JUNIPER NETWORKS

Network Configuration Example

Configuring Active Flow Monitoring Version 9

Release

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Release 11.1

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Flow Monitoring Overview

The flow monitoring application performs traffic flow monitoring and enables lawful interception of packets transiting between two routers. Traffic flows can either be passively monitored by an offline router or actively monitored by a router participating in the network.

Using a Juniper Networks router, a selection of Physical Interface Cards (PICs) for M Series and T Series routers—including the Monitoring Services PIC, Monitoring Services II PIC, Adaptive Services PIC, and MultiServices PICs—and other networking hardware, you can monitor traffic flow and export the monitored traffic. Monitoring traffic allows you to do the following:

- Gather and export detailed information about traffic flows between source and destination routers in your network.
- Sample all incoming traffic on the monitoring interface and present the data in record format.
- Encrypt or tunnel outgoing records, intercepted traffic, or both.
- Direct filtered traffic to different packet analyzers and present the data in its original format.
- Intercept unwanted traffic, discard it, and perform accounting on the discarded packets.

There are two main types of flow monitoring:

- Active Flow Monitoring
- Passive Flow Monitoring

Related Documentation

- Active Flow Monitoring Overview on page 3
- Passive Flow Monitoring Overview

Active Flow Monitoring Overview

Flow monitoring versions 5, 8, and 9 support active flow monitoring. For active flow monitoring, the monitoring station participates in the network as an active router. The major actions the router can perform during active flow monitoring are as follows:

- Sampling—The router selects and analyzes only a portion of the traffic.
- Sampling with templates—The router selects, analyzes, and arranges a portion of the traffic into templates.
- Sampling per sampling instance—The router selects, analyzes, and arranges a portion of the traffic according to the configuration and binding of a sampling instance.
- Port mirroring—The router copies entire packets and sends the copies to another interface.
- Multiple port mirroring—The router sends multiple copies of monitored packets to multiple export interfaces with the **next-hop-group** statement at the **[edit forwarding-options]** hierarchy level.
- Discard accounting—The router accounts for selected traffic before discarding it. Such traffic is not forwarded out of the router. Instead, the traffic is quarantined and deleted.
- Flow-tap processing—The router processes requests for active flow monitoring dynamically by using the Dynamic Tasking Control Protocol (DTCP).

Related Documentation

- Flow Monitoring Overview on page 1
- Passive Flow Monitoring Overview

Active Flow Monitoring Applications

Flow monitoring can be used for many different reasons such as network planning, accounting, usage-based network billing, security, and monitoring for Denial of Service attacks.

Some examples of the types of things you can use flow monitoring for are:

- Tracking what kind of traffic is entering or exiting an ISP or corporate network.
- Tracking traffic flows between BGP autonomous systems.
- Tracking traffic flows between enterprise network regions.
- Taking a snapshot of the existing QoS policy results prior to making changes in QoS policy in case you need to roll back changes later in the process.
- Verifying that load balancing techniques are performing as intended.
- Capturing a base line of current network performance prior to making changes intended to improve performance so that you know if the changes are helping.
- Discovering if network users at an enterprise are using bandwidth for work-related activities or for non work-related activities.

Examples of how flow monitoring helps with network administration include the following:

- A large service provider uses active flow monitoring on its core uplinks as a way to collect data on the protocols in use, packet sizes, and flow durations to better understand the usage of its Internet service offering. This helps the provider understand where network growth is coming from.
- IP Service Providers bill customers for the data sent or bandwidth used by sending captured flow data to third-party billing software.
- At a large enterprise, VoIP users at the remote site complained of poor voice quality. The flow monitoring reports showed that the VoIP traffic did not have the correct type of service settings.
- Users on an enterprise network, were reporting network slowdowns. The flow monitoring reports showed that one user's PC was generating a large portion of the network traffic. The PC was infected with malware.
- A growing enterprise was planning a deployment of new business management software and needed to know what type of network bandwidth demand the new software would create. During the software trial period, flow monitoring reports were used to identify the expected increase in traffic.

Thus, while flow monitoring is traditionally associated with traffic analysis, it also has a role in accounting and security.

Related Documentation

- Flow Monitoring Overview on page 1
- Active Flow Monitoring Overview on page 3

Best Practices for Configuring Active Flow Monitoring Version 9

Four settings control the behavior of active flow monitoring: Sampling rate, sampling run-length, flow active timeout, and flow inactive timeout. When you tune these settings, consider the following:

- Choosing a higher sampling rate or higher run-length increases the load on the Services PIC.
- Selecting a higher sampling rate collects more information and provides finer grain flow information.
- A nonzero run-length provides trailing context regarding the packets immediately following a triggered sample.
- Selecting a larger active or inactive timeout value reduces the load on the export CPU and reduces the rate of packets going to the flow collector.

Active and Inactive Timeouts

A flow is considered inactive if a packet matching the filter is not received for a duration longer than the inactive timeout value.

Flow monitoring tracks flows as unidirectional streams of packets. It is not aware of application-level session properties or protocol details. However, there is some minimal awareness of TCP/IP properties. A flow is considered inactive when a TCP FIN, FIN-ACK, or RST control signal is received.

When the inactive timeout is triggered, the services PIC purges the flow from its flow table and generates an export record for the flow.

The inactive timeout can be set to as small a value as can be handled considering the load on the services PIC. The inactive timeout is typically several seconds (30 to 60 seconds). The administrator can tune the timeout to a larger value to try to reduce the load on the control CPU. The effectiveness of this setting for reducing CPU load depends on the overall input flow rate and the rate at which flows are expiring.

In a similar manner, an active timeout is triggered when the active timer expires and the flow is still active. The active timeout is intended to capture information about long-lived flows.

In the absence of an active timeout mechanism, it is possible that a collector will not receive any information on a flow until it expires due to inactivity. Hence, the goal is to send periodic updates about a flow that has not expired.

When an active timeout is triggered, the flow start timestamp is not reset. Therefore, the collector can correlate a sequence of active timeout export packets and use the start time to identify long-lived flows, such as bulk transfers like FTP and peer-to-peer downloads of large files.

It is recommended to have a higher value for active timeout. Typical settings are in the range of several minutes (up to 10 minutes).

Sampling Rate

There is extensive research that helps identify the best choice for a sampling rate. Duffield et al (Properties and Prediction of Flow Statistics from Sampled Packet Streams, ACM SIGCOMM 2002) consider a variety of objectives and recommend heuristics and formulas to compute the sampling rate.

