



## Configuring Flexible NetFlow

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- [Prerequisites for Flexible NetFlow, on page 1](#)
- [Restrictions for Flexible NetFlow, on page 2](#)
- [Information About Flexible Netflow, on page 4](#)
- [How to Configure Flexible Netflow, on page 20](#)
- [Monitoring Flexible NetFlow, on page 34](#)
- [Configuration Examples for Flexible NetFlow, on page 35](#)
- [Additional References for NetFlow, on page 40](#)
- [Feature Information for Flexible NetFlow, on page 41](#)

## Prerequisites for Flexible NetFlow

The following are prerequisites for your Flexible NetFlow configuration:

- You must configure a source interface. If you do not configure a source interface, the exporter remains in a disabled state.
- You must configure a valid record name for every flow monitor.
- You must enable IPv6 routing to export the flow records to an IPv6 destination server.
- You must configure IPFIX export protocol for the flow exporter to export netflow records in IPFIX format.
- You are familiar with the Flexible NetFlow key fields as they are defined in the following commands in the Cisco IOS Flexible NetFlow Command Reference:
  - **match datalink**—Datalink (layer2) fields
  - **match flow**—Flow identifying fields
  - **match interface**—Interface fields
  - **match ipv4**—IPv4 fields
  - **match ipv6**—IPv6 fields
  - **match transport**—Transport layer fields
  - **match wireless**—Wireless fields

- **match flow cts**—CTS fields
- You are familiar with the Flexible NetFlow non-key fields as they are defined in the following commands in the Cisco IOS Flexible NetFlow Command Reference :
  - **collect counter**—Counter fields
  - **collect flow**—Flow identifying fields
  - **collect interface**—Interface fields
  - **collect timestamp**—Timestamp fields
  - **collect transport**—Transport layer fields
  - **collect wireless**—Wireless fields

#### IPv4 Traffic

- The networking device must be configured for IPv4 routing.
- One of the following must be enabled on your device and on any interfaces on which you want to enable Flexible NetFlow: Cisco Express Forwarding or distributed Cisco Express Forwarding.

#### IPv6 Traffic

- The networking device must be configured for IPv6 routing.
- One of the following must be enabled on your device and on any interfaces on which you want to enable Flexible NetFlow: Cisco Express Forwarding IPv6 or distributed Cisco Express Forwarding.

## Restrictions for Flexible NetFlow

The following are restrictions for Flexible NetFlow:

- Flexible NetFlow is not supported on the L2 port-channel interface, but is supported on the L2 port-channel member ports.
- Flexible NetFlow is not supported on the L3 port-channel interface, but is supported on the L3 port-channel member ports.
- Traditional NetFlow (TNF) accounting is not supported.
- Flexible NetFlow version 9 and version 10 export formats are supported. However, if you have not configured the export protocol, version 9 export format is applied by default.
- Microflow policing feature shares the NetFlow hardware resource with FNF.
- Only one flow monitor per interface and per direction is supported .
- Layer 2, IPv4, and IPv6 traffic types are supported. Multiple flow monitors of different traffic types can be applied for a given interface and direction. Multiple flow monitors of same traffic type cannot be applied for a given interface and direction.

- Layer 2, VLAN, WLAN and Layer 3 interfaces are supported, but the device does not support SVI and tunnels.
- The following NetFlow table sizes are supported:

Trim Level	Ingress NetFlow Table	Egress NetFlow Table
LAN Base	Not supported	Not supported
IP Base	8 K	16 K
IP Services	8 K	16 K

- Depending on the switch type, a switch will have one or two forwarding ASICs. The capacities listed in the above table are on a per-ASIC basis.
- The switch can support either one or two ASICs. Each ASIC has 8K ingress and 16 K egress entries, whereas each TCAM can handle up to 6K ingress and 12K egress entries.
- The NetFlow tables are on separate compartments and cannot be combined. Depending on which ASIC processed the packet, the flows will be created in the table in the corresponding ASIC.
- NetFlow hardware implementation supports four hardware samplers. You can select a sampler rate from 1 out of 2 to 1 out of 1024. Only random sampling mode is supported.
- With the microflow policing feature (which is enabled only for wireless implementation), NetFlow can and should be used only in full flow mode i.e. NetFlow policing cannot be used. For wireless traffic, applying a sampler is not permitted, as it hinders microflow QoS.
- Only full flow accounting is supported for wireless traffic.
- NetFlow hardware uses hash tables internally. Hash collisions can occur in the hardware. Therefore, in spite of the internal overflow Content Addressable Memory (CAM), the actual NetFlow table utilization could be about 80 percent.
- Depending on the fields that are used for the flow, a single flow could take two consecutive entries. IPv6 flows also take two entries. In these situations, the effective usage of NetFlow entries is half the table size, which is separate from the above hash collision limitation.
- The device supports up to 15 flow monitors.
- SSID-based NetFlow accounting is supported. SSID is treated in a manner similar to an interface. However, certain fields are not supported such as user ID .
- The NetFlow software implementation supports distributed NetFlow export, so the flows are exported from the same device in which the flow was created.
- Ingress flows are present in the ASIC that first received the packets for the flow. Egress flows are present in the ASIC from which the packets actually left the device set up.
- The reported value for the bytes count field (called “bytes long”) is Layer-2-packet-size—18 bytes. For classic Ethernet traffic (802.3), this will be accurate. For all other Ethernet types, this field will not be accurate. Use the “bytes layer2” field, which always reports the accurate Layer 2 packet size. For information about supported Flexible NetFlow fields, see [Supported Flexible NetFlow Fields, on page 16](#).
- Configuration of IPFIX exporter on an AVC flow monitor is not supported.

- Flexible NetFlow export is not supported on the Ethernet management port, Gi0/0.
- When a flow record has only Source Group Tag (SGT) and Destination Group Tag (DGT) fields (or only either of the two) and if both the values are not applicable, then a flow will still be created with zero values for SGT and DGT. The flow records are expected to include source and destination IP addresses, along with SGT and DGT fields.
- The flow monitor with flow record, that contains the CTS field, cannot be attached on the WLAN (SSID).
- When QoS marked packet is received on an interface which has NetFlow configured on the egress direction, the QoS value of the packet will be captured by the collector. However, when the packet is received on an interface which has NetFlow configured on the ingress direction, the QoS value of the packet will not be captured by the collector.

# Information About Flexible Netflow

## Flexible NetFlow Overview

Flexible NetFlow uses flows to provide statistics for accounting, network monitoring, and network planning.

A flow is a unidirectional stream of packets that arrives on a source interface and has the same values for the keys. A key is an identified value for a field within the packet. You create a flow using a flow record to define the unique keys for your flow.

The device supports the Flexible NetFlow feature that enables enhanced network anomalies and security detection. Flexible NetFlow allows you to define an optimal flow record for a particular application by selecting the keys from a large collection of predefined fields.

All key values must match for the packet to count in a given flow. A flow might gather other fields of interest, depending on the export record version that you configure. Flows are stored in the Flexible NetFlow cache.

You can export the data that Flexible NetFlow gathers for your flow by using an exporter and export this data to a remote system such as a Flexible NetFlow collector. The Flexible NetFlow collector can use an IPv4 or IPv6 address.

You define the size of the data that you want to collect for a flow using a monitor. The monitor combines the flow record and exporter with the Flexible NetFlow cache information.

## Wireless Flexible NetFlow Overview

The wireless Flexible NetFlow infrastructure supports the following:

- Flexible NetFlow Version 9.0 and 10
- User-based rate limiting
- Microflow policing
- Voice and video flow monitoring
- Reflexive access control list (ACL)

### Microflow Policing and User-Based Rate Limiting

Microflow policing associates a 2-color 1-rate policer and related drop statistics to each flow present in the NetFlow table. When the flow mask comprises all packet fields, this functionality is known as microflow

policing. When the flow mask comprises either source or destination only, this functionality is known as user-based rate limiting.

### Voice and Video Flow Monitoring

Voice and video flows are full flow mask-based entries. The ASIC provides the flexibility to program the policer parameters, share policers across multiple flows and rewrite the IP address and Layer 4 port numbers of these flows.



**Note** For dynamic entries, the NetFlow engine will use the policer parameters that are derived for the flow based on the policy (ACL/QoS-based policies). Dynamic entries cannot share policer across multiple flows.

### Reflexive ACL

Reflexive ACLs allow IP packets to be filtered based on upper-layer session information. The ACLs allow outbound traffic and limit inbound traffic in response to the sessions that originate inside the trusted network. The reflexive ACLs are transparent to the filtering mechanism until a data packet that matches the reflexive entry activates it. At this time, a temporary ACL entry is created and added to the IP-named access lists. The information obtained from the data packet to generate the reflexive ACL entry is permit/deny bit, the source IP address and port, the destination IP address, port, and the protocol type. During reflexive ACL entry evaluation, if the protocol type is either TCP or UDP, then the port information must match exactly. For other protocols, there is no port information to match. After this ACL is installed, the firewall is then opened for the reply packets to pass through. At this time, a potential hacker could have access to the network behind the firewall. To narrow this window, an idle timeout period can be defined. However, in the case of TCP, if two FIN bits or an RST is detected, the ACL entry can be removed.

## Original NetFlow and Benefits of Flexible NetFlow

Original NetFlow uses a fixed seven tuples of IP information to identify a flow.

