使用靜態路由和基於策略的路由配置PfRv2流量控制機制

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簡介

本檔案將介紹PfRv2（效能路由）如何根據PfRv2策略決策控制流量。本文討論在PfRv2中使用靜態路由和基於策略的路由。

必要條件

需求

思科建議您瞭解效能路由(PfR)的基本知識。

採用元件

設定

PfRv2允許網路管理員根據PfRv2策略結果配置策略並相應地路由流量。PfRv2控制流量的模式多種多樣，這取決於獲知目的地首碼的父路由所使用的協定。PfRv2能夠通過操縱路由協定、注入靜態路由或通過基於動態策略的路由來更改路由資訊庫(RIB)。

- 如果父路由是通過BGP獲知的，PfRv2可以使用本地優先順序等屬性動態操作路由。
- 如果父路由是通過EIGRP獲取的，PfRv2可以在EIGRP拓撲表中插入新路由。
- 如果父路由是通過靜態路由獲知的，則PfR2會在PfR選定的邊界路由器(BR)上注入更具體（更好）的路由。
- 如果父路由通過上述三種機制中的任何一種得知，則PfRv2使用基於策略的路由(PBR)將流量推

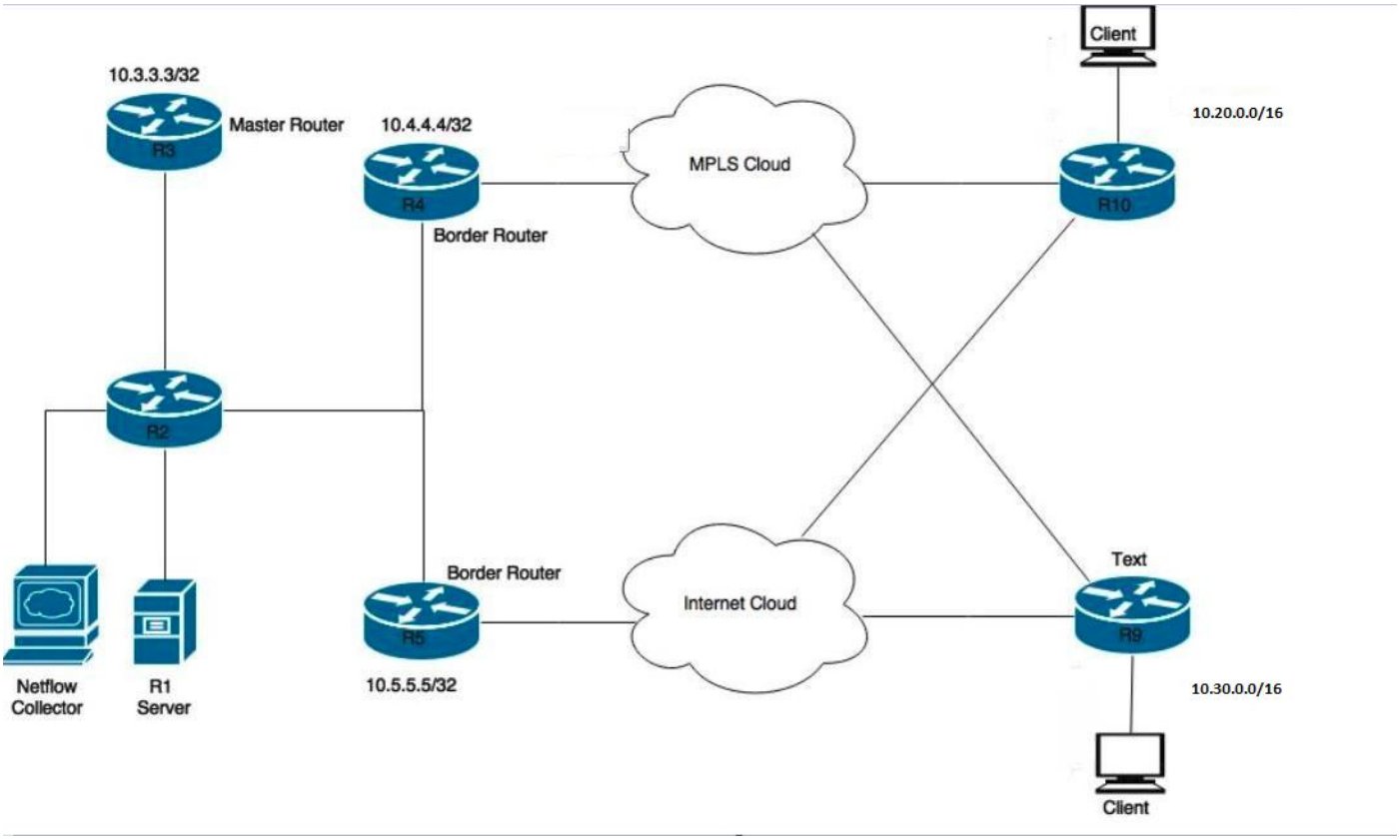
送到所選BR上。

Parent Route	Prefix control method
BGP	BGP
EIGRP	EIGRP
Static route	Static route
OSPF,ISIS,RIP etc	PBR

