

# Configure IPFIX


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# IPFIX

Internet Protocol Flow Information Export (IPFIX) is an IETF standard export protocol for sending Netflow packets. IPFIX is based on Netflow version 9.

The IPFIX feature formats Netflow data and transfers the Netflow information from an exporter to a collector using UDP as transport protocol.

### Restrictions for IPFIX

These IPFIX features are not supported:

- Variable-length information element in the IPFIX template
- Stream Control Transmission Protocol (SCTP) as the transport protocol

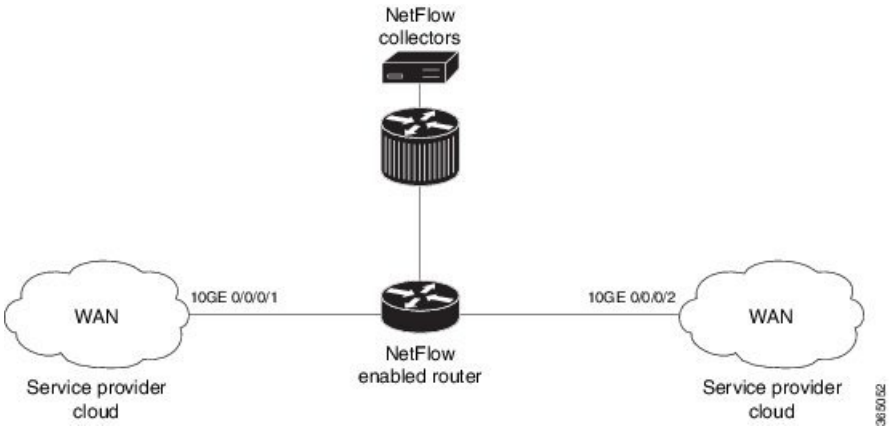
### Limitations for IPFIX

- You cannot modify an exporter version of an exporter map that is already applied to an interface. To modify the exporter version, first remove the exporter configuration applied on the interface, later modify the version and apply the configuration to the interface.
- An interface can have three different monitor-maps but all the monitor maps should have the same version for the exporters. There can be different exporters for the three monitor maps but they all need to have the same exporter version either v9 or IPFIX.
- You can only have monitor-maps one of each record type attached to an interface, that is one monitor-map for IPv4 record, one monitor-map for IPv6 record and one for MPLS record. There can be different exporter maps for these three monitor-maps but all the exporter maps should have same exporter version configured, either v9 or IPFIX.
- Multiple sampler-maps can be configured but only two sampler maps can be applied to an interface across the system.

# Configuring IPFIX

Consider SP-PE use case where SP (Service Provider) cloud is connected to the PE (Provider Edge) router through TenGigabit ethernet.

***Figure 1: SP-PE Topology***




Configuring NetFlow on PE router involves:

1. Configuring Exporter map with IPFIX as an exporter
2. Configuring Monitor map
3. Configuring Sampler map
4. Applying the Monitor map and Sampler map to an interface

### Configuring Exporter map with IPFIX as the exporter version

```
flow exporter-map fem_ipfix
 destination 10.1.1.1
 source Loopback 0
 transport udp 1025
 exit
version ipfix
 template data timeout 600
 options sampler-table
exit
```

### Configuring Monitor map

```
flow monitor-map fmm1
   record ipv4
    option filtered
   exporter fem_ipfix
   cache entries 10000
   cache timeout active 1800
   cache timeout inactive 15
   exit
```

### Configuring Sampler map

```
sampler-map fsm1
 random 1 out-of 4000  /*Sampling rate supported is 1:4000*/
exit
```

### Applying the Monitor map to an interface

Now apply the monitor-map **fmm1** that is configured with an exporter version IPFIX and sampler-map **fsm1** to the 10GE 0/0/0/1 interface in the ingress direction:

```
configure
 interface 10GE0/0/0/1
  flow ipv4 monitor fmm1 sampler fsm1 ingress
 exit
```

