

PfR RSVP Control

The PfR RSVP Control feature introduces the ability to perform application-aware path selection for traffic that is controlled by Resource Reservation Protocol (RSVP). This feature allows RSVP flows to be learned by Performance Routing (PfR) and protocol Path messages to be redirected after the PfR primary controller determines the best exit using PfR policies.

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Information About PfR RSVP Control

PfR and RSVP Control

The PfR RSVP Control feature introduces the ability for Performance Routing (PfR) to learn, monitor, and optimize Resource Reservation Protocol (RSVP) flows. PfR is an integrated Cisco IOS solution that allows you to monitor IP traffic flows and then define policies and rules based on traffic class performance, link load distribution, link bandwidth monetary cost, and traffic type. PfR provides active and passive monitoring systems, dynamic failure detection, and automatic path correction. Deploying PfR enables intelligent load distribution and optimal route selection in an enterprise network that uses multiple ISP or WAN connections at the network edge.

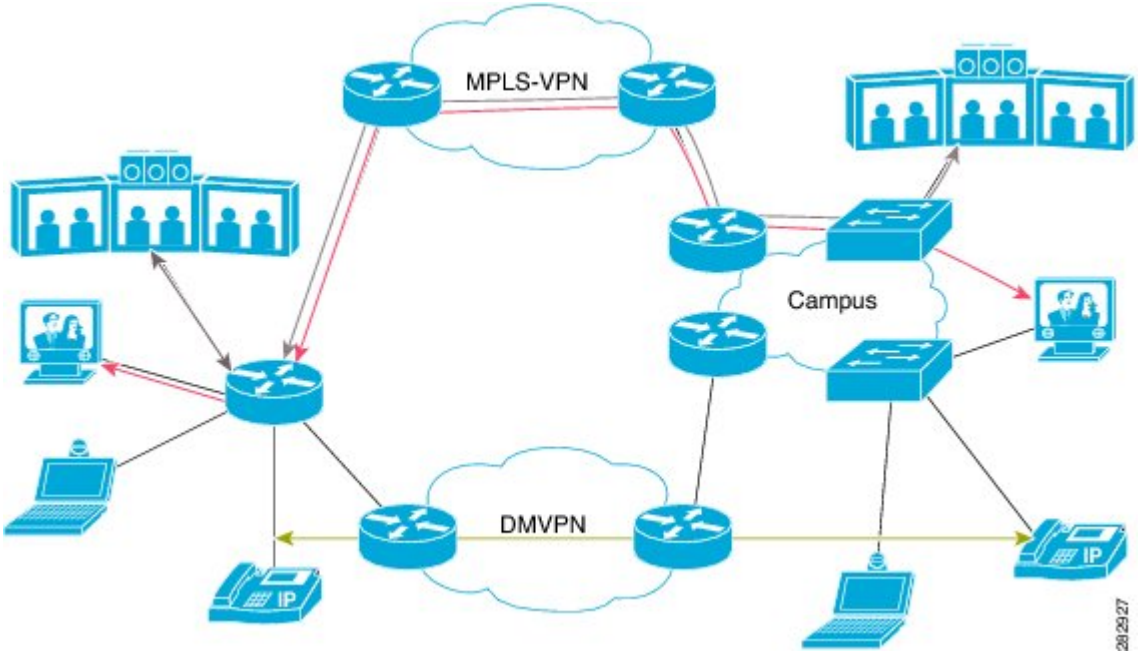
PfR can monitor and control applications and prefixes that are configured or learned by observing traffic that is flowing on the network. The controller is a centralized policy decision point at which policies are defined and applied to various traffic classes that traverse the border routers (BRs). The controller can be configured to learn and control traffic classes on the network. The controller makes exit selections and instructs the BRs to enforce the exit selection. While the current PfR implementation can be used to optimize voice/video traffic, the control exercised by PfR is not aware of technologies such as RSVP. The PfR RSVP integration will help RSVP leverage the application-specific control of routes that PfR can provide.

RSVP is a standards-based control protocol that allows for resources to be reserved to allow for better reliability for voice/video traffic. RSVP achieves this by signaling the traffic profile before the actual data flow to reserve resources for the data flow. Establishing end-to-end resource reservations along a media path allows RSVP to guarantee that resources are available when they are needed. RSVP consults the forwarding plane database (or CEF) in order to achieve path congruency with the media flow. The routes in the CEF database are mostly

dictated by the routing protocols where the only metric for determining the best route is the cumulative cost of the links on that path.

In the diagram shown below, there are two paths for the network on the left to reach the campus network on the right. One path uses the DMVPN cloud, and the other path uses the MPLS-VPN cloud. Depending on the speed and bandwidth required, it might make sense to route video applications over the MPLS-VPN network while routing voice applications over the DMVPN network. Such kind of application-aware path selection is not possible in CEF, but PfR can determine the best path for specific application traffic based on performance criteria.

