# Static Application Mapping Using Performance Routing

The OER - Application Aware Routing with Static Application Mapping feature introduces the ability to configure standard applications using just one keyword to simplify the configuration of traffic classes that PfR can automatically learn, or that can be manually configured. This feature also introduces a learn list configuration mode that allows Performance Routing (PfR) policies to be applied to traffic classes profiled in a learn list. Different policies can be applied to each learn list.



## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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.

# PrerequisitesforStaticApplicationMappingUsingPerformance Routing

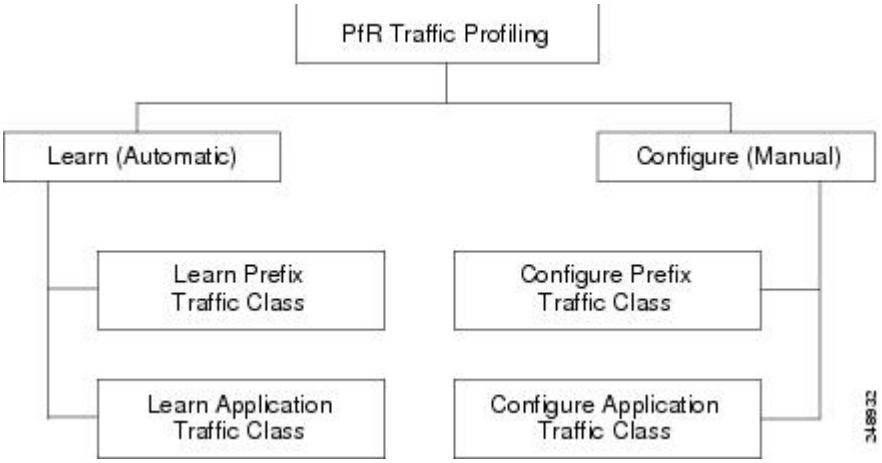
Cisco Express Forwarding (CEF) must be enabled on all participating devices. No other switching path is supported, even if otherwise supported by Policy-Based Routing (PBR).

# Information About Static Application Mapping Using Performance Routing

## Performance Routing Traffic Class Profiling

Before optimizing traffic, Performance Routing (PfR) must determine the traffic classes from the traffic that is flowing through the border routers. To optimize traffic routing, subsets of the total traffic must be identified; and these traffic subsets are named traffic classes. The list of traffic-class entries is named a Monitored Traffic Class (MTC) list. The entries in the MTC list can be profiled either by automatically learning the traffic flowing through the device or by manually configuring the traffic classes. Learned and configured traffic classes can both exist in the MTC list at the same time. Both the learn mechanism and the configure mechanism for traffic classes are implemented during the PfR profile phase. The overall structure of the PfR traffic class profile process and its components can be seen in the figure below.

***Figure 1: PfR Traffic Class Profiling Process***




PfR can automatically learn the traffic classes while monitoring the traffic flow through border routers using the embedded NetFlow capability. Although the goal is to optimize a subset of the traffic, you may not know all the exact parameters of this traffic, and PfR provides a method to automatically learn the traffic and create traffic classes by populating the MTC list. Within the automatic traffic class learning process, there are three components:

- Automatic learning of prefix-based traffic classes

- Automatic learning of application-based traffic classes
- Using learn lists to categorize both prefix-based and application-based traffic classes

PfR can be manually configured to create traffic classes for monitoring and subsequent optimizing. Automatic learning generally uses a default prefix length of /24, but manual configuration allows exact prefixes to be defined. Within the manual traffic class configuration process, there are two components:

- Manually configuring prefix-based traffic classes
- Manually configuring application-based traffic classes

The ultimate objective of the profile phase is to select a subset of traffic that is flowing through the network. This subset of traffic—the traffic classes in the MTC list—represents the classes of traffic that must be routed based on the best-performance path available.

More details about each of the traffic class profiling components in the figure above are contained in the "Understanding Performance Routing" module.