### Verification

Use the **show flow flow-exporter map** command to verify the exporter version configured is IPFIX:

```
RP/0/RP0/CPU0:router# show flow exporter-map fem_ipfix
Flow Exporter Map : fem_ipfix
-----------------------------------------------
Id                  : 3
Packet-Length       : 1468
DestinationIpAddr   : 10.1.1.1
VRFName             : default
SourceIfName        : Loopback1
SourceIpAddr        : 4.4.0.1
DSCP                : 40
TransportProtocol   : UDP
TransportDestPort   : 9001

Export Version: IPFIX
  Common Template Timeout : 1800 seconds
  Options Template Timeout : 1800 seconds
  Data Template Timeout : 1800 seconds
  Interface-Table Export Timeout : 0 seconds
  Sampler-Table Export Timeout : 0 seconds
  VRF-Table Export Timeout : 0 seconds
```

Exported packets in an IPFIX packet structure are in the form of template set or data set. The first data template is sent when the configuration is activated on the interface.

With constant stream, the flowset data does not change, so data is decoded. Data template is updated in the case of timeout on the template. To change the timeout options in the flow exporter, use the `template options timeout` command:

```
RP/0/RP0/CPU0:router(config)#flow exporter-map ipfix_exp1
RP/0/RP0/CPU0:router(config-fem)#version ipfix
RP/0/RP0/CPU0:router(config-fem-ver)#template options
RP/0/RP0/CPU0:TU-PE3(config-fem-ver)#template options timeout
RP/0/RP0/CPU0:TU-PE3(config-fem-ver)#template options timeout 30

RP/0/RP0/CPU0:router# show flow exporter-map ipfix_exp1
version ipfix

  template data timeout 30
```

```
!
dscp 40
transport udp 9001
source Loopback0
destination 10.127.59.86
```

# IPFIX Enablement for SRv6 and Services over SRv6 Core

***Table 1: Feature History Table***

| Feature Name | Release Information | Description |
|---|---|---|
| IPFIX Enablement for SRv6 and Services over SRv6 Core | Release 7.10.1 | During the transition from conventional IP/MPLS networks to SRv6-based networks, the necessity for monitoring SRv6 traffic flow becomes crucial. This feature enables IPFIX to effectively monitor SRv6 IP traffic flow from network devices.<br>The feature introduces these changes:<br>**CLI:**<br>• The **srv6** keyword is introduced in the**record ipv6** command.<br>The **srv6** keyword is supported on fourth generation and later ASR 9000 Series High Density Ethernet line cards. |

| Feature Name | Release Information | Description |
|---|---|---|
| Simultaneous L2 and L3 Flow Monitoring using IPFIX | Release 7.10.1 | This feature introduces support for simultaneous L2 and L3 flow monitoring. Now, you can configure IP Flow Information Export (IPFIX) to actively monitor and record end-to-end L2 and L3 flow information elements from network devices. Previously, only L2 or L3 flow could be monitored at a time.<br>The feature introduces these changes:<br>**CLI:**<br>• The **l2-l3** keyword is introduced in the **record ipv4** command.<br>• The **l2-l3** keyword is introduced in the **record ipv6** command.<br>**YANG DATA models:**<br>• New XPaths for `Cisco-IOS-XR-UM-flow-cfg` (see Github, YANG Data Models Navigator)<br>The **l2-l3** keyword is supported on fourth generation and later ASR 9000 Series High Density Ethernet line cards. |

During the transition from conventional IP/MPLS networks to SRv6-based networks, the requirement for information elements specific to SRv6 traffic flow arises. To address this requirement, we have introduced the **srv6** keyword within the **ipv6** command. Consequently, information related to SRv6 payload such as L2VPN and L3VPN services will also will be exported as part of IPFIX record.

### Restriction and Limitation

1. IPFIX with multiple SRH is not supported in IOS XR software version 7.10.1
2. When the VLAN rewrite pop/translate option is enabled, the fourth and fifth generation of the Cisco ASR 9000 line cards do not support capturing of the VLAN information on an L2 interface.
3. SRv6 encapsulated L2VPN IPFIX records captured at the Decap PE node may show IE89 ForwardingStatus as "forwarded," but IE14 egressInterface will be 0.
4. When ASR 9000 is the endpoint of SR, Base Format 1 Segment Identifier (SID) is not supported and only the Micro-SID format for Layer 2 VPN services is supported.