Flexible NetFlow allows the flow to be user defined. The benefits of Flexible NetFlow include:

- High-capacity flow recognition, including scalability and aggregation of flow information.
- Enhanced flow infrastructure for security monitoring and dDoS detection and identification.
- New information from packets to adapt flow information to a particular service or operation in the network. The flow information available will be customizable by Flexible NetFlow users.
- Extensive use of Cisco's flexible and extensible NetFlow Version 9 and version 10 export formats. With version 10 export format, support for variable length field for the wireless client's SSID is available.
- A comprehensive IP accounting feature that can be used to replace many accounting features, such as IP accounting, Border Gateway Protocol (BGP) Policy Accounting, and persistent caches.
- Support for ingress and egress NetFlow accounting.
- Support for full flow accounting and sampled NetFlow accounting.

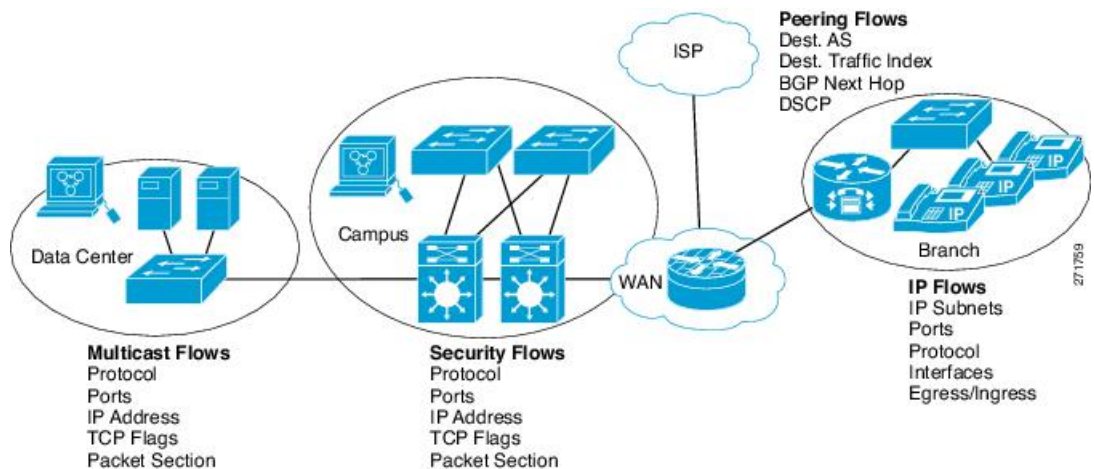
Original NetFlow allows you to understand the activities in the network and thus to optimize network design and reduce operational costs.

Flexible NetFlow allows you to understand network behavior with more efficiency, with specific flow information tailored for various services used in the network. The following are some example applications for a Flexible NetFlow feature:

- Flexible NetFlow enhances Cisco NetFlow as a security monitoring tool. For instance, new flow keys can be defined for packet length or MAC address, allowing users to search for a specific type of attack in the network.
- Flexible NetFlow allows you to quickly identify how much application traffic is being sent between hosts by specifically tracking TCP or UDP applications by the class of service (CoS) in the packets.
- The accounting of traffic entering a Multiprotocol Label Switching (MPLS) or IP core network and its destination for each next hop per class of service. This capability allows the building of an edge-to-edge traffic matrix.

The figure below is an example of how Flexible NetFlow might be deployed in a network.

**Figure 1: Typical Deployment for Flexible NetFlow**



## Flexible NetFlow Components

Flexible NetFlow consists of components that can be used together in several variations to perform traffic analysis and data export. The user-defined flow records and the component structure of Flexible NetFlow facilitates the creation of various configurations for traffic analysis and data export on a networking device with a minimum number of configuration commands. Each flow monitor can have a unique combination of flow record, flow exporter, and cache type. If you change a parameter such as the destination IP address for a flow exporter, it is automatically changed for all the flow monitors that use the flow exporter. The same flow monitor can be used in conjunction with different flow samplers to sample the same type of network traffic at different rates on different interfaces. The following sections provide more information on Flexible NetFlow components:

### Flow Records

In Flexible NetFlow a combination of key and nonkey fields is called a record. Flexible NetFlow records are assigned to Flexible NetFlow flow monitors to define the cache that is used for storing flow data. Flexible NetFlow includes several predefined records that can help you get started using Flexible NetFlow.

A flow record defines the keys that Flexible NetFlow uses to identify packets in the flow, as well as other fields of interest that Flexible NetFlow gathers for the flow. You can define a flow record with any combination of keys and fields of interest. The device supports a rich set of keys. A flow record also defines the types of counters gathered per flow. You can configure 64-bit packet or byte counters. The device enables the following match fields as the defaults when you create a flow record:

- match datalink—Layer 2 attributes
- match flow direction — Specifies a match to the fields identifying the direction of flow.
- match interface—Interface attributes
- match ipv4—IPv4 attributes
- match ipv6—IPv6 attributes
- match transport—Transport layer fields
- match wireless—Wireless fields
- match flow cts—CTS fields

## NetFlow Predefined Records

Flexible NetFlow includes several predefined records that you can use to start monitoring traffic in your network. The predefined records are available to help you quickly deploy Flexible NetFlow and are easier to use than user-defined flow records. You can choose from a list of already defined records that may meet the needs for network monitoring. As Flexible NetFlow evolves, popular user-defined flow records will be made available as predefined records to make them easier to implement.

The predefined records ensure backward compatibility with your existing NetFlow collector configurations for the data that is exported. Each of the predefined records has a unique combination of key and nonkey fields that offer you the built-in ability to monitor various types of traffic in your network without customizing Flexible NetFlow on your router.

Two of the predefined records (NetFlow original and NetFlow IPv4/IPv6 original output), which are functionally equivalent, emulate original (ingress) NetFlow and the Egress NetFlow Accounting feature in original NetFlow, respectively. Some of the other Flexible NetFlow predefined records are based on the aggregation cache schemes available in original NetFlow. The Flexible NetFlow predefined records that are based on the aggregation cache schemes available in original NetFlow do not perform aggregation. Instead each flow is tracked separately by the predefined records.

## User-Defined Records

Flexible NetFlow enables you to define your own records for a Flexible NetFlow flow monitor cache by specifying the key and nonkey fields to customize the data collection to your specific requirements. When you define your own records for a Flexible NetFlow flow monitor cache, they are referred to as *user-defined records*. The values in nonkey fields are added to flows to provide additional information about the traffic in the flows. A change in the value of a nonkey field does not create a new flow. In most cases the values for nonkey fields are taken from only the first packet in the flow. Flexible NetFlow enables you to capture counter values such as the number of bytes and packets in a flow as nonkey fields.

You can create user-defined records for applications such as QoS and bandwidth monitoring, application and end user traffic profiling, and security monitoring for dDoS attacks. Flexible NetFlow also includes several predefined records that emulate original NetFlow. Flexible NetFlow user-defined records provide the capability to monitor a contiguous section of a packet of a user-configurable size, and use it in a flow record as a key or

a nonkey field along with other fields and attributes of the packet. The section may include any Layer 3 data from the packet. The packet section fields allow the user to monitor any packet fields that are not covered by the Flexible NetFlow predefined keys. The ability to analyze packet fields that are not collected with the predefined keys enables more detailed traffic monitoring, facilitates the investigation of dDoS attacks, and enables implementation of other security applications such as URL monitoring.

Flexible NetFlow provides predefined types of packet sections of a user-configurable size. The following Flexible NetFlow commands (used in Flexible NetFlow flow record configuration mode) can be used to configure the predefined types of packet sections:

- **collect ipv4 section header size** *bytes* --Starts capturing the number of bytes specified by the *bytes* argument from the beginning of the IPv4 header of each packet.
- **collect ipv4 section payload size** *bytes* --Starts capturing bytes immediately after the IPv4 header from each packet. The number of bytes captured is specified by the *bytes* argument.
- **collect ipv6 section header size** *bytes* --Starts capturing the number of bytes specified by the *bytes* argument from the beginning of the IPv6 header of each packet.
- **collect ipv6 section payload size** *bytes* --Starts capturing bytes immediately after the IPv6 header from each packet. The number of bytes captured is specified by the *bytes* argument.

The *bytes* values are the sizes in bytes of these fields in the flow record. If the corresponding fragment of the packet is smaller than the requested section size, Flexible NetFlow will fill the rest of the section field in the flow record with zeros. If the packet type does not match the requested section type, Flexible NetFlow will fill the entire section field in the flow record with zeros.

Flexible NetFlow adds a new Version 9 export format field type for the header and packet section types. Flexible NetFlow will communicate to the NetFlow collector the configured section sizes in the corresponding Version 9 export template fields. The payload sections will have a corresponding length field that can be used to collect the actual size of the collected section.

## Flexible NetFlow Match Parameters

The following table describes Flexible NetFlow match parameters. You must configure at least one of the following match parameters for the flow records.

**Table 1: Match Parameters**

Command	Purpose
<b>match datalink</b> { <b>dot1q</b>   <b>ethertype</b>   <b>mac</b>   <b>vlan</b> }	Specifies a match to datalink or Layer 2 fields. The following command options are available: <ul style="list-style-type: none"> <li>• <b>dot1q</b>—Matches to the dot1q field.</li> <li>• <b>ethertype</b>—Matches to the ethertype of the packet.</li> <li>• <b>mac</b>—Matches the source or destination MAC fields.</li> <li>• <b>vlan</b>—Matches to the VLAN that the packet is located on (input or output).</li> </ul>
<b>match flow direction</b>	Specifies a match to the flow identifying fields.