If the objective is to obtain an accurate measurement of the original number of packets, the error in an estimate derived from sampled packets reduces in proportion to the square root of the sampling rate. For example, if the sampling rate is 100 and the original number of packets is 1 million, the expected error is on the order of (100/1,000,000) or about 1 percent. In other words, if the sampled packet count is 10,000, the original packet count can be in the range 990k to 1.01 million. This agrees with the idea that a higher sampling rate reduces the error in estimation.

Sampling Run Length

The run-length statement specifies the number of matching packets to sample following the initial one-packet trigger event. By default, the run-length is 0, which means that no more traffic is sampled after the trigger event. The range is from 0 through 20 packets. Configuring a run length greater than 0 allows you to sample packets following those already being sampled.

Related Documentation

- Flow Monitoring Overview on page 1
- Active Flow Monitoring Overview on page 3
- Active Flow Monitoring Applications on page 5
- Example: Configuring Active Flow Monitoring Version 9 for IPv4 on page 9
- Example: Configuring Active Flow Monitoring Version 9 for IPv6 on page 17
- Example: Configuring Active Flow Monitoring Version 9 for MPLS on page 25
- Example: Configuring Active Flow Monitoring Version 9 for MPLS and IPv4 on page 33

Example: Configuring Active Flow Monitoring Version 9 for IPv4

Requirements

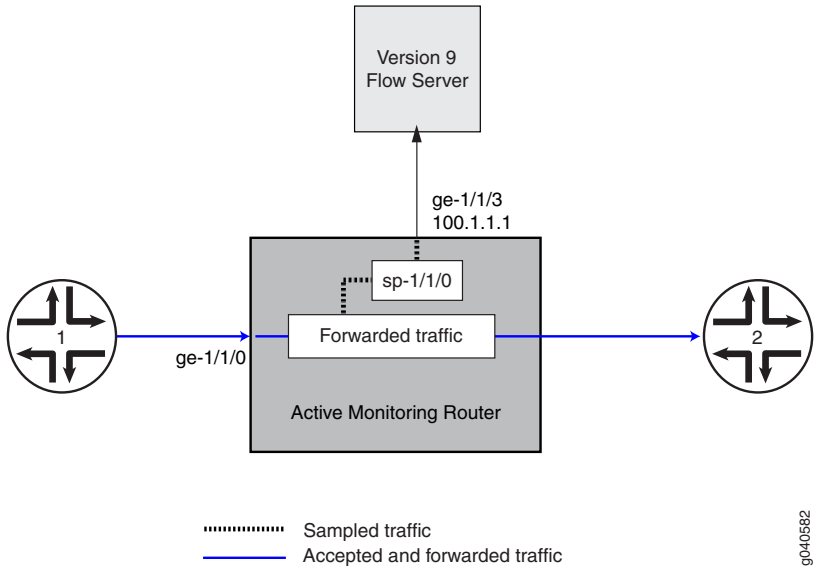
This example requires the following hardware and software components:

- Junos OS Release 9.2 or later
- One M40e or M320 Multiservice Edge Router, MX Series Ethernet Services Router, or T Series Core Router
- One Adaptive Services PIC

Overview of Flow Monitoring

This example provides a step-by-step procedure for monitoring IPv4 flows and troubleshooting the configuration.

The physical connections used in this example are shown in Figure 1 on page 9.



Configuring Active Flow Monitoring Version 9 for IPv4

Step-by-Step Procedure

1. Enable the services PIC interface to process IPv4 addresses by including the **family** statement and specifying the **inet** option at the **[edit interfaces sp-1/1/0 unit 0]** hierarchy level.

```
[edit interfaces]
sp-1/1/0 {
  unit 0 {
    family inet;
```

```
    }
  }
```

2. Configure the interface connected to the flow collector by including the **address** statement and specifying **100.1.1.1/24** as the IPv4 address of the interface at the **[edit interfaces ge-1/1/3 unit 0 family inet]** hierarchy level.

```
[edit interfaces]
ge-1/1/3 {
  description to-flow-collector;
  unit 0 {
    family inet {
      address 100.1.1.1/24;
    }
  }
}
```

3. Create a version 9 template by including the **template** statement and specifying **v4_template** as the name of the template at the **[edit services flow-monitoring version9]** hierarchy level.

   Enable the template for IPv4 flows by including the **ipv4-template** statement at the **[edit services flow-monitoring version9 template v4_template]** hierarchy level.

   Configure the flow active timeout by including the **flow-active-timeout** statement and specifying **600** seconds at the **[edit services flow-monitoring version9 template v4_template]** hierarchy level. Configure the flow inactive timeout by including the **flow-inactive-timeout** statement and specifying **30** seconds at the **[edit services flow-monitoring version9 template v4_template]** hierarchy level.

```
[edit services]
flow-monitoring {
  version9 {
    template v4_template {
      flow-active-timeout 600;
      flow-inactive-timeout 30;
      ipv4-template;
    }
  }
}
```

4. Since version 9 flow monitoring traffic is unidirectional from the monitor (router) to the flow collector, you must configure the monitor to send template definitions and options, such as sampling rate, to the collector.

   Configure the rate at which the router sends template definitions and options to the flow collector. In this example, the template definitions and options are refreshed every 3600 seconds or 480000 packets, whichever occurs first.

   Include the **packets** statement and specify **480000** packets at the **[edit services flow-monitoring version9 template v4_template template-refresh-rate]** and **[edit services flow-monitoring version9 template v4_template option-refresh-rate]** hierarchy levels. Include the **seconds** statement and specify **3600** seconds at the **[edit services flow-monitoring template v4_template version9 template-refresh-rate]** and **[edit services flow-monitoring version9 template v4_template option-refresh-rate]** hierarchy levels.

```
[edit services flow-monitoring version9 template v4_template]
template-refresh-rate {
    packets 480000;
    seconds 3600;
}
option-refresh-rate {
    packets 480000;
    seconds 3600;
}
```

5. Configure the sampling rate. The sampling rate determines the ratio of the number of packets to be sampled. For example, if you specify a rate of 10, 1 out of every 10 packets is sampled. In this example the rate is 1 out of every 1 packets.

   Sampling can be configured as a global chassis configuration that is applicable to all Flexible PIC Concentrators (FPCs) and Dense Port Concentrators (DPCs) at the **[edit forwarding-options sampling input]** hierarchy level. Sampling can also be configured at the **[edit forwarding-options sampling instance *instance-name*]** hierarchy level and then applied to a single FPC.

   Also configure the run length. The run length sets the number of samples to be taken following the initial trigger event. This allows you to sample packets following those already being sampled. Since you are sampling every packet in this example, the run length can be set to 1.

