Configuring Traffic Mirroring

This module describes the configuration of the traffic mirroring feature. Traffic mirroring is sometimes called port mirroring, or switched port analyzer (SPAN).

Feature History for Traffic Mirroring

Release 7.3.1	SPAN to File feature was introduced.
Release 7.2.12	Local SPAN feature was introduced.
Release 7.0.14	Support for the following features was introduced in ERSPAN: • Configuration of IP DSCP. • Tunnel IP. • Ability to source ranges of interfaces and SVIs. • Sequence bit is set in the GRE header and the value of sequence number is always 0 for ERSPAN packets. • ERSPAN and Security ACL should be separate. Support for File Mirroring was introduced.
Release 7.0.11	This feature was introduced.

Introduction to Traffic Mirroring

Traffic mirroring, which is sometimes called port mirroring, or Switched Port Analyzer (SPAN) is a Cisco proprietary feature. Traffic mirroring enables you to monitor Layer 3 network traffic passing in, or out of, a set of Ethernet interfaces. You can then pass this traffic to a network analyzer for analysis.

Traffic mirroring copies traffic from one or more Layer 3 interfaces or sub-interfaces. Traffic mirroring then sends the copied traffic to one or more destinations for analysis by a network analyzer or other monitoring device. Traffic mirroring does not affect the switching of traffic on the source interfaces or sub-interfaces. It allows the system to send mirrored traffic to a destination interface or sub-interface.

Traffic mirroring is introduced on switches because of a fundamental difference between switches and hubs. When a hub receives a packet on one port, the hub sends out a copy of that packet from all ports except from the one at which the hub received the packet. In case of switches, after a switch boots, it starts to build up a Layer 2 forwarding table on the basis of the source MAC address of the different packets that the switch receives. After the system builds this forwarding table, the switch forwards traffic that is destined for a MAC address directly to the corresponding port.

For example, if you want to capture Ethernet traffic that is sent by host A to host B, and both are connected to a hub, attach a traffic analyzer to this hub. All other ports see the traffic between hosts A and B.

Implementing Traffic Mirroring on the Cisco 8000 Series Routers

ERSPAN

Encapsulated Remote Switched Port Analyzer (ERSPAN) is a traffic mirroring mechanism used to monitor network traffic passing in or out of a set of ports on a router. It copies or mirrors traffic from one or more source ports and sends the copied traffic through GRE tunnels to one or more destinations for analysis. The destination may be a network analyzer or other monitoring devices.

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
Higher payload analysis with eight ERSPAN sessions	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature now enables the Cisco 8000 Series routers to support eight ERSPAN sessions on the following hardware thus allowing you to analyze higher payloads in real time across Layer 3 domains on your network. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
ERSPAN over GRE IPv6	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). With this release, the router allows you to mirror IPv4 or IPv6 traffic with ERSPAN over GRE IPv6 sessions to monitor traffic on remote traffic analyzers on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH

Feature Name	Release Information	Feature Description
Partial packet capture ability for ERSPAN (Rx)	Release 7.5.3	With this feature, you can perform partial packet capture in the RX direction. Earlier, the ability for entire packet capture was available, now you can choose entire or partial packet capture in the RX direction. Here, partial packet capture is also known as truncation.
ERSPAN over MPLS traffic	Release 7.5.3	With this release, the router allows you to mirror MPLS traffic and set up the GRE tunnel with the next hop over a labeled path. This feature helps you to remote-monitor the traffic on traffic analyzers.
Higher payload analysis with eight ERSPAN sessions	Release 7.3.2	With this release, Cisco 8000 Series routers support eight ERSPAN sessions. This functionality helps you analyze higher payloads in real time across Layer 3 domains on your network.
ERSPAN over GRE IPv6	Release 7.3.2	With this release, the router allows you to mirror IPv4 or IPv6 traffic with ERSPAN over GRE IPv6 sessions to monitor traffic on remote traffic analyzers. In earlier releases, ERSPAN traffic monitoring was possible only on IPv4 networks.

ERSPAN enables network operators to troubleshoot issues in the network in real-time using automated tools that auto-configures ERSPAN parameters on the network devices to send specific flows to management servers for in-depth analysis.

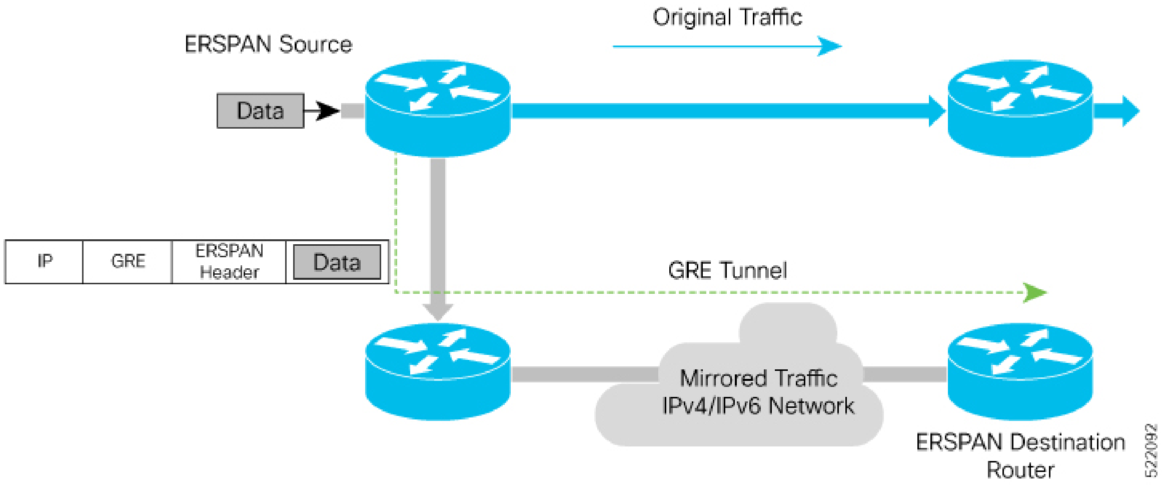
ERSPAN transports mirrored traffic over an IP network. The traffic is encapsulated at the source router and is transferred across the network.

From Cisco IOS XR Software Release 7.5.3 onwards, the packet truncation feature is supported over remote GRE tunnels. You can now get the flexibility to truncate packets and mirror the traffic.

Starting with Cisco IOS XR Software Release 7.0.14, sequence bit is set in the GRE header and the value of sequence number is always 0 for ERSPAN packets.

Starting with Cisco IOS XR Software Release 7.5.3, the sequence number bit will always be set to one and the sequence number field (4 bytes), will always be set to zero.

Figure 1: ERSPAN over GRE



Supported Capabilities

The following capabilities are supported:

- The source interfaces are layer 3 interfaces, such as physical, and bundle interfaces or subinterface.
- The routers mirror IPv4 and IPv6 traffic.
- ERSPAN with GRE IPv4 or IPv6 has tunnel destinations.
- ERSPAN over GRE IPv4 and IPv6 supports SPAN ACL.
- Supports MPLS traffic mirroring and GRE tunnel configuration with the next hop over a labeled path.
- Each monitor session allows only one destination interface.
- ACL permit or deny entries with capture action are part of mirroring features.
- The next hop interface must be a main interface. It can be a Physical or Bundle interface.
- Supports full packet capture.
- In ERSPAN over GRE IPv6, the **HopLimit** and **TrafficClass** fields in outer IPv6 header are editable under the tunnel configuration.
- The maximum SPAN sessions supported in the Cisco 8000 Router are as follows:.

SPAN Type	7.3.1 and Prior Releases	7.3.2 and Later Releases
ERSPAN (GRE IPv4, GRE IPv6, or GRE IPv4 + GRE IPv6)	4	8
Local SPAN	4	4
SPAN to File	4	4
Combined SPAN (GRE IPv4 + GRE IPv6 + Local SPAN + SPAN to File)	4	8

- Starting with Release 24.2.11, on all Egress Traffic Management (ETM)-based platforms, when the NPU compatibility mode is set to P100, the maximum number of SPAN sessions supported on the 88-LC1-52Y8H-EM and 88-LC1-12TH24FH-E line cards are as follows:
  - ERSPAN (GRE IPv4, GRE IPv6, or GRE IPv4 + GRE IPv6): 4
  - Local SPAN: 4
  - SPAN to File: 4
  - Combined SPAN (GRE IPv4 + GRE IPv6 + Local SPAN + SPAN to File): 4

Note For more information on NPU compatibility mode, see Configure the Compatibility Mode.

- Starting from Cisco IOS XR Release 24.3.1, the system creates one default monitor session and users can configure up to three additional monitor sessions, totaling four sessions, which is the maximum number of monitor sessions that the router allows. However, from Cisco IOS XR Release 24.3.2, the system's default session is bypassed, allowing you to configure four monitor sessions instead of three.

  If you have upgraded the router from Cisco IOS XR Release 24.3.2 to later releases, one of the four user-configured sessions (created in Cisco IOS XR Release 24.3.x) will be lost, as only upto three user-configured sessions are allowed.

Supported Capabilities for ERSPAN Packet Truncation support

The following are the capabilities and requirements:

- Ability to enable the new ERSPAN GREv4 and GREv6 truncation configuration per device.
- Truncation configuration should be on the monitor sessions. Packets received from all sources will only be truncated when you configure the truncation on a monitor session.
- By default, the whole packet will be mirrored without the **mirror first <number>** (truncation size) configuration.
- If the monitor session truncation size is less than the configured-truncation size (343 bytes), then whole packet is mirrored.

  If the monitor session truncation size exceeds 343 bytes, the configuration is accepted. However, only 343 bytes truncation size is programmed.

  An `ios-msg` is displayed to warn the user.

  Example: `ERSPAN only support 343 bytes truncation size. monitor-session with session_id <id> will be set to 343 bytes only.`

Restrictions

The following are the ERSPAN and SPAN ACL restrictions:

- The ERSPAN mirror packet is received with a TTL minus 1.

  The mirror packet is not identical to the incoming packet and TTL minus 1 is the expected value in the ERSPAN packet.

- The router mirrors only unicast traffic.

  However, from Cisco IOS XR Software Release 7.5.3 onwards, the router can mirror multicast traffic.

- Remove and re-apply monitor-sessions on all interfaces after modifying the access control list (ACL).
- GRE tunnel is only dedicated to ERSPAN mirrored packets. There should be no IPv4 and IPv6 address configured under the GRE tunnel.
- Only ERSPAN TYPE II header is supported. The value of the index field is always 0. The value of the session-ID field is an internal number that is used by the data path to distinguish between sessions.
- Traffic accounting of the ERSPAN mirrored packets is not supported.

Note You can view the SPAN packet count per session, using the **show monitor-session status internal** command.

- ERSPAN decapsulation is unsupported.
- From Cisco IOS XR Software Release 7.5.3 onwards, the ERSPAN will be functional regardless of any configuration related to MPLS or LDP present on the router.
- MPLS packet mirroring is supported only from Cisco IOS XR Software Release 7.5.3 onwards.
- On Q100-based systems, due to data path limitations, only the upper 64 bits of the source IPv6 address in the outer IPv6 header of an ERSPAN packet are valid; the lower 64 bits are set to zero. The destination GREv6 IPv6 address must use the full 128-bit value.

Traffic Mirroring Terminology

- Ingress traffic—Traffic that enters the switch.
- Egress traffic—Traffic that leaves the switch.
- Source port—A port that the system monitors with the use of traffic mirroring. It is also called a monitored port.
- Destination port—A port that monitors source ports, usually where a network analyzer is connected. It is also called a monitoring port.
- Monitor session—A designation for a collection of traffic mirroring configurations consisting of a single destination and, potentially, many source interfaces.

Characteristics of the Source Port

A source port, also called a monitored port, is a switched or routed port that you monitor for network traffic analysis. In a single local or remote traffic mirroring session, you can monitor source port traffic, such as received (Rx) for ingress traffic. Your router can support any number of source ports (up to a maximum number of 800).

A source port has these characteristics:

- It can be any port type, such as Bundle Interface, sub-interface, 100-Gigabit Ethernet, or 400-Gigabit Ethernet.

Note Bridge group virtual interfaces (BVIs) are not supported.

- Each source port can be monitored in only one traffic mirroring session.
- It cannot be a destination port.
- Each source port can be configured with a direction (ingress) to monitor. For bundles, the monitored direction applies to all physical ports in the group.

In the figure above, the network analyzer is attached to a port that is configured to receive a copy of every packet that host A sends. This port is called a traffic mirroring port.

Characteristics of the Monitor Session

A monitor session is a collection of traffic mirroring configurations consisting of a single destination and, potentially, many source interfaces. For any given monitor session, the traffic from the source interfaces (called *source ports*) is sent to the monitoring port or destination port. If there is more than one source port in a monitoring session, the traffic from the several mirrored traffic streams is combined at the destination port. The result is that the traffic that comes out of the destination port is a combination of the traffic from one or more source ports.

Monitor sessions have these characteristics:

- A single monitor session can have only one destination port.
- A single destination port can belong to only one monitor session.

Note The destination of ERSPAN monitoring session is a GRE IPv4 or IPv6 tunnel.

Supported Traffic Mirroring Types

The system supports the following traffic mirroring types:

- ACL-based traffic mirroring. The system mirrors traffic that is based on the configuration of the global interface ACL.
- Layer 3 traffic mirroring is supported. The system can mirror Layer 3 source ports.

ACL-Based Traffic Mirroring

You can mirror traffic that is based on the definition of a global interface access list (ACL). When you are mirroring Layer 3 traffic, the ACL is configured using the **ipv4 access-list** or **ipv6 access-list** command with the **capture** keyword. The **permit** and **deny** commands determine the behavior of regular traffic. The **capture** keyword designates that the packet is to be mirrored to the destination port.

Starting with Cisco IOS XR Software Release 7.0.14, configuration of ERSPAN and security ACL will be separate. Neither of these will have an impact or dependency on the other, but both can be applied simultaneously.

ERSPAN over GRE IPv6

The ERSPAN over GRE IPv6 feature enables mirroring IPv4 or IPv6 traffic in your network. The router encapsulates the traffic adding an ERSPAN header inside the GRE IPv6 packet. The GRE header of the ERSPAN encapsulated packets have the sequence number set to 0. The router sends the replicated traffic packet to be monitored to the destination through the GRE IPv6 channel to achieve traffic mirroring. The mirrored traffic is sent to remote traffic analyzer for monitoring purposes. For the traffic mirroring to work, the ERSPAN GRE IPv6 tunnel next-hop must have ARP or neighbor resolved. We recommend using the `cef proactive-arp-nd` enable command to configure missing adjacency information for the next hop.

