Using Performance Routing to Control EIGRP Routes with mGRE DMVPN Hub-and-Spoke Support

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The PfR EIGRP mGRE DMVPN Hub-and-Spoke Support feature introduces the ability to inject routes into the EIGRP routing table, which allows Performance Routing (PfR) to control prefixes and applications over EIGRP routes. This feature also adds support for multicast Generic Routing Encapsulation (mGRE) Dynamic Multipoint Virtual Private Network (DMVPN) deployments that follow a hub- and-spoke network design.

Performance Routing is an extension of the Optimized Edge Routing (OER) technology and many of the commands and command modes still use the OER naming conventions. All of the original OER features are incorporated into the Performance Routing technology. Some of the early OER features have been superseded by newer techniques, and the more recent configuration module titles now use Performance Routing naming.

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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.

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Prerequisites for Using PfR to Control EIGRP Routes

This feature assumes that EIGRP is already configured in your network and that basic OER functionality is also configured. See the Cisco IOS Optimized Edge Routing Overview and Setting Up OER Network Components modules for more details. For other OER and PfR features, see the Where to Go Next section or the Additional References section for more details.

Restrictions for Using PfR to Control EIGRP Routes

If you are deploying EIGRP in an mGRE DMVPN topology in your network, it must conform to a hub-and-spoke network design.

Information About Using PfR to Control EIGRP Routes

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PfR EIGRP Route Control

The PfR EIGRP mGRE DMVPN Hub-and-Spoke Support feature introduces PfR route control for EIGRP. When enabled, a parent route check is performed in the EIGRP database for controlling PfR prefixes and routes in addition to the existing BGP and static route databases.

PfR can only optimize paths for prefixes, which have an exact matching route or a less specific route (also called as parent route) in the routing protocols. The route being controlled by PfR can be an exact match of the parent route or can be a more specific one. For example, if PfR wants to control 10.1.1.0/24 but the EIGRP routing table has only 10.1.0.0/16 then the parent route is 10.1.0.0/16 and PfR will inject 10.1.1.0/24 in the EIGRP routing table.

If an exact matching parent route in the EIGRP routing table is found, PfR will attempt to install a route on an exit selected by the master controller by influencing the metric. If an exact match parent is not found, then PfR introduces a new route in the EIGRP table that matches the attributes of the parent. If the route installation in the EIGRP table is successful, PfR saves the EIGRP parent and registers for any updates to the parent route. If the parent route is removed, PfR will uncontrol any routes it has installed in the EIGRP table based on this parent route.

PfR monitors traffic performance for prefixes it is controlling either passively using NetFlow or actively using IP SLA probes. Performance statistics such as delay, loss, and reachability are gathered and compared against a set of policies configured for the prefixes. If the traffic performance does not conform to the policies, the prefix is said to be out-of-policy (OOP). PfR tries to find an alternate path when the prefix goes into the OOP state.

While both BGP and static route control are enabled by default, EIGRP route control must be configured. PfR always attempts to control a prefix using BGP first. If BGP route control fails, static route control is tried. When EIGRP route control is enabled, PfR will attempt to control a prefix using BGP first. If no

parent route is found, PfR will try to use EIGRP route control. If EIGRP route controls fails, static route control is tried.

To find an alternate path for a prefix, PfR tries to send active probes from all the external interfaces on the border routers to a set of hosts in the destination prefix network. Before an active probe can be sent on an external interface, a parent route lookup is performed in routing protocol tables. When the PfR EIGRP mGRE DMVPN Hub-and-Spoke Support feature is enabled, PfR checks EIGRP routing tables, in addition to BGP and static routing tables, for a parent route, before sending active probes on external interfaces. Active probes are initiated on all the external interfaces that have a parent route in the EIGRP routing table. When the probe activity completes and the timer expires, statistics are sent from the border router to the master controller for policy decision and selection of an optimal exit.

When an exit is selected, a control prefix command is sent to the border router with the selected exit, specifying EIGRP as the protocol to install or modify the route. When the border router receives the command, it checks the EIGRP table to find a parent route. If a parent route is found, OER will install or modify the route in the EIGRP table and will notify the master controller about the route control status.

If an EIGRP route is successfully installed and advertised into the domain, OER continues to monitor traffic performance for this prefix and takes further action as mentioned above if the prefix goes OOP.

For more details about the PfR control mode and details about other PfR exit link selection control techniques including BGP, static routes, policy-based routing, and Protocol Independent Route Optimization (PIRO), see the Using OER to Control Traffic Classes and Verify the Route Control Changes module.