   To configure the rate, include the **rate** statement and specify **1** as the rate at the **[edit forwarding-options sampling instance ins1 input]** hierarchy level. To configure the run length, include the **run-length** statement and specify **1** as the run length at the **[edit forwarding-options sampling instance ins1 input]** hierarchy level.

```
[edit forwarding-options]
sampling {
    instance ins1 {
        input {
            rate 1;
            run-length 1;
        }
    }
}
```

6. Apply the sampling instance to the desired FPC or DPC.

   To apply the sampling instance, include the **sampling-instance** statement and specify **ins1** at the **[edit chassis fpc 1]** hierarchy level.

```
[edit]
chassis {
    fpc 1 {
        sampling-instance ins1;
    }
}
```

7. Configure the flow collector and enable active flow monitoring using the version 9 template format.

   To configure the flow collector, include the **flow-server** statement and specify the IP address of the host system that is collecting traffic flows using version 9 at the

[edit forwarding-options sampling instance ins1 family inet output] hierarchy level. Also include the **port** statement and specify UDP port **2055** for use by the flow collector.

To enable active flow monitoring using the version 9 template format, include the **template** statement and specify **v4_template** as the name of the template to use at the **[edit forwarding-options sampling instance ins1 family inet output flow-server 100.1.1.2 version9]** hierarchy level.

```
[edit forwarding-options sampling instance ins1]
family inet {
  output {
    flow-server 100.1.1.2 {
      port 2055;
      version9 {
        template v4_template;
      }
    }
  }
}
```

8. Configure the IPv4 source address for the services PIC to be used in flow export.

   To configure the IPv4 source address for the **sp-1/1/0** interface, include the **source-address** statement and specify **12.1.1.1** at the **[edit forwarding-options sampling instance ins1 family inet output interface sp-1/1/0]** hierarchy level.

```
[edit forwarding-options sampling instance ins1 family inet output]
interface sp-1/1/0 {
  source-address 12.1.1.1;
}
```

9. Configure the firewall filter. The firewall filter identifies the traffic flows that need to be sampled and processed by the services PIC. Note that the implied from clause in the filter determines the packets that are matched and sampled according to the sampling rate.

   To configure the firewall filter, include the **filter** statement and specify **ipv4_sample_filter** as the name of the filter at the **[edit firewall family inet]** hierarchy level. Include the **term** statement and specify **1** as the name of the term. For active monitoring using version 9, you must include the **sample** and **accept** action statements at the **[edit firewall family inet filter ipv4_sample_filter term 1 then]** hierarchy level.

```
[edit firewall]
family inet {
  filter ipv4_sample_filter {
    term 1 {
      then {
        sample;
        accept;
      }
    }
  }
}
```

10. Apply the firewall filter to the set of media interfaces where traffic flow needs to be sampled. The filter can be applied to either the ingress or egress traffic depending on the use case. In this example, the filter is applied to the ingress (input) traffic.

    To apply the firewall filter to the **ge-1/1/0** interface, include the **input** statement and specify **ipv4_sample_filter** as the name of the filter at the **[edit interfaces ge-1/1/0 unit 0 family inet filter]** hierarchy level.

```
[edit]
interfaces {
   ge-1/1/0 {
      unit 0 {
         family inet {
            filter {
               input ipv4_sample_filter;
            }
         }
      }
   }
}
```

11. To display the configuration for the flow collector, use the **show configuration** command.

    For your reference, the relevant sample configuration for the IPv4 flow collector follows.

```
[edit]
services {
   flow-monitoring {
      version9 {
         template v4_template {
            flow-active-timeout 600;
            flow-inactive-timeout 30;
            template-refresh-rate {
               packets 480000;
               seconds 3600;
            }
            option-refresh-rate {
               packets 480000;
               seconds 3600;
            }
            ipv4-template;
         }
      }
   }
}
forwarding-options {
   sampling {
      instance ins1 {
         input {
            rate 1;
            run-length 1;
         }
         family inet {
            output {
```

```
            flow-server 100.1.1.2 {
              port 2055;
              version9 {
                template v4_template;
              }
            }
            interface sp-1/1/0 {
              source-address 12.1.1.1;
            }
          }
        }
      }
    }
  }
  chassis {
    fpc 1 {
      sampling-instance ins1;
    }
  }
  firewall {
    family inet {
      filter ipv4_sample_filter {
        term 1 {
          then {
            sample;
            accept;
          }
        }
      }
    }
  }
  interfaces {
    ge-1/1/0 {
      description media-interface-for-sampling;
      unit 0 {
        family inet {
          filter {
            input ipv4_sample_filter;
          }
        }
      }
    }
    sp-1/1/0 {
      description sampling-services-pic;
      unit 0 {
        family inet;
      }
    }
    ge-1/1/3 {
      description to-flow-collector;
      unit 0 {
        family inet {
          address 100.1.1.1/24;
        }
      }
    }
```

```
}
```

Related Documentation

- Flow Monitoring Overview on page 1
- Active Flow Monitoring Overview on page 3
- Active Flow Monitoring Applications on page 5
- Best Practices for Configuring Active Flow Monitoring Version 9 on page 7
- Example: Configuring Active Flow Monitoring Version 9 for IPv6 on page 17
- Example: Configuring Active Flow Monitoring Version 9 for MPLS on page 25
- Example: Configuring Active Flow Monitoring Version 9 for MPLS and IPv4 on page 33

Example: Configuring Active Flow Monitoring Version 9 for IPv6

Requirements

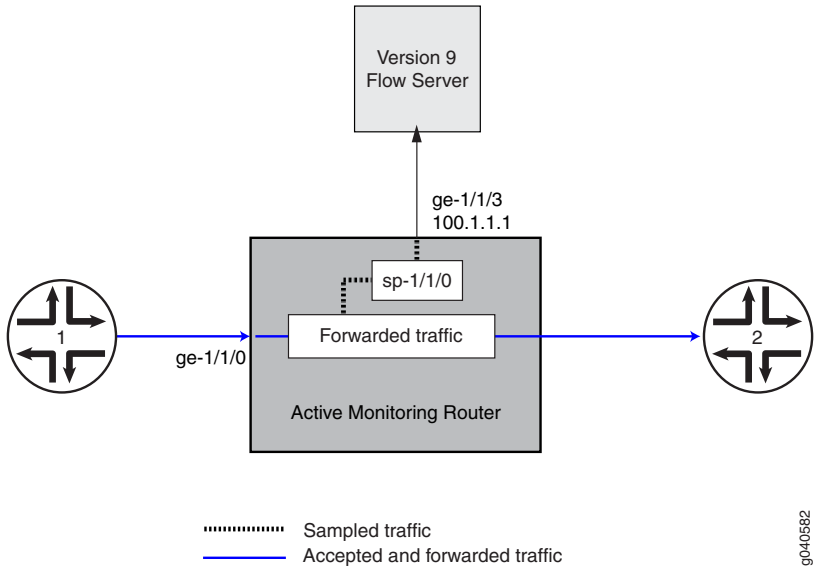
This example requires the following hardware and software components:

- Junos OS Release 9.2 or later
- One M Series Multiservice Edge Router, MX Series Ethernet Services Router, or T Series Core Router
- One Adaptive Services PIC

Overview of Flow Monitoring

This example provides a step-by-step procedure for monitoring IPv6 flows and troubleshooting the configuration.