Note The GRE tunnel configured for ERSPAN should only be used for mirrored traffic. There should be no IPv4 or IPv6 address configured under the GRE Tunnel.

```
Router# configure
Router(config)# cef proactive-arp-nd enable
Router(config)# commit
```

Configuring ERSPAN over GRE IPv6

1. Enable GRE IPv6 tunnel configuration.

```
RP/0/RP0/CPU0:router#configure
RP/0/RP0/CPU0:router(config)#interface tunnel-ip1
RP/0/RP0/CPU0:router(config-if)#tunnel mode gre ipv6
RP/0/RP0/CPU0:router(config-if)#tunnel source 2001:DB8:1::1
RP/0/RP0/CPU0:router(config-if)#tunnel destination 2001:DB8:2::1
RP/0/RP0/CPU0:router(config-if)#no shut
RP/0/RP0/CPU0:router(config)#commit
```

2. Enable ERSPAN session.

```
RP/0/RP0/CPU0:router#configure
RP/0/RP0/CPU0:router(config)#monitor-session mon1 ethernet
RP/0/RP0/CPU0:router(config-mon)#destination interface tunnel-ip1
RP/0/RP0/CPU0:router(config-mon)#commit
RP/0/RP0/CPU0:router(config-mon)#end
```

3. Configure ERSPAN session under port to be monitored.

```
RP/0/RP0/CPU0:router(config)#interface HundredGigE0/1/0/14
RP/0/RP0/CPU0:router(config-if)#monitor-session mon1 ethernet direction rx-only
RP/0/RP0/CPU0:router(config-if-mon)#exit
RP/0/RP0/CPU0:router(config-if)#exit
RP/0/RP0/CPU0:router(config)#interface Bundle-Ether1
RP/0/RP0/CPU0:router(config-if)#monitor-session mon1 ethernet direction rx-only
RP/0/RP0/CPU0:router(config-if-mon)#exit
RP/0/RP0/CPU0:router(config-if)#exit
RP/0/RP0/CPU0:router(config)#interface HundredGigE0/1/0/15.100
RP/0/RP0/CPU0:router(config-subif)#monitor-session mon1 ethernet direction rx-only
```

Verification

Use the `show monitor-session status` command o verify the configuration of the ERSPAN over GRE IPv6 feature.

```
P/0/RP0/CPU0:router#show monitor-session mon1 status
Monitor-session mon1
Destination interface tunnel-ip1
================================================================================
Source Interface            Dir         Status
---------------------      ----  ----------------------------------------------------
Hu0/1/0/14                  Rx    Operational
Hu0/1/0/15.100              Rx    Operational
BE1                         Rx    Operational
BE1.1                       Rx    Operational

RP/0/RP0/CPU0:R1-SF-D#show monitor-session erspan3 status internal
Thu Jul 15 06:00:14.720 UTC
Information from SPAN Manager and MA on all nodes:
Monitor-session erspan3 (ID 0x00000007) (Ethernet)
SPAN Mgr: Destination interface tunnel-ip372 (0x0f00049c)
          Last error: Success
          Tunnel data:
            Mode: GREoIPv6
            Source IP: 77:3:1::79
            Dest IP: 95::90
            VRF:
            ToS: 100
            TTL: 200
            DFbit: Not set
0/3/CPU0: Destination interface tunnel-ip372 (0x0f00049c)
          Tunnel data:
            Mode: GREoIPv6
            Source IP: 77:3:1::79
            Dest IP: 95::90
            VRF:
            ToS: 100
            TTL: 200
            DFbit: Not set
0/RP0/CPU0: Destination interface tunnel-ip372 (0x0f00049c)
          Tunnel data:
            Mode: GREoIPv6
            Source IP: 77:3:1::79
            Dest IP: 95::90
            VRF:
            ToS: 100
            TTL: 200
            DFbit: Not set
Information from SPAN EA on all nodes:
Monitor-session 0x00000007 (Ethernet)
0/3/CPU0: Name 'erspan3', destination interface tunnel-ip372 (0x0f00049c)
Platform, 0/3/CPU0:
  Monitor Session ID: 7

  Monitor Session Packets: 2427313444
  Monitor Session Bytes: 480591627492
```

Configuring Partial Packet Capture Ability for ERSPAN (RX)

To configure partial traffic mirroring, use the **mirror first** command in monitor session configuration mode.

`Mirror first <number>`: Configures the size of truncation packets for an ERSPAN session

Use the following command to create a ERSPAN monitor session for mirroring the packets:

```
monitor-session <name> [ethernet]
destination interface tunnel-ip <number>
mirror first <number>
    traffic-class <traffic-class>
```

Configuration Example

Use the following command to create a ERSPAN monitor session for mirroring packets to Tunnel-IP 30 with truncation enabled:

```
monitor-session mon1 ethernet
 destination interface tunnel-ip 30
 mirror first  343
!
```

Attach the session to the interfaces using the following configuration:

```
interface <>
  monitor-session session-name ethernet direction rx-only|tx-only|both | acl [acl_name]
```

Running Configuration

```
interface tunnel-ip30
 tunnel mode gre ipv4
 tunnel source 2.2.2.2
 tunnel destination 200.0.0.2
!
```

```
interface HundredGigE0/0/0/12
 ipv4 address 12.0.0.2 255.255.255.0
 monitor-session mon1 ethernet direction rx-only
!
```

Verification

The **show monitor-session status internal** displays the size of the programmed truncation.

Example:

```
Router#show monitor-session mon1 status internal
Fri Apr 12 18:50:45.006 UTC
Information from SPAN Manager and MA on all nodes:
Packet truncation size: 343B
Monitor-session mon1 (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination interface Tunnel-IP 20 (0x0f000250)
          Last error: Success

Information from SPAN EA on all nodes:
Monitor-session 0x00000001 (Ethernet)
0/RP0/CPU0: Name 'mon1', destination interface Tunnel-IP 20 (0x0f000250)
Platform, 0/RP0/CPU0:

  Monitor Session Packets: 142462

  Monitor Session Bytes: 7653237
```

ERSPAN traffic to a destination in a non-default VRF

ERSPAN traffic to a destination in a non-default VRF is an ERSPAN feature that sends mirrored traffic over GRE tunnels that belong to different VRF instances. This capability helps design a network with multiple Layer 3 partitions, enabling traffic segregation and management across different network segments.

Table 2: Feature History Table

Feature Name	Release Information	Description
ERSPAN traffic to a destination in a non-default VRF	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature is now supported on the following hardware thus allowing you design your network with multiple Layer 3 partitions. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
ERSPAN traffic to a destination in a non-default VRF	Release 7.5.2 Release 7.3.4	Encapsulated Remote Switched Port Analyzer (ERSPAN) now transports mirrored traffic through GRE tunnels with multiple VRFs, helping you design your network with multiple Layer 3 partitions. In earlier releases, ERSPAN transported mirrored traffic through GRE tunnels that belonged to only default VRF.

Restrictions for Traffic Mirroring

The system supports the following forms of traffic mirroring:

- Mirroring traffic to a GRE IPv4 or IPv6 tunnel (also known as Encapsulated Remote Switched Port Analyzer [ER-SPAN] in Cisco IOS Software). The system allows 8 monitor sessions for ERSPAN, 4 monitor sessions for Local SPAN, and 4 monitor sessions for SPAN to File. The total number of monitor sessions for all SPAN features is 8.
- The system does not support traffic mirroring counters per interface.
- The system does not support bundle member interfaces as sources for mirroring sessions.
- The router does not support port-level mirroring for any type of SPAN.

- ERSPAN tunnel statistics is not supported.
- The dropped packets at NPU cannot be captured by regular ERSPAN session. For capturing dropped packets at NPU, use Mirroring forward-drop packets, on page 50 feature.

The following general restrictions apply to traffic mirroring using ACLs:

- Configure ACLs on the source interface to avoid default mirroring of traffic. If a Bundle interface is a source interface, configure the ACLs on the bundle interface (not bundle members).

The following restrictions apply to ERSPAN ACL:

- ERSPAN next-hop must have ARP resolved.
    - Any other traffic or protocol triggers ARP.
- ERSPAN decapsulation is not supported.
- ERSPAN does not work if the GRE next hop is reachable over subinterface. For ERSPAN to work, the next hop must be reachable over the main interface.
- However, from Cisco IOS XR Software Release 7.5.3 onwards, GRE next hop can be resolved over subinterface or the main interface.

Modifying ERSPAN monitor-session configuration

When you modify the ERSPAN monitor-session configuration, the **show configuration** and **show configuration commit changes** command outputs differ. Specifically, the **show configuration commit changes** command output displays some extraneous ACL commands deleted and added back. This modified output doesn't impact your configuration or affect performance. This issue is fixed in Cisco IOS XR Release 7.5.1.

The following example highlights the extraneous ACL commands under the **show configuration commit changes** command output.

```
Router(config)#interface HundredGigE0/1/0/0
Router(config-if)#no monitor-session ERSPANTun2005
Router(config-if)#monitor-session ERSPANTun2 ethernet direction rx-only port-level
Router(config-if-mon)#acl
Router(config-if-mon)#acl ipv4 erspan-filter
Router(config-if-mon)#acl ipv6 erspan-filter-ipv6
Router(config-if-mon)#
Router(config-if-mon)#show configuration
Building configuration...
!! interface HundredGigE0/1/0/0
  monitor-session ERSPANTun2 ethernet direction rx-only port-level
   acl
   acl ipv4 erspan-filter
   acl ipv6 erspan-filter-ipv6
 !
!
end

Router(config-if-mon)#commit
Router(config-if-mon)#end
Router#sh configuration commit changes las 1
Building configuration...
!!
interface HundredGigE0/1/0/0
```

```
 no monitor-session ERSPANTun2005 ethernet direction rx-only port-level
 monitor-session ERSPANTun2 ethernet direction rx-only port-level
  no acl
  acl
  no acl ipv4 erspan-filter
  acl ipv4 erspan-filter
  no acl ipv6 erspan-filter-ipv6
  acl ipv6 erspan-filter-ipv6
 !
!
end
```

Configuring Traffic Mirroring

These tasks describe how to configure traffic mirroring:

Configuring ACLs for Traffic Mirroring

This section describes the configuration for creating ACLs for traffic mirroring. You must configure the global interface ACLs by using one of the following commands with the **capture** keyword:

- **ipv4 access-list**
- **ipv6 access-list**

Note Starting with Cisco IOS XR Software Release 7.0.14, ACL feature will provide a support of separate ACL configuration for SPAN.

Configuration

- **Security ACL**

  Use the following configuration to configure ACLs for traffic mirroring.

  ```
  /* Create an IPv4 ACL (TM-ACL) for traffic mirroring */
  Router(config)# ipv4 access-list TM-ACL
  Router(config-ipv4-acl)# 10 permit udp 10.10.10.0 0.0.0.255 eq 10 any capture
  Router(config-ipv4-acl)# 20 permit udp 10.10.10.0 0.0.0.255 eq 20 any
  Router(config-ipv4-acl)# exit
  Router(config)# commit

  /* Apply the traffic monitoring to SPAN source interface */
  Router(config)# interface HundredGigE0/0/0/12
  Router(config-if)# monitor-session mon1 ethernet direction rx-only port-level acl
  Router(config-if)# ipv4 access-group TM-ACL ingress
  !
  ```

Use the following configuration as an example to deny data forwarding for an ACE entry, but still mirror the traffic:

```
ipv4 access-list acl1
10 deny ipv4 any 2.1.0.0/16 capture
20 permit ipv4 any any
!
```

If `acl1` is attached to the interface as shown below:

```
RP/0/RP0/CPU0(config-if)# ipv4 access-group acl1 ingress
```

Data Traffic to 2.1.0.0/16 is dropped. Mirroring happens only if `icmp-off` keyword is added to the ACE as shown below. If this keyword is not added, mirroring does not take place. Furthermore, the `icmp-off` workaround is applicable only to security ACL.

```
ipv4 access-list acl1
10 deny ipv4 any 2.1.0.0/16 capture icmp-off
20 permit ipv4 any any
!
```

- **SPAN ACL**
  - SPAN ACL does not support User Defined Fields (UDF).
  - Deny action in SPAN ACL is ignored, and no packet drops from SPAN ACL. Deny ACEs will be internally converted to permit ACEs. Packets will also be mirrored.
  - There is no implicit deny-all entry in SPAN ACL.
  - IPV6 ACL is required for mirroring IPV6 packet, if IPV4 ACL is configured, and vice versa. This follows the same structure as Security ACL with IPv4 and IPv6 mirror options.

Use the following configuration to enable traffic mirroring with ACLs.

```
/* Create a SPAN IPv4 ACL (v4-monitor-acl) for traffic mirroring */
Router(config)# ipv4 access-list v4-monitor-acl
Router(config-ipv4-acl)# 10 permit udp 20.1.1.0 0.0.0.255 eq 10 any
Router(config-ipv4-acl)# 20 permit udp 30.1.1.0 0.0.0.255 eq 20 any
Router(config-ipv4-acl)# exit
Router(config)# commit

/*Create a SPAN IPv6 ACL (v6-monitor-acl) for traffic mirroring */
Router(config)# ipv6 access-list v6-monitor-acl
Router(config-ipv6-acl)# 10 permit ipv6 host 120:1:1::1 host 130:1:1::1
Router(config-ipv6-acl)# exit

/* Apply the traffic monitoring to SPAN source interface */
Router(config)# interface HundredGigE0/0/0/12
Router(config-if)# monitor-session mon1 ethernet direction rx-only
Router(config-if)# acl ipv4 v4-monitor-acl
Router(config-if)# acl ipv4 v6-monitor-acl!
```

Note For SPAN to work, the `capture` keyword is required for Security ACL.

Use the `show access-lists [ipv4 | ipv6] acl-name hardware ingress span [detail | interface | location | sequence | verify] location x` command to display ACL information:

```
Router# show access-lists ipv4 v4span1 hardware ingress span interface bundle-Ether 100
location 0/3/cpu0
ipv4 access-list v4span1
10 permit ipv4 host 51.0.0.0 host 101.0.0.0
20 permit ipv4 host 51.0.0.1 host 101.0.0.1
30 permit ipv4 host 51.0.0.2 any
40 permit ipv4 any host 101.0.0.3
```

```
50 permit ipv4 51.0.1.0 0.0.0.255 101.0.1.0 0.0.0.255
60 permit ipv4 51.0.2.0 0.0.0.255 101.0.2.0 0.0.0.255 precedence critical
```

Troubleshooting ACL-Based Traffic Mirroring

Take note of these configuration issues:

- Even when the system configures the **acl** command on the source mirroring port, if the ACL configuration command does not use the **capture** keyword, the system does not mirror traffic.
- If the ACL configuration uses the **capture** keyword, but you have not configured the **acl** command on the source port, the system mirrors the traffic, but does not apply access list configuration.