Command	Purpose
<b>match interface</b> { <b>input</b>   <b>output</b> }	Specifies a match to the interface fields. The following command options are available: <ul style="list-style-type: none"> <li>• <b>input</b>—Matches to the input interface.</li> <li>• <b>output</b>—Matches to the output interface.</li> </ul>
<b>match ipv4</b> { <b>destination</b>   <b>protocol</b>   <b>source</b>   <b>tos</b>   <b>ttl</b>   <b>version</b> }	Specifies a match to the IPv4 fields. The following command options are available: <ul style="list-style-type: none"> <li>• <b>destination</b>—Matches to the IPv4 destination address-based fields.</li> <li>• <b>protocol</b>—Matches to the IPv4 protocols.</li> <li>• <b>source</b>—Matches to the IPv4 source address based fields.</li> <li>• <b>tos</b>—Matches to the IPv4 Type of Service fields.</li> <li>• <b>ttl</b>—Matches to the IPv4 Time To Live fields.</li> <li>• <b>version</b>—Matches to the IP version from the IPv4 header.</li> </ul>
<b>match ipv6</b> { <b>destination</b>   <b>hop-limit</b>   <b>protocol</b>   <b>source</b>   <b>traffic-class</b>   <b>version</b> }	Specifies a match to the IPv6 fields. The following command options are available: <ul style="list-style-type: none"> <li>• <b>destination</b>—Matches to the IPv6 destination address-based fields.</li> <li>• <b>hop-limit</b>—Matches to the IPv6 hop limit fields.</li> <li>• <b>protocol</b>—Matches to the IPv6 payload protocol fields.</li> <li>• <b>source</b>—Matches to the IPv6 source address based fields.</li> <li>• <b>traffic-class</b>—Matches to the IPv6 traffic class.</li> <li>• <b>version</b>—Matches to the IP version from the IPv6 header.</li> </ul>

Command	Purpose
<b>match transport</b> {destination-port   igmp   icmp   source-port}	Specifies a match to the Transport Layer fields. The following command options are available: <ul style="list-style-type: none"> <li>• <b>destination-port</b>—Matches to the transport destination port.</li> <li>• <b>icmp</b>—Matches to ICMP fields, including ICMP IPv4 and IPv6 fields.</li> <li>• <b>igmp</b>—Matches to IGMP fields.</li> <li>• <b>source-port</b>—Matches to the transport source port.</li> </ul>
<b>match flow cts</b> {source   destination} group-tag	Specifies a match to the CTS fields support in FNF record. The following command options are available: <ul style="list-style-type: none"> <li>• <b>source</b> —Matches to the source of CTS entering the domain.</li> <li>• <b>destination</b> —Matches to the destination of the CTS leaving the domain.</li> </ul>

### Flexible NetFlow Collect Parameters

The following table describes the Flexible NetFlow collect parameters.

*Table 2: Collect Parameters*

Command	Purpose
<b>collect counter</b> { bytes { layer2 { long }   long }   packets { long } }	Collects the counter fields total bytes and total packets.
<b>collect interface</b> {input   output}	Collects the fields from the input or output interface.
<b>collect timestamp absolute</b> {first   last}	Collects the fields for the absolute time the first packet was seen or the absolute time the most recent packet was last seen (in milliseconds).

Command	Purpose
<b>collect transport tcp flags</b>	<p>Collects the following transport TCP flags:</p> <ul style="list-style-type: none"> <li>• <b>ack</b>—TCP acknowledgement flag</li> <li>• <b>cwr</b>—TCP congestion window reduced flag</li> <li>• <b>ece</b>—TCP ECN echo flag</li> <li>• <b>fin</b>—TCP finish flag</li> <li>• <b>psh</b>—TCP push flag</li> <li>• <b>rst</b>—TCP reset flag</li> <li>• <b>syn</b>—TCP synchronize flag</li> <li>• <b>urg</b>—TCP urgent flag</li> </ul> <p><b>Note</b> On the device, you cannot specify which TCP flag to collect. You can only specify to collect transport TCP flags. All TCP flags will be collected with this command.</p>
<b>collect counter bytes</b>	Configures the number of bytes seen in a flow as a nonkey field and enables collecting the total number of bytes from the flow.
<b>collect counter packets</b>	Configures the number of packets seen in a flow as a nonkey field and enables collecting the total number of packets from the flow.
<b>collect timestamp sys-uptime first</b>	Configures the system uptime for the time the first packet was seen from the flows as a nonkey field and enables collecting time stamps based on the system uptime for the time the first packet was seen from the flows.
<b>collect timestamp sys-uptime last</b>	Configures the system uptime for the time the last packet was seen from the flows as a nonkey field and enables collecting time stamps based on the system uptime for the time the most recent packet was seen from the flows.

## Flow Exporters

Flow exporters export the data in the flow monitor cache to a remote system, such as a server running NetFlow collector, for analysis and storage. Flow exporters are created as separate entities in the configuration. Flow exporters are assigned to flow monitors to provide data export capability for the flow monitors. You can create several flow exporters and assign them to one or more flow monitors to provide several export destinations. You can create one flow exporter and apply it to several flow monitors.

### NetFlow Data Export Format Version 10 (IPFIX)

Internet Protocol Flow Information Export (IPFIX) or version 10 is an Export Protocol that collects and exports predefined or user defined flow records. IPFIX is an IETF standard based on NetFlow version 9. The IPFIX format maintains the same principles of separate templates and records as NetFlow version 9. It supports variable length field for SSID of the wireless clients. For IPFIX exporting protocol, the default destination port is 4739, DSCP value is 0, and TTL is 255.

### NetFlow Data Export Format Version 9

The basic output of NetFlow is a flow record. Several different formats for flow records have evolved as NetFlow has matured. The most recent evolution of the NetFlow export format is known as Version 9. The distinguishing feature of the NetFlow Version 9 export format is that it is template-based. Templates provide an extensible design to the record format, a feature that should allow future enhancements to NetFlow services without requiring concurrent changes to the basic flow-record format. Using templates provides several key benefits:

- Third-party business partners who produce applications that provide collector or display services for NetFlow do not have to recompile their applications each time a new NetFlow feature is added. Instead, they should be able to use an external data file that documents the known template formats.
- New features can be added to NetFlow quickly without breaking current implementations.
- NetFlow is “future-proofed” against new or developing protocols because the Version 9 format can be adapted to provide support for them.

NetFlow Version 9 export format provides the following features and functionality:

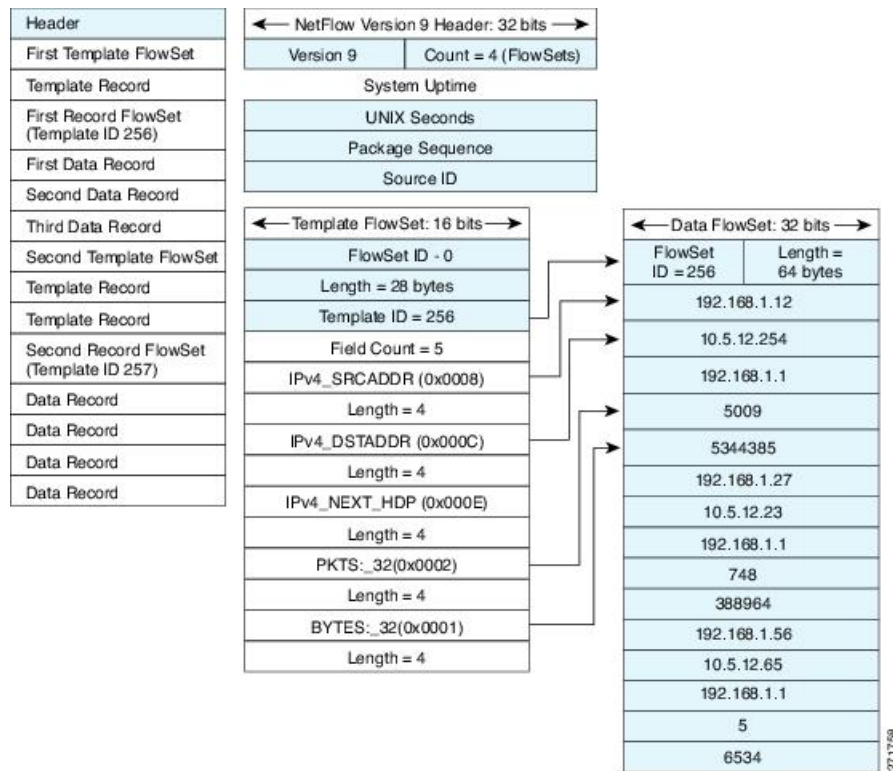
- Variable field specification format
- Support for IPv4 or IPv6 destination address export
- More efficient network utilization

The Version 9 export format consists of a packet header followed by one or more template flow or data flow sets. A template flow set provides a description of the fields that will be present in future data flow sets. These data flow sets may occur later within the same export packet or in subsequent export packets. Template flow and data flow sets can be intermingled within a single export packet, as illustrated in the figure below.