The physical connections used in this example are shown in Figure 2 on page 17.



Configuring Active Flow Monitoring Version 9 for IPv6

Step-by-Step Procedure

1. Enable the services PIC interface to process IPv6 addresses by including the **family** statement and specifying the **inet6** option at the **[edit interfaces sp-1/1/0 unit 0]** hierarchy.

```
[edit interfaces]
sp-1/1/0 {
  unit 0 {
    family inet6;
```

```
    }
  }
```

2. Configure the interface connected to the flow collector by including the **address** statement and specifying **100.1.1.1/24** as the IPv4 address of the interface at the **[edit interfaces ge-1/1/3 unit 0 family inet]** hierarchy level.

```
[edit interfaces]
ge-1/1/3 {
  description to-flow-collector;
  unit 0 {
    family inet {
      address 100.1.1.1/24;
    }
  }
}
```

3. Create a version 9 template by including the **template** statement and specifying **v6_template** as the name of the template at the **[edit services flow-monitoring version9]** hierarchy level.

   Enable the template for IPv6 flows by including the **ipv6-template** statement at the **[edit services flow-monitoring version9 template v6_template]** hierarchy level.

   Configure the flow active timeout by including the **flow-active-timeout** statement and specifying **600** seconds at the **[edit services flow-monitoring version9 template v6_template]** hierarchy level. Configure the flow inactive timeout by including the **flow-inactive-timeout** statement and specifying **30** seconds at the **[edit services flow-monitoring version9 template v6_template]** hierarchy level.

```
[edit services]
flow-monitoring {
  version9 {
    template v6_template {
      flow-active-timeout 600;
      flow-inactive-timeout 30;
      ipv6-template;
    }
  }
}
```

4. Since version 9 flow monitoring traffic is unidirectional from the monitor (router) to the flow collector, you must configure the monitor to send template definitions and options, such as sampling rate, to the collector.

   Configure the rate at which the router sends template definitions and options to the flow collector. In this example, the template definitions and options are refreshed every 3600 seconds or 480000 packets, whichever occurs first.

   Include the **packets** statement and specify **480000** packets at the **[edit services flow-monitoring version9 template v6_template template-refresh-rate]** and **[edit services flow-monitoring version9 template v6_template option-refresh-rate]** hierarchy levels. Include the **seconds** statement and specify **3600** seconds at the **[edit services flow-monitoring version9 template v6_template template-refresh-rate]** and **[edit services flow-monitoring version9 template v6_template option-refresh-rate]** hierarchy levels.

```
[edit services flow-monitoring version9 template v6_template]
template-refresh-rate {
    packets 480000;
    seconds 3600;
}
option-refresh-rate {
    packets 480000;
    seconds 3600;
}
```

5. Configure the sampling rate. The sampling rate determines the ratio of the number of packets to be sampled. For example, if you specify a rate of 10, 1 out of every 10 packets is sampled. In this example the rate is 1 out of every 1 packets.

   Sampling can be configured as a global chassis configuration that is applicable to all Flexible PIC Concentrators (FPCs) and Dense Port Concentrators (DPCs) at the **[edit forwarding-options sampling input]** hierarchy level. Sampling can also be configured at the **[edit forwarding-options sampling instance *instance-name*]** hierarchy level and then applied to a single FPC.

   Also configure the run length. The run length sets the number of samples to be taken following the initial trigger event. This allows you to sample packets following those already being sampled. Since you are sampling every packet in this example, the run length can be set to 1.

   To configure the rate, include the **rate** statement and specify **1** as the rate at the **[edit forwarding-options sampling instance ins1 input]** hierarchy level. To configure the run length, include the **run-length** statement and specify **1** as the run length at the **[edit forwarding-options sampling instance ins1 input]** hierarchy level.

   ```
   [edit forwarding-options]
   sampling {
       instance ins1 {
           input {
               rate 1;
               run-length 1;
           }
       }
   }
   ```

6. Apply the sampling instance to the desired FPC or DPC.

   To apply the sampling instance, include the **sampling-instance** statement and specify **ins1** at the **[edit chassis fpc 1]** hierarchy level.

   ```
   [edit]
   chassis {
       fpc 1 {
           sampling-instance ins1;
       }
   }
   ```

7. Configure the flow collector and enable active flow monitoring using the version 9 template format.

   To configure the flow collector, include the **flow-server** statement and specify the IPv4 address of the host system that is collecting traffic flows using version 9 at

the **[edit forwarding-options sampling instance ins1 family inet6 output]** hierarchy level. Also include the **port** statement and specify UDP port **2055** for use by the flow collector.

To enable active flow monitoring using the version 9 template format, include the **template** statement and specify **v6_template** as the name of the template to use at the **[edit forwarding-options sampling instance ins1 family inet6 output flow-server 100.1.1.2 version9]** hierarchy level.

```
[edit forwarding-options sampling instance ins1]
family inet6 {
  output {
    flow-server 100.1.1.2 {
      port 2055;
      version9 {
        template v6_template;
      }
    }
  }
}
```

8. Configure the IPv4 source address for the Services PIC to be used in flow export.

   To configure the IPv4 source address for the **sp-1/1/0** interface, include the **source-address** statement and specify **12.1.1.1** at the **[edit forwarding-options sampling instance ins1 family inet6 output interface sp-1/1/0]** hierarchy level.

```
[edit forwarding-options sampling instance ins1 family inet6 output]
interface sp-1/1/0 {
  source-address 12.1.1.1;
}
```

9. Configure the firewall filter. The firewall filter identifies the traffic flows that need to be sampled and processed by the services PIC. Note that the implied from clause in the filter determines the packets that are matched and sampled according to the sampling rate.

   To configure the firewall filter, include the **filter** statement and specify **ipv6_sample_filter** at the **[edit firewall family inet6]** hierarchy level. Include the **term** statement and specify **1** as the name of the term. For active monitoring using version 9, you must include the **sample** and **accept** action statements at the **[edit firewall family inet6 filter ipv6_sample_filter term 1 then]** hierarchy level.

```
[edit firewall]
family inet6 {
  filter ipv6_sample_filter {
    term 1 {
      then {
        sample;
        accept;
      }
    }
  }
}
```

10. Apply the firewall filter to the set of media interfaces where traffic flow needs to be sampled. The filter can be applied to either the ingress or egress traffic depending on the use case. In this example, the filter is applied to the egress (output) traffic.