This example shows both the **capture** keyword in the ACL definition and the **acl** command that is configured on the interface:

```
/* Create an IPv4 ACL (TM-ACL) for traffic mirroring */
Router(config)# ipv4 access-list TM-ACL
Router(config-ipv4-acl)# 10 permit udp 10.1.1.0 0.0.0.255 eq 10 any capture
Router(config-ipv4-acl)# 20 permit udp 10.1.1.0 0.0.0.255 eq 20 any

Apply the traffic monitoring to interface
Router(config)#interface HundredGigE0/0/0/12
Router(config-if)# monitor-session mon1 ethernet direction rx-only port-only acl
Router(config-if)# ipv4 access-group TM-ACL ingress
```

Flexible CLI for ERSPAN

Starting with Cisco IOS XR Software Release 7.0.14, ERSPAN can be configured using flexible CLI. This CLI is a single configuration object containing all the properties of an ERSPAN session, tunnel properties, and the list of source interfaces, which can be easily removed and re-added. Flexible CLI minimises risk of user error and promotes operational simplicity.

Configure a flexible CLI group in ERSPAN containing:

- Global ERSPAN session configuration
- Tunnel interface configuration
- ERSPAN source attachment configuration, applied to a regexp of interface names

Note The flexible CLI group contains only the session and interface properties. The session and interface objects themselves must be created in the configuration as usual.

The following example shows a global flexible CLI configuration:

```
group erspan-group-foo
  monitor-session ‘foo’ ethernet   /* Global configuration */
    destination interface tunnel-ip0
  !
  interface ‘tunnel-ip0’   /* Tunnel interface configuration */
    tunnel tos 10
    tunnel mode gre ipv4
    tunnel source 10.10.10.1
    tunnel destination 20.20.20.2
  !
  interface 'GigabitEthernet0/0/0/[0-3]'   /* Interface configuration */
    monitor-session foo ethernet
  !
end-group
```

To enable all ERSPAN configurations, execute `apply-group erspan-group-foo` command. To disable ERSPAN configuration, delete this command.

Note The following three keywords are regular expressions and must be quoted:

- Definition of session name (example: `foo`)
- Definition of tunnel name (example: `tunnel-ip0`)
- Set of source interface names (example: `GigabitEthernet0/0/0/[0-3]`)

Use the `show running-config inheritance` command to view the final configuration after the group is expanded, and the `show monitor-session status` to check the operational state of ERSPAN session.

Note Starting from Release 7.3.3, when a combination of IP-in-IP decap and GRE ERSPAN tunnels are in use, resource utilization of IP-in-IP decap tunnels is accounted. However, resource utilization of ERSPAN GRE tunnels is not accounted in the *Total In Use* counter of **show controllers npu resources sipidxtbl location all** command output, but the *OOR State* would display *RED* if the total number of IP-in-IP decap and ERSPAN GRE tunnels reach 15.

Attaching the Configurable Source Interface

Procedure

Step 1 **configure**

Example:

```
RP/0/RP0/CPU0# configure
```

Enters global configuration mode.

Step 2 **interface** *type number*

Example:

```
RP/0/RP0/CPU0(config)# interface HundredGigE 0/1/0/10/0/1/0
```

Enters interface configuration mode for the specified source interface. The interface number is entered in *rack*/*slot*/*module*/*port* notation. For more information about the syntax for the router, use the question mark (?) online help function.

Step 3 **ipv4 access-group** *acl-name* {**ingress** | **egress**}

Example:

```
RP/0/RP0/CPU0(config-if)# ipv4 access-group acl1 ingress
```

Controls access to an interface.

Step 4 **monitor-session** *session-name* **ethernet direction rx-onlyport-level**

Example:

```
RP/0/RP0/CPU0(config-if)# monitor-session mon1 ethernet direction rx-only port-level acl
RP/0/RP0/CPU0(config-if-mon)#
```

Attaches a monitor session to the source interface and enters monitor session configuration mode.

Note
rx-only specifies that only ingress traffic is replicated.

Step 5 **acl**

Example:

```
RP/0/RP0/CPU0(config-if-mon)# acl
```

Specifies that the traffic mirrored is according to the defined ACL.

Note
If an ACL is configured by name then this overrides any ACL that may be configured on the interface.

Step 6 **exit**

Example:

```
RP/0/RP0/CPU0(config-if-mon)# exit
RP/0/RP0/CPU0(config-if)#
```

Exits monitor session configuration mode and returns to interface configuration mode.

Step 7 **end** or **commit**

Example:

```
RP/0/RP0/CPU0(config-if)# end
```

or

```
RP/0/RP0/CPU0(config-if)# commit
```

Saves configuration changes.

- When you issue the **end** command, the system prompts you to commit changes:

  ```
  Uncommitted changes found, commit them before exiting (yes/no/cancel)?
  [cancel]:
  ```

  - Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.

- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.

- Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Step 8 **show monitor-session [session-name] status** [**detail**] [**error**]

Example:

```
RP/0/RP0/CPU0# show monitor-session status
```

Displays information about the monitor session.

Introduction to ERSPAN rate limit

ERSPAN rate limit is an ERSPAN feature used to control the amount of mirrored traffic being sent over the network to an ERSPAN destination. By setting a specific rate limit, you can prevent network congestion and ensure that the ERSPAN traffic does not overload the network infrastructure.

Table 3: Feature History Table

Feature Name	Release Information	Description
ERSPAN rate limit	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature helps you monitor traffic flow through any IP network including third-party switches and routers by providing rate limiting of the mirroring traffic. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH

With rate limiting, you can limit the amount of traffic to a specific rate, which prevents the network and remote ERSPAN destination traffic overloading. If the rate-limit exceeds, then the system may cap or drop the monitored traffic.

This feature enables you monitor traffic flow through any IP network. This includes third-party switches and routers.

ERSPAN operates in the following modes:

- ERSPAN Source Session – box where the traffic originates (is SPANned).
- ERSPAN Termination Session or Destination Session – box where the traffic is analyzed.

You can configure the QoS parameters on the traffic monitor session.

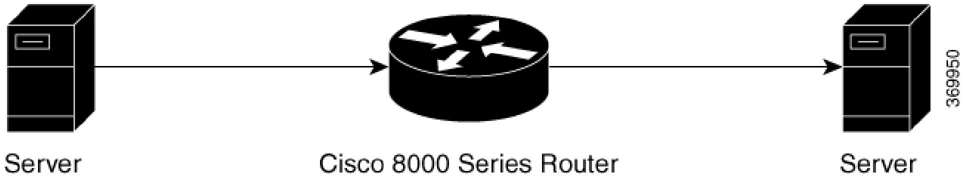
- Traffic Class (0 through 7)
  - Traffic class 0 has the lowest priority and 7 the highest.
  - The default traffic class is the same as that of the original traffic class.

Benefits

With ERSPAN rate limit feature, you can limit the mirrored traffic and use the mirrored traffic for data analysis.

Topology

Figure 2: Topology for ERSPAN Rate Limit



The encapsulated packet for ERSPAN is in ARPA/IP format with GRE encapsulation. The system sends the GRE tunneled packet to the destination box identified by an IP address. At the destination box, SPAN-ASIC decodes this packet and sends out the packets through a port. ERSPAN rate limit feature is applied on the router interface to rate limit the monitored traffic.

The intermediate switches carrying ERSPAN traffic from source session to termination session can belong to any L3 network.

Configure ERSPAN Rate Limit

Use the following steps to configure ERSPAN rate limit:

```
monitor-session ERSPAN ethernet
destination interface tunnel-ip1
!
```

```
RP/0/RP0/CPU0:pyke-008#sh run int tunnel-ip 1
```

```
interface tunnel-ip1
ipv4 address 4.4.4.1 255.255.255.0
tunnel mode gre ipv4
tunnel source 20.1.1.1
tunnel destination 20.1.1.2
!
```

```
RP/0/RP0/CPU0:pyke-008#sh run int hundredGigE 0/0/0/16
```

```
interface HundredGigE0/0/0/16
ipv4 address 215.1.1.1 255.255.255.0
ipv6 address 3001::2/64
monitor-session ERSPAN ethernet direction rx-only port-level
  acl
!
ipv4 access-group ACL6 ingress
```

Running Configuration

```
!!A traffic class needs to be configured under the monitor session.
monitor-session mon2 ethernet
destination interface tunnel-ip30
traffic class 5

A shaper needs to be configured for this traffic class:

policy-map m8
class TC1
  bandwidth percent 11
 !
 class TC2
  bandwidth percent 12
 !
 class TC3
  bandwidth percent 13
 !
 class TC4
  bandwidth percent 14
 !
 class TC5
  shape average percent 15
 !
 class TC6
  bandwidth percent 16
 !
 class TC7
  bandwidth percent 17

This policy-map has to be installed on the interface over which the mirrored traffic is
sent in the egress direction:
interface TenGigE0/6/0/9/0
service-policy output m8
```

Verification

```
RP/0/RP0/CPU0:ios#show monitor-session FOO status detail
Wed May 2 15:14:05.762 UTC
Monitor-session FOO
Destination interface tunnel-ip100
Source Interfaces
-----------------
TenGigE0/6/0/4/0
Direction: Both
Port level: True
ACL match: Disabled
```

Introduction to Local SPAN

Local SPAN overview

Local SPAN is the most basic form of traffic mirroring. In Local SPAN, both mirror source and mirror destination interfaces are present on the same router.

Local SPAN Supported Capabilities

The following capabilities are supported for Local SPAN:

- Only ingress traffic.
- The destination interface can only be an L2 or L3 physical main interface.
- The following interfaces are configured as sources for a Local SPAN session:
    - L3 physical main and sub-interface and bundle main and sub-interface.
    - L2 ethernet interfaces: Ethernet Flow Point (EFP) and trunk
    - BVI interface
- The following types of traffic are mirrored Local SPAN:
    - IPv4, IPv6, and MPLS
    - IP-in-IP
- Extended ACL to reduce mirrored traffic throughput
- Traffic shaping on the destination interface
- Session statistics. There's one counter for all types of traffic, that is, IPv4, IPv6, and MPLS.
- Up to four Local SPAN sessions. This session number is shared between ERSPAN, Local SPAN, and SPAN to File features.
- Up to 1000 source interfaces

Local SPAN Restrictions

The following are the restrictions for Local SPAN:

- Egress mirroring isn't supported.
- The physical interface used as destination can't be a bundle member link.
- GRE tunnels are not supported as source or destination interfaces.
- Per-source interface mirroring statistics isn't supported. However, SPAN session statistics are supported. The session statistics would contain total number of packets mirrored by the session.

- A destination interface can’t be a mirrored source interface and vice versa.
- ACLs for Local SPAN are applied only in ingress direction.
- If the ACL keyword is present in monitor-session configuration for an interface but no ACL is applied to that interface, traffic packets are not mirrored.
- ACL for MPLS traffic isn’t supported.
- NetFlow or sFlow configuration is not supported on interfaces that already have a Local SPAN session configured.
- The dropped packets at NPU cannot be captured by regular SPAN session. For capturing dropped packets at NPU, use Mirroring forward-drop packets, on page 50 feature.

Configuring Local SPAN

Configuring Local SPAN consists of 2 parts:

1. Creating a local SPAN session

```
RP/0/RP0/CPU0:router#configure
RP/0/RP0/CPU0:router(config)#monitor-session mon1 ethernet
RP/0/RP0/CPU0:router(config-mon)#destination interface HundredGigE0/1/0/0
RP/0/RP0/CPU0:router(config-mon)#commit
RP/0/RP0/CPU0:router(config-mon)#end
RP/0/RP0/CPU0:router#
```

2. Attaching the SPAN session to an interface

```
RP/0/RP0/CPU0:router(config-mon)#interface HundredGigE0/1/0/2
RP/0/RP0/CPU0:router(config-if)# monitor-session mon1 ethernet direction rx-only
RP/0/RP0/CPU0:router(config-if-mon)# no shut
RP/0/RP0/CPU0:router(config-if)#!
RP/0/RP0/CPU0:router(config-if)#
RP/0/RP0/CPU0:router(config-if)#interface Bundle-Ether1
RP/0/RP0/CPU0:router(config-if)# monitor-session mon1 ethernet direction rx-only
RP/0/RP0/CPU0:router(config-if-mon)# no shutdown
RP/0/RP0/CPU0:router(config-if)#!
RP/0/RP0/CPU0:router(config-if)#
```

```
RP/0/RP0/CPU0:monitor(config-if)#
RP/0/RP0/CPU0:monitor(config-if)#interface HundredGigE0/1/0/14.100
RP/0/RP0/CPU0:monitor(config-subif)# monitor-session mon1 ethernet direction rx-only
RP/0/RP0/CPU0:monitor(config-if-mon)# no shut
RP/0/RP0/CPU0:monitor(config-subif)#!
RP/0/RP0/CPU0:monitor(config-subif)#
RP/0/RP0/CPU0:monitor(config-subif)#interface Bundle-Ether1.1
RP/0/RP0/CPU0:monitor(config-subif)# monitor-session mon1 ethernet direction rx-only
RP/0/RP0/CPU0:monitor(config-if-mon)# no shut
RP/0/RP0/CPU0:monitor(config-subif)#!
RP/0/RP0/CPU0:monitor(config-subif)#commit
```

Verification

```
RP/0/RP0/CPU0:router#show monitor-session status
Monitor-session mon1
Destination interface HundredGigE0/1/0/0
=========================================
Source Interface      Dir   Status
--------------------- ----  ----------------
Hu0/1/0/2             Rx    Operational
```

```
Hu0/1/0/14.100        Rx    Operational
BE1                   Rx    Operational
BE1.1                 Rx    Operational
```

Execute the `show monitor-session status internal` command for session statistics:

```
RP/0/RP0/CPU0:router#show monitor-session status internal
Thu Aug 13 20:05:23.478 UTC
Information from SPAN Manager and MA on all nodes:
Monitor-session mon1 (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination interface HundredGigE0/1/0/0 (0x00800190)
          Last error: Success
0/1/CPU0: Destination interface HundredGigE0/1/0/0 (0x00800190)
0/RP0/CPU0: Destination interface HundredGigE0/1/0/0 (0x00800190)
Information from SPAN EA on all nodes:
Monitor-session 0x00000001 (Ethernet)
0/1/CPU0: Name 'mon1', destination interface HundredGigE0/1/0/0 (0x00800190)
Platform, 0/1/CPU0:

  Monitor Session ID: 1
  Monitor Session Packets: 32
  Monitor Session Bytes: 4024

0/2/CPU0: Name 'mon1', destination interface HundredGigE0/1/0/0 (0x00800190)
Platform, 0/2/CPU0:

  Monitor Session ID: 1
  Monitor Session Packets: 0
  Monitor Session Bytes: 0
```

Local SPAN with ACL

Local SPAN with ACL is used to filter and mirror ingress traffic. Only Access Control Entries (ACEs) with `capture` keyword are considered for mirroring. Both permit and deny packets are captured if the ACE contains `capture` keyword. Per interface, only one IPv4 ingress ACL and one IPv6 ingress ACL is allowed.