# Static Application Mapping Using PfR

The OER - Application Aware Routing with Static Application Mapping feature introduced the ability to define an application using a keyword to simplify the configuration of application-based traffic classes. PfR uses well-known applications with fixed ports, and more than one application may be configured at the same time. The list of static applications available for profiling Performance Routing traffic classes is constantly evolving. Use the **traffic-class application ?** command to determine if a static application is available for use with Performance Routing.

The table below displays a partial list of static applications that can be configured with Performance Routing. The applications are considered static because they are defined with fixed port and protocols as shown in the table. Configuration is performed on a master controller under learn list configuration mode.

***Table 1: Static Application List***

| Application | Keyword | Protocol | Port |
|---|---|---|---|
| **CU-SeeMe-Server** --CU-SeeMe desktop video conference | **cuseeme** | TCP UDP | 7648 7649 7648 7649 24032 |
| **DHCP-Client** --Dynamic Host Configuration Protocol client | **dhcp (Client)** | UDP/TCP | 68 |
| **DHCP-Server** --Dynamic Host Configuration Protocol server | **dhcp (Server)** | UDP/TCP | 67 |
| **DNS** --Domain Name Server lookup | **dns** | UDP/TCP | 53 |
| **FINGER-Server** --Finger server | **finger** | TCP | 79 |

| Application | Keyword | Protocol | Port |
|---|---|---|---|
| **FTP** --File Transfer Protocol | **ftp** | TCP | 20, 21 |
| **GOPHER-Server** --Gopher server | **gopher** | TCP/UDP | 70 |
| **HTTP--** Hypertext Transfer Protocol, World Wide Web traffic | **http** | TCP/UDP | 80 |
| **HTTPSSL-Server--** Hypertext Transfer Protocol over TLS/SSL, Secure World Wide Web traffic server | **secure-http** | TCP | 443 |
| **IMAP-Server** --Internet Message Access Protocol server | **imap** | TCP/UDP | 143 220 |
| **SIMAP-Server** --Secure Internet Message Access Protocol server | **secure-imap** | TCP/UDP | 585 993 (Preferred) |
| **IRC-Server** --Internet Relay Chat server | **irc** | TCP/UDP | 194 |
| **SIRC-Server** --Secure Internet Relay Chat server | **secure-irc** | TCP/UDP | 994 |
| **Kerberos-Server** --Kerberos server | **kerberos** | TCP/UDP | 88 749 |
| **L2TP-Server** --L2F/L2TP tunnel Layer 2 Tunnel Protocol server | **l2tp** | UDP | 1701 |
| **LDAP-Server** --Lightweight Directory Access Protocol server | **ldap** | TCP/UDP | 389 |
| **SLDAP-Server** --Secure Lightweight Directory Access Protocol server | **secure-ldap** | TCP/UDP | 636 |
| **MSSQL-Server** --MS SQL server | **mssql** | TCP | 1443 |

| Application | Keyword | Protocol | Port |
|---|---|---|---|
| **NETBIOS-Server** --NETBIOS server | **netbios** | UDP TCP | 137 138 137 139 |
| **NFS-Server** --Network File System server | **nfs** | TCP/UDP | 2049 |
| **NNTP-Server** --Network News Transfer Protocol | **nntp** | TCP/UDP | 119 |
| **SNNTP-Server** --Network News Transfer Protocol over TLS/SSL | **secure-nntp** | TCP/UDP | 563 |
| **NOTES-Server** --Lotus Notes server | **notes** | TCP/UDP | 1352 |
| **NTP-Server** --Network Time Protocol server | **ntp** | TCP/UDP | 123 |
| **PCanywhere-Server** --Symantec pcANYWHERE | **pcany** | UDP TCP | 22 5632 65301 5631 |
| **POP3-Server** --Post Office Protocol server | **pop3** | TCP/UDP | 110 |
| **SPOP3-Server** --Post Office Protocol over TLS/SSL server | **secure-pop3** | TCP/UDP | 123 |
| **PPTP-Server** --Point-to-Point Tunneling Protocol server | **pptp** | TCP | 17233 |
| **SSH** --Secured Shell | **ssh** | TCP | 22 |
| **SMTP-Server** --Simple Mail Transfer Protocol server | **smtp** | TCP | 25 |
| **Telnet** --Telnet | **telnet** | TCP | 23 |

The master controller is configured to learn the top prefixes based on highest outbound throughput or delay for the filtered traffic, and the resulting traffic classes are added to the PfR application database to be passively and actively monitored.