    To apply the firewall filter to the **ge-1/1/0** interface, include the **output** statement and specify **ipv6_sample_filter** as the name of the filter at the **[edit interfaces ge-1/1/0 unit 0 family inet filter]** hierarchy level.

```
[edit]
interfaces {
  ge-1/1/0 {
    unit 0 {
      family inet6 {
        filter {
          output ipv6_sample_filter;
        }
      }
    }
  }
}
```

11. To display the configuration for the flow collector, use the **show configuration** command.

    For your reference, the relevant sample configuration for the IPv6 flow collector follows.

```
[edit]
services {
  flow-monitoring {
    version9 {
      template v6_template {
        flow-active-timeout 600;
        flow-inactive-timeout 30;
        template-refresh-rate {
          packets 480000;
          seconds 3600;
        }
        option-refresh-rate {
          packets 480000;
          seconds 3600;
        }
        ipv6-template;
      }
    }
  }
}
forwarding-options {
  sampling {
    instance ins1 {
      input {
        rate 1;
        run-length 1;
      }
      family inet6 {
        output {
```

```
            flow-server 100.1.1.2 {
              port 2055;
              version9 {
                template v6_template;
              }
            }
            interface sp-1/1/0 {
              source-address 12.1.1.1;
            }
          }
        }
      }
    }
  }
  chassis {
    fpc 1 {
      sampling-instance ins1;
    }
  }
  firewall {
    family inet6 {
      filter ipv6_sample_filter {
        term 1 {
          then {
            sample;
            accept;
          }
        }
      }
    }
  }
  interfaces {
    ge-1/1/0 {
      description media-interface-for-sampling;
      unit 0 {
        family inet6 {
          filter {
            output ipv6_sample_filter;
          }
        }
      }
    }
    sp-1/1/0 {
      description sampling-services-pic;
      unit 0 {
        family inet6;
      }
    }
    ge-1/1/3 {
      description to-flow-collector;
      unit 0 {
        family inet {
          address 100.1.1.1/24;
        }
      }
    }
```

```
}
```

Related Documentation

- Flow Monitoring Overview on page 1
- Active Flow Monitoring Overview on page 3
- Active Flow Monitoring Applications on page 5
- Best Practices for Configuring Active Flow Monitoring Version 9 on page 7
- Example: Configuring Active Flow Monitoring Version 9 for IPv4 on page 9
- Example: Configuring Active Flow Monitoring Version 9 for MPLS on page 25
- Example: Configuring Active Flow Monitoring Version 9 for MPLS and IPv4 on page 33

Example: Configuring Active Flow Monitoring Version 9 for MPLS

Requirements

This example requires the following hardware and software components:

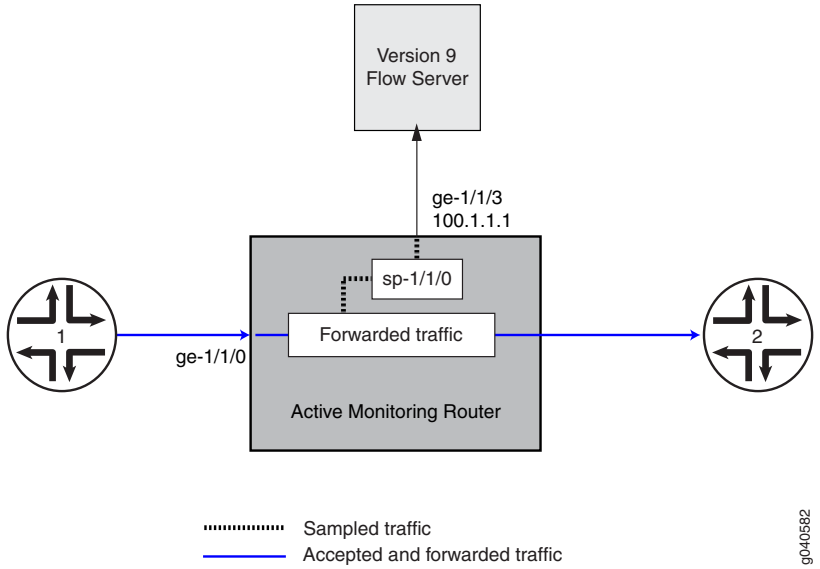
- Junos OS Release 9.2 or later
- One M Series Multiservice Edge Router, MX Series Ethernet Services Router, or T Series Core Router
- One Adaptive Services PIC

Overview of Flow Monitoring

This example provides a step-by-step procedure for monitoring MPLS flows and troubleshooting the configuration.

The physical connections used in this example are shown in Figure 3 on page 25.

Figure 3: Active Flow Monitoring Version 9 for MPLS Topology



Configuring Active Flow Monitoring Version 9 for MPLS

Step-by-Step Procedure

1. Enable the services PIC interface to process MPLS addresses by including the **family** statement and specifying the **mpls** option at the **[edit interfaces sp-1/1/0 unit 0]** hierarchy level.

```
[edit interfaces]
sp-1/1/0 {
  unit 0 {
```

```
    family mpls;
  }
}
```

2. Configure the interface connected to the flow collector by including the **address** statement and specifying **100.1.1.1/24** as the IPv4 address of the interface at the **[edit interfaces ge-1/1/3 unit 0 family inet]** hierarchy level.

```
[edit interfaces]
ge-1/1/3 {
  description to-flow-collector;
  unit 0 {
    family inet {
      address 100.1.1.1/24;
    }
  }
}
```

3. Create a version 9 template by including the **template** statement and specifying **mpls** as the name of the template at the **[edit services flow-monitoring version9]** hierarchy level.

   Enable the template for MPLS flows by including the **mpls-template** statement at the **[edit services flow-monitoring version9 template mpls]** hierarchy level. Also include the **label-position** statement and specify label positions **1** and **2** at the **[edit services flow-monitoring version9 template mpls mpls-template]** hierarchy level.

   Configure the flow active timeout by including the **flow-active-timeout** statement and specifying **600** seconds at the **[edit services flow-monitoring version9 template mpls]** hierarchy level. Configure the flow inactive timeout by including the **flow-inactive-timeout** statement and specifying **30** seconds at the **[edit services flow-monitoring version9 template mpls]** hierarchy level.

```
[edit services]
flow-monitoring {
  version9 {
    template mpls {
      flow-active-timeout 600;
      flow-inactive-timeout 30;
      mpls-template {
        label-position [ 1 2 ];
      }
    }
  }
}
```

4. Since version 9 flow monitoring traffic is unidirectional from the monitor (router) to the flow collector, you must configure the monitor to send template definitions and options, such as sampling rate, to the collector.

