

멀티캐스트 라우팅 - MSDP 및 PIM 통과

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소개

이 문서에서는 간단한 멀티캐스트 토폴로지를 사용하여 PIM(Protocol Independent Multicast) 및 MSDP(Multicast Source Discovery Protocol)의 작업에 대해 설명합니다. 이는 소스가 등록될 때부터 수신자가 멀티캐스트 패킷 수신을 시작할 때까지의 컨트롤 플레인 작업 및 이벤트 시퀀스를 이해하려면 유용합니다.

참고: 이 문서에 사용된 디바이스는 랩 환경에서 Cisco IOS® 버전 15.3M을 실행합니다.

토폴로지

왼쪽에 있는 자동 시스템 AS65000에는 멀티캐스트 소스가 포함됩니다. R1은 FHR(First Hop Router)의 역할을 하며 소스(10.1.1.1)을 PIM RP(Rendezvous Point) R3에 등록합니다. R7 및 R3은 iBGP 인접 디바이스이고 R3-R4 및 R7-R6은 eBGP 인접 디바이스입니다. R7과 R6은 두 자동 시스템 간의 기본 경로로 구성됩니다. AS64999에서 R5에는 로컬로 연결된 수신기가 있습니다. R5는 R4를 PIM RP로 사용하도록 구성됩니다.

컨트롤 플레인

이 비디오에서는 어떤 메시지가 언제 전송되는지 보여줍니다. 각 단계에서 자세한 내용은 이 비디오와 읽기를 참조하십시오.

소스 등록(1-3단계)

소스가 239.1.1.1에 멀티캐스트 데이터를 보내기 시작합니다. 이 데이터를 수신하면 R1(세그먼트의 PIM DR)이 멀티캐스트 패킷을 가져오고 PIM 레지스터 메시지를 작성합니다.

레지스터 메시지는 소스의 PIM RP에 알리기 위해 R1에서 R3으로 전송되는 유니캐스트 PIM 패킷입니다.

R1#

```
*May 21 14:54:08.461: PIM(0): Check RP 10.10.10.10 into the (*, 239.1.1.1) entry
```

```
*May 21 14:54:08.461: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*May 21 14:54:08.461: PIM(0): Adding register encap tunnel (Tunnel0) as forwarding interface of (10.1.1.1, 239.1.1.1).
```

이제 PIM RP, R3는 레지스터 메시지를 수신하고 register-stop으로 응답합니다. R3은 MSDP를 통해 R4에 MSDP SA 메시지를 보냅니다. 경로에 있는 "A" 플래그는 MSDP 광고 후보라는 것을 의미합니다. "P" 플래그는 그룹에 대한 수신자 또는 발신 인터페이스가 없기 때문에 삭제되었음을 나타냅니다.

```
R3#
*May 21 14:54:08.459: PIM(0): Received v2 Register on Ethernet1/0 from 10.0.12.1
*May 21 14:54:08.459:           for 10.1.1.1, group 239.1.1.1
*May 21 14:54:08.459: PIM(0): Check RP 10.10.10.10 into the (*, 239.1.1.1) entry
*May 21 14:54:08.459: PIM(0): Adding register decap tunnel (Tunnel1) as accepting interface of (*, 239.1.1.1).
*May 21 14:54:08.459: PIM(0): Adding register decap tunnel (Tunnel1) as accepting interface of (10.1.1.1, 239.1.1.1).
*May 21 14:54:08.459: PIM(0): Send v2 Register-Stop to 10.0.12.1 for 10.1.1.1, group 239.1.1.1
```

```
R3#show ip mroute 239.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
       X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
       Q - Received BGP S-A Route, q - Sent BGP S-A Route,
       V - RD & Vector, v - Vector
Outgoing interface flags: H - Hardware switched, A - Assert winner
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 239.1.1.1), 00:00:33/stopped, RP 10.10.10.10, flags: SP
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list: Null
```

```
(10.1.1.1, 239.1.1.1), 00:00:33/00:02:26, flags: PA
Incoming interface: Ethernet1/0, RPF nbr 10.0.37.7
Outgoing interface list: Null
```

```
R3#show ip msdp sa-cache
MSDP Source-Active Cache - 0 entries
R3#
*May 21 14:54:58.511: MSDP(0): (10.1.1.1/32, 239.1.1.1)
```