## Learn List Configuration Mode

The Learn List feature introduced a new configuration mode named learn list. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria including prefixes, application definitions, filters, and aggregation parameters for learning traffic classes can be configured. A traffic class is automatically learned by PfR based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different PfR policies to be applied to each learn list; in previous releases, the traffic classes could not be divided, and an PfR policy was applied to all the learned traffic classes.

Four types of traffic classes--to be automatically learned or manually configured--can be profiled:

- Traffic classes based on destination prefixes
- Traffic classes representing custom application definitions using access lists
- Traffic classes based on a static application mapping name with optional prefix lists to define destination prefixes

The **traffic-class** commands are used under learn list mode to simplify the automatic learning of traffic classes. Only one type of **traffic-class** command can be specified per learn list, and the **throughput** (PfR) and **delay** (PfR) commands are also mutually exclusive within a learn list.

The **match traffic-class** commands are used under PfR map configuration mode to simplify the manual configuration of traffic classes. Only one type of **match traffic-class** command can be specified per PfR map.

**Note** In addition to profiling the traffic and configuring the learn list parameters, the learn list must be referenced in a PfR policy using a PfR map and the **match pfr learn** command with the **list** keyword. To activate the policy, the **policy-rules** (PfR) command must be used.

# How to Configure Static Application Mapping Using Performance Routing

## Defining a Learn List to Automatically Learn Traffic Classes Using Static Application Mapping

Perform this task at the master controller to define a learn list using static application mapping. Within a learn list, a keyword that represents an application can be used to identify specific application traffic classes. The defined learn list will contain traffic classes to be automatically learned by PfR using the static application mapping. The resulting traffic classes can be filtered by a prefix list, if required.

In this task, a learn list is configured to create a traffic class using static application mapping keywords. Learn lists allow different PfR policies to be applied to each learn list. The resulting prefixes are aggregated to a prefix length of 24. A prefix list is applied to the traffic class to permit traffic from the 10.0.0.0/8 prefix. The master controller is configured to learn the top prefixes based on highest outbound throughput for the filtered traffic, and the resulting traffic class is added to the PfR application database.

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

To display information about the configured learn lists and the traffic classes learned by PfR, use the "Displaying and Resetting Traffic Class and Learn List Information" section.

## 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. **learn**
7. **list seq** *number* **refname** *refname*
8. **traffic-class application** *application-name...* [**filter** *prefix-list-name*]
9. **aggregation-type** {**bgp non-bgp prefix-length**} *prefix-mask*
10. **throughput**
11. **exit**
12. Repeat Step 7 to Step 11 to configure additional learn lists
13. **exit**
14. Repeat Step 13 to return to global configuration mode.
15. **pfr-map** *map-name sequence-number*
16. **match pfr learn list** *refname*
17. **end**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br><br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br><br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* \| **permit** *network/length* } | Creates an IP prefix list to filter prefixes for learning.<br>• An IP prefix list is used under learn list configuration mode to filter IP addresses that are learned. |