PfR and mGRE Dynamic Multipoint VPN

Dynamic Multipoint VPN (DMVPN) enables zero-touch deployment of IPsec encrypted VPN networks. The DMVPN topology leverages protocols like multipoint GRE (mGRE) for hub-to-spoke functionality, and for spoke-to-spoke functionality it utilizes the Next Hop Resolution Protocol (NHRP). Many DMVPN deployments use EIGRP networks, and support was added to PfR to allow DMVPN network deployments to use EIGRP route control within the DMVPN network. In the PfR EIGRP route control implementation, only hub-to-spoke network designs are supported.

For more details about configuring mGRE DMVPN networks, see the Dynamic Multipoint VPN module. For general information about DMVPN, go to http://www.cisco.com/go/dmvpn .

How to Configure PfR to Control EIGRP Routes

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- Disabling PfR EIGRP Route Control, page 5
- Manually Verifying the PfR EIGRP-Controlled Routes, page 6

Enabling PfR EIGRP Route Control and Setting a Community Value

Perform this task on the master controller to enable EIGRP route control. While both BGP and static route control are enabled by default, EIGRP route control must be enabled using a command-line interface (CLI) command, **mode route metric eigrp**. PfR always attempts to control a prefix using BGP first. If BGP route control fails, static route control is tried. When EIGRP route control is enabled, PfR will attempt to control a prefix using BGP first. If no parent route is found, PfR will try to use EIGRP route control. If EIGRP route controls fails, static route control is tried.

This task can also set an extended community value for an injected EIGRP route to allow the routes to be uniquely identified. An EIGRP route may be injected by PfR to control the traffic defined by a traffic class

when it goes out-of-policy (OOP). In this task, the PfR route control mode is configured globally with the **mode route control** command in OER master controller configuration mode, and any injected EIGRP routes will be tagged with a value of 700.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **oer master**
4. **mode route control**
5. **mode route metric eigrp tag** *community*
6. **end**

DETAILED STEPS

	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	**oer master** **Example:** `Router(config)# oer master`	Enters OER master controller configuration mode to configure a router as a master controller and to configure global operations and policies.
Step 4	**mode route control** **Example:** `Router(config-oer-mc)# mode route control`	Configures the OER route control mode on a master controller. • The **route**and **control** keywords enable route control mode. In control mode, the master controller analyzes monitored traffic classes and implements changes based on policy parameters. **Note** Only the syntax applicable to this task is shown. For more details, see the *Cisco IOS Optimized Edge Routing Command Reference*.

	Command or Action	Purpose
Step 5	**mode route metric eigrp tag** *community* **Example:** `Router(config-oer-mc)# mode route metric eigrp tag 7000`	Enables EIGRP route control and sets an EIGRP tag and community number value for injected EIGRP routes. • Use the **tag** keyword to apply a tag to an EIGRP route under OER control. The *community* argument is a number from 1 to 65535. **Note** Only the syntax applicable to this task is shown. For more details about setting metrics for BGP and static routes, see the *Cisco IOS Optimized Edge Routing Command Reference*.
Step 6	**end** **Example:** `Router(config-oer-mc)# end`	Exits OER master controller configuration mode and returns to privileged EXEC mode.

Disabling PfR EIGRP Route Control

Perform this task on the master controller to disable EIGRP route control.

Note When this task is complete, PfR withdraws all the routes that are being controlled using the EIGRP protocol.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **oer master**
4. **no mode route metric eigrp**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**oer master** **Example:** `Router(config)# oer master`	Enters OER master controller configuration mode to configure a router as a master controller and to configure global operations and policies.
Step 4	**no mode route metric eigrp** **Example:** `Router(config-oer-mc)# no mode route metric eigrp`	Disables EIGRP route control and removes all the routes that are being controlled using the EIGRP protocol.
Step 5	**end** **Example:** `Router(config-oer-mc)# end`	Exits OER master controller configuration mode and returns to privileged EXEC mode.

Manually Verifying the PfR EIGRP-Controlled Routes

PfR automatically verifies route control changes in the network using NetFlow output. PfR monitors the NetFlow messages and uncontrols a traffic class if a message does not appear to verify the route control change. Perform the steps in this optional task if you want to manually verify that the traffic control implemented in the PfR control phase actually changes the traffic flow, and brings the OOP event to be in-policy.

All the steps in this task are optional and are not in any order. The information from these steps can verify that a specific prefix associated with a traffic class has been moved to another exit or entrance link interface, or that it is being controlled by PfR. The first two commands are entered at the master controller, the last two commands are entered at a border router.

Only partial command syntax for some of the **show** commands used in this task is displayed. For more details about OER **show** commands, see the *Cisco IOS Optimized Edge Routing Command Reference*.