**Figure 2: Version 9 Export Packet**



NetFlow Version 9 will periodically export the template data so the NetFlow collector will understand what data is to be sent and also export the data flow set for the template. The key advantage to Flexible NetFlow is that the user configures a flow record, which is effectively converted to a Version 9 template and then forwarded to the collector. The figure below is a detailed example of the NetFlow Version 9 export format, including the header, template flow, and data flow sets.

**Figure 3: Detailed Example of the NetFlow Version 9 Export Format**

For more information on the Version 9 export format, refer to the white paper titled [Cisco IOS NetFlow Version 9 Flow-Record Format](http://www.cisco.com/en/US/tech/tk648/tk362/technologies_white_paper09186a00800a3db9.shtml), available at this URL:

[http://www.cisco.com/en/US/tech/tk648/tk362/technologies\\_white\\_paper09186a00800a3db9.shtml](http://www.cisco.com/en/US/tech/tk648/tk362/technologies_white_paper09186a00800a3db9.shtml).

## Flow Monitors

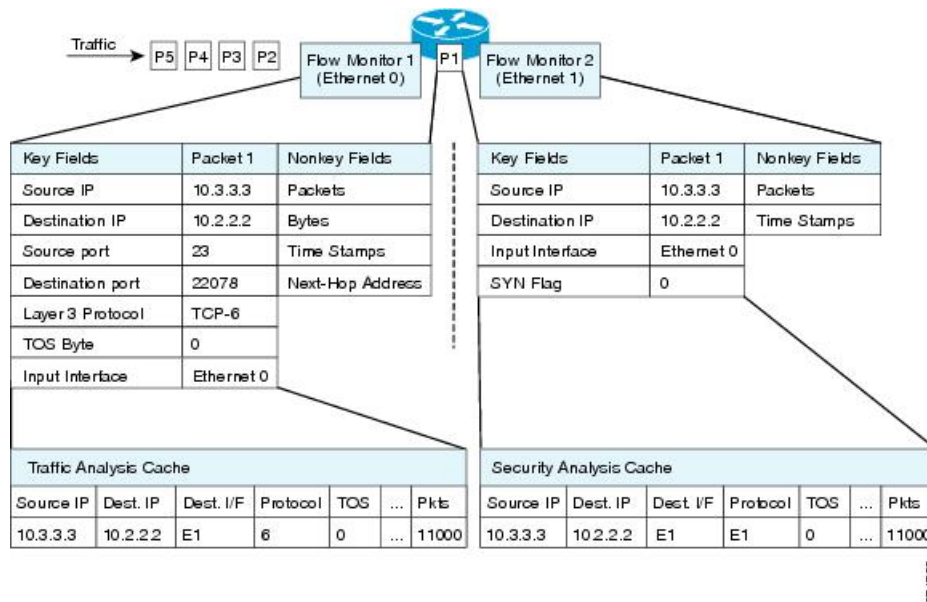
Flow monitors are the Flexible NetFlow component that is applied to interfaces to perform network traffic monitoring.

Flow monitors consist of a user-defined record, an optional flow exporter, and a cache that is automatically created at the time the flow monitor is applied to the first interface.

Flow data is collected from the network traffic and added to the flow monitor cache during the monitoring process based on the key and nonkey fields in the flow record.

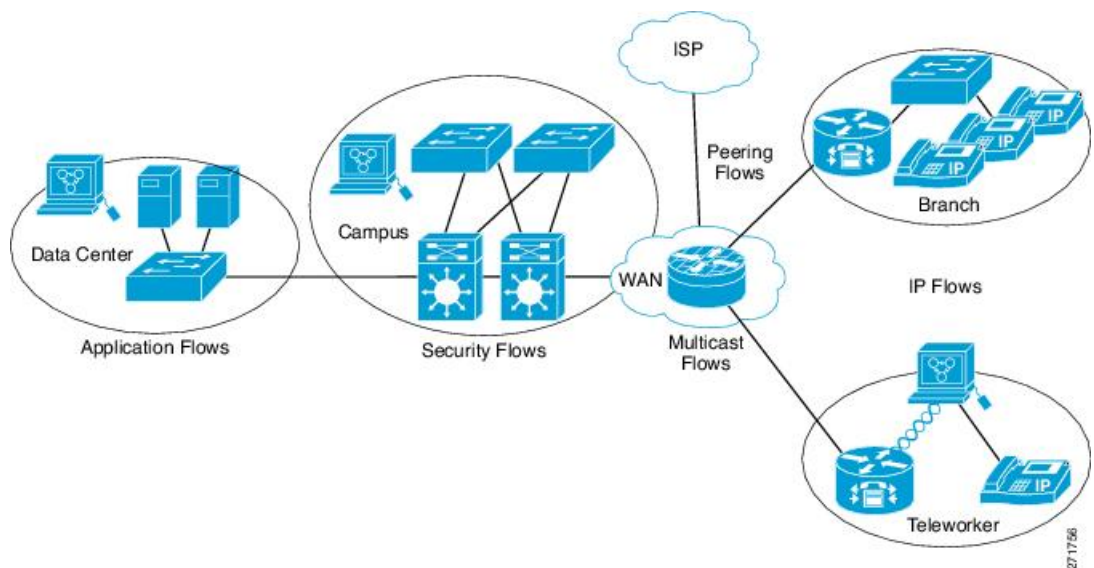
Flexible NetFlow can be used to perform different types of analysis on the same traffic. In the figure below, packet 1 is analyzed using a record designed for standard traffic analysis on the input interface and a record designed for security analysis on the output interface.

Figure 4: Example of Using Two Flow Monitors to Analyze the Same Traffic



The figure below shows a more complex example of how you can apply different types of flow monitors with custom records.

Figure 5: Complex Example of Using Multiple Types of Flow Monitors with Custom Records



There are three types of flow monitor caches. You change the type of cache used by the flow monitor after you create the flow monitor. The three types of flow monitor caches are described in the following sections:

### Normal

The default cache type is “normal”. In this mode, the entries in the cache are aged out according to the timeout active and timeout inactive settings. When a cache entry is aged out, it is removed from the cache and exported via any exporters configured.

**Immediate**

A cache of type "immediate" ages out every record as soon as it is created. As a result, every flow contains just one packet. The commands that display the cache contents will provide a history of the packets seen.

This mode is desirable when you expect only very small flows and you want a minimum amount of latency between seeing a packet and exporting a report.

**Caution**

This mode may result in a large amount of export data that can overload low-speed links and overwhelm any systems that you are exporting to. We recommended that you configure sampling to reduce the number of packets that are processed.

**Note**

The cache timeout settings have no effect in this mode.

**Permanent**

A cache of type "permanent" never ages out any flows. A permanent cache is useful when the number of flows you expect to see is low and there is a need to keep long-term statistics on the router. For example, if the only key field in the flow record is the 8-bit IP ToS field, only 256 flows can be monitored. To monitor the long-term usage of the IP ToS field in the network traffic, you can use a permanent cache. Permanent caches are useful for billing applications and for an edge-to-edge traffic matrix for a fixed set of flows that are being tracked. Update messages will be sent periodically to any flow exporters configured according to the "timeout update" setting.

**Note**

When a cache becomes full in permanent mode, new flows will not be monitored. If this occurs, a "Flows not added" message will appear in the cache statistics.

**Note**

A permanent cache uses update counters rather than delta counters. This means that when a flow is exported, the counters represent the totals seen for the full lifetime of the flow and not the additional packets and bytes seen since the last export was sent.

## Flow Samplers

Flow samplers are created as separate components in a router's configuration. Flow samplers are used to reduce the load on the device that is running Flexible NetFlow by limiting the number of packets that are selected for analysis.

Samplers use random sampling techniques (modes); that is, a randomly selected sampling position is used each time a sample is taken.

Flow sampling exchanges monitoring accuracy for router performance. When you apply a sampler to a flow monitor, the overhead load on the router of running the flow monitor is reduced because the number of packets that the flow monitor must analyze is reduced. The reduction in the number of packets that are analyzed by the flow monitor causes a corresponding reduction in the accuracy of the information stored in the flow monitor's cache.

Samplers are combined with flow monitors when they are applied to an interface with the **ip flow monitor** command.

## Supported Flexible NetFlow Fields

The following tables provide a consolidated list of supported fields in Flexible NetFlow (FNF) for various traffic types and traffic direction.



