interface-type interface-number</i>  <b>Example:</b> Router(config)# interface pos 3/0	(Required) Specifies the interface and enters interface configuration mode.

Command or Action	Purpose
<p><b>Step 4</b> <code>ip flow {ingress}</code></p> <p><b>Example:</b> Router(config-if)# ip flow ingress</p>	<p>(Required) Enables NetFlow on the interface.</p> <ul style="list-style-type: none"> <li>• <b>ingress</b>—captures traffic that is being received by the interface</li> </ul>
<p><b>Step 5</b> <code>exit</code></p> <p><b>Example:</b> Router(config-if)# exit</p>	<p>(Optional) Exits interface configuration mode and returns to global configuration mode.</p> <p><b>Note</b> You only need to use this command if you want to enable NetFlow on another interface.</p>
<p><b>Step 6</b> Repeat Steps 3 through 5 to enable NetFlow on other interfaces.</p>	<p>(Optional) —</p>
<p><b>Step 7</b> <code>ip flow-export version 9 [origin-as   peer-as] [bgp-nexthop]</code></p> <p><b>Example:</b> Router(config)# ip flow-export version 9 origin-as</p>	<p>(Optional) Enables the export of information in NetFlow cache entries.</p> <ul style="list-style-type: none"> <li>• The <b>version 9</b> keyword specifies that the export packet uses the Version 9 format.</li> <li>• The <b>origin-as</b> keyword specifies that export statistics include the origin autonomous system (AS) for the source and destination.</li> <li>• The <b>peer-as</b> keyword specifies that export statistics include the peer AS for the source and destination.</li> <li>• The <b>bgp-nexthop</b> keyword specifies that export statistics include BGP next hop related information.</li> </ul> <p> <b>Caution</b> Entering this command on a Cisco 12000 Series Internet Router causes packet forwarding to stop for a few seconds while NetFlow reloads the route processor and line card CEF tables. To avoid interruption of service to a live network, apply this command during a change window, or include it in the startup-config file to be executed during a router reboot.</p>

Command or Action	Purpose
<p><b>Step 8</b></p> <pre>ip flow-cache mpls label-positions [label-position-1 [label-position-2 [label-position-3]]] [no-ip-fields] [mps-length]</pre> <p><b>Example:</b> Router(config)# ip flow-cache mpls label-positions 1 2 3</p>	<p>(Required) Enables MPLS-aware NetFlow.</p> <ul style="list-style-type: none"> <li>The <i>label-position-n</i> argument identifies the position of an MPLS label of interest in the incoming label stack. Label positions are counted from the top of the stack, starting with 1.</li> <li>The <b>no-ip-fields</b> keyword controls the capture and reporting of MPLS flow fields. If the <b>no-ip-fields</b> keyword is specified, the following IP-related flow fields are not included: <ul style="list-style-type: none"> <li>Source IP address</li> <li>Destination IP address</li> <li>Transport layer protocol</li> <li>Source application port number</li> <li>Destination application port number</li> <li>IP type of service (ToS)</li> <li>TCP flag (the result of a bitwise OR of TCP)</li> </ul> </li> </ul> <p>If the <b>no-ip-fields</b> keyword is not specified, the IP related fields are captured and reported.</p> <ul style="list-style-type: none"> <li>The <b>mps-length</b> keyword controls the reporting of packet length. If the <b>mps-length</b> keyword is specified, the reported length represents the sum of the MPLS packet payload length and the MPLS label stack length.</li> </ul> <p>If the <b>mps-length</b> keyword is not specified, only the length of the MPLS packet payload is reported.</p>
<p><b>Step 9</b></p> <pre>exit</pre> <p><b>Example:</b> Router(config)# exit</p>	<p>(Required) Exits the current configuration mode and returns to privileged EXEC mode.</p>

## Configuring Sampling for MPLS-aware NetFlow

Perform the steps in this optional task to configure sampling for MPLS-aware NetFlow.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **flow-sampler-map** *sampler-map-name*
4. **mode random one-out-of** *packet-interval*
5. **exit**
6. **interface** *interface-type interface-number*