SUMMARY STEPS

1. **enable**
2. **show oer master prefix** *prefix* [**detail**]
3. Move to a border router to enter the next step.
4. **enable**
5. **show oer border routes eigrp** [**parent**]

DETAILED STEPS

Step 1 **enable**

Enables privileged EXEC mode. Enter your password if prompted.

Example:

```
Router> enable
```

Step 2 **show oer master prefix** *prefix* [**detail**]

This command is used to display the status of monitored prefixes. The output from this command includes information about the source border router, current exit interface, protocol, prefix delay, and egress and ingress interface bandwidth. In this example, the protocol displayed for the prefix 10.1.0.0/16 is EIGRP, which means that the parent route for the traffic class exists in the EIGRP routing table and EIGRP community values are used to control the prefix. Only syntax relevant to this task is shown in this step.

Example:

```
Router# show oer master prefix 10.1.0.0
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
Prefix                  State     Time Curr BR         CurrI/F         Protocol
                      PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                      ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                      ActSJit  ActPMOS
--------------------------------------------------------------------------------
10.1.0.0/16           DEFAULT*      @69 10.1.1.1        Gi1/22          EIGRP
                            U        U        0        0        0        0
                            U        U        0        0       22        8
                            N        N
```

Step 3 Move to a border router to enter the next step.

The next command is entered on a border router, not the master controller.

Example:

Step 4 **enable**

Enables privileged EXEC mode. Enter your password if prompted.

Example:

```
Router> enable
```

Step 5 **show oer border routes eigrp** [**parent**]

This command is entered on a border router. Use this command to display information about EIGRP routes controlled by PfR on a border router. In this example, the output shows that prefix 10.1.2.0/24 is being controlled by OER. This command is used to show parent route lookup and route changes to existing parent routes when the parent route is identified from the EIGRP routing table.

Example:

```
Router# show oer border routes eigrp
Flags: C - Controlled by oer, X - Path is excluded from control,
       E - The control is exact, N - The control is non-exact
Flags Network            Parent             Tag
CE    10.1.2.0/24        10.0.0.0/8         5000
```

In this example, the **parent** keyword is used and more details are shown about the parent route lookup.

Example:

```
Router# show oer border routes eigrp parent
Network            Gateway            Intf       Flags
10.0.0.0/8         10.40.40.2         Ethernet4  1
Child Networks
Network            Flag
10.1.2.0/24        6
```

- Troubleshooting Tips, page 8

Troubleshooting Tips

If the **show** commands are not displaying output that verifies the EIGRP route control, use the **debug oer border routes eigrp** command with the optional **detail** keyword for more information. Debugging must be enabled before entering the required commands, and the debug output depends on which commands are subsequently entered.

Configuration Examples for Using PfR to Control EIGRP Routes

- Enabling PfR EIGRP Route Control and Setting a Community Value Example, page 8

Enabling PfR EIGRP Route Control and Setting a Community Value Example

In the following configuration example, PfR route control is enabled first, and then the EIGRP route control is enabled and configured to set an extended community value of 700 to any injected EIGRP routes:

```
oer master
```

```
mode route control
mode route metric eigrp tag 700
end
```

Where to Go Next

This module covers PfR EIGRP route control. To learn more about PfR, start with the Cisco IOS Optimized Edge Routing Overview and the Setting Up OER Network Components modules. To learn more about the OER phases (same as Performance Routing phases) identified in the Cisco IOS Optimized Edge Routing Overview module, read through the other modules in the following list:

- Using Performance Routing to Profile the Traffic Classes
- Measuring the Traffic Class Performance and Link Utilization Using OER
- Configuring and Applying OER Policies
- Configuring Performance Routing Cost Policies
- Using OER to Control Traffic Classes and Verify the Route Control Changes

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS Master Command List	http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html
Command Lookup Tool	http://tools.cisco.com/Support/CLILookup
Cisco OER commands: complete command syntax, command mode, command history, defaults, usage guidelines and examples	*Cisco IOS Optimized Edge Routing Command Reference*
Cisco OER technology overview	Cisco IOS Optimized Edge Routing Overview module
Concepts and configuration tasks required to set up PfR network components	Setting Up OER Network Components module

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

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 Using PfR to Control EIGRP Routes

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.

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Table 1 Feature Information for Using PfR to Control EIGRP Routes

Feature Name	Releases	Feature Information
PfR EIGRP mGRE DMVPN Hub-and-Spoke Support	12.2(33)SRE 15.0(1)M	The PfR EIGRP feature introduces PfR route control capabilities based on EIGRP by performing a route parent check on the EIGRP database. The following commands were introduced or modified: **debug oer border routes**, **mode (OER)**, **show oer border routes**, and **show oer master prefix**.