### Configuration

From Cisco IOS-XR Release 7.10.1, a new optional keyword, `srv6` is introduced for the `record ipv6` option. See the following example:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config-fem)# flow monitor-map MON
RP/0/RP0/CPU0:router(config-fmm)# record ipv6 srv6
RP/0/RP0/CPU0:router(config-fmm)# exporter EXP
RP/0/RP0/CPU0:router(config-fmm)# cache timeout inactive 5
RP/0/RP0/CPU0:router(config-fmm)# !
RP/0/RP0/CPU0:router(config-fmm)# sampler-map SAMP
RP/0/RP0/CPU0:router(config-fmm)# random 1 out-of 1000
RP/0/RP0/CPU0:router(config-fmm)# !
RP/0/RP0/CPU0:router(config-fmm)# interface GigabitEthernet0/1/0/0
RP/0/RP0/CPU0:router(config-fmm)# ipv6 address 2002:1::1/64
RP/0/RP0/CPU0:router(config-fmm)# flow ipv6 monitor M1 sampler SAMP ingres
```

This example shows how to display SRv6 monitor-map data for a specific flow:

```
RP/0/RP0/CPU0:router# show flow monitor-map MON

Flow Monitor Map : MON
---------------------------------------------------
Id:                1
RecordMapName:     srv6
ExportMapName:     EXP
CacheAgingMode:    Normal
CacheMaxEntries:   65535
CacheActiveTout:   1800 seconds
CacheInactiveTout: 5 seconds
CacheUpdateTout:   N/A
CacheRateLimit:    2000
HwCacheExists:     False
HwCacheInactTout:  50
```

From Cisco IOS-XR Release 7.10.1, a new optional keyword, `l2-l3` is introduced for the `record ipv4` and `record ipv6` option. See the following example:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config-fem)# flow monitor-map M-IPv4
RP/0/RP0/CPU0:router(config-fmm)# record ipv4 l2-l3
RP/0/RP0/CPU0:router(config-fmm)# exporter EXP-ipfix
RP/0/RP0/CPU0:router(config-fmm)# !
RP/0/RP0/CPU0:router(config-fmm)# flow monitor-map M-IPv6
RP/0/RP0/CPU0:router(config-fmm)# record ipv6 l2-l3
RP/0/RP0/CPU0:router(config-fmm)# exporter EXP-ipfix
RP/0/RP0/CPU0:router(config-fmm)# !
RP/0/RP0/CPU0:router(config-fmm)# sampler-map SAMP
RP/0/RP0/CPU0:router(config-fmm)# random 1 out-of 1000
RP/0/RP0/CPU0:router(config-fmm)# !
RP/0/RP0/CPU0:router(config-fmm)# interface GigabitEthernet0/1/0/0
RP/0/RP0/CPU0:router(config-fmm)# description CE-PE Interface
RP/0/RP0/CPU0:router(config-fmm)# ipv4 address 1.1.1.1 255.255.255.0
RP/0/RP0/CPU0:router(config-fmm)# ipv6 address 2001:DB8:c18:1::/64
RP/0/RP0/CPU0:router(config-fmm)# flow ipv4 monitor M-IPv4 sampler SAMP ingres
RP/0/RP0/CPU0:router(config-fmm)# flow ipv6 monitor M-IPv6 sampler SAMP ingress
RP/0/RP0/CPU0:router(config-fmm)# !
RP/0/RP0/CPU0:router
```

This example shows how to display IPv4 monitor-map data for a specific flow:

```
RP/0/RP0/CPU0:router# show run flow monitor-map

flow monitor-map M-IPv4
 record ipv4 l2-l3
 exporter EXP
!
flow monitor-map M-IPv6
 record ipv6 l2-l3
 exporter EXP
!
```