**Note** If the packet has a VLAN field, then that length is not accounted for.

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
<b>Key or Collect Fields</b>							
Interface input	Yes	—	Yes	—	Yes	—	If you apply a flow monitor in the input direction: <ul style="list-style-type: none"> <li>• Use the <b>match</b> keyword and use the input interface as a key field.</li> <li>• Use the <b>collect</b> keyword and use the output interface as a collect field. This field will be present in the exported records but with a value of 0.</li> </ul>
Interface output	—	Yes	—	Yes	—	Yes	If you apply a flow monitor in the output direction: <ul style="list-style-type: none"> <li>• Use the <b>match</b> keyword and use the output interface as a key field.</li> <li>• Use the <b>collect</b> keyword and use the input interface as a collect field. This field will be present in the exported records but with a value of 0.</li> </ul>

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
<b>Key Fields</b>							



Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
Flow direction	Yes	Yes	Yes	Yes	Yes	Yes	
Ethertype	Yes	Yes	—	—	—	—	
VLAN input	Yes	—	Yes	—	Yes	—	Supported only for a switch port.
VLAN output	—	Yes	—	Yes	—	Yes	Supported only for a switch port.
dot1q VLAN input	Yes	—	Yes	—	Yes	—	Supported only for a switch port.
dot1q VLAN output	—	Yes	—	Yes	—	Yes	Supported only for a switch port.
dot1q priority	Yes	Yes	Yes	Yes	Yes	Yes	Supported only for a switch port.
MAC source address input	Yes	Yes	Yes	Yes	Yes	Yes	
MAC source address output	—	—	—	—	—	—	
MAC destination address input	Yes	—	Yes	—	Yes	—	
MAC destination address output	—	Yes	—	Yes	—	Yes	
IPv4 version	—	—	Yes	Yes	Yes	Yes	
IPv4 TOS	—	—	Yes	Yes	Yes	Yes	

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
IPv4 protocol	—	—	Yes	Yes	Yes	Yes	Must use if any of src/dest port, ICMP code/type, IGMP type or TCP flags are used.
IPv4 TTL	—	—	Yes	Yes	Yes	Yes	
IPv4 source address	—	—	Yes	Yes	—	—	
IPv4 destination address	—	—	Yes	Yes	—	—	
ICMP IPv4 type	—	—	Yes	Yes	—	—	
ICMP IPv4 code	—	—	Yes	Yes	—	—	
IGMP type	—	—	Yes	Yes	—	—	

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
<b>Key Fields continued</b>							
IPv6 version	—	—	Yes	Yes	Yes	Yes	Same as IP version.
IPv6 protocol	—	—	Yes	Yes	Yes	Yes	Same as IP protocol. Must use if any of src/dest port, ICMP code/type, IGMP type or TCP flags are used.
IPv6 source address	—	—	—	—	Yes	Yes	

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
IPv6 destination address	—	—	—	—	Yes	Yes	
IPv6 traffic-class	—	—	Yes	Yes	Yes	Yes	Same as IP TOS.
IPv6 hop-limit	—	—	Yes	Yes	Yes	Yes	Same as IP TTL.
ICMP IPv6 type	—	—	—	—	Yes	Yes	
ICMP IPv6 code	—	—	—	—	Yes	Yes	
source-port	—	—	Yes	Yes	Yes	Yes	
dest-port	—	—	Yes	Yes	Yes	Yes	

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
<b>Collect Fields</b>							
Bytes long	Yes	Yes	Yes	Yes	Yes	Yes	Packet size = (Ethernet frame size including FCS - 18 bytes) <b>Recommend:</b> Avoid this field and use Bytes layer2 long.
Packets long	Yes	Yes	Yes	Yes	Yes	Yes	
Timestamp absolute first	Yes	Yes	Yes	Yes	Yes	Yes	
Timestamp absolute last	Yes	Yes	Yes	Yes	Yes	Yes	
TCP flags	Yes	Yes	Yes	Yes	Yes	Yes	Collects all flags.

Field	Layer 2 In	Layer 2 Out	IPv4 In	IP v4 Out	IPv6 In	IPv6 Out	Notes
Bytes layer2 long	Yes	Yes	Yes	Yes	Yes	Yes	

## Default Settings

The following table lists the Flexible NetFlow default settings for the device.

**Table 3: Default Flexible NetFlow Settings**

Setting	Default
Flow active timeout	1800 seconds
Flow timeout inactive	15 seconds

## How to Configure Flexible Netflow

To configure Flexible Netflow, follow these general steps:

1. Create a flow record by specifying keys and non-key fields to the flow.
2. Create an optional flow exporter by specifying the protocol and transport destination port, destination, and other parameters.
3. Create a flow monitor based on the flow record and flow exporter.
4. Create an optional sampler.
5. Apply the flow monitor to a Layer 2 port, Layer 3 port, or VLAN.
6. If applicable to your configuration, configure a WLAN to apply a flow monitor to.

## Creating a Customized Flow Record

Perform this task to configure a customized flow record.

Customized flow records are used to analyze traffic data for a specific purpose. A customized flow record must have at least one **match** criterion for use as the key field and typically has at least one **collect** criterion for use as a nonkey field.

There are hundreds of possible permutations of customized flow records. This task shows the steps that are used to create one of the possible permutations. Modify the steps in this task as appropriate to create a customized flow record for your requirements.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>	Enables privileged EXEC mode.

	Command or Action	Purpose
	<b>Example:</b>  Device> enable	<ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b>  Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>flow record <i>record-name</i></b>  <b>Example:</b>  Device(config)# flow record FLOW-RECORD-1	Creates a flow record and enters Flexible NetFlow flow record configuration mode. <ul style="list-style-type: none"> <li>This command also allows you to modify an existing flow record.</li> </ul>
<b>Step 4</b>	<b>description <i>description</i></b>  <b>Example:</b>  Device(config-flow-record)# description Used for basic traffic analysis	(Optional) Creates a description for the flow record.
<b>Step 5</b>	<b>match {ip   ipv6} {destination   source} address</b>  <b>Example:</b>  Device(config-flow-record)# match ipv4 destination address	Configures a key field for the flow record.  <b>Note</b> This example configures the IPv4 destination address as a key field for the record. For information about the other key fields available for the <b>match ipv4</b> command, and the other <b>match</b> commands that are available to configure key fields.
<b>Step 6</b>	Repeat Step 5 as required to configure additional key fields for the record.	—
<b>Step 7</b>	<b>match flow cts {source   destination} group-tag</b>  <b>Example:</b>  Device(config-flow-record)# match flow cts source group-tag  Device(config-flow-record)# match flow cts destination group-tag	<b>Note</b> This example configures the CTS source group tag and destination group tag as a key field for the record. For information about the other key fields available for the <b>match ipv4</b> command, and the other <b>match</b> commands that are available to configure key fields.

	Command or Action	Purpose
		<p><b>Note</b></p> <ul style="list-style-type: none"> <li>• Ingress: <ul style="list-style-type: none"> <li>• In an incoming packet, if a header is present, SGT will reflect the same value as the header. If no value is present, it will show zero.</li> <li>• The DGT value will not depend on the ingress port SGACL configuration.</li> </ul> </li> <li>• Egress: <ul style="list-style-type: none"> <li>• If either propagate SGT or CTS is disabled on the egress interface, then SGT will be zero.</li> <li>• In an outgoing packet, if SGACL configuration that corresponds to the (SGT, DGT) exists, DGT will be non-zero.</li> <li>• If SGACL is disabled on the egress port/VLAN or if global SGACL enforcement is disabled, then DGT will be zero</li> </ul> </li> </ul>
<b>Step 8</b>	<b>Example:</b>	<p>Configures the input interface as a nonkey field for the record.</p> <p><b>Note</b> This example configures the input interface as a nonkey field for the record.</p>
<b>Step 9</b>	Repeat the above step as required to configure additional nonkey fields for the record.	—
<b>Step 10</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-flow-record)# end</pre>	Exits Flexible NetFlow flow record configuration mode and returns to privileged EXEC mode.
<b>Step 11</b>	<p><b>show flow record</b> <i>record-name</i></p> <p><b>Example:</b></p>	(Optional) Displays the current status of the specified flow record.

	Command or Action	Purpose
	Device# show flow record FLOW_RECORD-1	
<b>Step 12</b>	<b>show running-config flow record</b> <i>record-name</i>  <b>Example:</b>  Device# show running-config flow record FLOW_RECORD-1	(Optional) Displays the configuration of the specified flow record.

## Creating a Flow Exporter

You can create a flow export to define the export parameters for a flow.



**Note** Each flow exporter supports only one destination. If you want to export the data to multiple destinations, you must configure multiple flow exporters and assign them to the flow monitor.

You can export to a destination using IPv4 or IPv6 address.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b>  Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>flow exporter</b> <i>name</i>  <b>Example:</b>  Device(config)# <b>flow exporter ExportTest</b>	Creates a flow exporter and enters flow exporter configuration mode. You can also use this command to modify an existing flow exporter.
<b>Step 3</b>	<b>description</b> <i>string</i>  <b>Example:</b>  Device(config-flow-exporter)# <b>description ExportV9</b>	(Optional) Describes this flow record as a maximum 63-character string.
<b>Step 4</b>	<b>destination</b> { <i>ipv4-address</i>   <i>ipv6-address</i> }  <b>Example:</b>  Device(config-flow-exporter)#	Sets the IPv4/IPv6 destination address or hostname for this exporter.

