PfRv3 Inter-DC Optimization

The PfRv3 Inter-DC (IDC) Optimization feature optimizes traffic between hub and transit hub sites over a WAN overlay or a DCI overlay. A path-preference policy specific to inter-DC Optimization is used for optimizing traffic between two or more hub sites. The PfRv3-Inter-DC-Optimization routes traffic from a hub site to another hub site for specific traffic types such as data, voice, video, and so on.

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Feature Information for PfRv3 Inter-DC Optimization

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.

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<td>PfRv3 Inter-DC Optimization</td>
<td>Cisco IOS XE Everest 16.6.1</td>
<td>The following commands were introduced or modified: domain, inter-dc, interdc-path-preference.</td>
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Prerequisites for PfRv3 Inter-DC Optimization

- Hub sites must be upgraded for using the same version of IOS for the master and border devices.
- Static NHRP mapping must be used between hub sites. (NHRP shortcuts are not allowed between hub sites)
• Local LAN prefixes on each hub site (all borders) must have a specific route pointing to LAN interfaces and not to DCI or WAN interfaces.

Limitations and Guidelines for Inter-DC Optimization

• The PfRv3 Inter-DC Optimization does not optimize routes using common prefixes.

  Note
  A common prefix is a prefix which is configured as a static prefix on all the hub sites, that include hub sites and transite hub sites.

• The command `domain dci-path` should be added in DCI tunnel interface, but normal WAN interface with `domain path` command can also be chosen as DCI path. But DCI interface using `domain dci-path` cannot be chosen as the path for normal hub to spoke traffic.

• We recommend to use static configuration under DCI tunnel interface to set up peer between DC sites. If `nhrp shortcut` is used, a forwarding loop may occur.

• After enabling the IDC feature using the inter-dc command, you can configure `path-preference` and `interdc-path-preference` under policy.

  Note
  You should not configure DCI path in `global path-preference` because if you add DCI path into path-preference, there is no channel available between hub and spoke in the DCI path. The DCI path cannot be chosen for the normal traffic-classes.

• The IDC feature must be enabled on both peer masters. It is recommended to use the same overlay routing protocol for all WAN and DCI tunnels.

Information About PfRv3-Inter-DC-Optimization

Datacenter Optimization

The following figure illustrates the PfRv3 Inter-DC Optimization feature where traffic between hub sites DC1, DC2 and DC3 are routed to forward specific traffic through a specific hub. The figure shows four paths can be used as candidates for the traffic from DC1 to DC2. IDC1 and IDC2 are Inter-DC links that can be used for this traffic. MPLS and INET are normal WAN paths that can also be used for this traffic as candidates. It depends on the path-preference policy specific to inter-DC optimization.
The PfRv3 Inter-DC Optimization feature can be enabled with the `inter-dc` command in domain master controller advanced mode. All hubs in the network must be connected through WAN overlay or DCI overlay. All hub and transit hub masters must be enabled with this feature locally. WAN overlay is configured by defining a WAN interface using the `domain path` command. DCI overlay is configured by defining a DCI interface using the `domain dci-path` command.

The salient points of the PfRv3 Inter-DC Optimization feature are as follows:

- The `domain dci-path` command enables route control which routes the transit traffic on all DCI interfaces in ingress direction.
- Traffic classes are learnt based on the egress aggregate update and traffic channels over the WAN and DCI overlay.
- Tunnel addresses and path ID mapping are exchanged by site capability between the hub and transit masters.
DCI Path Options

Based on the actual deployment requirement, you can choose any of the following options for providing the DCI path:

**Using the existing DMVPN overlay and the same tunnel interface:**

In the hub to spoke DMVPN tunnel interface configuration, there is no dmvpn peer between DC sites. So, if the normal hub tunnel interface is used as DCI path, some additional configuration should be added to set up the dmvpn peer between DC sites, such as ip nhrp nhs 161.1.0.5 nbma 155.155.155.5 multicast above.

**Using an independent DCI link(s) with independent DMVPN overlay**

When there is dedicated DCI links between DC sites, a dedicated DMVPN overlay can be used as DCI path. And ideally, the dedicated DCI links are more stable than the normal WAN links. Using the existing hub to spoke DMVPN, or using a dedicated DCI DMVPN built over dedicated DCI links will depend on the available interfaces in the network, and which solution will meet the need of the network.