7. **flow-sampler** *sampler-map-name*
8. **end**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	(Required) Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	(Required) Enters global configuration mode.
Step 3	<b>flow-sampler-map</b> <i>sampler-map-name</i>  <b>Example:</b> Router(config)# flow-sampler-map mysampler	(Required) Defines a named object representing a NetFlow sampler. <ul style="list-style-type: none"> <li>The <i>sampler-map-name</i> argument is the name of the NetFlow sampler.</li> </ul>
Step 4	<b>mode random one-out-of</b> <i>packet-interval</i>  <b>Example:</b> Router(config-sampler-map)# mode random one-out-of 100	(Required) Specifies the sampling mode for the NetFlow sampler. <ul style="list-style-type: none"> <li>The <b>random</b> keyword specifies the random sampling mode.</li> <li>The <b>one-out-of</b> <i>packet-interval</i> keyword argument combination defines the interval selected for random sampling. The packet interval is from 1 to 65535.</li> </ul>
Step 5	<b>exit</b>  <b>Example:</b> Router(config-sampler-map)# exit	(Required) Exits sampler map configuration mode and returns to global configuration mode.
Step 6	<b>interface</b> <i>interface-type interface-number</i>  <b>Example:</b> Router(config)# interface ethernet 0/0	(Required) Specifies the interface that you want to enable NetFlow on and enters interface configuration mode.
Step 7	<b>flow-sampler</b> <i>sampler-map-name</i>  <b>Example:</b> Router(config-if)# flow-sampler mysampler	(Required) Enables sampled NetFlow accounting on the interface. <ul style="list-style-type: none"> <li>The <i>sampler-map-name</i> argument is the name of the NetFlow sampler.</li> </ul>
Step 8	<b>end</b>  <b>Example:</b> Router(config-if)# end	(Required) Exits the current configuration mode and returns to privileged EXEC mode.

## Troubleshooting Tips

Use the **show-sampler** *sampler-map-name* command to verify the configuration of NetFlow sampling, including the NetFlow sampling mode, sampling mode parameters, and number of packets sampled by the NetFlow sampler.

For more information on NetFlow export sampling, see the [“Using NetFlow Filtering or Sampling to Select the Network Traffic to Track”](#) module.

## Verifying the NetFlow Sampler Configuration

Perform the steps in this optional task to verify the NetFlow sampler configuration on your router:

### SUMMARY STEPS

1. **show flow-sampler** [*sampler-map-name*]
2. **show flow sampler**

### DETAILED STEPS

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#### Step 1 **show flow-sampler** [*sampler-map-name*]

Use this command to verify the following information about a specific NetFlow sampler: sampling mode, sampling parameters (such as packet sampling interval), and number of packets selected by the sampler for NetFlow processing. For example:

```
Router# show flow-sampler mysampler

Sampler : mysampler, id : 1, packets matched : 10, mode : random sampling mode
sampling interval is : 100
```

#### Step 2 **show flow-sampler**

Use the following command to verify the configuration for all Netflow samplers on the router:

```
Router# show flow-sampler

Sampler : mysampler, id : 1, packets matched : 10, mode : random sampling mode
sampling interval is : 100

Sampler : mysampler1, id : 2, packets matched : 5, mode : random sampling mode
sampling interval is : 200
```

---

## Displaying MPLS-aware NetFlow Information on a Router

Perform the steps in this optional task to display a snapshot of the MPLS-aware NetFlow cache on a router.

### SUMMARY STEPS

1. **enable**

2. **attach** *slot-number* (Cisco 12000 series routers only) or **if-con** *slot-number* (Cisco 7500 series routers only)
3. **show ip cache verbose flow**
4. **show ip cache flow**
5. **exit** (Cisco 12000 Series Internet routers only) or **if-quit** (Cisco 7500 series routers only)

## DETAILED STEPS

### Step 1 enable

Use this command to enable privileged EXEC mode. Enter your password if required. For example:

```
Router> enable
Router#
```

### Step 2 attach *slot-number* (Cisco 12000 Series Internet routers only) or if-con *slot-number* (Cisco 7500 series routers only)

Use the **attach** command to access the Cisco IOS on the line card of a Cisco 12000 Series Internet Router. For example:

```
Router# attach 3
LC-Slot3#
```

Use the **if-con** command to access the Cisco IOS on the line card of a Cisco 7500 series router. For example:

```
Router# if-con 3
LC-Slot3#
```