| | Command or Action | Purpose |
|---|---|---|
| | **Example:**<br>`Router(config)# ip prefix-list INCLUDE_10_NET permit 10.0.0.0/8` | • The example creates an IP prefix list named INCLUDE_10_NET for PfR to profile the prefix, 10.0.0.0/8. |
| **Step 4** | **pfr master**<br>**Example:**<br>`Router(config)# pfr master` | Enters PfR master controller configuration mode to configure a Cisco router as a master controller and to configure master controller policy and timer settings. |
| **Step 5** | **policy-rules** *map-name*<br>**Example:**<br>`Router(config-pfr-mc)# policy-rules LL_REMOTE_MAP` | Selects a PfR map and applies the configuration under PfR master controller configuration mode.<br>• Use the *map-name* argument to specify the PfR map name to be activated.<br>• The example applies the PfR map named LL_REMOTE_MAP that includes the learn list configured in this task. |
| **Step 6** | **learn**<br>**Example:**<br>`Router(config-pfr-mc)# learn` | Enters PfR Top Talker and Top Delay learning configuration mode to automatically learn traffic classes. |
| **Step 7** | **list seq** *number* **refname** *refname*<br>**Example:**<br>`Router(config-pfr-mc-learn)# list seq 10 refname LEARN_REMOTE_LOGIN_TC` | Creates an PfR learn list and enters learn list configuration mode.<br>• Use the **seq** keyword and *number* argument to specify a sequence number used to determine the order in which learn list criteria is applied.<br>• Use the **refname** keyword and *refname* argument to specify a reference name for the learn list.<br>• The example creates a learn list named LEARN_REMOTE_LOGIN_TC. |
| **Step 8** | **traffic-class application** *application-name...* [**filter** *prefix-list-name*]<br>**Example:**<br>`Router(config-pfr-mc-learn-list)# traffic-class application telnet ssh` | Defines an PfR traffic class using a pre-defined static application.<br>• Use the *application-name* argument to specify one or more keywords that represent pre-defined static applications. The ellipses are used to show that more than one application keyword can be specified.<br>• The example defines a traffic class as containing telnet and ssh traffic. |
| **Step 9** | **aggregation-type** {**bgp non-bgp prefix-length**} *prefix-mask* | (Optional) Configures a master controller to aggregate learned prefixes based on traffic flow type. |

| | Command or Action | Purpose |
|---|---|---|
| | **Example:**<br>`Router(config-pfr-mc-learn-list)# aggregation-type prefix-length 24` | • The **bgp** keyword configures prefix aggregation based on entries in the BGP routing table. This keyword is used if BGP peering is enabled in the network.<br>• The **non-bgp** keyword configures learned prefix aggregation based on static routes. Entries in the BGP routing table are ignored when this keyword is entered.<br>• The **prefix-length** keyword configures aggregation based on the specified prefix length. The range of values that can be configured for this argument is a prefix mask from 1 to 32.<br>• If this command is not specified, the default aggregation is performed based on a /24 prefix length.<br>• The example configures prefix length aggregation based on a /24 prefix length. |
| **Step 10** | **throughput**<br>**Example:**<br>`Router(config-pfr-mc-learn-list)# throughput` | Configures the master controller to learn the top prefixes based on the highest outbound throughput.<br>• When this command is enabled, the master controller will learn the top prefixes across all border routers according to the highest outbound throughput.<br>• The example configures a master controller to learn the top prefixes based on highest outbound throughput for the LEARN_REMOTE_LOGIN_TC traffic class. |
| **Step 11** | **exit**<br>**Example:**<br>`Router(config-pfr-mc-learn-list)# exit` | Exits learn list configuration mode, and returns to PfR Top Talker and Top Delay learning configuration mode. |
| **Step 12** | Repeat Step 7 to Step 11 to configure additional learn lists | -- |
| **Step 13** | **exit**<br>**Example:**<br>`Router(config-pfr-mc-learn)# exit` | Exits PfR Top Talker and Top Delay learn configuration mode, and returns to PfR master controller configuration mode. |
| **Step 14** | Repeat Step 13 to return to global configuration mode. | -- |
| **Step 15** | **pfr-map** *map-name sequence-number* | Enters PfR map configuration mode to configure a PfR map. |

| | Command or Action | Purpose |
|---|---|---|
| | **Example:**<br>`Router(config)# pfr-map LL_REMOTE_MAP 10` | • Only one match clause can be configured for each PfR map sequence.<br>• The example creates a PfR map named LL_REMOTE_MAP. |
| **Step 16** | **match pfr learn list** *refname*<br>**Example:**<br>`Router(config-oer-map)# match pfr learn list LEARN_REMOTE_LOGIN_TC` | Creates a match clause entry in a PfR map to match PfR learned prefixes.<br>• The example defines a traffic class using the criteria defined in the PfR learn list named LEARN_REMOTE_LOGIN_TC.<br>**Note** Only the syntax relevant to this task is used here. |
| **Step 17** | **end**<br>**Example:**<br>`Router(config-oer-map)# end` | (Optional) Exits OER map configuration mode and returns to privileged EXEC mode. |