Figure 1: Application-Aware Path Selection



With the RSVP integration, PfR will learn, monitor, and optimize RSVP flows. RSVP is included as a new learn source. PfR will learn RSVP flows that traverse internal and external interfaces. Each RSVP flow is learned as a PfR traffic class and is controlled independently of the other RSVP flows. While filtering of the learned flows is supported with prefix lists and route maps, aggregating RSVP flows is not advised. The PfR controller chooses a best exit based on the configured PfR policies and installs route maps to redirect traffic. If any of the RSVP flows enters an Out-of-Policy (OOP) condition, PfR will find and switch the RSVP flow to a new exit. RSVP will reinstall the reservation on the new path at the time of refresh (usually within a span of 30 seconds) or as a Fast Local Repair (FLR) case in less than 5 seconds.

The intent of the PfR RSVP Control feature is to identify and install route maps at the time the router receives an RSVP Path message. The route map captures the data traffic, while RSVP uses this path for the Path message.

RSVP flows are learned as PfR traffic classes defined as a single application flow that can be identified by the source address, source port, destination address, destination port and IP protocol. This microflow is optimized as an application by PfR, and a dynamic policy route is created by PfR to forward this traffic class over the selected exit.

All RSVP flows are optimized only after PfR checks that there is enough bandwidth on the exit that is being considered. This information is pushed periodically from the BRs to the MC. On the BR itself, RSVP notifies PfR every time the bandwidth pool on an interface changes.

Equivalent-Path Round-Robin Resolver

PfR introduced a new resolver with the PfR RSVP Control feature. PfR, by default, uses a random resolver to decide between equivalent paths, exits with the same cost determined by the PfR policies. When the round-robin resolver is configured using the **equivalent-path-round-robin** command, the next exit (next-hop interface) is selected and compared to the running PfR policy. The round-robin resolver is handed an array of equivalent exits from which it chooses in a round-robin fashion. Exits are pruned in the same fashion they are today by each resolver. If the exit matches the policy, the exit becomes the best exit. The round-robin resolver does not do any specific RSVP checking. To return to using the random resolver, enter the no form of the **equivalent-path-round-robin** command.

Any PfR traffiic class can use the round-robin resolver, and it provides a load-balancing scheme for multiple equivalent paths as determined by PfR policy.

RSVP Post Dial Delay Timer for Best Path Selection

In the PfR RSVP Control feature, the **rsvp post-dial-delay** command was introduced to set a value for the RSVP post dial delay timer that runs on the border routers when RSVP flow learning is enabled on a PfR controller. The timer is updated on the border routers at the start of every PfR learn cycle, and the timer determines the delay, in milliseconds, before the routing path is returned to RSVP. When the PfR and RSVP integration is enabled, PfR tries to locate a best path for any RSVP flows that are learned before the delay timer expires. If the current path is not the best path, PfR attempts to install the new path. RSVP reacts to this policy route injection as a case of Fast Local Repair (FLR) and resignals a new reservation path.

RSVP Signaling Retries for Alternative Reservation Path

The PfR RSVP Control feature introduced a new command, **rsvp signaling-retries**, which is configured on a controller and is used to instruct PfR to provide an alternate reservation path when an RSVP reservation returns an error condition. If an alternate path is provided by PfR, RSVP can resend the reservation signal. The default number of retries is set to 0; no signaling retries are to be permitted, and a reservation error message is sent when a reservation failure occurs.

Performance Statistics from PfR Commands

The PfR controller learns and monitors IP traffic that flows through the border routers, and the master controller selects the best exit for a traffic flow based on configured policies and the performance information received from the border routers. To view some of the performance data collected by the controller, use the following commands:

- **show pfr master active-probes**
- **show pfr master border**
- **show pfr master exits**
- **show pfr master statistics**
- **show pfr master traffic-class**
- **show pfr master traffic-class performance**

All these commands are entered at the controller, and some of the commands have keywords and arguments to filter the output. For detailed information about these commands, see the Cisco IOS Performance Routing Command Reference.

How to Configure PfR RSVP Control

Configuring PfR RSVP Control Using a Learn List

Perform this task on the controller to define a learn list that contains traffic classes that are automatically learned based on RSVP flows and filtered by a prefix list. In this task, the goal is to optimize all video traffic that is learned from RSVP flows.

The VIDEO traffic class is defined as any prefix that matches 10.100.0.0/16 or 10.200.0.0/16 and a PfR policy, named POLICY_RSVP_VIDEO, is created.