### Step 3 show ip cache verbose flow

Use this command to display IP and MPLS flow records in the NetFlow cache on a Cisco 12000 Series Internet Router or Cisco 7500 series router. For example:

```
LC-Slot3# show ip cache verbose flow

...
SrcIf          SrcIPAddress  DstIf          DstIPAddress  Pr TOS Flgs Pkts
Port Msk AS    Port Msk AS    NextHop        B/Pk Active
PO3/0         10.1.1.1      PO5/1          10.2.1.1      01 00 10     9
0100 /0 0      0200 /0 0      0.0.0.0        100     0.0
Pos:Lbl-Exp-S 1:12305-6-0 (LDP/10.10.10.10) 2:12312-6-1
```

In this example, the value of the top label is 12305, the experimental bits value is 6, and the end-of-stack bit is 0. The label is LDP and it has an associated IP address of 10.10.10.10. The value of the next from the top label is 12312, the experimental bits value is 6, and the end-of-stack bit is 1. The 1 indicates that this is the last MPLS label in the stack.

Use this command to display IP and MPLS flow records in the NetFlow cache on a Cisco 7200 series router. For example:

```
Router# show ip cache verbose flow

...
SrcIf          SrcIPAddress  DstIf          DstIPAddress  Pr TOS Flgs Pkts
Port Msk AS    Port Msk AS    NextHop        B/Pk Active
PO3/0         10.1.1.1      PO5/1          10.2.1.1      01 00 10     9
0100 /0 0      0200 /0 0      0.0.0.0        100     0.0
Pos:Lbl-Exp-S 1:12305-6-0 (LDP/10.10.10.10) 2:12312-6-1
```

In this example, the value of the top label is 12305, the experimental bits value is 6, and the end-of-stack bit is 0. The label is LDP and has an associated IP address of 10.10.10.10. The value of the next from the top label is 12312, the experimental bits value is 6, and the end-of-stack bit is 1. The 1 indicates that this is the last MPLS label in the stack.

#### Step 4 **show ip cache flow**

Use this command to display a summary of the IP and MPLS flow records in the NetFlow cache on a Cisco 12000 Series Internet Router or Cisco 7500 series router. For example, the following output of the **show ip cache flow** command shows the IP portion of the MPLS flow record in the NetFlow cache:

```
LC-Slot3# show ip cache flow
...
SrcIf          SrcIPAddress  DstIf          DstIPAddress   Pr SrcP DstP  Pkts
PO3/0         10.1.1.1      PO5/1          10.2.1.1       01 0100 0200   9
...
```

Use this command to display a summary of the IP and MPLS flow records in the NetFlow cache on a Cisco 7200 series router. For example:

```
Router# show ip cache flow
...
SrcIf          SrcIPAddress  DstIf          DstIPAddress   Pr SrcP DstP  Pkts
PO3/0         10.1.1.1      PO5/1          10.2.1.1       01 0100 0200   9
...
```

#### Step 5 **exit** (Cisco 12000 series routers only) or **if-quit** (Cisco 7500 series routers only)

Use the **exit** command to exit from the line card to privileged EXEC mode of a Cisco 12000 Series Internet Router. For example:

```
LC-Slot3# exit
Router#
```

Use the **if-quit** command to exit from the line card to privileged EXEC mode of a Cisco 7500 Series Router. For example:

```
LC-Slot3# if-quit
Router#
```

## Configuration Examples for MPLS-aware NetFlow

This section contains the following configuration examples for MPLS-aware NetFlow:

- [Configuring MPLS-aware NetFlow on a Router: Examples, page 16](#)
- [Configuring Sampling for MPLS-aware NetFlow: Examples, page 18](#)

## Configuring MPLS-aware NetFlow on a Router: Examples

The following example shows MPLS-aware NetFlow configured globally and NetFlow enabled on an interface on a Cisco 12000 series P router with Cisco IOS Release 12.0(24)S and later:

```

configure terminal
!
interface pos 3/0
 ip address 10.10.10.2 255.255.255.0
 ip route-cache flow sampled
 exit
!
ip flow-export version 9 origin-as
ip flow-sampling-mode packet-interval 101
ip flow-cache mpls label-positions 1 2 3
exit