   Configure the rate at which the router sends template definitions and options to the flow collector. In this example, the template definitions and options are refreshed every 3600 seconds or 480000 packets, whichever occurs first.

   Include the **packets** statement and specify **480000** packets at the **[edit services flow-monitoring version9 template mpls template-refresh-rate]** and **[edit services**

flow-monitoring version9 template mpls option-refresh-rate] hierarchy levels. Include the **seconds** statement and specify **3600** seconds at the **[edit services flow-monitoring version9 template mpls template-refresh-rate]** and **[edit services flow-monitoring version9 template mpls option-refresh-rate]** hierarchy levels.

```
[edit services flow-monitoring version9 template mpls]
template-refresh-rate {
   packets 480000;
   seconds 3600;
}
option-refresh-rate {
   packets 480000;
   seconds 3600;
}
```

5. Configure the sampling rate. The sampling rate determines the ratio of the number of packets to be sampled. For example, if you specify a rate of 10, 1 out of every 10 packets is sampled. In this example the rate is 1 out of every 1 packets.

   Sampling can be configured as a global chassis configuration that is applicable to all Flexible PIC Concentrators (FPCs) and Dense Port Concentrators (DPCs) at the **[edit forwarding-options sampling input]** hierarchy level. Sampling can also be configured at the **[edit forwarding-options sampling instance *instance-name*]** hierarchy level and then applied to a single FPC.

   In this example two sampling categories are created. The global instance is configured to sample all packets matching a flow. Instance **inst1** is configured to sample one in every 10 packets.

   To configure the global rate, include the **rate** statement and specify **1** as the rate at the **[edit forwarding-options sampling input]** hierarchy level. To configure the global rate, include the **rate** statement and specify **10** as the rate at the **[edit forwarding-options sampling instance ins1 input]** hierarchy level.

```
[edit forwarding-options]
sampling {
   input {
      rate 1;
   }
   instance ins1 {
      input {
         rate 10;
      }
   }
}
```

6. Apply the sampling instance to the desired FPC or DPC.

   To apply the sampling instance, include the **sampling-instance** statement and specify **ins1** at the **[edit chassis fpc 1]** hierarchy level.

```
[edit]
chassis {
   fpc 1 {
      sampling-instance ins1;
   }
}
```

7. Configure the flow collector and enable active flow monitoring using the version 9 template format.

   To configure the flow collector, include the **flow-server** statement and specify the IP address of the host system that is collecting traffic flows using version 9 at the **[edit forwarding-options sampling instance ins1 family mpls output]** hierarchy level. Also include the **port** statement and specify UDP port **2055** for use by the flow collector.

   To enable active flow monitoring using the version 9 template format, include the **template** statement and specify the **mpls** as the name of the template to use at the **[edit forwarding-options sampling instance ins1 family mpls output flow-server 100.1.1.2 version9]** hierarchy level.

   ```
   [edit forwarding-options sampling instance ins1]
   family mpls {
     output {
       flow-server 100.1.1.2 {
         port 2055;
         version9 {
           template mpls;
         }
       }
     }
   }
   ```

8. Configure the IPv4 source address for the Services PIC to be used in flow export.

   To configure the IPv4 source address for the **sp-1/1/0** interface, include the **source-address** statement and specify **12.1.1.1** at the **[edit forwarding-options sampling instance ins1 family inet output interface sp-1/1/0]** hierarchy level.

   ```
   [edit forwarding-options sampling instance ins1 family inet output]
   interface sp-1/1/0 {
     source-address 12.1.1.1;
   }
   ```

9. Configure the firewall filter. The firewall filter identifies the traffic flows that need to be sampled and processed by the services PIC. Note that the implied from clause in the filter determines the packets that are matched and sampled according to the sampling rate.

   To configure the firewall filter, include the **filter** statement and specify **mpls_sample_filter** at the **[edit firewall family inet]** hierarchy level. Include the **term** statement and specify **1** as the name of the term. For active monitoring using version 9, you must include the **sample** and **accept** action statements at the **[edit firewall family mpls filter mpls_sample_filter term 1 then]** hierarchy level.

   ```
   [edit firewall]
   family mpls {
     filter mpls_sample_filter {
       term 1 {
         then {
           sample;
           accept;
         }
   ```

```
    }
  }
}
```

10. Apply the firewall filter to the set of media interfaces where traffic flow needs to be sampled.

    To apply the firewall filter to the **ge-1/1/0** interface, include the **input** statement and specify **mpls_sample_filter** as the name of the filter at the **[edit interfaces ge-1/1/0 unit 0 family mpls filter]** hierarchy level.

```
[edit]
interfaces {
  ge-1/1/0 {
    unit 0 {
      family mpls {
        filter {
          input mpls_sample_filter;
        }
      }
    }
  }
}
```

11. To display the configuration for the flow collector, use the **show configuration** command.

    For your reference, the relevant sample configuration for the MPLS flow collector follows.

```
[edit]
services {
  flow-monitoring {
    version9 {
      template mpls {
        flow-active-timeout 600;
        flow-inactive-timeout 30;
        template-refresh-rate {
          packets 480000;
          seconds 3600;
        }
        option-refresh-rate {
          packets 480000;
          seconds 3600;
        }
        mpls-template {
          label-position [ 1 2 ];
        }
      }
    }
  }
}
forwarding-options {
  sampling {
    input {
      rate 1;
    }
```

```
    instance ins1 {
      input {
        rate 10;
      }
      family mpls {
        output {
          flow-server 100.1.1.2 {
            port 2055;
            version9 {
              template mpls {
              }
            }
          }
          interface sp-1/1/0 {
            source-address 12.1.1.1;
          }
        }
      }
    }
  }
}
chassis {
  fpc 1 {
    sampling-instance ins1;
  }
}
firewall {
  family mpls {
    filter mpls_sample_filter {
      term 1 {
        then {
          sample;
          accept;
        }
      }
    }
  }
}
interfaces {
  ge-1/1/0 {
    description media-interface-for-sampling;
    unit 0 {
      family mpls {
        filter {
          input mpls_sample_filter;
        }
      }
    }
  }
  sp-1/1/0 {
    description sampling-services-pic;
    unit 0 {
      family mpls;
    }
  }
  ge-1/1/3 {
```

```
        description to-flow-collector;
        unit 0 {
          family inet {
            address 100.1.1.1/24;
          }
        }
      }
    }
```