This example shows how to display l2-l3 monitor-map data for IPv4 specific flow:

```
RP/0/RP0/CPU0:router# show flow monitor-map M-IPv4

Flow Monitor Map : M-IPv4
-----------------------------------------------
Id:                3
RecordMapName:     ipv4-l2-l3
ExportMapName:     EXP
CacheAgingMode:    Normal
CacheMaxEntries:   65535
CacheActiveTout:   1800 seconds
CacheInactiveTout: 15 seconds
CacheUpdateTout:   N/A
CacheRateLimit:    2000
HwCacheExists:     False
HwCacheInactTout:  50
```

This example shows how to display l2-l3 monitor-map data for IPv6 specific flow:

```
RP/0/RP0/CPU0:router# show flow monitor-map M-IPv6

Flow Monitor Map : M-IPv6
-----------------------------------------------
Id:                4
RecordMapName:     ipv6-l2-l3
ExportMapName:     EXP
CacheAgingMode:    Normal
CacheMaxEntries:   65535
CacheActiveTout:   1800 seconds
CacheInactiveTout: 15 seconds
CacheUpdateTout:   N/A
CacheRateLimit:    2000
HwCacheExists:     False
HwCacheInactTout:  50
```

This example shows the complete recorded data for SRv6 L2 services :

```
RP/0/RP0/CPU0:router# show flow monitor M-IPv6 location 0/0/CPU0

Cache summary for Flow Monitor M1:
Cache size:                         65535
Current entries:                        3
Flows added:                            4
Flows not added:                        0
Ager Polls:                         68143
```

```
  - Active timeout                      0
  - Inactive timeout                    1
  - Immediate                           0
  - TCP FIN flag                        0
  - Emergency aged                      0
  - Counter wrap aged                   0
  - Total                               1
Periodic export:
  - Counter wrap                        0
  - TCP FIN flag                        0
Flows exported                          1

========== Record number: 1 ==========
IPv6SrcAddr           : 2::2
IPv6DstAddr           : bbbb:bc00:88:e000::
BGPDstOrigAS          : 0
BGPSrcOrigAS          : 0
BGPNextHopV6          : fe80::232:17ff:fe7e:1ce1
IPv6TC                : 0
IPv6FlowLabel         : 50686
IPv6OptHdrs           : 0x0
IPV6Prot              : 143
L4SrcPort             : 0
L4DestPort            : 0
L4TCPFlags            : 0
IPV6DstPrfxLen        : 48
IPV6SrcPrfxLen        : 128
InputInterface        : Hu0/0/0/10
OutputInterface       : BE111.1
ForwardStatus         : Fwd
FirstSwitched         : 01 18:51:25:797
LastSwitched          : 01 18:51:25:797
ByteCount             : 61004304
PacketCount           : 113814
Dir                   : Ing
SamplerID             : 1
InputVRFID            : default
OutputVRFID           : default
InnerIPV4SrcAddr      : 0.0.0.0
InnerIPV4DstAddr      : 0.0.0.0
InnerIPv6SrcAddr      : ::
InnerIPv6DstAddr      : ::
InnerL4SrcPort        : 0
InnerL4DestPort       : 0
SrcMacAddr            : 00:0c:29:0e:d8:32
DstMacAddr            : 00:0c:29:0e:d8:3c
EthType               : 2048
Dot1qPriority         : 0
Dot1qVlanId           : 2001
RecordType            : SRv6 L2 Service Record
SRHFlags              : 0x0
SRHTags               : 0x0
SRHSegmentsLeft       : 0
SRHNumSegments        : 0
```