本文討論PfRv2使用靜態路由（當父路由通過靜態路由時）和PBR（當RIB中的父路由通過RIP、OSPF、ISIS等時）來控制流量。

網路圖表

本文檔將以下影象作為本文檔其餘部分的示例拓撲。



R1 —
R3- PfR
R4R5- PfR
R9R10R1

組態

在此案例中，將配置兩個學習清單，一個用於應用(APPLICATION-LEARN-LIST)和資料(DATA-LEARN-LIST)流量。此案例使用字首清單來定義流量。訪問清單還可用於匹配TCP、UDP、ICMP等流量型別。DSCP和TOS也可用於定義流量。

```
key chain pfr
 key 0
```

```
 key-string cisco
pfr master
 policy-rules PFR
 !
 border 10.4.4.4 key-chain pfr
 interface Tunnel0 internal
 interface Ethernet1/0 external
 interface Ethernet1/2 internal
 link-group MPLS
 !
 border 10.5.5.5 key-chain pfr
 interface Tunnel0 internal
 interface Ethernet1/3 internal
 interface Ethernet1/0 external
  link-group INET
 !

learn
 traffic-class filter access-list DENY-ALL
 list seq 10 refname APPLICATION-LEARN-LIST      //Learn-list for application traffic
  traffic-class prefix-list APPLICATION
  throughput
 list seq 20 refname DATA-LEARN-LIST              //Learn-list for data traffic
  traffic-class prefix-list DATA
  throughput
 !
!
pfr-map PFR 10
 match pfr learn list APPLICATION-LEARN-LIST
 set periodic 90
 set delay threshold 25
 set mode monitor active
 set active-probe echo 10.20.21.1
 set probe frequency 5
 set link-group MPLS fallback INET
!
pfr-map PFR 20
 match pfr learn list DATA-LEARN-LIST
 set periodic 90
 set delay threshold 25
 set mode monitor active
 set resolve delay priority 1 variance 10
 set active-probe echo 10.30.31.1
 set probe frequency 5
 set link-group INET fallback MPLS

ip prefix-list DATA
  seq 5 permit 10.30.0.0/24

ip prefix-list APPLICATION
  seq 5 permit 10.20.0.0/24
```

驗證

案例1：父路由通過邊界路由器上的靜態路由獲取

在此場景中，流向目標10.20.20.1和10.30.30.1的流量如下。下面是父路由在R4和R5上的樣子。

```
R4#show ip route
--output suppressed--
S        10.20.0.0/16 [1/0] via 10.0.68.8
```

```
S        10.30.0.0/16 [1/0] via 10.0.68.8
```

R5#show ip route

```
--output suppressed--
S        10.20.0.0/16 [1/0] via 10.0.57.7
S        10.30.0.0/16 [1/0] via 10.0.57.7
```

流量流動時，PfRv2會獲知流量字首，流量會進入INPOLICY狀態，如下圖輸出所示。

R3#show pfr master traffic-class

```
OER Prefix Statistics:
--output suppressed--
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
------------------------------------------------------------------------------
10.20.20.0/24             N    N    N           N           N N
                         INPOLICY       31          10.4.4.4 Et1/0           STATIC
             N        N        N        N        N        N        N        N
             1        2        0        0        N        N        N        N

10.30.30.0/24             N    N    N           N           N N
                         INPOLICY       30          10.5.5.5 Et1/0           STATIC
             N        N        N        N        N        N        N        N
             4        2        0        0        N        N        N        N
```

從下面可以看到，R4(10.4.4.4)路由器注入了更具體的路由10.20.20.0/24。此自動生成的路由自動使用標籤值5000標籤。此更具體的更佳路由使R4成為發往10.20.20.0/24的流量的更好BR。

R4#show pfr border routes static

```
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    10.20.20.0/24      10.20.0.0/16       5000
XN    10.30.30.0/24

R4#show ip route 10.20.20.0 255.255.255.0
Routing entry for 10.20.20.0/24
 Known via "static", distance 1, metric 0
 Tag 5000
 Redistributing via ospf 100
 Routing Descriptor Blocks:
 * 10.0.46.6, via Ethernet1/0
     Route metric is 0, traffic share count is 1
     Route tag 5000
```