### Example

In this example, two learn lists are configured to identify remote login traffic and file transfer traffic. The remote login traffic class is configured using keywords representing Telnet and Secure Shell (SSH) traffic, and the resulting prefixes are aggregated to a prefix length of 24. The file transfer traffic class is configured using a keyword that represents FTP and is also aggregated to a prefix length of 24. A prefix list is applied to the file transfer traffic class to permit traffic from the 10.0.0.0/8 prefix. The master controller is configured to learn the top prefixes based on highest outbound throughput for the filtered traffic, and the resulting traffic classes are added to the PfR application database. PfR maps are configured to match the learn lists and the File Transfer traffic class is activated using the **policy-rules** (PfR) command.

```
ip prefix-list INCLUDE_10_NET 10.0.0.0/8
pfr master
 policy-rules LL_FILE_MAP
 learn
  list seq 10 refname LEARN_REMOTE_LOGIN_TC
   traffic-class application telnet ssh
   aggregation-type prefix-length 24
   throughput
   exit
  list seq 20 refname LEARN_FILE_TRANSFER_TC
   traffic-class application ftp filter INCLUDE_10_NET
   aggregation-type prefix-length 24
   throughput
   exit
  exit
 exit
pfr-map LL_REMOTE_MAP 10
 match pfr learn list LEARN_REMOTE_LOGIN_TC
 exit
pfr-map LL_FILE_MAP 20
 match pfr learn list LEARN_FILE_TRANSFER_TC
 end
```

# Manually Selecting Traffic Classes Using Static Application Mapping

Perform this task to manually select traffic classes using static application mapping. Use this task when you know the destination prefixes and the applications that you want to select for the traffic classes. In this task, an IP prefix list is created to define the destination prefixes, and static applications are defined using the **match traffic-class application** (PfR) command. Using a PfR map, each prefix is matched with each application to create the traffic classes.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* | **permit** *network/length*}
4. Repeat Step 3 for more prefix list entries, as required.
5. **pfr-map** *map-name sequence-number*
6. **match traffic-class application** *application-name* **prefix-list** *prefix-list-name*
7. **end**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **enable**<br><br>**Example:**<br>`Router> enable` | Enables privileged EXEC mode.<br>• Enter your password if prompted. |
| **Step 2** | **configure terminal**<br><br>**Example:**<br>`Router# configure terminal` | Enters global configuration mode. |
| **Step 3** | **ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* \| **permit** *network/length*}<br><br>**Example:**<br>`Router(config)# ip prefix-list LIST1 permit 10.1.1.0/24` | Creates a prefix list to specify destination prefix-based traffic classes.<br>• The example specifies a destination prefix of 10.1.1.0/24 to be used to filter application traffic classes. |
| **Step 4** | Repeat Step 3 for more prefix list entries, as required. | -- |
| **Step 5** | **pfr-map** *map-name sequence-number*<br><br>**Example:**<br>`Router(config)# pfr-map APPLICATION_MAP 10` | Enters PfR map configuration mode to configure a PfR map.<br>• Only one match clause can be configured for each PfR map sequence. |

| | Command or Action | Purpose |
|---|---|---|
| | | • Permit sequences are first defined in an IP prefix list and then applied with the **match traffic-class** command in Step 6.<br>• The example creates a PfR map named APPLICATION_MAP. |
| **Step 6** | **match traffic-class application** *application-name* **prefix-list** *prefix-list-name*<br>**Example:**<br>`Router(config-pfr-map)# traffic-class application telnet ssh prefix-list LIST1` | Manually configures one or more static applications as match criteria against a prefix list to create traffic classes using a PfR map.<br>• Use the *application-name* argument to specify one or more keywords that represent pre-defined static applications.<br>• The example defines traffic classes as application X with destination prefix Y, where X is Telnet or Secure Shell and Y is a destination address defined in the IP prefix list named LIST1. |
| **Step 7** | **end**<br>**Example:**<br>`Router(config-pfr-map)# end` | (Optional) Exits PfR map configuration mode and returns to privileged EXEC mode. |

# Displaying and Resetting Traffic Class and Learn List Information

Perform this task to display traffic class and learn list information and optionally, to reset some traffic class information. These commands can be entered on a master controller after learn lists are configured and traffic classes are automatically learned, or when traffic classes are manually configured using a PfR map. The commands can be entered in any order and all the commands are optional.