Configuring Local SPAN with ACL

Use the following configuration to enable local SPAN with IPv4 ACLs:

1. Configure ACLs for traffic mirroring.

   ```
   Router(config)# ipv4 access-list acl1
   Router(config-ipv4-acl)# 10 permit ipv4 25.0.0.0 0.0.0.255 any capture
   Router(config-ipv4-acl)# 20 permit ipv4 20.0.0.0 0.0.0.255 any
   Router(config-ipv4-acl)# 30 permit ipv4 131.1.1.0 0.0.0.255 any capture
   Router(config-ipv4-acl)# 40 permit ipv4 191.1.1.0 0.0.0.255 any capture
   ```

2. Apply the traffic monitoring to an interface.

   ```
   Router(config)# interface HundredGigE0/1/0/2
   Router(config-if)# ipv4 address 131.1.1.2 255.255.255.0
   Router(config-if)# monitor-session mon1 ethernet direction rx-only port-level
   Router(config-if-mon)# acl
   Router(config-if-mon)# ipv4 access-group acl1 ingress
   ```

Verification

```
RP/0/RP0/CPU0:ios#show running-config ipv4 access-list acl1
Thu Aug 13 20:22:54.388 UTC
ipv4 access-list acl1
 10 permit ipv4 22.0.0.0 0.0.0.255 any capture
```

```
 20 permit ipv4 20.0.0.0 0.0.0.255 any
 30 permit ipv4 131.1.1.0 0.0.0.255 any capture
 40 deny ipv4 181.1.1.0 0.0.0.255 any capture
!
```

Use the following configuration to enable local SPAN with IPv6 ACLs:

1. Configure ACLs for traffic mirroring.

   ```
   Router(config)# ipv6 access-list acl2
   Router(config-ipv6-acl)# 10 permit ipv6 10:1:1::2/64 any capture
   Router(config-ipv6-acl)# 20 permit ipv6 10:1:1::3/64 any
   Router(config-ipv6-acl)# 30 permit ipv6 10:1:1::4/64 any capture
   ```

2. Apply the traffic monitoring to an interface.

   ```
   Router(config)# interface HundredGigE0/1/0/3
   Router(config-if)# ipv6 address 10:1:1::5/64
   Router(config-if)# monitor-session mon2 ethernet direction rx-only port-level
   Router(config-if-mon)# acl
   Router(config-if-mon)# ipv6 access-group acl2 ingress
   ```

Verification

```
RP/0/RP0/CPU0:ios#show running-config ipv6 access-list acl2
Thu Aug 14 20:22:54.388 UTC
ipv6 access-list acl2
 10 permit ipv6 10:1:1::2/64 any capture
 20 permit ipv6 10:1:1::3/64 any
 30 permit ipv6 10:1:1::4/64 any capture
 !
```

Local SPAN Rate Limit

Local SPAN rate limiting takes place at the session level and not at source interface level. For rate limiting, local SPAN session should configure a traffic class. This traffic class is used to shape traffic on an egress interface. A QoS policy is applied to the egress interface over which mirrored traffic is sent.

Example for Local SPAN Rate Limit Configuration

```
Router# monitor-session mon2 ethernet
destination interface HundredGigE0/1/0/19
 traffic-class 5

class-map match-any TC5
 match traffic-class 5
 end-class-map

policy-map shape-foo
 class TC5  /* This has to match the class that was configured on monitor session */
 shape average percent 15
 class class-default

interface HundredGigE0/1/0/19    /* This is the egress interface over which mirrored packets
 are sent */
 service-policy output shape-foo
```

Traffic Mirroring with DSCP

Differentiated Service Code Point (DSCP) value of Differentiated Services (DS) field in IP packet is used to classify the traffic in the network. DS field formerly known as Type of Service (ToS).You can set the DSCP value in the six most significant bits of the differentiated services (DS) field of the IP header, thereby giving 2^6 = 64 different values (0 to 63). These six bits affect the Per Hop Behavior (PHB) and hence affects how a packet is moved forward. The default value of DSCP is zero (0). DSCP was defined under RFC 2474.

Following the principle of traffic classification, DSCP places a particular packet into a limited number of traffic classes. Similarly, the router is also informed about the DSCP values and the router can prioritize thepacket in traffic flow.

Refer the table to know more about the service class names defined in RFC 2474.

Table 4: DSCP, DS, and ToS values

DSCPValue in Decimal	DS Binary	DSHex	DSCPName	DS/ToSValue	ServiceClass
0	000000	0x00	DF/CS0	0	Standard
-	-	-	none	2	
1	000001	0x01	None	4	
1	000001	0x01	LE	4	Lower-effort
2	000010	0x02	None	8	
4	000100	0x04	None	16	
8	001 000	0x08	CS1	32	Low-priority data
10	001 010	0x0a	AF11	40	High-throughput data
12	001 100	0x0c	AF12	48	High-throughput data
14	001 110	0x0e	AF13	56	High-throughput data
16	010 000	0x10	CS2	64	OAM
18	010 010	0x12	AF21	72	Low-latency data
20	010 100	0x14	AF22	80	Low-latency data
22	010 010	0x16	AF23	88	Low-latency data
24	011 000	0x18	CS3	96	Broadcastvideo
26	011 000	0x1a	AF31	104	Multimedia streaming
28	011 100	0x1c	AF32	112	Multimedia streaming
30	011 110	0x1e	AF33	120	Multimedia streaming
32	100 000	0x20	CS4	128	Real-timeinteractive
34	100 010	0x22	AF41	136	Multimedia conferencing
36	100 100	0x24	AF42	144	Multimedia conferencing

38	100 110	0x26	AF43	152	Multimedia conferencing
40	101 000	0x28	CS5	160	Signaling(IP telephony, etc)
44	101 100	0x2c	Voice-admit	176	
46	101 110	0x2e	EF	184	Telephony
48	110 000	0x30	CS6	192	Networkrouting control
56	111 000	0x38	CS7	224	“reserved”

DSCP marking on egress GRE tunnel in ERSPAN

DSCP marking on egress GRE tunnel in ERSPAN is a mechanism used to classify and manage network traffic by assigning different priority levels to packets. Configuring the DSCP marking on an egress GRE tunnel for ERSPAN traffic, enables you to define the Quality of Service (QoS) for those mirrored packets.

Table 5: Feature History Table

Feature Name	Release Information	Feature Description
DSCP marking on egress GRE tunnel in ERSPAN	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature which allows you to control the QoS for your network's ERSPAN GRE tunnel traffic and eases the effort to control your customers' bandwidth across next-hop routers is supported on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH

Feature Name	Release Information	Feature Description
DSCP marking on egress GRE tunnel in ERSPAN	Release 7.5.4	You can now set or modify Differentiated Service Code Point (DSCP) value on the ERSPAN GRE tunnel header. This feature allows you to control the QoS for your network's ERSPAN GRE tunnel traffic and eases the effort to control your customers' bandwidth across next-hop routers.

Starting Cisco IOS XR Software Release 7.5.4, you can set or modify the DSCP marking on the ERSPAN GRE tunnels. ERSPAN uses GRE encapsulation to route captured traffic.

Configure DSCP Marking on Egress GRE Tunnel in ERSPAN

Configuration Example

This example shows how you can configure DSCP Marking on Egress GRE tunnel in ERSPAN.

```
Router#configure terminal
Router(config)#interface tunnel-ip1
Router(config-if)#tunnel tos 96
Router(config-if)#tunnel mode gre ipv4
Router(config-if)#tunnel source 192.0.2.1
Router(config-if)#tunnel destination 192.0.2.254
Router(config-if)#commit
```

Note You can configure DSCP value on both IPv4 and IPv6 headers.

Running Configuration

```
interface tunnel-ip1
 tunnel tos 96
 tunnel mode gre ipv4
 tunnel source 192.0.2.1
 tunnel destination 192.0.2.254
!
```

Verification

You can use the following commands to verify that ToS value is configured:

```
Router#show run interface tunnel-ip 1
interface tunnel-ip1
 ipv4 address 192.0.2.0/24
 tunnel tos 96
 tunnel mode gre ipv4
 tunnel source 192.0.2.1
 tunnel vrf red
 tunnel destination 192.0.2.254
```

```
Router#show monitor-session ERSPAN-2 status internal
Information from SPAN Manager and MA on all nodes:
```

```
Monitor-session ERSPAN-2 (ID 0x00000003) (Ethernet)
SPAN Mgr: Destination interface tunnel-ip1 (0x20008024)
          Last error: Success
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 192.0.2.1
            Dest IP: 192.0.2.254
            VRF: red
            VRF TBL ID: 0
            ToS: 96
            TTL: 255
            DFbit: Not set
```

DSCP bitmask to filter ingress ERSPAN traffic

DSCP bitmask to filter ingress ERSPAN traffic is a mechanism used to filter ingress ERSPAN traffic with a specific DSCP value. The router matches the bitmask found in the ACL rule with the DSCP field in the IP packet header. The result determines whether the packet matches the desired bitmask for classifying and prioritizing traffic as it enters the network.

Table 6: Feature History Table

Feature Name	Release Information	Feature Description
DSCP bitmask to filter ingress ERSPAN traffic	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature now allows to mirror multiple traffic flows for matched DSCP value of IP header on the ERSPAN on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH

Feature Name	Release Information	Feature Description
DSCP bitmask to filter ingress ERSPAN traffic	Release 7.5.4	You can now mirror multiple traffic flows for matched Differentiated Service Code Point (DSCP) value of IP header on the Encapsulated remote SPAN (ERSPAN). The matched DSCP value is based on the DSCP value and the bitmask configured in Access Control List (ACL) rule. Earlier, you could monitor single traffic flow by setting the RFC 4594 defined DSCP values in the GRE tunnel header. This feature introduces the following changes: • **CLI:** deny (IPv4), deny (IPv6), permit (IPv4), and permit (IPv6) are modified to include new keyword **bitmask**. • **YANG DATA Model:** New XPaths for Cisco-IOS-XR-um-ipv4-access-list-cfg and Cisco-IOS-XR-um-ipv6-access-list-cfg (see Github, YANG Data Models Navigator).

Starting Release 7.5.4, You can configure an ACL rule with DSCP bitmask on the ERSPAN GRE tunnels to mirror specific traffic flows.

Without ACL rule, ERSPAN mirrors all the traffic on the incoming port. When ACL is configured with DSCP and DSCP mask on the ERSPAN, ERSPAN mirrors the traffic whose DSCP value lies within the combination of DSCP value and the specified mask.

A DSCP value is mapped to a single traffic class as per the defined value in RFC2474. Masking the DSCP value in ACL rule allows to mirror multiple traffic flows. DSCP value and mask operate similar to IPv4 address and mask.

Configure DSCP Bitmask to Filter Ingress ERSPAN Traffic

To configure DSCP bitmask, use the bitmask option along with the dscp option while configuring the ACL.

Configuration Example for IPv4

This example shows how you can configure DSCP bitmask on ingress ERSPAN for IPv4 traffic.

```
/*configure the ACL*/
Router# config
Router(config)# ipv4 access-list acl1
Router(config-ipv4-acl)# 10 permit ipv4 host 192.0.2.1 any dscp af22 bitmask 0x3f
Router(config-ipv4-acl)# commit
Router(config-ipv4-acl)# exit

/* Perform the following configurations to attach the created ACL to an interface*/
Router(config)# interface HundredGigE0/0/0/6
Router(config-if)# ipv4 address 192.0.2.51 255.255.255.0

/* Monitor the ingress ACL applied and DSCP masked IPv4 traffic on ERSPAN*/
Router(config-if)# monitor-session TEST ethernet direction rx-only port-level acl ipv4 acl1
Router(config-if)# commit
```

Running Configuration

```
Router(config)# show running-config ipv4 access-list
ipv4 access-list acl1
 10 permit ipv4 host 192.0.2.1 any dscp af22 bitmask 0x3f
!

interface HundredGigE0/0/0/6
 ipv4 address 192.0.2.51 255.255.255.0
 monitor-session TEST ethernet direction rx-only port-level  acl ipv4 acl1
!
!
```

Configuration Example for IPv6

This example shows how you can configure DSCP bitmask on ingress ERSPAN for IPv6 traffic.

```
/*configure the ACL*/
Router# config
Router(config)# ipv6 access-list acl1
Router(config-ipv6-acl)# 10 permit ipv6 host 2001:DB8::2/32 any dscp 33 bitmask 0x3f
Router(config-ipv6-acl)# commit
Router(config-ipv6-acl)# exit

/* Perform the following configurations to attach the created ACL to an interface*/
Router(config)# interface HundredGigE 0/0/10/3
Router(config-if)# ipv6 address 2001:DB8::1/32

/* Monitor the ingress ACL applied and DSCP masked IPv4 traffic on ERPSAN*/
Router(config-if)# monitor-session TEST ethernet direction rx-only port-level acl ipv6 acl1
Router(config-if)# commit
```

Running Configuration

```
Router(config)# show running-config ipv6 access-list
ipv6 access-list acl1
 10 permit ipv6 acl1 host 2001:DB8::2/32 any dscp 33 bitmask 0x3f
!
interface HundredGigE0/0/10/3
 ipv6 address 2001:db8::1/32
 monitor-session TEST ethernet direction rx-only port-level acl ipv6 acl1
!
!
```

Multiple SPAN ACL sessions for MPLS

Table 7: Feature History Table

Feature Name	Release Information	Description
Multiple SPAN ACL sessions for MPLS	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature allows to configure multiple SPAN ACL sessions for MPLS on Layer 3 interfaces configured on the Label-Switched Paths (LSPs) to monitor the MPLS traffic based on the labels and the EXP bit. This feature verifies the overall network performance simultaneously from various network locations and ensures a better network visibility, network resource efficiency, and flexibility. This MPLS SPAN ACL configuration is supported only in the ingress direction. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH This feature introduces these changes: **CLI:** • **acl mpls** • **mpls access-list** **YANG Data Model:** `Cisco-IOS-XR-um-mpls-acl-cfg.yang` (see Github, YANG Data Models Navigator).

Starting from Cisco IOS XR Release 24.4.1, you can monitor the MPLS traffic by configuring multiple SPAN ACL sessions for MPLS. With this feature, the ingressing MPLS traffic is mirrored. This is achieved with the **monitor-session** *session-name* **ethernet direction rx-only port-level** configuration.

This feature is supported on both the Physical and Bundle main and subinterfaces. However,the feature supports only the GRE tunnel interfaces as the destination interfaces.