```

The following examples show MPLS-aware NetFlow configured globally and NetFlow enabled on an interface on a Cisco 7200 or 7500 series P router with Cisco IOS 12.0S releases:

```

configure terminal
!
interface pos 3/0
 ip address 10.10.10.2 255.255.255.0
 ip route-cache flow sampled
 exit
!
ip flow-export version 9 origin-as
ip flow-sampling-mode packet-interval 101
ip flow-cache mpls label-positions 1 2 3
exit

```

The following examples show MPLS-aware NetFlow configured globally and NetFlow enabled on an interface on a router with a Cisco IOS Release 12.2(14)S, 12.2(15)T, or 12.0(22)S or later:

```

configure terminal
!
interface pos 3/0
 ip address 10.10.10.2 255.255.255.0
 ip flow ingress
 exit
!
ip flow-export version 9 origin-as
ip flow-sampling-mode packet-interval 101
ip flow-cache mpls label-positions 1 2 3
exit

```

To export MPLS-aware NetFlow data from the router, you need to configure NetFlow Version 9 export format. This example shows the NetFlow Version 9 export format configuration options for MPLS-aware NetFlow and IP NetFlow data export along with an explanation of what each command configures:

configure terminal ip flow-export version 9 origin-as	Enters global configuration mode and requests Version 9 flow export, reports origin-as for IP packets.
ip flow-export template options sampling	Specifies the template option sampling configuration.
ip flow-export template options export-stats	Reports the number of export packets sent and the number of flows exported.
ip flow-export template options timeout 5	Exports template options every 5 minutes.
ip flow-export template timeout 5	Resends templates to the collector every 5 minutes.
ip flow-export destination 10.21.32.25 9996	Specifies export destination and UDP port.

<code>ip flow-export source Loopback0</code>	Specifies export source.
<code>ip flow-sampling-mode packet-interval 101</code>	Configures the sampling mode packet interval.
<code>ip flow-cache mpls label-positions 1 2 3</code>	Configured the MPLS-aware NetFlow feature to report the top 3 labels.
<code>interface pos 3/0</code> <code>ip route-cache flow [sampled]</code> <code>end</code>	Enables full or sampled IP and MPLS-aware NetFlow on interface POS 3/0 and returns to privileged EXEC mode.  <b>Note</b> The combination of sampled IP and MPLS-aware NetFlow is supported on the Cisco 12000 Series Internet Router only.

## Configuring Sampling for MPLS-aware NetFlow: Examples

The following examples show how to define a Netflow sampler that randomly selects 1 out of 100 packets for NetFlow processing, and how to apply this sampler to an interface on a Cisco 7500 or 7200 series router.

### Defining the NetFlow Sampler

The following example shows how to define a NetFlow sampler called mysampler that randomly selects 1 out of 100 packets for NetFlow processing:

```
configure terminal
!
flow-sampler-map mysampler
 mode random one-out-of 100
end
exit
```

### Applying the NetFlow Sampler to an Interface

The following example shows how to apply the NetFlow sampler named mysampler to an interface:

```
configure terminal
!
interface FastEthernet 2/0
 flow-sampler mysampler
end
exit
```

# Additional References

The following sections provide references related to configuring MPLS-aware NetFlow.