This example shows the complete recorded data for IPv6 L2-L3 services :

```
RP/0/RP0/CPU0:router# show flow monitor M-IPv6 location 0/0/CPU0

RP/0/RP0/CPU0:router# show flow monitor MON-MAP-v6 location 0/0/CPU0
Thu Apr 28 11:36:47.622 IST
…
```

```
========== Record number: 1 ==========
IPv6SrcAddr           : 151:1::1
IPv6DstAddr           : ff02::1:ff00:2
BGPDstOrigAS          : 0
BGPSrcOrigAS          : 0
BGPNextHopV6          : ::
IPv6TC                : 224
IPv6FlowLabel         : 0
IPv6OptHdrs           : 0x0
IPV6Prot              : icmpv6
MinimumTTL            : 255
MaximumTTL            : 255
L4SrcPort             : 0
L4DestPort            : 135
L4TCPFlags            : 0
IPV6DstPrfxLen        : 0
IPV6SrcPrfxLen        : 0
InputInterface        : BE999.1
OutputInterface       : 0
ForwardStatus         : FwdNoFrag
FirstSwitched         : 01 18:51:25:797
LastSwitched          : 01 18:51:25:797
ByteCount             : 104
PacketCount           : 1
Dir                   : Ing
SamplerID             : 1
InputVRFID            : default
OutputVRFID           : default
SrcMacAddr            : 00:0c:29:0e:d8:32
DstMacAddr            : 00:0c:29:0e:d8:3c
EthType               : 2048
Dot1qPriority         : 0
Dot1qVlanId           : 100
CustVlanId            : 200
```

# IP Flow Information Export (IPFIX) 315

Internet Protocol Flow Information Export (IPFIX) is an IETF standard export protocol (RFC 7011) for sending IP flow information. Cisco NCS 540 Series Router supports IPFIX 315 format to export flow information. IPFIX 315 format facilitates sending ‘n’ octets frame information starting from ethernet header till transport header of the traffic flow over the network. IPFIX 315 supports sending variable size packet record with variable payload information such as IPv4, IPv6, MPLS, and Nested packets like OuterIP-GRE-InnerIP and so on. The process includes sampling and exporting the traffic flow information. Along with the ethernet frame information, IPFIX 315 format exports information of incoming and outgoing interface of the sampled packet.

Use **hw-module profile netflow ipfix315 location** < *linecard location* > command to enable IPFIX 315.

The information of the packets flowing through a device is used for variety of purpose including network monitoring, capacity planning, traffic management, and so on,

**Note** Cisco NCS 540 Series Router does not support Netflow version 9 format to export flow information.

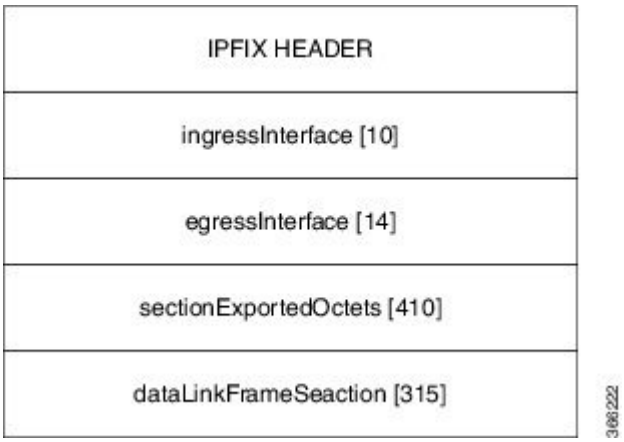
### Sampling and Exporting Information

You must configure a sampling map to sample the traffic flow information. The sampler map specifies the rate at which packets (one out of n packets) are sampled. The minimun sampling rate is 1 out of 4000 packets. Not all packets flowing through a device are exported; packets selected as per sampling rate are considered for exporting.

- The size of the exported packet is determined by the sampled packet size from the outermost Layer 2 header.
- If the sampled packet size is less than 160 bytes, the actual packet size is exported.
- If the sampled packet size is 160 bytes or more, the exported packet size is capped at 160 bytes.
- The exported packet includes data up to the Layer 4 header if present; however, if the Layer 4 header is not found within the first 160 bytes, the export size is limited to 160 bytes.

The below figure *IPFIX 315 Export Packet Format* shows exported packet information.

***Figure 2: IPFIX 315 Export Packet Format***




A special cache type called Immediate Aging is used while exporting the packets. Immediate Aging ensures that the flows are exported as soon as they are added to the cache. Use the command **cache immediate** in flow monitor map configuration to enable Immediate Aging cache type.