You should specify the monitor sessions to be used on the configured interfaces. You can configure a maximum of upto three sessions simultaneously.

You can use the SPAN session ID to distinguish between multiple SPAN sessions under the same source interface.

Benefits

- Improves flexibility of the associated user interface.
- Avoids redundancy.
- Provides backward compatibility.
- Minimises configuration size on the disk.
- Reduces process memory in both the shared plane and local plane for scale configurations.

Restrictions

- Supported only in the ingress (Rx) direction.
- Supports a maximum of four SPAN sessions.
- Does not support the **Deny** action.
- Supports only the GRE tunnel interfaces as the destination interfaces.

Configure multiple SPAN ACL sessions for MPLS

Define ACLs

This example defines multiple SPAN ACLs for the incoming (Rx) traffic or MPLS packets captured.

```
/* Create multiple SPAN ACLs (mp1 and mp2) for mirroring MPLS traffic */
Router(config)# mpls access-list mp1
Router(config-mpls-acl)# 10 permit label1 2000  label2 3000  label3 4000  exp1 5 exp2 5
exp3 7
Router(config-mpls-acl)# exit
Router(config)# mpls access-list mp2
Router(config-mpls-acl)# 10 permit label3 9000  exp3 5
Router(config-mpls-acl)# exit
Router(config)# commit
```

Configure monitor session

This example configures a monitor session on the specified destination interface for the incoming (Rx) traffic.

```
RP/0/RP0/CPU#config
RP/0/RP0/CPU0:R1(config)#interface tunnel-ip41
RP/0/RP0/CPU0:R1(config-if)#tunnel source 11.11.11.11
RP/0/RP0/CPU0:R1(config-if)#tunnel destination 22.22.22.22
RP/0/RP0/CPU0:R1(config-if)#ipv4 address 41.41.41.2 255.255.255.0
RP/0/RP0/CPU0:R1(config-if)#tunnel mode gre ipv4
RP/0/RP0/CPU0:R1(config-if)#commit
RP/0/RP0/CPU0:R1(config-if)#exit
```

```
!
RP/0/RP0/CPU0:R1(config)#monitor-session S1 ethernet destination interface tunnel-ipv41
RP/0/RP0/CPU0:R1(config-if)#commit
!
```

Attach monitor session to source interface

This configuration attaches the MPLS SPAN ACL sessions to the specified source interface. Use the **direction** keyword so that only the ingress traffic is mirrored.

```
Router(config)# interface tenGigE 0/0/0/14
Router(config-if)# monitor-session S1 ethernet direction rx-only port-level
Router(config-if-mon)# acl mpls mp1
!!
```

Running configuration for source interface

This example shows the running configuration for the configured source interface.

```
RP/0/RP0/CPU0:ios# show running-config interface tenGigE 0/0/0/14
Mon Apr  1 13:16:47.430 UTC
interface TenGigE0/0/0/14
 ipv4 address 1.1.1.1 255.255.255.0
 ipv6 address 1111::1:1/96
 monitor-session S1 ethernet direction rx-only port-level
  acl mpls mp1
 !
RP/0/RP0/CPU0:ios#
```

Verify monitor session

This example shows the details of the monitor session.

```
RP/0/RP0/CPU0:ios# show monitor-session status
Mon Apr  1 13:16:40.408 UTC
Monitor-session S1
Destination interface tunnel-ip41
==============================================================================
Source Interface      Dir   Status
--------------------- ----  --------------------------------------------------
Te0/0/0/14 (port)     Rx    Operational
```

This example shows how to verify the traffic using the **show monitor-session** command.

```
RP/0/RP0/CPU0:ios# show monitor-session status detail
Mon Apr  1 13:19:11.124 UTC
Monitor-session S1
  Destination interface tunnel-ip41
  Source Interfaces
  -----------------
  TenGigE0/0/0/14
    Direction:     Rx-only
    Port level:    True
    ACL match:     Disabled
    IPv4 ACL:      Disabled
    IPv6 ACL:      Disabled
    MPLS ACL:      Enabled (mp1)
    Portion:       Full packet
    Interval:      Mirror all packets
    Mirror drops:  Disabled
    Status:        Operational
RP/0/RP0/CPU0:ios#
```

Monitor multiple ERSPAN sessions with SPAN and security ACL

Table 8: Feature History Table

Feature Name	Release Information	Feature Description
Monitor multiple ERSPAN sessions with SPAN and security ACL	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature now enables you to use SPAN and security ACL together to monitor multiple ERSPAN sessions under the same source interface thus distributing the mirrored traffic over different destination interfaces and allowing selective incoming traffic on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
Monitor multiple ERSPAN sessions with SPAN and security ACL	Release 7.5.4	With this feature, you can use SPAN and security ACL together to monitor multiple ERSPAN sessions under the same source interface. SPAN ACL helps you to distribute the mirrored traffic over different destination interfaces and Security ACL helps you to allow selective incoming traffic.

Starting Cisco IOS XR Software Release 7.5.4 you can monitor multiple ERSPAN sessions using GREv4 and GREv6 under the same source interface. Multiple ERSPAN monitor sessions configured on an interface allow you to choose the destination interface for the mirrored traffic. For the configuration of monitor sessions, you can use SPAN and security ACLs together. The SPAN and security ACLs are applicable only in the ingress traffic.

Configure Multiple Monitor ERSPAN Sessions with SPAN and Security ACL

This example shows how to configure SPAN and Security ACL for SPAN with GREv4 and GREv6 Monitor Sessions.

Configuration example

Use the following configuration to attach SPAN and security ACLs for traffic mirroring.

```
Router# config
/*Perform the following configurations to attach the SPAN ACL to an interface*/
Router(config-if)#monitor-session always-on-v4 ethernet direction rx-only port-level
Router(config-if-mon)#acl ipv4 v4-monitor-acl1
Router(config-if-mon)#acl ipv6 v6-monitor-acl1
Router(config-if-mon)#exit
Router(config-if)#monitor-session on-demand-v4 ethernet direction rx-only port-level
Router(config-if-mon)#acl ipv4 v4-monitor-acl2
Router(config-if-mon)#acl ipv6 v6-monitor-acl2
Router(config-if-mon)#exit
/*Perform the following configurations to attach the security ACL to an interface*/
Router(config-if)#ipv4 access-group sec_aclv4 ingress
Router(config-if)#ipv6 access-group sec_aclv6 ingress
Router(config-if)#commit
```

Running configuration

```
Router(config)#show running-config interface
monitor-session always-on-v4 ethernet direction rx-only port-level
  acl ipv4 v4-monitor-acl2
  acl ipv6 v6-monitor-acl2
!
monitor-session on-demand-v4 ethernet direction rx-only port-level
  acl ipv4 v4-monitor-acl2
  acl ipv6 v6-monitor-acl2
!
ipv4 access-group sec_aclv4 ingress
ipv6 access-group sec_aclv6 ingress
!
!
```

SPAN to file

SPAN to file is a network monitoring feature that allows the captured traffic from a SPAN session to be written directly to a file for later analysis.

Table 9: Feature History Table

Feature name	Release information	Feature description
Always-On SPAN-to-File with periodic write	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700); Centralized Systems (8600); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]). The routers can now provide reliable, always-available packet capture for post-event analysis, eliminating the need for prior configuration or user interaction. The enhanced SPAN-to-File feature provides continuous packet capture and debugging capability with always-on functionality that starts automatically upon destination configuration. It prevents data loss during node reloads by periodically writing packet buffer contents to disk, without stopping the capture. A default SPAN-to-File session for forwarding and buffer drops is always active and can be disabled if not needed. The feature also supports packet truncation and sampling in software for software-mirrored packets, independent of NPU capabilities. The feature introduces these changes: **CLI:** • **monitor-session default-capture-disable** • **monitor-session local-capture-capacity** • The **always-on, periodic-write,**and **capacity** keywords are introduced in the **destination file** command. • The **write** keyword is introduced in the **monitor-session <name> packet-collection** action command. **YANG data models:** • New Xpaths for `Cisco-IOS-XR-um-monitor-session-cfg.yang` • New Xpaths for `Cisco-IOS-XR-Ethernet-SPAN-cfg.yang` • New Xpaths for `Cisco-IOS-XR-Ethernet-SPAN-act.yang` (see GitHub, YANG Data Models Navigator)

Feature name	Release information	Feature description
SPAN-to-file in Tx direction	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature now allows to capture packets in the Tx direction on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
SPAN-to-file support in Tx and Rx direction	Release 7.5.3	With this feature, the ability to capture the packet in Tx direction along with the ability to store the capture on the file is supported. You can now capture the packet in the Tx direction and store the capture on the file. Earlier, you could only capture or mirror the traffic in the Rx direction. You now have the flexibility to choose Tx, Rx, or both directions. You can now capture and analyze the outgoing (Tx) packets.
Partial packet capture ability for SPAN-to-file (Rx)	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature now allows you to perform partial packet capture in the Rx direction on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH

Feature name	Release information	Feature description
Partial packet capture ability for SPAN-to-file (Rx)	Release 7.5.3	With this feature, you can perform partial packet capture in the Rx direction. Earlier, the ability for entire packet capture was available in the Tx direction only, now you can choose entire or partial packet capture in the Rx direction also. Here, partial packet capture is also known as truncation.
SPAN-to-file PCAPng file format	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This PCAPng File Format feature that contains different blocks used to rebuild the captured packets into recognizable data is now supported on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
SPAN-to-file PCAPng file format	Release 7.3.1	PCAPng is the next generation of packet capture format that contains a dump of data packets captured over a network and stored in a standard format. The PCAPng file contains different types of information blocks, such as the section header, interface description, enhanced packet, simple packet, name resolution, and interface statistics. These blocks can be used to rebuild the captured packets into recognizable data. The PCAPng file format: • Provides the capability to enhance and extend the existing capabilities of data storage over time • Allows you to merge or append data to an existing file. • Enables to read data independently from network, hardware, and operating system of the machine that made the capture.

SPAN to File is an extension of the pre-existing SPAN feature that allows network packets to be mirrored to a file instead of an interface. This helps in the analysis of the packets at a later stage. The file format is PCAP, which helps that data to be used by tools, such as tcpdump or Wireshark.

Note A maximum of 100 source ports are supported across the system. Individual platforms may support lower numbers. All the SPAN sessions are configured under the Ethernet class. At any given time, the system supports four SPAN to File sessions.

When you configure a file as a destination for a SPAN session, the system creates buffer on each node to which the network packets are logged. The buffer is for all packets on the node regardless of which interface they are from. That is, multiple interfaces can provide packets to the same buffer. The system deletes the buffer when the session configuration is removed. Each node writes a file on the active RP, which contains the node ID of the node on which the buffer was located.

The minimum buffer size is 1KB. The maximum buffer size is 1000KB and default buffer size is 2KB.

If multiple interfaces are attached to a session, then interfaces on the same node are expected to have their packets sent to the same file. Bundle interfaces can be attached to a session with a file destination, which is similar to attaching individual interfaces.

From Cisco IOS XR Software Release 7.5.3 onwards, the capture of all the outgoing packets from the router is supported.

Earlier to Cisco IOS XR Software Release 7.5.3, there was no functionality which enables to capture the payload of packets coming from your customers for security reasons.

Limitations and restrictions for SPAN to File

- Only incoming packet mirroring on the source interface is supported. Outgoing mirrored packets cannot be dumped to the file.

  However, from Cisco IOS XR Software Release 7.5.3 onwards, there are no restrictions.

- SPAN ACLs can only be applied in ingress direction only. Hence, ACLs for SPAN to File can only be applied in ingress direction only.

- ACL on MPLS traffic is not supported.

- MPLS over GRE traffic is supported, however, GRE interfaces cannot be configured as source interfaces.

- Packet truncation applies for SPAN to File and ERSPAN interfaces only. If you change the destination to Local SPAN, then an **ios_msg** is displayed as a warning. The entire packet is mirrored after this message is displayed.

  Example: `The Partial Packet Capture feature is not supported by Local SPAN. The entire Packet will be mirrored.`

- Packet truncation is per monitor session.

- Currently, truncation per interface is not supported.

- For outgoing (TX) SPAN to File, Security ACL is not supported.

- For outgoing (TX) SPAN to File, only transit traffic is mirrored.

  Self-originating traffic cannot be mirrored.

Supported capabilities for SPAN to File

- The ability to mirror outgoing traffic and punt it to the CPU across all NPU versions.
- Ability to mirror outgoing IPv4, IPv6, and MPLS traffic to file.
- Ability to mirror outgoing traffic across all types of L3 interfaces, including physical, sub, bundle, and bundle sub interfaces
- Ability to mirror outgoing traffic across L2 or BVI interfaces.
- Ability to enable the new SPAN to File truncation configuration for both RX and TX direction. You can specify the `both` keyword to enable RX and TX mirroring on a single source interface.

  See Configuring SPAN to File for Truncation and Direction, on page 44
- Ability to configure a different truncation size on each monitor session.
- Ability to configure SPAN to File mirroring packet truncation size from 1 to 10000. If you try to configure a value out of the range, the configuration will not accept it and displays an error message.
- Ability to change the truncation size, when packet collecting has stopped. Removing or re-adding the monitor session is not required.
- Ability to change the truncation size during packet collecting ON. Not required to stop the monitor session.
- The entire packet is mirrored by default, without the mirror first (truncation size) configuration.

  Also, if the packet size is less than the configured truncation size, the entire packet is mirrored.

Action commands for SPAN to File

Action commands allows you to start and stop network packet collection. For sessions with active packet collection, you can also use this command to write the contents of a packet buffer to disk without stopping the packet capture. You can run the action commands on sessions where the destination is a file. The action command autocompletes names of the globally configured SPAN to File sessions. The following table provides more information on action commands.

Table 10: Action commands for SPAN to File

Action	Command	Description
Start	`monitor-session <name> packet-collection start`	Use this command to start writing packets for the specified session to the configured buffer. This command has no effect for sessions configured as `always-on`.

Action	Command	Description
Stop	`monitor-session <name> packet-collection stop [ discard-data | write directory <dir> filename <filename> ]`	Use this command to stop writing packets to the configured buffer. If you specify the `discard-data` option, the system clears the buffer. If you specify the `write` option, the system writes the buffer to disk before clearing it. When writing the buffer to disk, save the file in .pcap format at the following location: `/<directory>/<node_id>/<filename>`. If you include a .pcap extension when specifying the filename, the system will remove it to prevent the extension from being added twice. This command returns an error for sessions configured as `always-on`.
Write	`monitor-session <name> packet-collection write [directory <dir>] [filename <filename>]`	Use this command to write the contents of a packet buffer to disk without stopping the packet capture. The write command is available only for sessions with active packet collection. You can start the packet collection explicitly with the action command or through always-on collection. You may specify the full directory path and the file name to which the buffer needs to be written. If you specify the directory, it must already exist. If the directory or file name are not specified, the following default values are used: Directory: /misc/scratch/SPAN/<node>/ Filename: <session_name>_<node>_<timestamp>.pcap

Configuring SPAN to File

Use the following command to configure SPAN to File:

```
monitor-session <name> [ethernet|ipv4|ipv6|mpls-ipv4|mpls-ipv6]
    destination file [size <kbytes>] [buffer-type linear]
```

The `monitor-session <name> [ethernet|ipv4|ipv6|mpls-ipv4|mpls-ipv6]` part of the command creates a monitor-session with the specified name and class and is a pre-existing chain point from the current SPAN feature. The `destination file [size <kbytes>] [buffer-type linear]` part of the command adds a new “file” option to the existing “destination”.