Related Documentation

- Flow Monitoring Overview on page 1
- Active Flow Monitoring Overview on page 3
- Active Flow Monitoring Applications on page 5
- Best Practices for Configuring Active Flow Monitoring Version 9 on page 7
- Example: Configuring Active Flow Monitoring Version 9 for IPv4 on page 9
- Example: Configuring Active Flow Monitoring Version 9 for IPv6 on page 17
- Example: Configuring Active Flow Monitoring Version 9 for MPLS and IPv4 on page 33

Example: Configuring Active Flow Monitoring Version 9 for MPLS and IPv4

Requirements

This example requires the following hardware and software components:

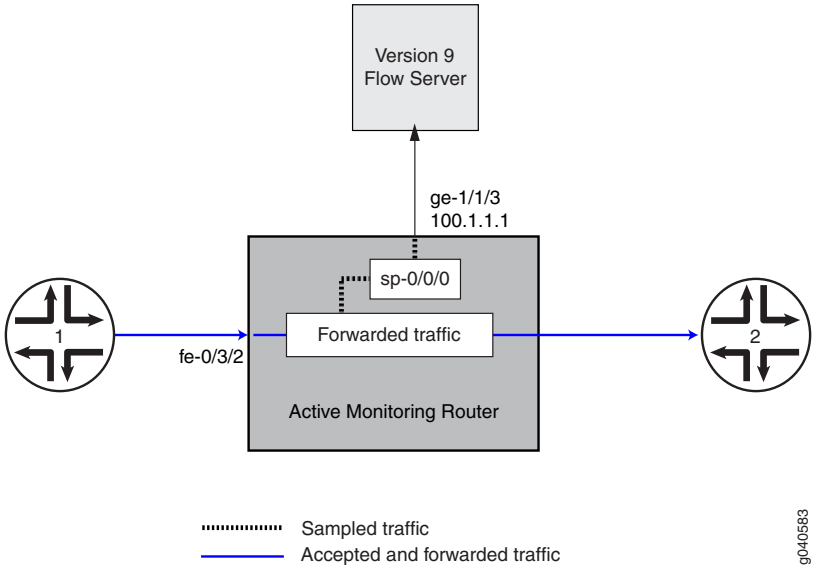
- Junos OS Release 9.2 or later
- One M Series Multiservice Edge Router, MX Series Ethernet Services Router, or T Series Core Router
- One Adaptive Services PIC

Overview of Flow Monitoring

This example provides a step-by-step procedure for monitoring MPLS and IPv4 flows and troubleshooting the configuration.

The physical connections used in this example are shown in Figure 4 on page 33.

Figure 4: Active Flow Monitoring Version 9 for MPLS and IPv4 Topology



Configuring Active Flow Monitoring Version 9 for MPLS and IPv4

Step-by-Step Procedure

1. Enable the services PIC interface to process MPLS and IPv4 addresses by including the **family** statement and specifying the **mpls** option and the **inet** option at the **[edit interfaces sp-0/0/0 unit 0]** hierarchy level.

```
[edit interfaces]
sp-0/0/0 {
  unit 0 {
```

```
        family inet;
        family mpls;
    }
}
```

2. Configure the interface connected to the flow collector by including the **address** statement and specifying **100.1.1.1/24** as the IPv4 address of the interface at the **[edit interfaces ge-1/1/3 unit 0 family inet]** hierarchy level.

```
[edit interfaces]
ge-1/1/3 {
    description to-flow-collector;
    unit 0 {
        family inet {
            address 100.1.1.1/24;
        }
    }
}
```

3. Create a version 9 template by including the **template** statement and specifying **mpls-ipv4** as the name of the template at the **[edit services flow-monitoring version9]** hierarchy level.

   Enable the template for MPLS and IPv4 flows by including the **mpls-ipv4-template** statement at the **[edit services flow-monitoring version9 template mpls-ipv4]** hierarchy level. Also include the **label-position** statement and specify label positions **1** and **2** at the **[edit services flow-monitoring version9 template mpls-ipv4 mpls-template]** hierarchy level.

   Configure the flow active timeout by including the **flow-active-timeout** statement and specifying **600** seconds at the **[edit services flow-monitoring version9 template mpls-ipv4]** hierarchy level. Configure the flow inactive timeout by including the **flow-inactive-timeout** statement and specifying **30** seconds at the **[edit services flow-monitoring version9 template mpls-ipv4]** hierarchy level.

```
[edit services]
flow-monitoring {
    version9 {
        template mpls-ipv4 {
            flow-active-timeout 600;
            flow-inactive-timeout 30;
            mpls-ipv4-template {
                label-position [ 1 2 ];
            }
        }
    }
}
```

4. Since version 9 flow monitoring traffic is unidirectional from the monitor (router) to the flow collector, you must configure the monitor to send template definitions and options, such as sampling rate, to the collector.

   Configure the rate at which the router sends template definitions and options to the flow collector. In this example, the template definitions and options are refreshed every 3600 seconds or 480000 packets, whichever occurs first.

Include the **packets** statement and specify **480000** packets at the **[edit services flow-monitoring version9 template mpls-ipv4 template-refresh-rate]** and **[edit services flow-monitoring version9 template mpls-ipv4 option-refresh-rate]** hierarchy levels. Include the **seconds** statement and specify **3600** seconds at the **[edit services flow-monitoring version9 template mpls-ipv4 template-refresh-rate]** and **[edit services flow-monitoring version9 template mpls-ipv4 option-refresh-rate]** hierarchy levels.

```
[edit services flow-monitoring version9 template mpls-ipv4]
template-refresh-rate {
   packets 480000;
   seconds 3600;
}
option-refresh-rate {
   packets 480000;
   seconds 3600;
}
```

5. Configure the sampling rate. The sampling rate determines the ratio of the number of packets to be sampled. For example, if you specify a rate of 10, 1 out of every 10 packets is sampled. In this example the rate is 1 out of every 1 packets.

   Sampling can be configured as a global chassis configuration that is applicable to all Flexible PIC Concentrators (FPCs) and Dense Port Concentrators (DPCs) at the **[edit forwarding-options sampling input]** hierarchy level. Sampling can also be configured at the **[edit forwarding-options sampling instance *instance-name*]** hierarchy level and then applied to a single FPC.

   In this example two sampling categories are created. The global instance is configured to sample all packets matching a flow. Instance **inst1** is configured to sample one in every 10 packets.

   To configure the global rate, include the **rate** statement and specify **1** as the rate at the **[edit forwarding-options sampling input]** hierarchy level. To configure the global rate, include the **rate** statement and specify **10** as the rate at the **[edit forwarding-options sampling instance ins1 input]** hierarchy level.

   ```
   [edit forwarding-options]
   sampling {
      input {
         rate 1;
      }
      instance ins1 {
         input {
            rate 10;
         }
      }
   }
   ```

6. Apply the sampling instance to the desired FPC or DPC.

   To apply the sampling instance, include the **sampling-instance** statement and specify **ins1** at the**[edit chassis fpc 4]** hierarchy level.