同樣，在R5上也可以看到類似行為，它會注入更具體的路由10.30.30.0/24，並且標籤為5000。這使得R5成為路由10.30.30.0/24流量的合適候選。這就是PfRv2優先路由流量的方式，如上述「show pfr master traffic-class」所示。

R5#show pfr border routes static

```
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
XN    10.20.20.0/24
CE    10.30.30.0/24      10.30.0.0/16       5000
```

```
R5#show ip route 10.30.30.0 255.255.255.0
Routing entry for 10.30.30.0/24
 Known via "static", distance 1, metric 0
 Tag 5000
 Redistributing via ospf 100
 Routing Descriptor Blocks:
 * 10.0.57.7, via Ethernet1/0
     Route metric is 0, traffic share count is 1
     Route tag 5000
```

如果有多個邊界路由器（就像本例中一樣），這些自動生成的靜態路由必須手動重新分發到IGP中，以便它可以到達其他邊界路由器，而且它們可以根據由選定BR生成的更具體路由來路由流量。

案例2：通過OSPF學習父路由

任何未通過BGP、EIGRP或靜態路由獲知的父路由都使用基於策略的路由(PBR)進行控制。PfRv2會注入動態路由對映和訪問清單來控制流量。以下是R4和R5上OSPF父路由的樣子。

```
R4#show ip route
--output suppressed--
O E2     10.20.0.0/16 [110/20] via 10.0.46.6, 02:16:35, Ethernet1/0
O E2     10.30.0.0/16 [110/20] via 10.0.46.6, 02:16:35, Ethernet1/0

R5#show ip route
--output suppressed--
O E2     10.20.0.0/16 [110/20] via 10.0.57.7, 02:18:20, Ethernet1/0
O E2     10.30.0.0/16 [110/20] via 10.0.57.7, 02:18:20, Ethernet1/0
```

當PfRv2必須通過基於策略的路由控制流量時，它需要BR之間的直接連線介面。此直接連線的鏈路可以是物理連線或GRE隧道。此隧道必須手動建立並在PfRv2邊界定義中配置為內部介面。

```
R4
interface tunnel 0                 // Defining GRE tunnel for policy routing of traffic.
ip add 10.0.45.4
tunnel source 10.0.24.4
tunnel destination 10.0.25.5

R5
interface tunnel 0
ip add 10.0.45.5
tunnel source 10.0.25.5
tunnel destination 10.0.24.4

border 10.4.4.4 key-chain pfr
 interface Tunnel0 internal                                  // Packets would be policy routed
to selected BR using this Tunnel.
 interface Ethernet1/0 external
 interface Ethernet1/2 internal
 link-group MPLS
 !
 border 10.5.5.5 key-chain pfr
 interface Tunnel0 internal                                 // Packets would be policy routed
to selected BR using this Tunnel.
 interface Ethernet1/3 internal
 interface Ethernet1/0 external
  link-group INET

R3#show pfr master traffic-class
OER Prefix Statistics:
--output suppressed--
```

```
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
------------------------------------------------------------------------------
10.20.20.0/24              N    N    N           N           N N
                          INPOLICY       @8          10.4.4.4 Et1/0           RIB-PBR
              N        N        N        N        N        N        N        N
              2        1        0        0        N        N        N        N

10.30.30.0/24              N    N    N           N           N N
                          INPOLICY       82          10.5.5.5 Et1/0           RIB-PBR
              N        N        N        N        N        N        N        N
              1        1        0        0        N        N        N        N
```

根據PfRv2定義的策略，它為10.20.20.0/24和10.30.30.0/24提供最佳出口路由器(BR)。例如，當發往10.20.20.0/24的流量到達R5(10.5.5.5)（而不是選定的BR）時，會自動注入動態路由對映和訪問清單，以將流量路由到選定的BR R4(10.4.4.4)。 資料包是通過之前定義的隧道介面路由的策略。

```
R5#show route-map dynamic
route-map OER_INTERNAL_RMAP, permit, sequence 0, identifier 436207617
 Match clauses:
   ip address (access-lists): oer#1
 Set clauses:
   ip next-hop 10.0.45.4
   interface Tunnel0                      // Tunnel is used to PBR traffic to R4.
 Policy routing matches: 314076 packets, 16960104 bytes

R5#show ip access-lists dynamic
Extended IP access list oer#1
   1073741823 permit ip any 10.20.20.0 0.0.0.255 (315125 matches)
   2147483647 deny ip any any (314955 matches)
```