The learn lists are referenced in a PfR policy using a PfR map and are activated using the **policy-rules** (PfR) command.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* | **permit** *network/length*}
4. **pfr master**
5. **policy-rules** *map-name*
6. **rsvp signaling-retries** *number*
7. **rsvp post-dial-delay** *msecs*
8. **learn**
9. **list seq** *number* **refname** *refname*
10. **traffic-class prefix-list** *prefix-list-name* [**inside**]
11. **rsvp**
12. **exit**
13. Repeat Step 9 to Step 12 to configure additional learn lists.
14. **exit**
15. Use the **exit** command as necessary to return to global configuration mode.
16. **pfr-map** *map-name sequence-number*
17. **match pfr learn list** *refname*
18. **set mode route control**
19. **set resolve equivalent-path-round-robin**
20. **end**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* | **permit** *network/length*} **Example:** `Router(config)# ip prefix-list RSVP_VIDEO seq 10 permit 10.100.0.0/16`	Creates an IP prefix list to filter prefixes for learning. • An IP prefix list is used under learn list configuration mode to filter IP addresses that are learned. • The example creates an IP prefix list named RSVP_VIDEO for PfR to profile the prefix, 10.100.0.0/16.
Step 4	**pfr master** **Example:** `Router(config)# pfr master`	Enters the PfR master controller configuration mode to configure a Cisco router as the primary controller and to configure the master controller policy and the timer settings.
Step 5	**policy-rules** *map-name* **Example:** `Router(config-pfr-mc)# policy-rules POLICY_RSVP_VIDEO`	Selects a PfR map and applies the configuration under the PfR master controller configuration mode. • Use the *map-name* argument to specify the PfR map name to be activated. • The example applies the PfR map named POLICY_RSVP_VIDEO which includes the learn list configured in this task.
Step 6	**rsvp signaling-retries** *number* **Example:** `Router(config-pfr-mc)# rsvp signaling-retries 1`	Specifies the number of alternate paths that PfR provides for an RSVP reservation when a reservation error condition is detected. • Use the *number* argument to specify the number of alternate paths. • The example configured in this task shows how to configure PfR to set the number of alternate paths for RSVP signaling retries to 1.

	Command or Action	Purpose
Step 7	**rsvp post-dial-delay** *msecs* **Example:** `Router(config-pfr-mc)# rsvp post-dial-delay 100`	Configures the RSVP post dial delay timer to set the delay before PfR returns the routing path to RSVP. • Use the *msecs* argument to specify the delay, in milliseconds. • The example configured in this task shows how to configure PfR to set the RSVP post dial delay to 100 milliseconds.
Step 8	**learn** **Example:** `Router(config-pfr-mc)# learn`	Enters PfR Top Talker and Top Delay learning configuration mode to automatically learn traffic classes.
Step 9	**list seq** *number* **refname** *refname* **Example:** `Router(config-pfr-mc-learn)# list seq 10 refname LEARN_RSVP_VIDEO`	Creates a PfR learn list and enters learn list configuration mode. • Use the **seq** keyword and *number* argument to specify a sequence number used to determine the order in which learn list criteria are applied. • Use the **refname** keyword and *refname* argument to specify a reference name for the learn list. • The example creates a learn list named LEARN_RSVP_VIDEO.
Step 10	**traffic-class prefix-list** *prefix-list-name* [**inside**] **Example:** `Router(config-pfr-mc-learn-list)# traffic-class prefix-list RSVP_VIDEO`	Configures the primary controller to automatically learn traffic based only on destination prefixes. • Use the *prefix-list-name* argument to specify a prefix list. • The example defines a traffic class using the prefix list named RSVP_VIDEO.
Step 11	**rsvp** **Example:** `Router(config-pfr-mc-learn-list)# rsvp`	Configures the primary controller to learn the top prefixes based on RSVP flows. • When this command is enabled, the primary controller learns the top prefixes across all border routers according to the highest outbound throughput. • The example configures the primary controller to learn the top prefixes based on RSVP flows for the LEARN_RSVP_VIDEO learn list.
Step 12	**exit** **Example:**	Exits learn list configuration mode, and returns to PfR Top Talker and Top Delay learning configuration mode.

	Command or Action	Purpose
	`Router(config-pfr-mc-learn-list)# exit`	
Step 13	Repeat Step 9 to Step 12 to configure additional learn lists.	--
Step 14	**exit** **Example:** `Router(config-pfr-mc-learn)# exit`	Exits PfR Top Talker and Top Delay learn configuration mode, and returns to the PfR master controller configuration mode.
Step 15	Use the **exit** command as necessary to return to global configuration mode.	--
Step 16	**pfr-map** *map-name sequence-number* **Example:** `Router(config)# pfr-map POLICY_RSVP_VIDEO 10`	Enters PfR map configuration mode to configure a PfR map. • The example creates a PfR map named POLICY_RSVP_VIDEO.
Step 17	**match pfr learn list** *refname* **Example:** `Router(config-pfr-map)# match pfr learn list LEARN_RSVP_VIDEO`	Creates a match clause entry in a PfR map to match PfR-learned prefixes. • Only one match clause can be configured for each PfR map sequence. • The example defines a traffic class using the criteria defined in the PfR learn list named LEARN_RSVP_VIDEO. **Note** Only the syntax relevant to this task is used here.
Step 18	**set mode route control** **Example:** `Router(config-pfr-map)# set mode route control`	Creates a set clause entry to configure route control for matched traffic. • In the control mode, the primary controller analyzes monitored prefixes and implements changes based on policy parameters.
Step 19	**set resolve equivalent-path-round-robin** **Example:** `Router(config-pfr-map)# set resolve equivalent-path-round-robin`	Creates a set clause entry to specify the use of the equivalent-path round-robin resolver. • In this task, the equivalent-path round-robin resolver is used to choose between equivalent paths instead of the random resolver.
Step 20	**end** **Example:** `Router(config-pfr-map)# end`	(Optional) Exits PfR map configuration mode and returns to privileged EXEC mode.