	Command or Action	Purpose
	<b>destination 192.0.2.1</b> (IPv4 destination)  Device(config-flow-exporter) # <b>destination 2001:0:0:24::10</b> (IPv6 destination)	
<b>Step 5</b>	<b>dscp value</b>  <b>Example:</b>  Device(config-flow-exporter) # <b>dscp 0</b>	(Optional) Specifies the differentiated services codepoint value. The range is from 0 to 63. The default is 0.
<b>Step 6</b>	<b>source { source type }</b>  <b>Example:</b>  Device(config-flow-exporter) # <b>source gigabitEthernet1/0/1</b>	(Optional) Specifies the interface to use to reach the NetFlow collector at the configured destination. The following interfaces can be configured as source: <ul style="list-style-type: none"> <li>• <b>Auto Template</b>—Auto-Template interface</li> <li>• <b>Capwap</b>—CAPWAP tunnel interface</li> <li>• <b>GigabitEthernet</b>—Gigabit Ethernet IEEE 802</li> <li>• <b>GroupVI</b>—Group virtual interface</li> <li>• <b>Internal Interface</b>—Internal interface</li> <li>• <b>Loopback</b>—Loopback interface</li> <li>• <b>Null</b>—Null interface</li> <li>• <b>Port-channel</b>—Ethernet Channel of interface</li> <li>• <b>TenGigabitEthernet</b>—10-Gigabit Ethernet</li> <li>• <b>Tunnel</b>—Tunnel interface</li> <li>• <b>Vlan</b>—Catalyst VLANs</li> </ul>
<b>Step 7</b>	<b>transport udp number</b>  <b>Example:</b>  Device(config-flow-exporter) # <b>transport udp 200</b>	(Optional) Specifies the UDP port to use to reach the NetFlow collector. The range is from 0 to 65535. For IPFIX exporting protocol, the default destination port is 4739.
<b>Step 8</b>	<b>ttl seconds</b>  <b>Example:</b>	(Optional) Configures the time-to-live (TTL) value for datagrams sent by the exporter. The



	Command or Action	Purpose
	Device(config-flow-exporter)# <b>ttl 210</b>	range is from 1 to 255 seconds. The default is 255.
<b>Step 9</b>	<b>export-protocol {netflow-v5   netflow-v9   ipfix}</b> <b>Example:</b> Device(config-flow-exporter)# export-protocol netflow-v9	Specifies the version of the NetFlow export protocol used by the exporter. • Default: <b>netflow-v9</b> .
<b>Step 10</b>	<b>end</b> <b>Example:</b> Device(config-flow-record)# <b>end</b>	Returns to privileged EXEC mode.
<b>Step 11</b>	<b>show flow exporter [name record-name]</b> <b>Example:</b> Device# <b>show flow exporter ExportTest</b>	(Optional) Displays information about NetFlow flow exporters.
<b>Step 12</b>	<b>copy running-config startup-config</b> <b>Example:</b> Device# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

**What to do next**

Define a flow monitor based on the flow record and flow exporter.

## Creating a Customized Flow Monitor

Perform this required task to create a customized flow monitor.

Each flow monitor has a separate cache assigned to it. Each flow monitor requires a record to define the contents and layout of its cache entries. These record formats can be one of the predefined formats or a user-defined format. An advanced user can create a customized format using the **flow record** command.

**Before you begin**

If you want to use a customized record instead of using one of the Flexible NetFlow predefined records, you must create the customized record before you can perform this task. If you want to add a flow exporter to the flow monitor for data export, you must create the exporter before you can complete this task.



**Note** You must use the **no ip flow monitor** command to remove a flow monitor from all of the interfaces to which you have applied it before you can modify the parameters for the **record** command on the flow monitor.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>flow monitor <i>monitor-name</i></b> <b>Example:</b> <pre>Device(config)# flow monitor FLOW-MONITOR-1</pre>	Creates a flow monitor and enters Flexible NetFlow flow monitor configuration mode. <ul style="list-style-type: none"> <li>• This command also allows you to modify an existing flow monitor.</li> </ul>
<b>Step 4</b>	<b>description <i>description</i></b> <b>Example:</b> <pre>Device(config-flow-monitor)# description Used for basic ipv4 traffic analysis</pre>	(Optional) Creates a description for the flow monitor.
<b>Step 5</b>	<b>record {<i>record-name</i>   netflow-original   netflow {<i>ipv4</i>   <i>ipv6</i>} record [<i>peer</i>]}</b> <b>Example:</b> <pre>Device(config-flow-monitor)# record FLOW-RECORD-1</pre>	Specifies the record for the flow monitor.
<b>Step 6</b>	<b>cache {<i>entries number</i>   timeout {<i>active</i>   <i>inactive</i>   <i>update</i>} <i>seconds</i>   {<i>immediate</i>   <i>normal</i>   <i>permanent</i>}}</b> <b>Example:</b>	The values for the keywords associated with the <b>timeout</b> keyword have no effect when the cache type is set to <b>immediate</b> .  Associates a flow cache with the specified flow monitor.
<b>Step 7</b>	Repeat Step 6 as required to finish modifying the cache parameters for this flow monitor.	—

	Command or Action	Purpose
<b>Step 8</b>	<b>statistics packet protocol</b> <b>Example:</b> <pre>Device(config-flow-monitor)# statistics packet protocol</pre>	(Optional) Enables the collection of protocol distribution statistics for Flexible NetFlow monitors.
<b>Step 9</b>	<b>statistics packet size</b> <b>Example:</b> <pre>Device(config-flow-monitor)# statistics packet size</pre>	(Optional) Enables the collection of size distribution statistics for Flexible NetFlow monitors.
<b>Step 10</b>	<b>exporter exporter-name</b> <b>Example:</b> <pre>Device(config-flow-monitor)# exporter EXPORTER-1</pre>	(Optional) Specifies the name of an exporter that was created previously.
<b>Step 11</b>	<b>end</b> <b>Example:</b> <pre>Device(config-flow-monitor)# end</pre>	Exits Flexible NetFlow flow monitor configuration mode and returns to privileged EXEC mode.
<b>Step 12</b>	<b>show flow monitor [[name] monitor-name [cache [format {csv   record   table}   aggregate   filter   sort]] [statistics]]</b> <b>Example:</b> <pre>Device# show flow monitor FLOW-MONITOR-2 cache</pre>	(Optional) Displays the status and statistics for a Flexible NetFlow flow monitor.
<b>Step 13</b>	<b>show running-config flow monitor monitor-name</b> <b>Example:</b> <pre>Device# show running-config flow monitor FLOW_MONITOR-1</pre>	(Optional) Displays the configuration of the specified flow monitor.
<b>Step 14</b>	<b>copy running-config startup-config</b> <b>Example:</b> <pre>Device# copy running-config startup-config</pre>	(Optional) Saves your entries in the configuration file.

## Configuring and Enabling Flow SamplingCreating a Flow Sampler

Perform this required task to configure and enable a flow sampler.



**Note** When you specify the "NetFlow original," or the "NetFlow IPv4 original input," or the "NetFlow IPv6 original input" predefined record for the flow monitor to emulate original NetFlow, the flow monitor can be used only for analyzing input (ingress) traffic.

When you specify the "NetFlow IPv4 original output" or the "NetFlow IPv6 original output" predefined record for the flow monitor to emulate the Egress NetFlow Accounting feature, the flow monitor can be used only for analyzing output (egress) traffic.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> <pre>Device&gt; enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>sampler <i>sampler-name</i></b> <b>Example:</b> <pre>Device(config)# sampler SAMPLER-1</pre>	Creates a sampler and enters sampler configuration mode. <ul style="list-style-type: none"> <li>• This command also allows you to modify an existing sampler.</li> </ul>
<b>Step 4</b>	<b>description <i>description</i></b> <b>Example:</b> <pre>Device(config-sampler)# description Sample at 50%</pre>	(Optional) Creates a description for the flow sampler.
<b>Step 5</b>	<b>mode {random} 1 out-of <i>window-size</i></b> <b>Example:</b> <pre>Device(config-sampler)# mode random 1 out-of 2</pre>	Specifies the sampler mode and the flow sampler window size. <ul style="list-style-type: none"> <li>• The range for the <i>window-size</i> argument is from 0 to 1024 to 32768.</li> </ul>
<b>Step 6</b>	<b>exit</b> <b>Example:</b> <pre>Device(config-sampler)# exit</pre>	Exits sampler configuration mode and returns to global configuration mode.
<b>Step 7</b>	<b>interface <i>type number</i></b> <b>Example:</b>	Specifies an interface and enters interface configuration mode.

	Command or Action	Purpose
	Device(config)# interface GigabitEthernet 0/0/0	
<b>Step 8</b>	<b>{ip   ipv6} flow monitor <i>monitor-name</i></b> <b>[[sampler] <i>sampler-name</i>] {input   output}</b> <b>Example:</b>  Device(config-if)# ip flow monitor FLOW-MONITOR-1 sampler SAMPLER-1 input	Assigns the flow monitor and the flow sampler that you created to the interface to enable sampling.
<b>Step 9</b>	<b>end</b> <b>Example:</b>  Device(config-if)# end	Exits interface configuration mode and returns to privileged EXEC mode.
<b>Step 10</b>	<b>show sampler <i>sampler-name</i></b> <b>Example:</b>  Device# show sampler SAMPLER-1	Displays the status and statistics of the flow sampler that you configured and enabled.