`destination file` has the following configuration options:

- Buffer size.
- Two types of buffer:
    - Circular: Once the buffer is full, the start is overwritten.
    - Linear: Once the buffer is full, no further packets are logged.

Note The default buffer-type is circular. Only linear buffer is explicitly configurable. Changing any of the parameters (buffer size or type) recreates the session, and clears any buffers of packets.

All configuration options which are applied to an attachment currently supported for other SPAN types should also be supported by SPAN to file. This may include:

- ACLs
- Write only first X bytes of packet.
- In Cisco IOS XR Release 7.5.3, truncation per global session is supported and not per interface.

Note These options are implemented by the platform when punting the packet.

Once a session has been created, then interfaces may be attached to it using the following configuration:

```
interface GigabitEthernet 0/0/0/0
    monitor-session <name> [ethernet|ipv4|ipv6|mpls-ipv4|mpls-ipv6]
```

The attachment configuration is unchanged by SPAN to File feature.

Configuration Examples

To configure a `mon1` monitor session, use the following commands:

```
monitor-session mon1 ethernet
          destination file size 230000
         !
```

In the above example, omitting the `buffer-type` option results in default circular buffer.

To configure a `mon2` monitor session, use the following commands:

```
monitor-session mon2 ethernet
          destination file size 1000 buffer-type linear
         !
```

To attach monitor session to a physical or bundle interface, use the following commands:

```
RP/0/RSP0/CPU0:router#show run interface Bundle-Ether 1
Fri Apr 24 12:12:59.348 EDT
interface Bundle-Ether1
monitor-session ms7 ethernet|ipv4|ipv6|mpls-ipv4|mpls-ipv6]
[direction {rx-only|tx-only|both[SW(1] }] [port-level]
acl [<acl_name>]!
```

Running Configuration

```
!! IOS XR Configuration 7.1.1.124I
!! Last configuration change at Tue Nov 26 19:29:05 2019 by root
```

```
!
hostname OC
logging console informational
!
monitor-session mon1 ethernet
 destination file size 230000 buffer-type circular
!
monitor-session mon2 ethernet
 destination file size 1000 buffer-type linear

!
interface Bundle-Ether1
monitor-session ms7 ethernet
          direction rx-only
end
```

Verification

To verify packet collection status:

```
RP/0/RP0/CPU0:router#show monitor-session status
Monitor-session mon1
Destination File - Packet collecting
=============================================
Source Interface        Dir.      Status
--------------------- ---- ------------------
Hu0/9/0/2                    Rx       Operational

Monitor-session mon2
Destination File - Packet collecting
=========================================
Source Interface         Dir    Status
--------------------- ---- --------------
BE2.1.                           Rx     Operational
```

If packet collection is not active, the following line is displayed:

```
Monitor-session mon2
Destination File - Not collecting
```

Configuring SPAN to File for Truncation and Direction

Configuring SPAN to File for Truncation

Use the **mirror first** command in monitor session configuration mode to create a SPAN to File monitor session for mirroring the packets with truncation enabled:

```
monitor-session <name> [ethernet]
destination file [size <kbytes>] [buffer-type linear|circular]
mirror first <number>
```

Once a session has been created, then interfaces may be attached to it using the following configuration:

```
interface <>
  monitor-session session-name ethernet direction rx-only|tx-only|both | acl [acl_name]
```

Configuration Examples

To configure a `mon1` monitor session, use the following commands:

```
monitor-session mon1 ethernet
 destination file
 mirror first 128
!
```

Configuring SPAN to File for Direction

Use the following command to create a SPAN to File monitor session for mirroring the packets:

```
monitor-session mon2 ethernet
 destination file
!
```

Attach the session which has been created to the interfaces using the following configuration:

```
interface <>
  monitor-session session-name ethernet direction rx-only|tx-only|
acl [acl_name]
```

Running Configuration for all

```
monitor-session mon3 ethernet
destination file
!

interface Hu0/9/0/2
monitor-session mon1 ethernet
direction rx-only
!

interface bundle-ether1
monitor-session mon2 ethernet
direction tx-only
!

interface bundle-ether2.1
monitor-session mon3 ethernet
direction both
end
```

Verification

The **show monitor-session status** displays the direction.

```
Router#show monitor-session status
                   Monitor-session mon1
                   Destination File - Packet collecting
                   =============================================
                   Source Interface      Dir   Status
                   --------------------- ----  ------------------
                   Hu0/9/0/2             Rx    Operational
                   Monitor-session mon2
                   Destination File - Packet collecting
                   =========================================
                   Source Interface      Dir   Status
                   --------------------- ----  --------------
                   BE1                  Tx    Operational
                   Monitor-session mon3
                   Destination File - Packet collecting
                   =========================================
                   Source Interface      Dir   Status
                   --------------------- ----  --------------
                   BE2.1                 Both    Operational
```

Always-On SPAN-to-File with periodic write

The SPAN-to-File feature is enhanced to serve as a more reliable tool in investigating unexpected packet drops and traffic blackholing. The improved functionality allows diagnosis of issues without reproducing faults, changing configurations, or needing prior user interaction before the event. Let us explore these functionalities in detail.

1. **Default SPAN enablement**

   Enables a default SPAN-to-File session for packet forwarding and buffer drops automatically, provided the platform supports it. The session is always active and periodically writes to the disk without stopping the capture, up to the maximum configured storage capacity limit. This functionality ensures continuous packet capture and storage.

   You can disable this session if it's not needed using the **monitor-session default-capture-disable** command.

2. **SPAN truncation and sampling**

   Allows for packet truncation and sampling for software-mirrored packets like SPAN-to-File, even if hardware support isn't available. This functionality enhances flexibility by enabling these operations within the software.

3. **Always-on SPAN-to-File**

   Automatically starts packet capture when the file destination is configured, without requiring additional action commands. This functionality ensures immediate and continuous packet capture.

   Use the **destination file always-on** command in monitor-session configuration mode to enable always-on packet capture.

4. **SPAN-to-File continuous capture**

   Provides the ability to write packet data to a file without stopping the ongoing packet capture. This capability ensures uninterrupted packet monitoring and data collection.

   Use the **monitor-session <session name> packet-collection write** `[directory <dir>] [filename <file>]` command to write the current packet buffer to a file without stopping packet collection. If you don't use the optional keywords `directory` and `filename`, the system writes the buffer contents to a file named <session_name>_<node location>_<timestamp>.pcap in a default capture directory.

5. **SPAN periodic file writing**

   Allows you to set a period after which the buffered SPAN-to-File packet data is automatically written to a file. This automatic writing prevents data loss if there is a system reload and ensures persistent storage of captured packets. The feature includes configurable limits to manage file storage effectively, ensuring user-written files remain intact and session-specific data management doesn't impact other sessions.

   Use the **destination file**`[size <kbytes>] [always-on [periodic-write <secs> [capacity [<num> <kB|MB|GB>]]]` command in monitor-session configuration mode to set the file writing interval.

   When the periodic-write option is used, the contents of the buffer are written to a file named <session_name>_<node location>_<timestamp>.pcap, in a default capture directory `/misc/scratch/SPAN/<node>/`.

   Storage capacity management and file retention rules

   There are two configurable capacity options to manage the periodically written files.

   - A per-session limit: The maximum storage capacity for the set of files captured periodically for an individual monitor session. When this limit is exceeded, the system automatically deletes the oldest files to make room for new ones. Depending on the newer file size, it may delete multiple older files. In cases where only a single file is captured, the file is written completely, even if its size exceeds the per-session capacity limit. The file remains stored until another file is captured for that session.

When a new file is significantly larger than the previous captures, the system may delete all existing files, leaving only the new file. This ensures that the new file is saved in its entirety without any truncation.

Use the **destination file [capacity <num> <kB|MB|GB>]** command to configure the per-session capacity limit.

- A global limit: The total storage capacity for all files captured by SPAN on disk. If this limit is exceeded, further write operations don’t happen. Stopping the write operation without deleting files protects periodic and user-triggered writes in the default directory that remain unmoved or uncleared, regardless of session.

  Use the **monitor-session local-capture-capacity <num> <kB|MB|GB>** command to configure the global capacity limit.

Note This capacity limit configuration applies only to files written in the default directory. Any files moved out of the default directory don't count toward this limit.

If you don't configure these capacity parameters, the system uses default values specific to the platform variant to manage storage capacity.

Benefits of Always-On SPAN-to-File with periodic write

These are some of the benefits of the enhanced SPAN-to-File feature.

- **Reliable diagnostics**: Allows investigation of unexpected packet drops and traffic blackholing without the need to reproduce fault scenarios or change configurations.
- **Continuous packet capture**: Ensures uninterrupted packet monitoring and data collection by continuously capturing and storing packets without stopping.
- **Immediate activation**: Configuring the file destination automatically starts packet capture, ensuring immediate and continuous monitoring. Activating immediately reduces the risk of missing important data because of user mistakes or delays.
- **Data loss prevention**: Periodically writes packet data to a file, preventing data loss if there are system reloads and ensuring persistent storage.
- **Efficient storage management**: Provides configurable storage limits for individual sessions and overall capture, managing space effectively without deleting user-written files.
- **User control**: Allows you to disable default SPAN sessions and configure storage limits, giving the control over the packet capture and storage settings.

Guidelines and restrictions for Always-On SPAN-to-File with periodic write

- The platform enables the default SPAN-to-File session only if it supports it.
- If you do not specify directory and filename options for the **packet-collection write** action command, the system saves buffer contents as `<session_name>_<node location>_<timestamp>.pcap` in the default capture directory `/misc/scratch/SPAN/<node>/`.

- Ensure that the user-specified directory already exists before you use it in the **packet-collection write** action command.
- The system enforces a per-session storage limit; exceeding it results in the deletion of the oldest captures.
- The system enforces a global storage limit for all captured files; exceeding this prevents further write operations.
- The system enforces the global storage limit only on the default capture directory.
- If you do not configure storage capacity limit parameters, the system uses platform-specific default values.
- When you change a SPAN-to-File session from **always-on** to **on-demand,** you must explicitly stop packet collection or write the packet buffer to enable on-demand operation.

Configure Always-On SPAN-to-File with periodic write

This section includes configuration for always-on SPAN-to-File with periodic write and default enablement.

Procedure

Step 1 **Note**

This is an optional step. Perform this step only if you wish to disable the default SPAN-to-File session.

Default SPAN-To-File: Default SPAN-to-File session for packet forwarding and buffer drops is enabled automatically. To disable the default SPAN-to-File session, use the **monitor-session default-capture-disable** command.

Example:

```
Router#configure
Router(config)#monitor-session default-capture-disable
Router(config)#commit
```

Step 2 **Always-on SPAN-to-File:** To enable Always-on SPAN-to-File, use the **destination file always-on** command in monitor-session configuration mode.

Example:

```
Router(config)#monitor-session test
Router(config-mon)#destination file always-on
Router(config-mon)#commit
```

Step 3 **SPAN-to-File continuous capture:** To write the current packet buffer to a file without stopping packet collection, use the **monitor-session <session name> packet-collection write** `[directory <dir>] [filename <file>]` action command.

Example:

```
Router#monitor-session test packet-collection write directory var/xr/scratch/SPAN/test file testfile
```

Step 4 **SPAN periodic file writing:** To configure an interval for automatically writing buffered packet data to a file, use **destination file**`[size <kbytes>] [always-on [periodic-write <secs> [capacity [<num> <kB|MB|GB>]]]` command in monitor-session configuration mode.

Example:

```
Router(config)#monitor-session test
Router(config-mon)#destination file always-on periodic-write 300
Router(config-mon)#commit
```

Step 5 **Storage capacity management:**

- To set the storage capacity limit for all monitor-sessions, use **monitor-session local-capture-capacity <num> <kB|MB|GB>** command in global configuration mode.
- To set the per-session limit, use **destination file [capacity <num> <kB|MB|GB>]** command in monitor-session configuration mode.

Example:

```
Router(config)#monitor-session local-capture-capacity 300 MB
Router(config)#monitor-session test
Router(config-mon)#destination file always-on periodic-write 300 capacity 100 MB
Router(config-mon)#commit
```

Step 6 Verify the running configuration using the **show running-config** command.

Example:

```
monitor-session test ethernet
 destination file always-on periodic-write 300 capacity 100 MB
!
monitor-session local-capture-capacity 300 MB
monitor-session default-capture-disable
```

Step 7 Use the **monitor-session status detail** command to verify the monitor-session details.

Example:

```
Router#show monitor-session status detail
Monitor-session test
  Destination File - Packet collecting (always-on)
  Periodic write interval: 300 seconds
  Maximum periodic capture capacity: 100MB
  Source Interfaces
  -----------------
......
```

Step 8 Use the **show monitor-session status internal** command to verify global configuration items and information about platform capabilities.

Example:

```
Router#show monitor-session status internal
Global Configuration:
    Router ID: Default
    Global local-capture-capacity: 300MB
    Default session disabled
Write command supported

Information from SPAN Manager and MA on all nodes:
Monitor-session test (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination File - FileID:0
          Filename/directory name not set
          Last error: Success

Information from SPAN EA on all nodes:
Monitor-session 0x00000001 (Ethernet)
0/RP0/CPU0: Name 'test', destination file FileID:0
            Filename/directory name not set
Platform, 0/RP0/CPU0:

  Monitor Session ID: 1
  Truncation Size: 0
```

```
Buffer type: Circular
Buffer size: 2000
```

Mirroring forward-drop packets

Mirroring forward-drop packets is a network monitoring feature that captures and analyzes packets that a router drops while forwarding them.