## SUMMARY STEPS

1. **enable**
2. **show pfr master traffic-class** [**access-list** *access-list-name*| **application** *application-name*[*prefix*] | **inside** | **learned**[**delay** | **inside** | **list** *list-name*| **throughput**] | **prefix** *prefix*| **prefix-list** *prefix-list-name*] [**active**| **passive**| **status**] [**detail**]
3. **show pfr master learn list** [*list-name*]
4. **clear pfr master traffic-class** [**access-list** *access-list-name*| **application** *application-name*[*prefix*]| **inside** | **learned**[**delay** | **inside** | **list** *list-name*| **throughput**]| **prefix** *prefix*| **prefix-list** *prefix-list-name*]

## DETAILED STEPS

**Step 1** **enable**
Enables privileged EXEC mode. Enter your password if prompted.

**Example:**

```
Router> enable
```

**Step 2** **show pfr master traffic-class** [**access-list** *access-list-name*| **application** *application-name*[*prefix*] | **inside** | **learned**[**delay** | **inside** | **list** *list-name*| **throughput**] | **prefix** *prefix*| **prefix-list** *prefix-list-name*] [**active**| **passive**| **status**] [**detail**]

This command is used to display information about traffic classes learned or manually configured under PfR learn list configuration mode.

**Example:**

```
Router# show pfr master traffic-class
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
--------------------------------------------------------------------------------
10.1.1.0/24               N defa    N           N           N N
               #          OOPOLICY       32         10.11.1.3  Gi0/0/1      BGP
              N        N        N        N        N        N        N      IBwN
            130      134        0        0        N        N
```

**Step 3** **show pfr master learn list** [*list-name*]

This command is used to display one or all of the configured PfR learn lists. In this example, the information about two learn lists is displayed.

**Example:**

```
Router# show pfr master learn list
Learn-List LIST1 10
   Configuration:
    Application: ftp
    Aggregation-type: bgp
    Learn type: thruput
    Policies assigned: 8 10
   Stats:
    Application Count: 0
    Application Learned:
 Learn-List LIST2 20
   Configuration:
    Application: telnet
    Aggregation-type: prefix-length 24
    Learn type: thruput
    Policies assigned: 5 20
   Stats:
    Application Count: 2
    Application Learned:
```

```
Appl Prefix 10.1.5.0/24 telnet
Appl Prefix 10.1.5.16/28 telnet
```

**Step 4** **clear pfr master traffic-class** [**access-list** *access-list-name*| **application** *application-name*[*prefix*]| **inside** | **learned**[**delay** | **inside** | **list** *list-name*| **throughput**]| **prefix** *prefix*| **prefix-list** *prefix-list-name*]
This command is used to clear PfR controlled traffic classes from the master controller database. The following example clears traffic classes defined by the Telnet application and the 10.1.1.0/24 prefix:

**Example:**

```
Router# clear pfr master traffic-class application telnet 10.1.1.0/24
```

# Configuration Examples for Static Application Mapping Using Performance Routing

## Example Defining a Learn List to Automatically Learn Traffic Classes Using Static Application Mapping

The following example defines application traffic classes using static application mapping. In this example, the following two PfR learn lists are defined:

- LEARN_REMOTE_LOGIN_TC--Remote login traffic represented by Telnet and SSH.
- LEARN_FILE_TRANSFER_TC--File transfer traffic represented by FTP and filtered by the 10.0.0.0/8 prefix.