How to Configure PfRv3-Inter-DC-Optimization

**Specifying the DCI interface on a Hub Site**

```
enable
configure terminal
interface tunnel155
 domain dci-path DCI path-id 11
 exit
```

**Configuring Inter-DC on Hub Master Controller**

To configure the Inter-DC Optimization feature on the hub master controller, use the following commands:

```
enable
configure terminal
domain default
vrf green
 master hub
 source-interface Loopback1
 site-prefixes prefix-list HUBPFX
```
advanced
inter-dc
  enterprise-prefix prefix-list ENTPFX
class BUSINESS sequence 10
  match dscp ef policy custom
  priority 1 one-way-delay threshold 100
interdc-path-preference DCI1 DCI2 fallback MPLS next-fallback INET
exit

Configuring Inter-DC on Transit Hub

To configure Inter-DC on the transit hub, use the following commands:

enable
Configure terminal
domain default
vrf green
  master transit 2
  source-interface Loopback1
  site-prefixes prefix-list HUBPFX
  hub 100.10.1.1
advanced
inter-dc
  class BUSINESS sequence 10
  interdc-path-preference DCI1 fallback MPLS next-fallback INET
exit

Specifying IDC Local Policy

This is an optional task to overwrite the global path-preference.

enable
configure terminal
domain default
vrf green
  master transit 2
  class BUSINESS sequence 10
  interdc-path-preference DCI1 fallback ISP1 next-fallback ISP2
exit

Verifying Inter-DC Configuration

HMCBR# show domain default vrf green master status
*** Domain MC Status ***
Master VRF: green
  Instance Type: Hub
  Instance id: 1
  Operational status: Up
  Configured status: Up
  Loopback IP Address: 100.10.1.1
  Global Config Last Publish status: Peering Success
  Smart Probe Profile:
    General Monitor:
      Packets per burst: 1
      Interval(secs): 1
    Quick Monitor:
      Packets per burst: 20
      Interval(secs): 1
Verifying Master Controller Configuration

HMCBR# show domain default vrf green master status

*** Domain MC Status ***
Master VRF: green
Instance Type: Hub
Instance id: 1
Operational status: Up
Configured status: Up
Loopback IP Address: 100.10.1.1
Global Config Last Publish status: Peering Success

Minimum Packet Loss Calculation Threshold: 15 packets
Minimum Bytes Loss Calculation Threshold: 1 bytes

Borders:
- IP address: 100.10.3.1
- Version: 2
- Connection status: CONNECTED (Last Updated 15:44:28 ago)
- Interfaces configured:
  - Name: Tunnel10 | type: external | Service Provider: ISP1 path-id:3 | Status: UP | Zero-SLA: NO | Path of Last Resort: Disabled
    - Number of default Channels: 0

- Name: Tunnel40 | type: external | Service Provider: ISP4 path-id:9 | Status: UP | Zero-SLA: NO | Path of Last Resort: Disabled
  - Number of default Channels: 0

- Name: Tunnel155 | type: DCI | Service Provider: DCI1 path-id:103 | Status: UP | Zero-SLA: NO | Path of Last Resort: Disabled
  - Number of default Channels: 0

Tunnel if: Tunnel0
- IP address: 100.10.1.1
- Version: 2
- Connection status: CONNECTED (Last Updated 15:44:21 ago)
- Interfaces configured:
  - Name: Tunnel10 | type: external | Service Provider: ISP1 path-id:1 | Status: UP | Zero-SLA: NO | Path of Last Resort: Disabled
    - Number of default Channels: 0

  - Name: Tunnel130 | type: external | Service Provider: ISP3 path-id:7 | Status: UP | Zero-SLA: NO | Path of Last Resort: Disabled
    - Number of default Channels: 0

  - Name: Tunnel155 | type: DCI | Service Provider: DCI1 path-id:101 | Status: UP | Zero-SLA: NO | Path of Last Resort: Disabled
    - Number of default Channels: 0

Verifying the Channel Status

HMCBR# show domain default vrf green master channels

Legend: * (Value obtained from Network delay:)
Channel Id: 7  Dst Site-Id: 100.20.1.1  Link Name: ISP1  DSCP: default [0] pfr-label: 0:0
Example Configurations for PfRv3 Inter-DC

Example for Policy Configured on the Hub MC with Inter DC

In this example, the policy can work on the normal hub-spoke traffic and the IDC traffic. For IDC traffic, the ‘interdc-path-preference’ takes effect. DCI1 and DCI2 are primary paths. If they are out-of-policy, the MPLS, which is a backup path, will be used. For normal hub-spoke traffic, the ‘path-preference’ takes effect. The other configuration is same as normal PfRv3 policy. For example, the threshold of delay is 100 ms for both the IDC traffic and the normal hub-spoke traffic.
Example for Policy Configured on the Transit Hub MC with Inter DC

On transit hub master, you can see the same policy. But, if the interdc-path-preference is configured on this transit hub. The local interdc-path-preference will overwrite the policy from hub site

class BUSINESS sequence 10
    interdc-path-preference DCI1 DCI2 fallback MPLS next-fallback INET

Example for 'show domain vrf master policy' on hub master

--------------------------------------------------------------------------------
Global-policy-list:

class BUSINESS sequence 10
    path-preference MPLS fallback INET
    class type: Dscp Based
        match dscp ef policy custom
        priority 1 one-way-delay threshold 100 msec
--------------------------------------------------------------------------------
InterDC-policy-list:

class BUSINESS sequence 10
    interdc-path-preference DCI1 DCI2 fallback MPLS next-fallback INET
    class type: Dscp Based
        match dscp ef policy custom
        priority 1 one-way-delay threshold 100 msec

Additional References for PfRv3-Inter-DC-Optimization

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