Displaying PfR RSVP Control Information

Although the PfR RSVP Control feature is configured on the primary controller, the border routers actually collect the performance information, and there are **show** and **debug** commands available to display the RSVP information for both the primary controller and border routers. The first few commands in this task are entered on the primary controller and, for the rest of the commands, there is a step to move to a border router through which the application traffic is flowing. These **show** and **debug** commands can be entered in any order.

SUMMARY STEPS

1. **enable**
2. **show pfr master traffic-class** [**rsvp**] [**active** | **passive** | **status**] [**detail**]
3. **show pfr master policy** [*sequence-number* | *policy-name* | **default** | **dynamic**]
4. **debug pfr master rsvp**
5. Move to a border router through which the RSVP traffic is flowing.
6. **enable**
7. **show pfr border rsvp**
8. **show pfr border routes rsvp-cache**
9. **debug pfr border rsvp**

DETAILED STEPS

Procedure

Step 1 **enable**

Enables privileged EXEC mode. Enter your password if prompted.

Example:

```
Router> enable
```

Step 2 **show pfr master traffic-class** [**rsvp**] [**active** | **passive** | **status**] [**detail**]

This command is used to display information about PfR traffic classes that are learned as RSVP traffic classes.

Example:

```
Router# show pfr master traffic-class rsvp

OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied

DstPrefix           Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
          Flags             State     Time            CurrBR  CurrI/F Protocol
         PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos      EBw      IBw
```

```
         ActSDly  ActLDly   ActSUn   ActLUn  ActSJit  ActPMOS  ActSLos  ActLLos
--------------------------------------------------------------------------------
10.1.0.10/32              N    N  tcp       75-75       75-75 10.1.0.12/32
                          INPOLICY       @0         10.1.0.24 Tu24            PBR
               U        U        0        0        0        0        0        0
               1        1        0        0        N        N        N        N
```

Step 3 **show pfr master policy** [*sequence-number* | *policy-name* | **default** | **dynamic**]

This command is used to display policy information. The following example uses the **dynamic** keyword to display the policies dynamically created by provider applications. Note the RSVP configuration commands.

Example:

```
Router# show pfr master policy dynamic

Dynamic Policies:

  proxy id 10.3.3.3
  sequence no. 18446744069421203465, provider id 1001, provider priority 65535
    host priority 65535, policy priority 101, Session id 9
  backoff 90 90 90
  delay relative 50
  holddown 90
  periodic 0
  probe frequency 56
  mode route control
  mode monitor both
  mode select-exit good
  loss relative 10
  jitter threshold 20
  mos threshold 3.60 percent 30
  unreachable relative 50
  next-hop not set
  forwarding interface not set
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
  proxy id 10.3.3.3
  sequence no. 18446744069421269001, provider id 1001, provider priority 65535
    host priority 65535, policy priority 102, Session id 9
  backoff 90 90 90
  delay relative 50
  holddown 90
  periodic 0
  probe frequency 56
  mode route control
  mode monitor both
  mode select-exit good
  loss relative 10
  jitter threshold 20
  mos threshold 3.60 percent 30
  unreachable relative 50
  next-hop not set
  forwarding interface not set
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
  proxy id 10.3.3.4
  sequence no. 18446744069421334538, provider id 1001, provider priority 65535
    host priority 65535, policy priority 103, Session id 10
  backoff 90 90 90
  delay relative 50
  holddown 90
  periodic 0
  probe frequency 56
```

```
  mode route control
  mode monitor both
  mode select-exit good
  loss relative 10
  jitter threshold 20
  mos threshold 3.60 percent 30
  unreachable relative 50
  next-hop not set
  forwarding interface not set
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
```

Step 4 **debug pfr master rsvp**

Displays debugging information about PfR RSVP events on the PfR controller.