Table 11: Feature History Table

Feature Name	Release Information	Description
Mirroring forward-drop packets	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature with the mirroring and analysis of packets dropped during the forwarding process helps identify the types of traffic that are blocked, analyze potential security threats, troubleshoot, and optimize network performance. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
Mirroring forward-drop packets	Release 7.5.4	Mirroring forward-drop packets feature copies or mirrors the packets that are dropped during the forwarding process at the router ingress to a configured destination. These mirrored packets can be captured and analyzed using network monitoring tools. The analysis of dropped packets helps you understand the types of traffic that are blocked, analyze potential security threats, troubleshoot, and optimize network performance. This feature introduces the following changes: • **CLI: drops** • **YANG Data Model:**New XPath for Cisco-IOS-XR-um-monitor-session-cfg.yang (see GitHub, YANG Data Models Navigator)

In a network, packets are forwarded from one device to another until they reach their destination. However, in some cases, routers may drop packets during this forwarding process. These packets are known as forward-drop packets.

The packet drop can happen for several reasons, such as congestion on the network, errors in the packet header or payload, blocking by firewall or access control lists (ACL), and so on. These forward-drop packets are typically discarded before they can reach their intended destination, and may have to be re-transmitted by the source device. This feature supports mirroring of these forward-drop packets at the ingress (Rx direction) to another destination. When a global forward-drop session is configured for the router, the forward-drop packets at the ingress are mirrored or copied to the configured destination. You can configure the mirror destination as a file (for SPAN-to-file sessions) or an IPv4 GRE tunnel ID (for ERSPAN) or sFlow.

Mirroring forward-drop packets to a suitable destination for analysis can help in the following:

- Network visibility: By mirroring and analyzing forward-drop packets, network administrators gain better visibility into the types of traffic that are blocked by the firewalls and access control lists (ACL).
- Threat detection: As the original dropped packet is forwarded without any change, it helps in identifying the source of potential security threats.
- Troubleshooting: Analyzing forward-drop packets helps in troubleshooting network issues that may be causing the packet drop. This helps in taking proactive measures to avoid escalation of the issue.

Guidelines and restrictions for mirroring forward-drop packets

- Only one global forward-drop session can be configured on a router.
- In-band traffic destined to router management interface cannot be captured using this functionality.
- For ERSPAN sessions that monitor forward-drop packets, a default value of 0 is used for the encapsulation traffic class, irrespective of the DSCP value assigned for the tunnel.
- ERSPAN counters are not updated for forward-drop packets.
- Not all packets that are dropped by NPU will be mirrored.

Configuring Forward-Drop

Perform the following tasks on the router to configure a global session for mirroring forward-drop packets:

1. Configure the tunnel mode.
2. Configure the tunnel source.
3. Configure the tunnel destination.
4. Configure a traffic mirroring session.
5. Associate a destination interface with the traffic mirroring session.
6. Run **drops** command to start mirroring forward-drop packets.

Note Forward-drop can be configured using either ERSPAN or sFlow. However, it is recommended not to enable both features simultaneously, as this may lead to router instability.

This example shows how to configure a global traffic mirroring session for forward-drop packets.

```
Router(config)# interface tunnel-ip 2
Router(config-if)# tunnel mode gre ipv4
Router(config-if)# tunnel source 20.20.20.20
Router(config-if)# tunnel destination 192.1.1.3
Router(config-if)# exit
Router(config)# monitor-session mon2 ethernet
Router(config)# destination interface tunnel-ip2
Router(config)# drops packet-processing rx
Router(config)# commit
```

Running Configuration

This section shows forward-drop running configuration.

```
RP/0/RSP0/CPU0:router# show running-config
interface tunnel-ip 2
tunnel mode gre ipv4
tunnel source 20.20.20.20
tunnel destination 192.1.1.3
!
monitor-session mon2 ethernet
destination interface tunnel-ip2
drops packet-processing rx
!
```

Verification

Verify the forward-drop packets are mirrored using the **show monitor-session** command.

```
Router# show monitor-session mon2 status detail
Mon Aug 15 19:14:31.975 UTC
Monitor-session mon2
   Destination interface tunnel-ip2
   All forwarding drops:
      Direction: Rx
Source Interfaces
-----------------
```

Mirroring buffer drop packets

Mirroring buffer drop packets is a network monitoring feature that

- captures packets dropped by a router due to buffer overflow, and
- sends these packets to a monitoring system for analysis.

Table 12: Feature History Table

Feature Name	Release Information	Description
Mirroring buffer drop packets	Release 24.4.1	Introduced in this release on: Fixed Systems(8200, 8700)(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*). This feature which mirrors packets dropped by the Traffic Management (TM) buffer when it is full and starts dropping incoming packets so that the mirrored copy of the dropped packets can be retained and stored is now supported on the following hardware. *This feature is now supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM • 88-LC1-36EH
Mirroring buffer drop packets	Release 24.2.11	The SPAN-to-file and ERSPAN mirroring capability is enhanced to mirror dropped packets by the Traffic Management (TM) buffer when it's full and starts dropping incoming packets. This capability allows you to retain and store a mirrored copy of the dropped packets, and work effectively even during process restarts or network failovers, providing a dependable solution for traffic monitoring. This feature is supported only on Cisco Silicon One P100- and Q200-based routers. This feature introduces the following changes: • **CLI: drops** • **YANG Data Model:**New XPath for `Cisco-IOS-XR-Ethernet-SPAN-cfg.yang` (see GitHub, YANG Data Models Navigator)

Traffic Management (TM) buffer drops can occur for various reasons, primarily due to network congestion. The TM buffer stores packets for processing; however, if it becomes full, it can no longer hold additional packets and starts dropping the packets. This condition occurs when the rate at which the packets arrive is higher than the processing rate of the buffer. With the enhanced SPAN to File and ERSPAN mirroring capability, a mirrored copy of these dropped packets is retained.

This feature covers the following packet drop scenarios:

- The router drops packets when the line rate of incoming traffic is faster than the policer configured on the ingress interface. The reason for dropping these packets is notified as PACKET_GOT_DROPPED_DUE_TO_EXACT_METER (displayed as TM_EXACT_METER_DROP).

- The router drops packets when traffic is sent at a 100% line rate on an ingress interface for regular SPAN to File configuration. The reason for dropping these packets is notified as PACKET_GOT_DROPPED_DUE_TO_STATISTICAL_METER (Displayed as TM_STATISTICAL_METER_DROP).

Benefits of Mirroring Buffer Drop Packets

This feature ensures robust traffic analysis and network performance optimization, even during restarts and failovers:

- Data Preservation: During process restarts, while new packet logging is paused, all previously collected data remains intact, ensuring no critical diagnostic information is lost.
- Control Plane Stability: The operation of this feature remains unaffected by restarts of any control plane process, allowing for uninterrupted traffic analysis.
- Failover Assurance: For interfaces not located on the Route Processor (RP), this feature ensures a seamless failover experience. Traffic mirroring and packet capture proceed without disruption, even amidst hardware changes or network reconfigurations, safeguarding continuous network analysis.

Guidelines and Restrictions for Mirroring Buffer Drop Packets

- SPAN to File Buffer drop is a global configuration, not specific to any interface.
- Mirroring of buffer drop packets is supported only on the ingress interface.
- Only the packets dropped by the reasons TM_EXACT_METER_DROP and TM_STATISTICAL_METER_DROP are mirrored.
- Maximum of one drop session with destination as Span to File and one drop session with destination as ERSPAN can be configured globally per router.
- From Release 24.2.11, one forward-drop session and one TM buffer drop session are supported for file and GRE tunnel interface destinations.
- For ERSPAN sessions that monitor buffer drop packets, a default value of 0 is used for the encapsulation traffic class, irrespective of the DSCP value assigned for the tunnel.
- ERSPAN counters are not updated for buffer drop packets.

Configure Mirroring Buffer Drop Packets

Perform the following tasks on the router to configure a global session for mirroring buffer drop packets:

For SPAN To File destination:

1. Configure a traffic mirroring session.
2. Specify the destination as file.
3. Configure the TM buffer drop session.

For ERSPAN destination:

1. Configure the tunnel mode.
2. Configure the tunnel source.
3. Configure the tunnel destination.
4. Configure a traffic mirroring session.
5. Associate a destination interface with the traffic mirroring session.
6. Configure the TM buffer drop session.

Configuration Example

Enable Feature for SPAN To File Destination

The following example shows how to configure TM buffer drop mirroring for packets for SPAN To File Destination.

```
Router(config)# monitor-session S2F_sessnethernet /* Create a Span To File monitor session
 */
Router(config-mon)# destination file
Router(config-mon)# exit
Router(config)# interface HundredGigE0/0/0/0
Router(config-if)# monitor-session S2F_sessnethernet direction rx-only /* Attach Span To
File monitor session to the interface */
Router(config-if-mon)# exit
Router(config-if)# exit
Router(config)# monitor-session mon1 ethernet /* Create global monitor session for TM drop
 packets */
Router(config-mon)# destination file
Router(config-mon)# drops traffic-management rx /* Enable TM buffer drop feature for SPAN
To File Destination */
Router(config-mon)# commit
```

Enable Feature for ERSPAN Destination

You can use the following example configuration to enable TM buffer drop mirroring for ERSPAN destination.

```
Router(config)# interface tunnel-ip2
Router(config-if)# tunnel mode gre ipv4
Router(config-if)# tunnel source 10.10.10.10
Router(config-if)# tunnel destination 192.0.2.1
Router(config-if) exit
Router(config)# monitor-session mon2 ethernet
Router(config-mon)# destination interface tunnel-ip2
Router(config-mon)# drops traffic-management rx
Router(config)# commit
```

Policer Configuration to check TM_EXACT_METER_DROP Packets

Configure a policer on the ingress interface and send the traffic at a line rate faster than the policer. The router drops the packets with the reason PACKET_GOT_DROPPED_DUE_TO_EXACT_METER (displayed as TM_EXACT_METER_DROP).

```
Router(config)# class-map match-any dscp1
Router(config-cmap)# match dscp ipv4 1
Router(config-cmap)# end-class-map
Router(config)# policy-map test-police-1R2C
Router(config-pmap)# class dscp1
Router(config-pmap-c)# police rate 100 mbps
Router(config-pmap-c-police)# exit
Router(config-pmap-c)# class class-default
Router(config-pmap-c)# police rate 100 mbps
Router(config-pmap-c-police)# exit
Router(config-pmap-c)# end-policy-map
Router(config)# interface HundredGigE0/0/0/0
Router(config-if)# service-policy input test-police-1R2C
Router(config-if)# commit
```

To Check TM_STATISTICAL_METER_DROP Packets

Configure a regular SPAN to File on the ingress interface and send the traffic at 100% line rate. The router drops the packets with the reason PACKET_GOT_DROPPED_DUE_TO_STATISTICAL_METER (Displayed as: TM_STATISTICAL_METER_DROP).

Running Configuration

Enable Feature for SPAN To File Destination

```
Router# show running-config
monitor-session S2F_sess ethernet
 destination file
!
interface HundredGigE0/0/0/0
 monitor-session S2F_sessnethernet direction rx-only
!
monitor-session mon1 ethernet
 destination file
 drops traffic-management rx
!
```

Enable Feature for ERSPAN Destination

```
Router# show running-config
interface tunnel-ip 2
 tunnel mode gre ipv4
 tunnel source 10.10.10.10
 tunnel destination 192.0.2.1
!
monitor-session mon2 ethernet
 destination interface tunnel-ip2
 drops traffic-management rx
!
```

Policer Configuration to check TM_EXACT_METER_DROP Packets

```
Router# show running-config
class-map match-any dscp1
 match dscp ipv4 1
 end-class-map
!
policy-map test-police-1R2C
 class dscp1
  police rate 100 mbps
  !
 !
 class class-default
  police rate 100 mbps
  !
 !
 end-policy-map
!
interface configure HundredGigE0/0/0/0
 service-policy input test-police-1R2C
!
```

Verification

Verify the buffer drop packets are mirrored using the **show monitor-session status** command.

```
Router# show monitor-session status
Monitor-session mon1
Destination File - Not collecting
==========================================================================================
SW Mirrored Packet Type Dir
----------------------- ----
TM Drops                Rx
```

To Verify TM_STATISTICAL_METER_DROP and TM_EXACT_METER_DROP Packets

The Packets Accepted counter of the statistical meter dropped packets and exact meter dropped packets in **show controllers npu stats traps-all** should match the "SPAN drop" counter in **show spp node-counters** within an acceptable range. This is because the statistics displayed are not updated in real-time; they refresh every 30 seconds from the hardware.

```
Router# show controllers npu stats traps-all instance all location 0/RP0/CPU0
Trap Type                                NPU  Trap  Punt       Punt  Punt  Punt Configured
 Hardware   Policer Avg-Pkt Packets                 Packets
                                          ID   ID    Dest       VoQ   VLAN  TC   Rate(pps)
  Rate(pps)  Level   Size    Accepted             Dropped
==========================================================================================
TM_EXACT_METER_DROP                      0    256  RPLC_CPU    208   1538  0    542
   523    NPU     N/A     25              18167604
TM_STATISTICAL_METER_DROP                0    257  RPLC_CPU    208   1538  0    542
   523    NPU     N/A     31143           18167604

Router# show spp node-counters location all | i SPAN
SPAN to File: 55724
SPAN drop: 31168
```

Introduction to file mirroring

Table 13: Feature History Table

Feature Name	Release Information	Description
File mirroring	Release 7.0.14	This feature enables the router to copy files and directories automatically from an active RP to a standby RP thus eliminating the manual intervention or the use of EEM scripts.

Prior to Cisco IOS XR Software Release 7.2.1 7.0.14, the router did not support file mirroring from active RP to standby RP. Administrators had to manually perform the task or use EEM scripts to sync files across active RP and standby RP. Starting with Cisco IOS XR Software Release 7.0.14, file mirroring feature enables the router to copy files or directories automatically from `/harddisk:/mirror` location in active RP to `/harddisk:/mirror` location in standby RP or RSP without user intervention or EEM scripts.

Two new CLIs have been introduced for the file mirroring feature:

- **`mirror enable`**

  The `/harddisk:/mirror` directory is created by default, but file mirroring functionality is only enabled by executing the `mirror enable` command from configuration terminal. Status of the mirrored files can be viewed with `show mirror status` command.

- **`mirror enable checksum`**

The `mirror enable checksum` command enables MD5 checksum across active to standby RP to check integrity of the files. This command is optional.

Limitations

The following limitations apply to file mirroring:

- Supported only on Dual RP systems.
- Supports syncing only from active to standby RP. If files are copied into standby `/harddisk:/mirror` location, it won't be synced to active RP.
- A slight delay is observed in `show mirror` command output when mirror checksum configuration is enabled.
- Not supported on multichassis systems.