## Related Documents

Related Topic	Document Title
Overview of Cisco IOS NetFlow	<a href="#">“Cisco IOS NetFlow Overview”</a>
List of the features documented in the <i>Cisco IOS NetFlow Configuration Guide</i> configuration guide	<a href="#">“Cisco IOS NetFlow Features Roadmap”</a>
The minimum information about and tasks required for configuring NetFlow and NetFlow Data Export	<a href="#">“Getting Started with Configuring NetFlow and NetFlow Data Export”</a>
Tasks for configuring NetFlow to capture and export network traffic data	<a href="#">“Configuring NetFlow and NetFlow Data Export”</a>
Tasks for configuring MPLS egress NetFlow accounting	<a href="#">Configuring MPLS Egress NetFlow Accounting and Analysis</a>
Tasks for configuring NetFlow input filters	<a href="#">“Using NetFlow Filtering or Sampling to Select the Network Traffic to Track”</a>
Tasks for configuring Random Sampled NetFlow	<a href="#">“Using NetFlow Filtering or Sampling to Select the Network Traffic to Track”</a>
Tasks for configuring NetFlow aggregation caches	<a href="#">“Configuring NetFlow Aggregation Caches”</a>
Tasks for configuring NetFlow BGP next hop support	<a href="#">“Configuring NetFlow BGP Next Hop Support for Accounting and Analysis”</a>
Tasks for configuring NetFlow multicast support	<a href="#">“Configuring NetFlow Multicast Accounting”</a>
Tasks for detecting and analyzing network threats with NetFlow	<a href="#">Detecting and Analyzing Network Threats With NetFlow</a>
Tasks for configuring NetFlow Reliable Export With SCTP	<a href="#">NetFlow Reliable Export With SCTP</a>
Tasks for configuring NetFlow Layer 2 and Security Monitoring Exports	<a href="#">“NetFlow Layer 2 and Security Monitoring Exports”</a>
Tasks for configuring the SNMP NetFlow MIB	<a href="#">“Configuring SNMP and using the NetFlow MIB to Monitor NetFlow Data”</a>
Tasks for configuring the NetFlow MIB and Top Talkers feature	<a href="#">“Configuring NetFlow Top Talkers using Cisco IOS CLI Commands or SNMP Commands”</a>
Information for installing, starting, and configuring the CNS NetFlow Collection Engine	<a href="#">“Cisco CNS NetFlow Collection Engine Documentation”</a>

## Standards

Standards	Title
The IETF working group, IP Flow Information Export (ipfix), is developing a standard that this feature will support.	—

## MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

## RFCs

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

## Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	<a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a>

# Glossary

**AToM**—Any Transport over MPLS. A protocol that provides a common framework for encapsulating and transporting supported Layer 2 traffic types over a Multiprotocol Label Switching (MPLS) network core.

**BGP**—Border Gateway Protocol. An interdomain routing protocol that replaces Exterior Gateway Protocol (EGP). A BGP system exchanges reachability information with other BGP systems. It is defined by RFC 1163.

**CE router**—customer edge router. A router that is part of a customer network and that interfaces to a provider edge (PE) router. CE routers do not have routes to associated Virtual Private Networks (VPNs) in their routing tables.

**core router**—In a packet-switched star topology, a router that is part of the backbone and that serves as the single pipe through which all traffic from peripheral networks must pass on its way to other peripheral networks.

**EGP**—Exterior Gateway Protocol. Internet protocol for exchanging routing information between autonomous systems. It is documented in RFC 904. This term is not to be confused with the general term exterior gateway protocol. EGP is an obsolete protocol that was replaced by Border Gateway Protocol (BGP).

**export packet**—(NetFlow) A packet from a device (for example, a router) with NetFlow services enabled that is addressed to another device (for example, a NetFlow collector). This other device processes the packet (parses, aggregates, and stores information on IP flows).

**FEC**—Forward Equivalency Class. A set of packets that can be handled equivalently for the purpose of forwarding and thus is suitable for binding to a single label. The set of packets destined for an address prefix is one example of an FEC. A flow is another example.

**flow**—A unidirectional set of packets (IP or Multiprotocol Label Switching [MPLS]) that arrive at the router on the same subinterface and have the same source and destination IP addresses, the same Layer 4 protocol, the same TCP/UDP source and destination ports, and the same type of service (ToS) byte in the IP header.

**IPv6**—IP Version 6. Replacement for the current version of IP (Version 4). IPv6 includes support for flow ID in the packet header, which can be used to identify flows. Formerly called IPng (next generation).

**label**—A short, fixed-length identifier that tells switching nodes how the data (packets or cells) should be forwarded.

**label imposition**—The act of putting a label or labels on a packet.

**LDP**—Label Distribution Protocol. A standard protocol that operates between Multiprotocol Label Switching (MPLS)-enabled routers to negotiate the labels (addresses) used to forward packets. The Cisco proprietary version of this protocol is the Tag Distribution Protocol (TDP).

**LFIB**—label forwarding information base. A data structure and way of managing forwarding in which destinations and incoming labels are associated with outgoing interfaces and labels.

**LSR**—label switch router. A router that forwards packets in a Multiprotocol Label Switching (MPLS) network by looking only at the fixed-length label.