Example:

```
Router# debug pfr master rsvp

Jan 23 21:18:19.439 PST: PFR_MC_RSVP: recvd a RSVP flow
Jan 23 21:18:19.439 PST: PFR_MC_RSVP: Processing 1 rsvp flows
Jan 23 21:18:19.439 PST: PFR_MC_RSVP: Resolve: src: 10.1.0.12 dst: 10.1.25.19 pr
oto: 17 sport min: 1 sport max: 1 dport min: 1 dport max: 1 from BR 10.1.0.23
Jan 23 21:18:19.439 PST: PFR_MC_RSVP: Marking: 10.1.0.23, FastEthernet1/0
Jan 23 21:18:19.439 PST: %OER_MC-5-NOTICE: Uncontrol Prefix 10.1.25.19/32, Probe frequency changed
Jan 23 21:18:19.439 PST: PFR_MC_RSVP: Marked: 10.1.0.23, FastEthernet1/0 as current
Jan 23 21:18:19.467 PST: PFR_MC_RSVP: recv new pool size
Jan 23 21:18:19.467 PST: PFR_MC_RSVP: Update from 10.1.0.23, Fa1/0: pool 8999
Jan 23 21:18:20.943 PST: %OER_MC-5-NOTICE: Prefix Learning WRITING DATA
Jan 23 21:18:21.003 PST: %OER_MC-5-NOTICE: Prefix Learning STARTED
Jan 23 21:18:22.475 PST: PFR_MC_RSVP: RSVP resolver invoked
Jan 23 21:18:22.475 PST: PFR RSVP MC:  10.1.25.19/32 Appl 17 [1, 1][1, 1] 0:
        BR 10.1.0.23, Exit Fa1/0, is current exit
Jan 23 21:18:22.475 PST: PFR RSVP MC:  10.1.25.19/32 Appl 17 [1, 1][1, 1] 0:
        BR 10.1.0.23, Exit Fa1/0, is current exit
Jan 23 21:18:22.475 PST: PFR_MC_RSVP: BR:10.1.0.23 Exit:Fa1/0pool size : 8999
est : 8999 tc->tspec: 1, fit: 8999
Jan 23 21:18:22.475 PST: PFR_MC_RSVP: BR:10.1.0.24 Exit:Tu24pool size : 9000
est : 9000 tc->tspec: 1, fit: 8999
Jan 23 21:18:22.475 PST: PFR_MC_RSVP: BR:10.1.0.23 Exit:Fa1/1pool size : 9000
est : 9000 tc->tspec: 1, fit: 8999
```

Step 5 Move to a border router through which the RSVP traffic is flowing.

Step 6 **enable**

Enables privileged EXEC mode. Enter your password if prompted.

Example:

```
Router> enable
```

Step 7 **show pfr border rsvp**

The following example shows information about the current values for the RSVP post dial timeout timer and signaling retries on a PfR border router:

Example:

```
Router# show pfr border rsvp

PfR BR RSVP parameters:
```

```
        RSVP Signaling retries:          1
        Post-dial-timeout(msec):         0
```

Step 8 **show pfr border routes rsvp-cache**

This command is used to show all the RSVP paths that PfR is aware of.

Note
Only syntax appropriate to this example is shown.

Example:

```
Router# show pfr border routes rsvp-cache

SrcIP       DstIP       Protocol Src_port Dst_port Nexthop       Egress I/F PfR/RIB
----------- ----------- -------- -------- -------- ------------- ---------- --------
10.1.25.19  10.1.35.5   UDP      1027     1027     10.1.248.5    Gi1/0       RIB*
10.1.0.12   10.1.24.10  UDP      48       48       10.1.248.24   Gi1/0       PfR*
10.1.0.12   10.1.42.19  UDP      23       23       10.1.248.24   Gi1/0       PfR*
10.1.0.12   10.1.18.10  UDP      12       12       172.16.43.2   Fa1/1       PfR*
```

Step 9 **debug pfr border rsvp**

Displays debugging information about PfR RSVP events on a PfR border router.

Example:

```
Router# debug pfr border rsvp

Jan 23 21:18:19.434 PST: PfR RSVP:RESOLVE called for src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1; tspec 1
Jan 23 21:18:19.434 PST: PfR RSVP:hash index = 618
Jan 23 21:18:19.434 PST: PfR RSVP:Searching flow: src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1
Jan 23 21:18:19.434 PST: PfR RSVP:Add flow: src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1
Jan 23 21:18:19.434 PST: PfR RSVP:hash index = 618
Jan 23 21:18:19.434 PST: PfR RSVP:Searching flow: src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1
Jan 23 21:18:19.434 PST: PfR RSVP:hash index = 618
Jan 23 21:18:19.434 PST: PfR RSVP:successfully added the flow to the db
Jan 23 21:18:19.434 PST: PfR RSVP:flow: src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1 lookup; topoid: 0
Jan 23 21:18:19.434 PST: PfR RSVP(det):ret nh: 10.185.252.1, idb: 35
Jan 23 21:18:19.434 PST: PfR RSVP:Adding new context
Jan 23 21:18:19.434 PST: PfR RSVP(det):Num contexts: 0
Jan 23 21:18:19.434 PST: PfR RSVP(det):Num contexts: 1
Jan 23 21:18:19.434 PST: PfR RSVP:flow src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1 now pending notify
Jan 23 21:18:19.434 PST: PfR RSVP:Resolve on flow: src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1
Jan 23 21:18:19.434 PST: PfR RSVP:Filtering flow: src: 10.1.0.12 dst: 10.1.25.19
 proto: 17 sport: 1 dport: 1
```

Displaying PfR Performance and Statistics Information

Enter the commands in this task to view more detailed performance or statistical information about PfR traffic classes or exits. The commands can be entered in any order within each section.