   ```
   [edit]
   chassis {
   ```

```
    fpc 4 {
      sampling-instance ins1;
    }
  }
```

7. Configure the flow collector and enable active flow monitoring for IPv4 and for MPLS using the version 9 template format.

   - To configure the flow collector for IPv4, include the **flow-server** statement and specify the IP address of the host system that is collecting traffic flows using version 9 at the **[edit forwarding-options sampling instance ins1 family inet output]** hierarchy level. Also include the **port** statement and specify UDP port **2055** for use by the flow collector.

     To enable active flow monitoring for IPv4 using the version 9 template format, include the **template** statement and specify the **ipv4-template** as the name of the template to use at the **[edit forwarding-options sampling instance ins1 family inet output flow-server 100.1.1.2 version9]** hierarchy level.

   - To configure the flow collector for MPLS, include the **flow-server** statement and specify the IP address of the host system that is collecting traffic flows using version 9 at the **[edit forwarding-options sampling instance ins1 family mpls output]** hierarchy level. Also include the **port** statement and specify UDP port **2055** for use by the flow collector.

     To enable active flow monitoring for MPLS using the version 9 template format, include the **template** statement and specify **mpls** as the name of the template to use at the **[edit forwarding-options sampling instance ins1 family mpls output flow-server 100.1.1.2 version9]** hierarchy level.

```
[edit forwarding-options sampling instance ins1]
family inet {
  output {
    flow-server 100.1.1.2 {
      port 2055;
      version9 {
        template v4_template;
        }
      }
    }
  }
}
family mpls {
  output {
    flow-server 100.1.1.2 {
      port 2055;
      version9 {
        template mpls;
        }
      }
    }
  }
}
```

8. Configure the IPv4 source address for the service PIC to be used in flow export.

To configure the IPv4 source address for the **sp-0/0/0** interface, include the **source-address** statement and specify **3.3.3.3** at the **[edit forwarding-options sampling instance ins1 family inet output interface sp-0/0/0]** hierarchy level.

```
[edit forwarding-options sampling instance ins1 family inet output]
interface sp-0/0/0 {
   source-address 3.3.3.3;
}
```

9. Configure the firewall filter. The firewall filter identifies the traffic flows that need to be sampled and processed by the services PIC. Note that the implied from clause in the filter determines the packets that are matched and sampled according to the sampling rate.

   - To configure the firewall filter for IPv4, include the **filter** statement and specify **ipv4_sample_filter** at the **[edit firewall family inet]** hierarchy level. Include the **term** statement and specify **1** as the name of the term. For active monitoring using version 9, you must include the **sample** and **accept** action statements at the **[edit firewall family inet filter ipv4_sample_filter term 1 then]** hierarchy level.
   - To configure the firewall filter for MPLS, include the **filter** statement and specify **mpls_sample_filter** at the **[edit firewall family mpls]** hierarchy level. Include the **term** statement and specify **1** as the name of the term. For active monitoring using version 9, you must include the **sample** and **accept** action statements at the **[edit firewall family mpls filter mpls_sample_filter term 1 then]** hierarchy level.

   ```
   [edit firewall]
   family inet {
      filter ipv4_sample_filter {
         term 1 {
            then {
               sample;
               accept;
            }
         }
      }
   }
   family mpls {
      filter mpls_sample_filter {
         term 1 {
            then {
               sample;
               accept;
            }
         }
      }
   }
   ```

10. Apply the firewall filter to the set of media interfaces where traffic flow needs to be sampled.

    To apply the firewall filter to the **fe-0/3/2** interface, include the **input** statement and specify **ipv4_sample_filter** as the name of the filter at the **[edit interfaces fe-0/3/2 unit 0 family inet filter]** hierarchy level.

```
[edit]
interfaces {
   fe-0/3/2 {
      unit 0 {
         family inet {
            filter {
               input ipv4_sample_filter;
            }
         }
         family mpls {
            filter {
               input mpls_sample_filter;
            }
         }
      }
   }
}
```

11. To display the configuration for the flow collector, use the **show configuration** command.

    For your reference, the relevant sample configuration for the IPv4 flow collector follows.

```
[edit]
services {
   flow-monitoring {
      version9 {
         template mpls-ipv4 {
            flow-active-timeout 600;
            flow-inactive-timeout 30;
            mpls-ipv4-template {
               label-position [ 1 2 ];
            }
            template-refresh-rate {
               packets 480000;
               seconds 3600;
            }
            option-refresh-rate {
               packets 480000;
               seconds 3600;
            }
            ipv4-template;
         }
      }
   }
}
forwarding-options {
   sampling {
      input {
         rate 1;
      }
      instance ins1 {
         input {
            rate 10;
         }
```



```
        family inet {
          output {
            flow-server 100.1.1.2 {
              port 2055;
              version9 {
                template v4_template;
              }
            }
            interface sp-0/0/0 {
              source-address 3.3.3.3;
            }
          }
        }
        family mpls {
          output {
            flow-server 100.1.1.2 {
              port 2055;
              version9 {
                template mpls;
              }
            }
            interface sp-0/0/0 {
              source-address 3.3.3.3;
            }
          }
        }
      }
    }
  }
  chassis {
    fpc 4 {
      sampling-instance ins1;
    }
  }
  firewall {
    family inet {
      filter ipv4_sample_filter {
        term 1 {
          then {
            sample;
            accept;
          }
        }
      }
    }
    family mpls {
      filter mpls_v4_sample_filter {
        term 1 {
          then {
            sample;
            accept;
          }
        }
      }
    }
  }
```

```
interfaces {
   fe-0/3/2 {
      unit 0 {
         family inet {
            filter {
               input ipv4_sample_filter;
            }
         }
         family mpls {
            filter {
               input mpls_sample_filter;
            }
         }
      }
   }
   sp-0/0/0 {
      unit 0 {
         family inet;
         family mpls;
      }
   }
   ge-1/1/3 {
      description to-flow-collector;
      unit 0 {
         family inet {
            address 100.1.1.1/24;
         }
      }
   }
}
```

Related Documentation

- Flow Monitoring Overview on page 1
- Active Flow Monitoring Overview on page 3
- Active Flow Monitoring Applications on page 5
- Best Practices for Configuring Active Flow Monitoring Version 9 on page 7
- Example: Configuring Active Flow Monitoring Version 9 for IPv4 on page 9
- Example: Configuring Active Flow Monitoring Version 9 for IPv6 on page 17
- Example: Configuring Active Flow Monitoring Version 9 for MPLS on page 25