**MPLS**—Multiprotocol Label Switching. A switching method in which IP traffic is forwarded through use of a label. This label instructs the routers and the switches in the network where to forward the packets. The forwarding of MPLS packets is based on preestablished IP routing information.

**MPLS flow**—A unidirectional sequence of Multiprotocol Label Switching (MPLS) packets that arrive at a router on the same subinterface and have the same source and destination IP addresses, the same Layer 4 protocol, the same TCP/UDP source and destination ports, and the same type of service (ToS) byte in the IP header. A TCP session is an example of a flow.

**packet header**— (NetFlow) The first part of an export packet that provides basic information about the packet, such as the NetFlow version, number of records contained within the packet, and sequence numbering. The header information enables lost packets to be detected.

**PE router**—provider edge router. A router that is part of a service provider's network connected to a customer edge (CE) router. All Virtual Private Network (VPN) processing occurs in the PE router.

**P router**—provider core or backbone router. A router that is part of a service provider's core or backbone network and is connected to the provider edge (PE) routers.

**TDP**—Tag Distribution Protocol. The Cisco proprietary version of the protocol (label distribution protocol) between Multiprotocol Label Switching (MPLS)-enabled routers to negotiate the labels (addresses) used to forward packets.

**TE**—traffic engineering. Techniques and processes that cause routed traffic to travel through the network on a path other than the one that would have been chosen if standard routing methods were used.

**TE tunnel**—traffic engineering tunnel. A label-switched tunnel that is used for traffic engineering. Such a tunnel is set up through means other than normal Layer 3 routing; it is used to direct traffic over a path different from the one that Layer 3 routing could cause the tunnel to take.

**VPN**—Virtual Private Network. A secure IP-based network that shares resources on one or more physical networks. A VPN contains geographically dispersed sites that can communicate securely over a shared backbone.

## Feature Information for Configuring MPLS-aware NetFlow

Table 3 lists the features in this module and provides links to specific configuration information. Only features that were introduced or modified in Cisco IOS Release 12.2(1) or 12.0(3)S or a later release appear in the table.

Not all commands may be available in your Cisco IOS software release. For details on when support for a specific command was introduced, see the command reference documentation.

For information on a feature in this technology that is not documented here, see the “[Cisco IOS NetFlow Features Roadmap](#)” module.

Cisco IOS software images are specific to a Cisco IOS software release, a feature set, and a platform. Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at <http://www.cisco.com/go/fn>. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.



### Note

Table 3 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

**Table 3** Feature Information for Configuring MPLS-aware NetFlow

Feature Name	Releases	Feature Configuration Information
MPLS-aware NetFlow	12.0(24)S, 12.0(25)S, 12.0(26)S, 12.0(26)S1, 12.3(8)T	<p>Multiprotocol Label Switching (MPLS)-aware NetFlow is an extension of the NetFlow accounting feature that provides highly granular traffic statistics for Cisco routers. MPLS-aware NetFlow collects statistics on a per-flow basis just as NetFlow does. MPLS-aware NetFlow uses the NetFlow Version 9 export format.</p> <p>The following sections provide information about this feature:</p> <ul style="list-style-type: none"> <li>• <a href="#">MPLS-aware NetFlow Overview, page 4</a></li> <li>• <a href="#">MPLS Label Stack, page 4</a></li> <li>• <a href="#">MPLS-aware NetFlow Capture of MPLS Labels, page 6</a></li> <li>• <a href="#">MPLS-aware NetFlow Display of MPLS Labels, page 7</a></li> <li>• <a href="#">Information Captured and Exported by MPLS-aware NetFlow, page 8</a></li> <li>• <a href="#">Full and Sampled MPLS-aware NetFlow Support, page 9</a></li> <li>• <a href="#">Configuring MPLS-aware NetFlow on a Router, page 10</a></li> <li>• <a href="#">Configuring Sampling for MPLS-aware NetFlow, page 12</a></li> <li>• <a href="#">Verifying the NetFlow Sampler Configuration, page 14</a></li> <li>• <a href="#">Displaying MPLS-aware NetFlow Information on a Router, page 14</a></li> </ul> <p>The following commands were modified by this feature: <b>ip flow-cache mpls label-positions</b> and <b>show ip cache verbose flow</b>.</p>

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