SUMMARY STEPS

1. **enable**
2. **show pfr master traffic-class** [**policy** *policy-seq-number* | *rc-protocol* | **state** {**hold**| **in** | **out** | **uncontrolled**}] [**detail**]
3. **show pfr master traffic-class performance** [**application** *application-name* [*prefix*] | **history** [**active** | **passive**] | **inside** | **learn** [**delay** | **inside** | **list** *list-name* | **rsvp** | **throughput**] | **policy** *policy-seq-number* | *rc-protocol* | **state** {**hold** | **in** | **out** | **uncontrolled**} | **static**] [**detail**]
4. **show pfr master exits**
5. **show pfr master active-probes** [**assignment** | **running**] [**forced** *policy-sequence-number* | **longest-match**]
6. **show pfr master border** [*ip-address*] [**detail** | **report** | **statistics** | **topology**]
7. **show pfr master statistics** [**active-probe** | **border** | **cc** | **exit** | **netflow** | **prefix** | **process** | **system** | **timers**]

DETAILED STEPS

Procedure

Step 1 **enable**

Enables privileged EXEC mode. Enter your password if prompted.

Example:

```
Router> enable
```

Step 2 **show pfr master traffic-class** [**policy** *policy-seq-number* | *rc-protocol* | **state** {**hold**| **in** | **out** | **uncontrolled**}] [**detail**]

This command is used to display information about traffic classes that are monitored and controlled by a PfR controller. In this example, the **state in** keywords are used to filter the output to show only traffic classes that are in an in-policy state.

Example:

```
Router# show pfr master traffic-class state in

OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied

DstPrefix           Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
           Flags              State     Time            CurrBR  CurrI/F Protocol
         PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos      EBw      IBw
         ActSDly  ActLDly   ActSUn   ActLUn  ActSJit  ActPMOS  ActSLos  ActLLos
------------------------------------------------------------------------------
10.1.0.0/24               N    N    N           N           N N
                          INPOLICY        0          10.1.1.1 Et0/0           BGP
              14       14        0        0        0        0       78        9
               N        N        N        N        N        N

10.2.0.0/24               N    N    N           N           N N
```

```
                          INPOLICY        0          10.1.1.2 Et0/0           BGP
              14       14        0        0        0        0       75        9
               N        N        N        N        N        N

10.3.0.0/24               N    N    N          N           N N
                          INPOLICY        0          10.1.1.3 Et0/0           BGP
              14       14        0        0        0        0       77        9
               N        N        N        N        N        N

10.4.0.0/24               N    N    N          N           N N
                          INPOLICY        0          10.1.1.4 Et0/0           BGP
              14       14        0        0        0        0       77        9
               N        N        N        N        N        N

10.1.8.0/24               N    N    N          N           N N
                          INPOLICY        0          10.1.1.3 Et0/0           BGP
              14       14    62500    73359        0        0        5        1
               N        N        N        N        N        N

10.1.1.0/24               N    N    N          N           N N
                          INPOLICY        0          10.1.1.2 Et0/0           BGP
              14       14     9635     9386     1605     1547       34        4
               N        N        N        N        N        N
```

Step 3 **show pfr master traffic-class performance** [**application** *application-name* [*prefix*] | **history** [**active** | **passive**] | **inside** | **learn** [**delay** | **inside** | **list** *list-name* | **rsvp** | **throughput**] | **policy** *policy-seq-number* | *rc-protocol* | **state** {**hold** | **in** | **out** | **uncontrolled**} | **static**] [**detail**]

This command displays performance information about traffic classes that are monitored and controlled by a PfR controller.

Note
Only the syntax applicable to this example is shown.

Example:

The following output shows traffic-class performance history on current exits during the last 60 minutes.

```
Router# show pfr master traffic-class performance history

Prefix: 10.70.0.0/16
efix performance history records
 Current index 1, S_avg interval(min) 5, L_avg interval(min) 60

Age       Border          Interface       OOP/RteChg Reasons
Pas: DSum  Samples  DAvg  PktLoss  Unreach   Ebytes   Ibytes     Pkts    Flows
Act: Dsum Attempts  DAvg    Comps  Unreach   Jitter LoMOSCnt   MOSCnt
00:00:33  10.1.1.4        Et0/0
Pas: 6466      517    12        2       58  3400299   336921    10499     2117
Act:    0        0     0        0        0        N        N        N
00:01:35  10.1.1.4        Et0/0
Pas:15661     1334    11        4      157  4908315   884578    20927     3765
Act:    0        0     0        0        0        N        N        N
00:02:37  10.1.1.4        Et0/0
Pas:13756     1164    11        9      126  6181747   756877    21232     4079
Act:    0        0     0        0        0        N        N        N
00:03:43  10.1.1.1        Et0/0
Pas:14350     1217    11        6      153  6839987   794944    22919     4434
Act:    0        0     0        0        0        N        N        N
00:04:39  10.1.1.3        Et0/0
Pas:13431     1129    11       10      122  6603568   730905    21491     4160
Act:    0        0     0        0        0        N        N        N
00:05:42  10.1.1.2        Et0/0
Pas:14200     1186    11        9      125  4566305   765525    18718     3461
Act:    0        0     0        0        0        N        N        N
```

```
00:06:39  10.1.1.3        Et0/0
Pas:14108     1207    11        5      150  3171450   795278    16671     2903
Act:    0        0     0        0        0        N        N        N
00:07:39  10.1.1.4        Et0/0
Pas:11554      983    11       15      133  8386375   642790    23238     4793
Act:    0        0     0        0        0        N        N        N
```

Step 4 show pfr master exits

Use this command to display information about the exits used for PfR traffic classes, including the IP address, nickname of the PfR managed external interface, the exit policy, interface of the border router, and exit performance data. The example below shows RSVP pool information.

Example:

```
Router# show pfr master exits

PfR Master Controller Exits:

General Info:
=============
  E - External
  I - Internal
  N/A - Not Applicable
                                                                                  Up/
   ID Name         Border          Interface   ifIdx IP Address      Mask Policy      Type Down
  --- ------------ --------------- ----------- ----- --------------- ---- ----------- ---- ----
    6 external1    10.1.0.23       Fa1/0           9 10.185.252.23     27 Util          E  UP
    5 external2    10.1.0.23       Fa1/1          10 172.16.43.23      27 Util          E  UP
    4              10.1.0.24       Tu24           33 10.20.20.24       24 Util          E  UP

Global Exit Policy:
===================
    Range Egress:      In Policy - No difference between exits - Policy 10%
   Range Ingress:      In Policy - No difference between entrances - Policy 0%
     Util Egress:      In Policy
    Util Ingress:      In Policy
            Cost:      In Policy

Exits Performance:
==================
                  Egress                                          Ingress
    ------------------------------------------------- -----------------------------------
 ID Capacity  MaxUtil    Usage   %      RSVP POOL    OOP Capacity  MaxUtil    Usage   %  OOP
 --- -------- -------- -------- --- -------------- ----- -------- -------- -------- --- -----
  6   100000    90000       66   0           9000    N/A   100000   100000       40   0  N/A
  5   100000    90000       34   0           8452    N/A   100000   100000       26   0  N/A
  4   100000    90000      128   0           5669    N/A   100000   100000      104   0  N/A

TC and BW Distribution:
=======================
                      # of TCs                BW (kbps)            Probe   Active
     Name/ID   Current Controlled InPolicy    Controlled       Total  Failed  Unreach
                                                                    (count) (fpm)
        ----   ----------------------------   ----------------------  ------  --------
           6        0          0        0            0           66       0          0
           5      548        548      548            0           34       0          0
           4     3202       3202     3202            0          128       0          0

Exit Related TC Stats:
======================
                              Priority
                           highest       nth
```

```
                          ------------------
  Number of TCs with range:        0         0
   Number of TCs with util:        0         0
   Number of TCs with cost:        0         0

       Total number of TCs:     3800
```

Step 5 **show pfr master active-probes** [**assignment** | **running**] [**forced** *policy-sequence-number* | **longest-match**]

The following example shows the status of all created or in-progress probes.

Example:

```
Router# show pfr master active-probes running

PfR Master Controller running probes:

Border         Interface   Type     Target         TPort Codec    Freq Forced Pkts DSCP
                                                                      (Pol
                                                                       Seq)
-------------- ----------- -------- -------------- ----- -------- ---- ------ ---- ----
10.100.100.200 Ethernet1/0 tcp-conn 10.100.200.100 65535 g711alaw 10   20     100  ef
10.2.2.3       Ethernet1/0 tcp-conn 10.1.5.1       23    N        56   10     1    defa
10.1.1.1       Ethernet1/0 tcp-conn 10.1.5.1       23    N        30   N      1    defa
10.1.1.2       Ethernet1/0 tcp-conn 10.1.2.1       23    N        56   N      1    defa
10.2.2.3       Ethernet1/0 tcp-conn 10.1.2.1       23    N        56   N      1    defa
10.1.1.1       Ethernet1/0 tcp-conn 10.1.2.1       23    N        56   N      1    defa
```

Step 6 **show pfr master border** [*ip-address*] [**detail** | **report** | **statistics** | **topology**]

Entered on the controller, this command displays statistics about all the border routers.