# IPFIX 315 Implementation Considerations

Here are few key points to consider before implementing IPFIX 315:

- Supported only in ingress direction.
- Supported on main interface only. The traffic on all sub-interfaces under the main interface is exported. This applies to releases up to and including IOS-XR software release 7.10.x.
- Sampling rate for bundles is per member-link and not per bundle interface.
- The outgoing interface information may not be correct incase of packets that are multicasted or broadcasted on multiple ports.
- The incoming and outgoing interface will have information of main interface and not the sub-interface even if the packet is routed via sub-interface. Incase of bundles it will point to bundle main interface.

- IPFIX 315 is not supported on BVI interface.
- Sampling and exporting of the control packets is not supported.
- When you configure **ipfix315-enable**, then you must configure all the ports on that LC with `datalinkframesection` flow.
- When the HQoS profile is enabled, Netflow does not give correct Output Interface. DSP is unique for each sub-interface.
- Netflow on the L2 interface assumes IPv4/IPv6/MPLS traffic, and if the traffic is purely L2 based, then the system ignores that traffic.
- You must remove all v9 configurations before reloading an LC. Else, with the existing v9 configurations on LC reload, you might encounter a few configuration apply error. Or, flow might be seen on an interface even when apply on interface has failed.

# Configuring IPFIX 315

Configuring IPFIX 315 involves:

1. Configuring Exporter map
2. Configuring Monitor map
3. Configuring Sampler map
4. Enabling IPFIX 315 on a line card
5. Applying the Monitor map and Sampler map to an interface

### Configuring Exporter map

```
flow exporter-map ipfix_exp
 version ipfix
 !
 dscp 40
 transport udp 9001
 source Loopback1
 destination 100.10.1.159
!
```

**Note** For **options** command and its configurations in Exporter Map, see options.

### Configuring Monitor map

```
flow monitor-map ipfix_mon
 record datalinksectiondump
 exporter ipfix_exp
 cache immediate
 cache entries 1000000
 cache timeout rate-limit 1000000
!
```

### Configuring Sampler map

```
sampler-map ipfix_sm
 random 1 out-of 32000
!
```

**Note** The default cache size is 65535, hence you can configure sampling rate as 1 out of 65535 packets. However the recommended sampling rate is 1 out of 32000 packets.

### Enabling IPFIX 315 on a line card

```
(config)# hw-module profile netflow ipfix315-enable location 0/0/CPU0
```

You should reload the LC for the changes to take effect.

### Applying the Monitor map to an interface

```
interface HundredGigE 0/0/0/18
        flow datalinkframesection monitor ipfix_mon sampler ipfix_sm ingress
```

### Verification

Use the **show flow platform producer statistics location** command to display the IPFIX 315 ingress packets flow statistics:

```
RP/0/RP0/CPU0#show flow platform producer statistics location 0/0/CPU0
Netflow Platform Producer Counters:
IPv4 Ingress Packets:                        0
IPv4 Egress Packets:                         0
IPv6 Ingress Packets:                        0
IPv6 Egress Packets:                         0
MPLS Ingress Packets:                        0
MPLS Egress Packets:                         0
IPFIX315 Ingress Packets:               630478
IPFIX315 Egress Packets:                     0
Drops (no space):                            0
Drops (other):                               0
Unknown Ingress Packets:                     0
Unknown Egress Packets:                      0
Worker waiting:                           2443
```

Use the **show flow monitor <monitor-map> cache location** command to check the flow monitor stats. In this example flow statistics for *ipfix_mon* monitor map are displayed:

```
RP/0/RP0/CPU0#show flow monitor ipfix_mon cache location 0/0/CPU0

Cache summary for Flow Monitor ipfix_mon:
Cache size:                         65535
Current entries:                        0
Flows added:                        50399
Flows not added:                        0
Ager Polls:                          2784
  - Active timeout                      0
  - Inactive timeout                    0
  - Immediate                       50399 /*cache type immediate*/
  - TCP FIN flag                        0
  - Emergency aged                      0
  - Counter wrap aged                   0
  - Total                           50399
```

```
Periodic export:
  - Counter wrap                        0
  - TCP FIN flag                        0
Flows exported                      50399


Matching entries:                       0
```

Above example shows that there were 50399 flows added to the cache and exported.