Configure File Mirroring

File mirroring has to be enabled explicitly on the router. It is not enabled by default.

```
RP/0/RSP0/CPU0:router#show run mirror

Thu Jun 25 10:12:17.303 UTC
mirror enable
mirror checksum
```

Following is an example of copying running configuration to `harddisk:/mirror` location:

```
RP/0/RSP0/CPU0:router#copy running-config harddisk:/mirror/run_config
Wed Jul  8 10:25:51.064 PDT
Destination file name (control-c to abort): [/mirror/run_config]?
Building configuration..
32691 lines built in 2 seconds (16345)lines/sec
[OK]
```

Verification

To verify the syncing of file copied to mirror directory, use the `show mirror` command.

```
RP/0/RSP0/CPU0:router#show mirror
Wed Jul  8 10:31:21.644 PDT
% Mirror rsync is using checksum, this show command may take several minutes if you have
many files. Use Ctrl+C to abort
MIRROR DIR: /harddisk:/mirror/
% Last sync of this dir ended at Wed Jul  8 10:31:11 2020
Location   |Mirrored |MD5 Checksum                     |Modification Time
--------------------------------------------------------------------------
run_config |yes      |76fc1b906bec4fe08ecda0c93f6c7815 |Wed Jul  8 10:25:56 2020
```

If checksum is disabled, `show mirror` command displays the following output:

```
RP/0/RSP0/CPU0:router#show mirror
Wed Jul 8 10:39:09.646 PDT
MIRROR DIR: /harddisk:/mirror/
% Last sync of this dir ended at Wed Jul  8 10:31:11 2020
Location   |Mirrored |Modification Time
-----------------------------------------
run_config |yes         |Wed Jul  8 10:25:56 2020
```

If there is a mismatch during the syncing process, use `show mirror mismatch` command to verify.

```
RP/0/RP0/CPU0:router# show mirror mismatch
Wed Jul  8 10:31:21.644 PDT
 MIRROR DIR: /harddisk:/mirror/
 % Last sync of this dir ended at Wed Jul  8 10:31:11 2020
 Location  |Mismatch Reason     |Action Needed
------------------------------------------------
 test.txt  |newly created item. |send to standby
```

Traffic Mirroring Configuration Examples

This section contains examples of how to configure traffic mirroring:

Viewing Monitor Session Status: Example

This example shows sample output of the **show monitor-session** command with the **status** keyword:

```
RP/0/RP0/CPU0:router# show monitor-session status

Monitor-session cisco-rtp1
Destination interface HundredGigE0/5/0/38
================================================================================
Source Interface   Dir  Status
--------------------- ---- ----------------------------------------------------
Gi0/5/0/4         Rx Operational
Gi0/5/0/17        Rx Operational

RP/0/RP0/CPU0:router# show monitor-session status detail

Monitor-session sess1
 Destination interface is not configured
 Source Interfaces
 -----------------
 HundredGigE0/0/0/0
  Direction: Rx
  ACL match: Enabled
  Portion:  Full packet
  Status:  Not operational (destination interface not known).
 HundredGigE0/0/0/2
  Direction: Rx
  ACL match: Disabled
  Portion:  First 100 bytes

RP/0/RP0/CPU0:router# show monitor-session status error

Monitor-session ms1
Destination interface HundredGigE0/2/0/15 is not configured
================================================================================
Source Interface   Dir  Status
--------------------- ---- ----------------------------------------------------

Monitor-session ms2
Destination interface is not configured
================================================================================
Source Interface   Dir  Status
--------------------- ---- ----------------------------------------------------
```

Monitor Session Statistics: Example

The monitor session statistics is provided in the form of packets and bytes. Use the following command to get the status:

```
RP/0/RP0/CPU0:router# show monitor-session <session_name> status internal
RP/0/RP0/CPU0:Router1#show monitor-session mon2 status internal
Wed Oct  9 19:39:30.402 UTC
Information from SPAN Manager and MA on all nodes:
Monitor-session mon2 (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination interface tunnel-ip2 (0x0f000034)
          Last error: Success
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.1.1.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set
0/1/CPU0: Destination interface tunnel-ip2 (0x0f000034)
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.1.1.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set

Information from SPAN EA on all nodes:
Monitor-session 0x00000001 (Ethernet)
0/1/CPU0: Name 'mon2', destination interface tunnel-ip2 (0x0f000034)
Platform, 0/1/CPU0:

  Monitor Session ID: 1

  Monitor Session Packets: 11
  Monitor Session Bytes: 1764

0/2/CPU0: Name 'mon2', destination interface tunnel-ip2 (0x0f000034)
Platform, 0/2/CPU0:

  Monitor Session ID: 1

  Monitor Session Packets: 0
  Monitor Session Bytes: 0
```

Note

- Currently, the system does not allow you to clear these counters.
- The counters are present on the line-card that contains the interface over which the mirrored packets are sent to the ERSPAN session destination.

  If required, to clear the counters, delete and recreate the monitor session. Also, clear the counters by performing a Shut/No Shut of the tunnel interface, which triggers a Delete+Create action.

Layer 3 ACL-Based Traffic Mirroring: Example

This example shows how to configure Layer 3 ACL-based traffic mirroring:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# monitor-session ms1
RP/0/RP0/CPU0:router(config-mon)# destination tunnel-ip 1

RP/0/RP0/CPU0:router(config-mon)# commit

RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# interface HundredGigE/2/0/11
RP/0/RP0/CPU0:router(config-if)# ipv4 access-group span ingress
RP/0/RP0/CPU0:router(config-if)# monitor-session ms1 ethernet direction rx-only acl
RP/0/RP0/CPU0:router(config-if-mon)# commit

RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# ipv4 access-list span
RP/0/RP0/CPU0:router(config-ipv4-acl)# 5 permit ipv4 any any dscp 5 capture
RP/0/RP0/CPU0:router(config-ipv4-acl)# 10 permit ipv4 any any
RP/0/RP0/CPU0:router(config-ipv4-acl)# commit
```

Troubleshooting Traffic Mirroring

When you encounter any issue with traffic mirroring, begin troubleshooting by checking the output of the **show monitor-session status** command. This command displays the recorded state of all sessions and source interfaces:

```
Monitor-session sess1
<Session status>
================================================================================
Source Interface   Dir  Status
--------------------- ---- ----------------------------------------------------
Gi0/0/0/0       Both <Source interface status>
Gi0/0/0/2       Both <Source interface status>
```

In the preceding example, the line marked as `<Session status>` can indicate one of these configuration errors:

Session Status	Explanation
Session is not configured globally	The session does not exist in global configuration. Check **show run** command output to ensure that a session with a correct name has been configured.
Destination interface <intf> is not configured	The interface that has been configured as the destination does not exist. For example, the destination interface may be configured to be a VLAN subinterface, but the VLAN subinterface may not have been yet created.

Session Status	Explanation
Destination interface <intf> (<down-state>)	The destination interface is not in Up state in the Interface Manager. You can verify the state using the **show interfaces** command. Check the configuration to see what might be keeping the interface from coming up (for example, a sub-interface needs to have an appropriate encapsulation configured).

The <Source interface status> can report these messages:

Source Interface Status	Explanation
Operational	Everything appears to be working correctly in traffic mirroring PI. Please follow up with the platform teams in the first instance, if mirroring is not operating as expected.
Not operational (Session is not configured globally)	The session does not exist in global configuration. Check the **show run** command output to ensure that a session with the right name has been configured.
Not operational (destination interface not known)	The session exists, but it either does not have a destination interface specified, or the destination interface named for the session does not exist (for example, if the destination is a sub-interface that has not been created).
Not operational (source same as destination)	The session exists, but the destination and source are the same interface, so traffic mirroring does not work.
Not operational (destination not active)	The destination interface or pseudowire is not in the Up state. See the corresponding *Session status* error messages for suggested resolution.
Not operational (source state <down-state>)	The source interface is not in the Up state. You can verify the state using the **show interfaces** command. Check the configuration to see what might be keeping the interface from coming up (for example, a sub-interface needs to have an appropriate encapsulation configured).
Error: see detailed output for explanation	Traffic mirroring has encountered an error. Run the **show monitor-session status detail** command to display more information.

The **show monitor-session status detail** command displays full details of the configuration parameters, and of any errors encountered. For example:

```
RP/0/RP0/CPU: router#show monitor-session status detail


Monitor-session sess1
 Destination interface is not configured
 Source Interfaces
 -----------------
 HundredGigE0/0/0/0
  Direction: Both
  ACL match: Enabled
  Portion:  Full packet
  Status:  Not operational (destination interface not known)
 HundredGigE0/0/0/2
  Direction: Both
  ACL match: Disabled
  Portion:  First 100 bytes
  Status: Not operational (destination interface not known). Error: 'Viking SPAN PD' detected
 the 'warning' condition 'PRM connection creation failure'.
Monitor-session foo
 Destination next-hop HundredGigE 0/0/0/0
 Source Interfaces
 -----------------
 HundredGigE 0/1/0/0.100:
  Direction: Both
  Status:  Operating
 HundredGigE 0/2/0/0.200:
  Direction: Tx
  Status:  Error: <blah>

Monitor session bar
 No destination configured
 Source Interfaces
 -----------------
 HundredGigE 0/3/0/0.100:
  Direction: Rx
  Status:  Not operational(no destination)
```

Additional Debugging Commands

Here are additional trace and debug commands:

```
RP/0/RP0/CPU0:router# show monitor-session platform trace ?

 all   Turn on all the trace
 errors Display errors
 events Display interesting events

RP/0/RP0/CPU0:router# show monitor-session trace ?

 process Filter debug by process

RP/0/RP0/CPU0:router# debug monitor-session platform ?

 all   Turn on all the debugs
 errors VKG SPAN EA errors
 event  VKG SPAN EA event
 info  VKG SPAN EA info

RP/0/RP0/CPU0:router# debug monitor-session platform all

RP/0/RP0/CPU0:router# debug monitor-session platform event

RP/0/RP0/CPU0:router# debug monitor-session platform info

RP/0/RP0/CPU0:router# show monitor-session status ?

 detail  Display detailed output
 errors  Display only attachments which have errors
 internal Display internal monitor-session information
 |     Output Modifiers

RP/0/RP0/CPU0:router# show monitor-session status

RP/0/RP0/CPU0:router# show monitor-session status errors

RP/0/RP0/CPU0:router# show monitor-session status internal
```

If there is no route to the destination IPv4 address, the status displayed for the monitor session looks like this:

```
RP/0/RP0/CPU0:Router1#show monitor-session mon2 status internal
Wed Oct  9 19:24:06.084 UTC
Information from SPAN Manager and MA on all nodes:
Monitor-session mon2 (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination interface tunnel-ip2 (0x0f000034) (down)
          Last error: Success
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.10.10.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set
0/1/CPU0: Destination interface  is not configured
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.10.10.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set
```

To verify if there is a route to the destination IPv4 address, use the following command:

```
RP/0/RP0/CPU0:Router1#show cef ipv4 130.10.10.2
Wed Oct  9 19:25:12.282 UTC
0.0.0.0/0, version 0, proxy default, default route handler, drop adjacency, internal 0x1001011
 0x0 (ptr 0x8e88d2b8) [1], 0x0 (0x8ea4d0a8), 0x0 (0x0)
Updated Oct  9 19:03:36.068
Prefix Len 0, traffic index 0, precedence n/a, priority 15
   via 0.0.0.0/32, 3 dependencies, weight 0, class 0 [flags 0x0]
    path-idx 0 NHID 0x0 [0x8e2db240 0x0]
    next hop 0.0.0.0/32
     drop adjacency
```

When a route is present, the command used in the previous example displays the following:

```
RP/0/RP0/CPU0:Router1#show cef ipv4 130.10.10.2
Wed Oct  9 19:26:06.141 UTC
130.1.1.0/24, version 20, internal 0x1000001 0x0 (ptr 0x8e88aa18) [1], 0x0 (0x8ea4dc68),
0x0 (0x0)
Updated Oct  9 19:26:02.139
Prefix Len 24, traffic index 0, precedence n/a, priority 3
   via 131.1.1.1/32, HundredGigE0/1/0/2, 2 dependencies, weight 0, class 0 [flags 0x0]
    path-idx 0 NHID 0x0 [0x8f8e2260 0x0]
    next hop 131.10.10.1/32
    local adjacency
```

The show monitor command displays the following:

```
show monitor-session mon2 status internal
Wed Oct  9 19:26:12.405 UTC
Information from SPAN Manager and MA on all nodes:
```

```
Monitor-session mon2 (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination interface tunnel-ip2 (0x0f000034)
          Last error: Success
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.10.10.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set
0/1/CPU0: Destination interface tunnel-ip2 (0x0f000034)
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.10.10.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set

Information from SPAN EA on all nodes:
Monitor-session 0x00000001 (Ethernet)
0/1/CPU0: Name 'mon2', destination interface tunnel-ip2 (0x0f000034)
Platform, 0/1/CPU0:

  Monitor Session ID: 1

  Monitor Session Packets: 0
  Monitor Session Bytes: 0

0/2/CPU0: Name 'mon2', destination interface tunnel-ip2 (0x0f000034)
Platform, 0/2/CPU0:

  Monitor Session ID: 1

  Monitor Session Packets: 0
  Monitor Session Bytes: 0

Missing ARP to the next hop to the destination
This condition is detected via this show command:
show monitor-session mon2 status internal
```

After resolving ARP for the next hop, which is done by invoking a ping command to the destination, the show command output displays the following:

```
RP/0/RP0/CPU0:Router1#show monitor-session mon2 status internal
Wed Oct  9 19:32:24.856 UTC
Information from SPAN Manager and MA on all nodes:
Monitor-session mon2 (ID 0x00000001) (Ethernet)
SPAN Mgr: Destination interface tunnel-ip2 (0x0f000034)
          Last error: Success
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.10.10.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set
0/1/CPU0: Destination interface tunnel-ip2 (0x0f000034)
          Tunnel data:
            Mode: GREoIPv4
            Source IP: 2.2.2.2
            Dest IP: 130.10.10.2
            VRF:
            ToS: 0 (copied)
            TTL: 255
            DFbit: Not set

Information from SPAN EA on all nodes:
Monitor-session 0x00000001 (Ethernet)
0/1/CPU0: Name 'mon2', destination interface tunnel-ip2 (0x0f000034)
Platform, 0/1/CPU0:

  Monitor Session ID: 1
    Monitor Session Packets: 0
  Monitor Session Bytes: 0

0/2/CPU0: Name 'mon2', destination interface tunnel-ip2 (0x0f000034)
Platform, 0/2/CPU0:

  Monitor Session ID: 1
    Monitor Session Packets: 0
  Monitor Session Bytes: 0
```

Where to Go Next

When you have configured an Ethernet interface, you can configure individual VLAN subinterfaces on that Ethernet interface.

For information about modifying Ethernet management interfaces for the shelf controller (SC), route processor (RP), and distributed RP, see the Advanced Configuration and Modification of the Management Ethernet Interface later in this document.

For information about IPv6 see the Implementing Access Lists and Prefix Lists on

Cisco IOS XR Software module in the Cisco IOS XR IP Addresses and Services Configuration Guide.