Example:

```
Router# show pfr master border statistics

PFR Master Controller Border
 MC Version: 2.3
 Keepalive : 5 second
 Keepalive : DISABLED

                                                  Last
Border           Status Up/Down UpTime   AuthFail  Receive  Version
---------------- ------ ------- -------- --------  -------- -------
10.200.200.200   ACTIVE UP      03:12:12        0  00:00:04 2.2
10.1.1.2         ACTIVE UP      03:10:53        0  00:00:10 2.2
10.1.1.1         ACTIVE UP      03:12:12        0  00:01:00 2.2

Border Connection Statistics
============================

                         Bytes         Bytes    Msg    Msg    Sec Buf
Border                     Sent         Recvd   Sent  Recvd Bytes Used
---------------- -------------- ------------- ------ ------ ----------
10.200.200.200           345899        373749      5     10          0
10.1.1.2                 345899        373749      5     10          0
10.1.1.1                 345899        373749      5     10          0

                 Socket Invalid   Context
Border           Closed Message Not Found
---------------- ------ ------- ---------
10.200.200.200        5      10       100
```

```
10.1.1.2              5       10        100
10.1.1.1              5       10        100
```

Step 7 **show pfr master statistics** [**active-probe** | **border** | **cc** | **exit** | **netflow** | **prefix** | **process** | **system** | **timers**]

This command displays statistics from the controller. Use the keywords to filter the display information. In the example below, the **system** keyword displays PfR system statistics.

Example:

```
Router# show pfr master statistics system

   Active Timers: 14
    Total Traffic Classes = 65, Prefixes = 65, Appls =0
   TC state:
    DEFAULT = 0, HOLDDOWN = 11, INPOLICY = 54, OOP = 0, CHOOSE = 0,
    Inside = 1, Probe all = 0, Non-op = 0, Denied = 0
    Controlled 60, Uncontrolled 5, Alloced 65, Freed 0, No memory 0
   Errors:
    Invalid state = 0, Ctrl timeout = 0, Ctrl rej = 0, No ctx = 7616,
    Martians = 0
    Total Policies = 0
    Total Active Probe Targets = 325
    Total Active Probes Running = 0
   Cumulative Route Changes:
    Total  : 3246
    Delay  : 0
    Loss   : 0
    Jitter : 0
    MOS    : 0
    Range  : 0
    Cost   : 0
    Util   : 0
   Cumulative Out-of-Policy Events:
    Total  : 0
    Delay  : 0
    Loss   : 0
    Jitter : 0
    MOS    : 0
    Range  : 0
    Cost   : 0
    Util   :
```

Configuration Examples for PfR RSVP Control

Example Defining Traffic Classes Using RSVP Flows

The following example, configured on the primary controller, defines a learn list that will contain traffic classes that are automatically learned based on RSVP flows and filtered by a prefix list. In this example, the goal is to optimize all video traffic using the policy named POLICY_RSVP_VIDEO. The RSVP_VIDEO traffic class is defined as any prefix that matches 10.100.0.0/16 or 10.200.0.0/16 and is learned from RSVP flows.

This example configures prefix learning based on RSVP traffic flows.

```
ip prefix-list RSVP_VIDEO permit seq 10 10.100.0.0/16
ip prefix-list RSVP_VIDEO permit seq 20 10.200.0.0/16
pfr master
 policy-rules POLICY_RSVP_VIDEO
 rsvp signaling-retries 1
 rsvp post-dial-delay 100
 learn
 list seq 10 refname LEARN_RSVP_VIDEO
 traffic-class prefix-list RSVP_VIDEO
 rsvp
 exit
 exit
pfr-map POLICY_RSVP_VIDEO 10
 match learn list LEARN_RSVP_VIDEO
 set mode route control
 set resolve equivalent-path-round-robin
 end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Cisco PfR commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	Cisco IOS Performance Routing Command Reference
Basic PfR configuration	"Configuring Basic Performance Routing" module
NetFlow and NetFlow data export	*Configuring NetFlow and NetFlow Data Export*
PfR home page with links to PfR-related content on our DocWiki collaborative environment	PfR:Home

RFCs

RFC	Title
RFC 3954	*Cisco Systems NetFlow Services Export Version 9*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for PfR RSVP Control

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for PfR RSVP Control

Feature Name	Releases	Feature Information
PfR RSVP Control	Cisco IOS XE Release 3.4S	The PfR RSVP Control feature provides support for optimizing RSVP flows using application-aware PfR techniques. The following commands were introduced or modified by this feature: **debug pfr border rsvp**, **debug pfr master rsvp**, **rsvp (PfR)**, **rsvp post-dial-delay**, **rsvp signaling-retries**, **resolve (PfR)**, **set resolve (PfR)**, **show pfr border rsvp**, **show pfr border routes**, **show pfr master active-probes**, **show pfr master border**, **show pfr master exits**, **show pfr master policy**, **show pfr master statistics**, **show pfr master traffic-class**, and **show pfr master traffic-class performance**.