## Applying a Flow to an Interface

You can apply a flow monitor and an optional sampler to an interface.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b>  Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>interface <i>type</i></b> <b>Example:</b>  Device(config)# <b>interface</b> <b>GigabitEthernet1/0/1</b>	Enters interface configuration mode and configures an interface.  Flexible NetFlow is not supported on the L2 port-channel interface, but is supported on the L2 port-channel member ports.  Flexible NetFlow is not supported on the L3 port-channel interface, but is supported on the L3 port-channel member ports.  Command parameters for the interface configuration include: <ul style="list-style-type: none"> <li>• <b>GigabitEthernet</b>—GigabitEthernet IEEE 802</li> </ul>

	Command or Action	Purpose
		<ul style="list-style-type: none"> <li>• <b>Loopback</b>—Loopback interface</li> <li>• <b>TenGigabitEthernet</b>—10- Gigabit Ethernet</li> <li>• <b>Vlan</b>—Catalyst VLANs</li> <li>• <b>Range</b>—Interface range</li> <li>• <b>WLAN</b>—WLAN interface</li> </ul>
<b>Step 3</b>	<p><b>{ip flow monitor   ipv6 flow monitor} name</b>  <b>[ sampler name ] {input}</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# ip flow monitor MonitorTest input</pre>	<p>Associate an IPv4 or an IPv6 flow monitor, and an optional sampler to the interface for input or output packets.</p> <p>You can associate multiple monitors to an interface in both input and output directions.</p>
<b>Step 4</b>	<p><b>{ip flow monitor   ipv6 flow monitor   datalink flow monitor} name [sampler name]</b>  <b>{input   output}</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# ip flow monitor MonitorTest input</pre>	<p>Associate an IPv4, IPv6 and datalink flow monitor, and an optional sampler to the interface for input or output packets.</p> <p>You can associate multiple monitors of different traffic types to an interface in the same direction. However, you cannot associate multiple monitors of same traffic type to an interface in the same direction.</p>
<b>Step 5</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-flow-monitor)# end</pre>	Returns to privileged EXEC mode.
<b>Step 6</b>	<p><b>show flow interface [interface-type number]</b></p> <p><b>Example:</b></p> <pre>Device# show flow interface</pre>	(Optional) Displays information about NetFlow on an interface.
<b>Step 7</b>	<p><b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>Device# copy running-config startup-config</pre>	(Optional) Saves your entries in the configuration file.

## Configuring a Bridged NetFlow on a VLAN

You can apply a flow monitor and an optional sampler to a VLAN.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b>  Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>vlan [configuration] vlan-id</b>  <b>Example:</b>  Device(config)# <b>vlan configuration 30</b> Device(config-vlan-config)#	Enters VLAN or VLAN configuration mode.
<b>Step 3</b>	<b>ip flow monitor monitor name [sampler sampler name] {input   output}</b>  <b>Example:</b>  Device(config-vlan-config)# <b>ip flow monitor MonitorTest input</b>	Associates a flow monitor and an optional sampler to the VLAN for input or output packets.
<b>Step 4</b>	<b>copy running-config startup-config</b>  <b>Example:</b>  Device# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

## Configuring Layer 2 NetFlow

You can define Layer 2 keys in Flexible NetFlow records that you can use to capture flows in Layer 2 interfaces.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b>  Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>flow record name</b>	Enters flow record configuration mode.

	Command or Action	Purpose
	<b>Example:</b> Device(config)# <b>flow record L2_record</b> Device(config-flow-record)#	
<b>Step 3</b>	<b>match datalink {dot1q   ethertype   mac   vlan}</b>  <b>Example:</b> Device(config-flow-record)# <b>match datalink ethertype</b>	Specifies the Layer 2 attribute as a key.
<b>Step 4</b>	<b>end</b>  <b>Example:</b> Device(config-flow-record)# <b>end</b>	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show flow record [name ]</b>  <b>Example:</b> Device# <b>show flow record</b>	(Optional) Displays information about NetFlow on an interface.
<b>Step 6</b>	<b>copy running-config startup-config</b>  <b>Example:</b> Device# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

## Configuring WLAN to Apply Flow Monitor in Data Link Input/Output Direction

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>wlan [wlan-name { wlan-id SSID_NetworkName   wlan_id }   wlan-name   shutdown]</b>  <b>Example:</b> Device (config) # <b>wlan wlan1</b>	Enters WLAN configuration submenu.  <i>wlan-id</i> is the wireless LAN identifier. The range is 1 to 64.  SSID_NetworkName is the SSID which can contain 32 alphanumeric characters.



	Command or Action	Purpose
		<b>Note</b> If you have already configured this command, enter the <b>wlan wlan-name</b> command.
<b>Step 3</b>	<b>datalink flow monitor monitor-name {input   output}</b> <b>Example:</b> <pre>Device (config-wlan) # datalink flow monitor flow-monitor-1 {input   output}</pre>	Applies flow monitor to Layer 2 traffic in the direction of interest.
<b>Step 4</b>	<b>end</b> <b>Example:</b> <pre>Device (config) # end</pre>	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show run wlan wlan-name</b> <b>Example:</b> <pre>Device # show wlan mywlan</pre>	(Optional) Verifies your configuration.

### Example

## Configuring WLAN to Apply Flow Monitor in IPV4 and IPv6 Input/Output Direction

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> <pre>Device# configure terminal</pre>	Enters global configuration mode
<b>Step 2</b>	<b>wlan {wlan-name { wlan-id SSID_NetworkName   wlan_id}   wlan-name   shutdown}</b> <b>Example:</b> <pre>Device (config) # wlan wlan1</pre>	<p>Enters WLAN configuration submode.</p> <p><i>wlan-id</i> is the wireless LAN identifier. The range is 1 to 64.</p> <p><i>SSID_NetworkName</i> is the SSID which can contain 32 alphanumeric characters.</p> <p><b>Note</b> If you have already configured this command, enter the <b>wlan wlan-name</b> command.</p>

	Command or Action	Purpose
<b>Step 3</b>	<b>{ip   ipv6} flow monitor monitor-name {input   output}</b>  <b>Example:</b>  <pre>Device (config-wlan) # ip flow monitor flow-monitor-1 input</pre>	Associates a flow monitor to the WLAN for input or output packets.
<b>Step 4</b>	<b>end</b>  <b>Example:</b>  <pre>Device (config) # end</pre>	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show run wlan wlan-name</b>  <b>Example:</b>  <pre>Device # show wlan mywlan</pre>	(Optional) Verifies your configuration.

### Example

## Monitoring Flexible NetFlow

The commands in the following table can be used to monitor Flexible NetFlow.

**Table 4: Flexible NetFlow Monitoring Commands**

Command	Purpose
<b>show flow exporter</b> [broker   export-ids   name   name   statistics   templates]	Displays information about NetFlow flow exporters and statistics.
<b>show flow exporter</b> [ name exporter-name]	Displays information about NetFlow flow exporters and statistics.
<b>show flow interface</b>	Displays information about NetFlow interfaces.
<b>show flow monitor</b> [ name exporter-name]	Displays information about NetFlow flow monitors and statistics.
<b>show flow monitor statistics</b>	Displays the statistics for the flow monitor
<b>show flow monitor cache format</b> {table   record   csv}	Displays the contents of the cache for the flow monitor, in the format specified.
<b>show flow record</b> [ name record-name]	Displays information about NetFlow flow records.
<b>show sampler</b> [broker   name   name]	Displays information about NetFlow samplers.

# Configuration Examples for Flexible NetFlow

## Example: Configuring a Flow

This example shows how to create a flow and apply it to an interface:

```
Device# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Device(config)# flow export export1
Device(config-flow-exporter)# destination 10.0.101.254
Device(config-flow-exporter)# transport udp 2055
Device(config-flow-exporter)# exit
Device(config)# flow record record1
Device(config-flow-record)# match ipv4 source address
Device(config-flow-record)# match ipv4 destination address
Device(config-flow-record)# match ipv4 protocol
Device(config-flow-record)# match transport source-port
Device(config-flow-record)# match transport destination-port
Device(config-flow-record)# match flow cts source group-tag
Device(config-flow-record)# match flow cts destination group-tag
Device(config-flow-record)# collect counter byte long
Device(config-flow-record)# collect counter packet long
Device(config-flow-record)# collect timestamp absolute first
Device(config-flow-record)# collect timestamp absolute last
Device(config-flow-record)# exit
Device(config)# flow monitor monitor1
Device(config-flow-monitor)# record record1
Device(config-flow-monitor)# exporter export1
Device(config-flow-monitor)# exit
Device(config)# interface tenGigabitEthernet 1/0/1
Device(config-if)# ip flow monitor monitor1 input
Device(config-if)# end
```

## Example: Monitoring IPv4 ingress traffic

This example shows how to monitor IPv4 ingress traffic (int g1/0/11 sends traffic to int g1/0/36 and int g3/0/11).

```
Device# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.

Device(config)# flow record fr-1
Device(config-flow-record)# match ipv4 source address
Device(config-flow-record)# match ipv4 destination address
Device(config-flow-record)# match interface input
Device(config-flow-record)# collect counter bytes long
Device(config-flow-record)# collect counter packets long
Device(config-flow-record)# collect timestamp absolute first
Device(config-flow-record)# collect timestamp absolute last
Device(config-flow-record)# collect counter bytes layer2 long
Device(config-flow-record)# exit
```

### Example: Monitoring IPv4 egress traffic

```

Device(config)# flow exporter fe-ipfix6
Device(config-flow-exporter)# destination 2001:0:0:24::10
Device(config-flow-exporter)# source Vlan106
Device(config-flow-exporter)# transport udp 4739
Device(config-flow-exporter)# export-protocol ipfix
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow exporter fe-ipfix
Device(config-flow-exporter)# description IPFIX format collector 100.0.0.80
Device(config-flow-exporter)# destination 100.0.0.80
Device(config-flow-exporter)# dscp 30
Device(config-flow-exporter)# ttl 210
Device(config-flow-exporter)# transport udp 4739
Device(config-flow-exporter)# export-protocol ipfix
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow exporter fe-1
Device(config-flow-exporter)# destination 10.5.120.16
Device(config-flow-exporter)# source Vlan105
Device(config-flow-exporter)# dscp 32
Device(config-flow-exporter)# ttl 200
Device(config-flow-exporter)# transport udp 2055

Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow monitor fm-1
Device(config-flow-monitor)# exporter fe-ipfix6
Device(config-flow-monitor)# exporter fe-ipfix
Device(config-flow-monitor)# exporter fe-1
Device(config-flow-monitor)# cache timeout inactive 60
Device(config-flow-monitor)# cache timeout active 180
Device(config-flow-monitor)# record fr-1
Device(config-flow-monitor)# end

Device# show running-config interface g1/0/11
Device# show running-config interface g1/0/36
Device# show running-config interface g3/0/11
Device# show flow monitor fm-1 cache format table