The goal is to optimize the remote login traffic using one policy (POLICY_REMOTE), and to optimize the file transfer traffic using a different policy (POLICY_FILE). This task configures traffic class learning based on the highest delay. The **policy-rules** (PfR) command activates the remote traffic class learn list. To activate the file transfer traffic class, replace the POLICY_REMOTE map name with the POLICY_FILE map name using the **policy-rules** (PfR) command.

```
ip prefix-list INCLUDE_10_NET 10.0.0.0/8
pfr master
 policy-rules POLICY_REMOTE 10
 learn
 list seq 10 refname LEARN_REMOTE_LOGIN_TC
 traffic-class application telnet ssh
 aggregation-type prefix-length 24
 delay
 exit
 list seq 20 refname LEARN_FILE_TRANSFER_TC
 traffic-class application ftp filter INCLUDE_10_NET
 aggregation-type prefix-length 24
 delay
 exit
 exit
pfr-map POLICY_REMOTE 10
 match pfr learn list LEARN_REMOTE_LOGIN_TC
 exit
```

```
pfr-map POLICY_FILE 20
 match pfr learn list LEARN_FILE_TRANSFER_TC
 end
```

# Example Defining a Learn List for Automatically Learned Prefix-Based Traffic Classes

The following example configured on the master controller, defines a learn list that will contain traffic classes that are automatically learned based only on a prefix list. In this example, there are three branch offices and the goal is to optimize all the traffic going to branch offices A and B using one policy (Policy1), and to optimize traffic going to branch office C using a different policy (Policy2).

Branch A is defined as any prefix that matches 10.1.0.0./16, Branch B is defined as any prefix that matches 10.2.0.0./16, and Branch C is defined as any prefix that matches 10.3.0.0./16.

This task configures prefix learning based on the highest outbound throughput. The **policy-rules** (PfR) command activates the traffic class learn list configured for branch offices A and B.

```
ip prefix-list BRANCH_A_B permit seq 10 10.1.0.0/16
ip prefix-list BRANCH_A_B permit seq 20 10.2.0.0/16
ip prefix-list BRANCH_C permit seq 30 10.3.0.0/16
pfr master
 policy-rules POLICY1
 learn
  list seq 10 refname LEARN_BRANCH_A_B
   traffic-class prefix-list BRANCH_A_B
   throughput
   exit
  list seq 20 refname LEARN_BRANCH_C
   traffic-class prefix-list BRANCH_C
   throughput
   exit
  exit
 exit
pfr-map POLICY1 10
 match pfr learn list LEARN_BRANCH_A_B
 exit
pfr-map POLICY2 10
 match pfr learn list LEARN_BRANCH_C
 end
```

# Example Defining a Learn List for Automatically Learned Application Traffic Classes Using an Access List

The following example creates an access list that defines custom application traffic classes. In this example, the custom application consists of four criteria:

- Any TCP traffic on destination port 500
- Any TCP traffic on ports in the range from 700 to 750
- Any UDP traffic on source port 400
- Any IP packet marked with a DSCP bit of ef

The goal is to optimize the custom application traffic using a learn list that is referenced in a PfR policy named POLICY_CUSTOM_APP. This task configures traffic class learning based on the highest outbound throughput. The **policy-rules** (PfR) command activates the custom application traffic class learn list.

```
ip access-list extended USER_DEFINED_TC
 permit tcp any any 500
 permit tcp any any range 700 750
 permit udp any eq 400 any
 permit ip any any dscp ef
 exit
pfr master
 policy-rules POLICY_CUSTOM_APP
 learn
  list seq 10 refname CUSTOM_APPLICATION_TC
   traffic-class access-list USER_DEFINED_TC
   aggregation-type prefix-length 24
   throughput
   exit
  exit
 exit
pfr-map POLICY_CUSTOM_APP 10
 match pfr learn list CUSTOM_APPLICATION_TC
 end
```