```

## Example: Monitoring IPv4 egress traffic

```

Device# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Device(config)# flow record fr-1 out
Device(config-flow-record)# match ipv4 source address
Device(config-flow-record)# match ipv4 destination address
Device(config-flow-record)# match interface output
Device(config-flow-record)# collect counter bytes long
Device(config-flow-record)# collect counter packets long
Device(config-flow-record)# collect timestamp absolute first
Device(config-flow-record)# collect timestamp absolute last
Device(config-flow-record)# exit

Device(config)# flow exporter fe-1
Device(config-flow-exporter)# destination 10.5.120.16

```

```

Device(config-flow-exporter)# source Vlan105
Device(config-flow-exporter)# dscp 32
Device(config-flow-exporter)# ttl 200
Device(config-flow-exporter)# transport udp 2055
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow exporter fe-ipfix6
Device(config-flow-exporter)# destination 2001:0:0:24::10
Device(config-flow-exporter)# source Vlan106
Device(config-flow-exporter)# transport udp 4739
Device(config-flow-exporter)# export-protocol ipfix
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow exporter fe-ipfix
Device(config-flow-exporter)# description IPFIX format collector 100.0.0.80
Device(config-flow-exporter)# destination 100.0.0.80
Device(config-flow-exporter)# dscp 30
Device(config-flow-exporter)# ttl 210
Device(config-flow-exporter)# transport udp 4739
Device(config-flow-exporter)# export-protocol ipfix
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow monitor fm-1-output
Device(config-flow-monitor)# exporter fe-1
Device(config-flow-monitor)# exporter fe-ipfix6
Device(config-flow-monitor)# exporter fe-ipfix
Device(config-flow-monitor)# cache timeout inactive 50
Device(config-flow-monitor)# cache timeout active 120
Device(config-flow-monitor)# record fr-1-out
Device(config-flow-monitor)# end

Device# show flow monitor fm-1-output cache format table

```

## Example: Configuring IPv4 Flexible NetFlow in WLAN (Ingress Direction)

The following example shows how to configure IPv4 Flexible NetFlow on WLAN ingress direction:

```

flow record WLAN-FLOW07
description Working AP mac
match datalink mac source address input
match ipv4 tos
match ipv4 protocol
match ipv4 source address
match ipv4 destination address
match wireless ssid
collect counter bytes long
collect counter packets long
collect wireless ap mac address
flow monitor WLAN-FLOW07
exporter wlan-export
cache timeout inactive 30
cache timeout active 10
record WLAN-FLOW07
wlan CC0506-CC0404
ip flow monitor WLAN-FLOW07 input

Device#show flow monitor WLAN-FLOW07 cache

```

**Example: Configuring IPv6 and Transport Flag Flexible NetFlow in WLAN (Egress Direction)**

```

Cache type: Normal (Platform cache)
Cache size: Unknown
Current entries: 6

Flows added: 276
Flows aged: 270

    Active timeout ( 10 secs) 257
    Inactive timeout ( 30 secs) 13

DATALINK MAC SOURCE ADDRESS INPUT: 3CA9.F421.4E34
IPV4 SOURCE ADDRESS: 192.168.11.1
IPV4 DESTINATION ADDRESS: 10.29.5.6
WIRELESS SSID: CC0506-CC0404
IP TOS: 0x00
IP PROTOCOL: 6
counter bytes long: 66
counter packets long: 1
wireless ap mac address: B0AA.778E.EB60

```

## Example: Configuring IPv6 and Transport Flag Flexible NetFlow in WLAN (Egress Direction)

The following example shows how to configure IPv6 and transport flag Flexible NetFlow on WLAN egress direction:

```

Device# configure terminal
Device(config)# flow record fr_v6
Device(config-flow-record)# match ipv6 destination address
Device(config-flow-record)# match ipv6 source address
Device(config-flow-record)# match ipv6 hop-limit
Device(config-flow-record)# match ipv6 protocol
Device(config-flow-record)# match ipv6 traffic
Device(config-flow-record)# match ipv6 version
Device(config-flow-record)# match wireless ssid
Device(config-flow-record)# collect wireless ap mac address
Device(config-flow-record)# collect counter bytes long
Device(config-flow-record)# collect transport tcp flags
Device(config-flow-record)# exit

Device(config)# flow monitor fm_v6
Device(config-flow-monitor)# record fr_v6
Device(config-flow-monitor)# exit

Device(config)# wlan wlan_1
Device(config-wlan)# ipv6 flow monitor fm_v6 out
Device(config-wlan)# end

Device# show flow monitor fm_v6 cache

```

**Note**

On the device, you cannot specify which TCP flag to collect. You can only specify to collect transport TCP flags.

## Example: Configuring IPv6 Flexible NetFlow in WLAN (Both Ingress and Egress Directions)

The following example shows how to configure IPv6 Flexible NetFlow on WLAN in both directions:

```
Device# configure terminal
Device (config)# flow record fr_v6
Device (config-flow-record)# match ipv6 destination address
Device (config-flow-record)# match ipv6 source address
Device (config-flow-record)# match ipv6 hop-limit
Device (config-flow-record)# match ipv6 protocol
Device (config-flow-record)# match ipv6 traffic
Device (config-flow-record)# match ipv6 version
Device (config-flow-record)# match wireless ssid
Device (config-flow-record)# collect wireless ap mac address
Device (config-flow-record)# collect counter packets long
Device (config-flow-record)# exit

Device (config)# flow monitor fm_v6
Device (config-flow-monitor)# record fr_v6
Device (config-flow-monitor)# exit

Device (config)# wlan wlan_1
Device (config-wlan)# ipv6 flow monitor fm_v6 in
Device (config-wlan)# ipv6 flow monitor fm_v6 out
Device (config-wlan)# end

Device# show flow monitor fm_v6 cache
```

## Example: Monitoring wireless ingress traffic

```
Device# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Device(config)# flow record fr-wlan-input
Device(config-flow-record)# match datalink mac source address input
Device(config-flow-record)# match datalink mac destination address input
Device(config-flow-record)# match ipv4 source address
Device(config-flow-record)# match ipv4 destination address
Device(config-flow-record)# match wireless ssid
Device(config-flow-record)# collect counter bytes long
Device(config-flow-record)# collect counter packets long
Device(config-flow-record)# collect timestamp absolute first
Device(config-flow-record)# collect timestamp absolute last
Device(config-flow-record)# exit

Device(config)# flow exporter fe-ipfix
Device(config-flow-exporter)# description IPFIX format collector 100.0.0.80
Device(config-flow-exporter)# destination 100.0.0.80
Device(config-flow-exporter)# dscp 30
Device(config-flow-exporter)# ttl 210
Device(config-flow-exporter)# transport udp 4739
Device(config-flow-exporter)# export-protocol ipfix
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit
```

```

Device(config)# flow exporter fe-ipfix6
Device(config-flow-exporter)# destination 2001:0:0:24::10
Device(config-flow-exporter)# source Vlan106
Device(config-flow-exporter)# transport udp 4739
Device(config-flow-exporter)# export-protocol ipfix
Device(config-flow-exporter)# template data timeout 240
Device(config-flow-exporter)# exit

Device(config)# flow monitor fm-wlan-input
Device(config-flow-monitor)# exporter fe-ipfix
Device(config-flow-monitor)# exporter fe-ipfix6
Device(config-flow-monitor)# cache timeout inactive 30
Device(config-flow-monitor)# cache timeout active 180
Device(config-flow-monitor)# record fr-wlan-input
Device(config-flow-monitor)# end

Device# show running-config wlan nfl_1
Device# show flow monitor fm-wlan-input cache format table

```

## Additional References for NetFlow

### Related Documents

Related Topic	Document Title
Flexible NetFlow CLI Commands	<i>Cisco Flexible NetFlow Command Reference (Catalyst 3850 Switches)</i>  <i>Flexible NetFlow Command Reference, Cisco IOS XE Release 3SE (Cisco WLC 5700 Series)</i>

### Error Message Decoder

Description	Link
To help you research and resolve system error messages in this release, use the Error Message Decoder tool.	<a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a>

### Standards and RFCs

Standard/RFC	Title
RFC 3954	Cisco Systems NetFlow Services Export Version 9



**MIBs**

<b>MIB</b>	<b>MIBs Link</b>
All the supported MIBs for this release.	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>

**Technical Assistance**

<b>Description</b>	<b>Link</b>
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/support">http://www.cisco.com/support</a>

## Feature Information for Flexible NetFlow

<b>Release</b>	<b>Modification</b>
Cisco IOS XE 3.2SE	This feature was introduced.
Cisco IOS XE 3.3SE	<p>The following new commands were added:</p> <ul style="list-style-type: none"> <li>• <b>match wireless ssid</b></li> <li>• <b>collect wireless ap mac address</b></li> </ul>