# Example Manually Selecting Traffic Classes Using Static Application Mapping

The following example starting in global configuration mode, configures a PfR map to include application traffic predefined as telnet or Secure Shell and destined to prefixes in the 10.1.1.0/24 network, 10.1.2.0/24 network, and 172.16.1.0/24 network.

```
ip prefix-list LIST1 permit 10.1.1.0/24
ip prefix-list LIST1 permit 10.1.2.0/24
ip prefix-list LIST1 permit 172.16.1.0/24
pfr-map PREFIXES 10
 match traffic-class application telnet ssh prefix-list LIST1
 end
```

# Example Manually Selecting Prefix-Based Traffic Classes Using a Prefix List

The following example configured on the master controller, manually selects traffic classes based only on destination prefixes. Use this task when you know the destination prefixes that you want to select for the traffic classes. An IP prefix list is created to define the destination prefixes and using a PfR map, the traffic classes are profiled.

```
ip prefix-list PREFIX_TC permit 10.1.1.0/24
ip prefix-list PREFIX_TC permit 10.1.2.0/24
ip prefix-list PREFIX_TC permit 172.16.1.0/24
pfr-map PREFIX_MAP 10
 match traffic-class prefix-list PREFIX_TC
 end
```

# Example Manually Selecting Application Traffic Classes Using an Access List

The following example configured on the master controller, manually selects traffic classes using an access list. Each access list entry is a traffic class that must include a destination prefix and may include other optional parameters.

```
ip access-list extended ACCESS_TC
 permit tcp any 10.1.1.0 0.0.0.255 eq 500
 permit tcp any 172.17.1.0 0.0.255.255 eq 500
 permit tcp any 172.17.1.0 0.0.255.255 range 700 750
 permit tcp 192.168.1.1 0.0.0.0 10.1.2.0 0.0.0.255 eq 800any any dscp ef
 exit
pfr-map ACCESS_MAP 10
 match traffic-class access-list ACCESS_TC
```

# Additional References

### Related Documents

| Related Topic | Document Title |
|---|---|
| Cisco IOS commands | Cisco IOS Master Command List, All Releases |
| Cisco IOS PfR commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples | Cisco IOS Performance Routing Command Reference |
| Basic PfR configuration for Cisco IOS XE releases | “Configuring Basic Performance Routing” module |
| Information about configuration for the border router only functionality for Cisco IOS XE Releases 3.1 and 3.2 | “Performance Routing Border Router Only Functionality” module |
| Concepts required to understand the Performance Routing operational phases for Cisco IOS XE releases | “Understanding Performance Routing” module |
| Advanced PfR configuration for Cisco IOS XE releases | “Configuring Advanced Performance Routing” module |
| IP SLAs overview | “Cisco IOS IP SLAs Overview” module |
| PfR home page with links to PfR-related content on our DocWiki collaborative environment | PfR:Home |

### MIBs

| MIB | MIBs Link |
|---|---|
| • CISCO-PFR-MIB<br>• CISCO-PFR-TRAPS-MIB | To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL:<br>http://www.cisco.com/go/mibs |

### 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 Static Application Mapping Using Performance Routing

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 2: Feature Information for Static Application Mapping Using Performance Routing*

| Feature Name | Releases | Feature Configuration Information |
|---|---|---|
| OER - Application Aware Routing with Static Application Mapping | Cisco IOS XE Release 3.3S | The OER - Application Aware Routing with Static Application Mapping feature introduces the ability to configure standard applications using just one keyword. This feature also introduces a learn list configuration mode that allows Performance Routing (PfR) policies to be applied to traffic classes profiled in a learn list. Different policies can be applied to each learn list. New **traffic-class** and **match traffic-class** commands are introduced to simplify the configuration of traffic classes that PfR can automatically learn, or that can be manually configured.<br><br>The following commands were introduced or modified by this feature: **clear pfr master traffic-class**, **count (PfR)**, **delay (PfR)**,**list (PfR)**, **match traffic-class access-list (PfR)**, **match traffic-class application (PfR)**, **match traffic-class prefix-list (PfR)**, **show pfr border defined application**, **show pfr master defined application**, **show pfr master learn list**, **show pfr master traffic-class**, **throughput (PfR)**, **traffic-class access-list (PfR)**, **traffic-class application (PfR), traffic-class prefix-list (PfR)**. |