여기서 R1은 R3에서 레지스터 스톱을 받습니다.

```
*May 21 14:54:08.461: PIM(0): Received v2 Register-Stop on Ethernet0/0 from 10.10.10.10
*May 21 14:54:08.461: PIM(0):           for source 10.1.1.1, group 239.1.1.1
*May 21 14:54:08.461: PIM(0): Removing register encap tunnel (Tunnel0) as forwarding interface of (10.1.1.1, 239.1.1.1).
*May 21 14:54:08.461: PIM(0): Clear Registering flag to 10.10.10.10 for
```

(10.1.1.1/32, 239.1.1.1)

R4에서는 경로 상태가 없지만 MSDP SA가 있습니다.

```
R4#show ip mroute
```

```
*May 21 14:54:58.591: MSDP(0): (10.1.1.1/32, 239.1.1.1), accepted
```

```
R4#show ip mroute
```

```
IP Multicast Routing Table
```

```
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,  
L - Local, P - Pruned, R - RP-bit set, F - Register flag,  
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,  
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,  
U - URD, I - Received Source Specific Host Report,  
Z - Multicast Tunnel, z - MDT-data group sender,  
Y - Joined MDT-data group, y - Sending to MDT-data group,  
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,  
Q - Received BGP S-A Route, q - Sent BGP S-A Route,  
V - RD & Vector, v - Vector
```

```
Outgoing interface flags: H - Hardware switched, A - Assert winner
```

```
Timers: Uptime/Expires
```

```
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(* , 224.0.1.40), 00:35:32/00:02:31, RP 10.20.20.20, flags: SJCL
```

```
Incoming interface: Null, RPF nbr 0.0.0.0
```

```
Outgoing interface list:
```

```
Ethernet1/0, Forward/Sparse, 00:23:16/00:02:36
```

```
Loopback0, Forward/Sparse, 00:35:31/00:02:31
```

```
R4#show ip msdp sa-cache
```

```
MSDP Source-Active Cache - 1 entries
```

```
(10.1.1.1, 239.1.1.1), RP 10.10.10.10, BGP/AS 65000, 00:01:00/00:05:49, Peer 10.33.33.33
```

수신자 조인 그룹(단계 4 - 11)

R5는 인터페이스에서 IGMP 조인을 수신하고 PIM 가입 패킷(*,G 조인)을 구축합니다. 조인이 R6로 전송됩니다.

```
R5#conf t
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
R5(config)#int e0/1
```

```
R5(config-if)#ip igmp join-group 239.1.1.1
```

```
R5(config-if)#
```

```
*May 21 14:56:43.234: PIM(0): Check RP 10.20.20.20 into the (*, 239.1.1.1) entry
```

```
*May 21 14:56:43.234: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message  
for 239.1.1.1
```

```
*May 21 14:56:43.234: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message  
for 239.1.1.1
```

```
*May 21 14:56:43.234: PIM(0): Insert (*,239.1.1.1) join in nbr 10.0.56.6's queue
```

```
*May 21 14:56:43.246: PIM(0): Building Join/Prune packet for nbr 10.0.56.6
```

```
*May 21 14:56:43.246: PIM(0): Adding v2 (10.20.20.20/32, 239.1.1.1), WC-bit, RPT-bit,  
S-bit Join
```

```
*May 21 14:56:43.246: PIM(0): Send v2 join/prune to 10.0.56.6 (Ethernet0/0)
```

R6은 R5에서 (*,G) PIM 조인을 수신하고 R4 PIM RP에 (*,G) 조인을 보냅니다.

```
R6#
```

```
*May 21 14:56:43.248: PIM(0): Received v2 Join/Prune on Ethernet2/0 from 10.0.56.5,
```

to us

```
*May 21 14:56:43.248: PIM(0): Join-list: (*, 239.1.1.1), RPT-bit set, WC-bit set, S-bit set
*May 21 14:56:43.248: PIM(0): Check RP 10.20.20.20 into the (*, 239.1.1.1) entry
*May 21 14:56:43.248: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*May 21 14:56:43.248: PIM(0): Add Ethernet2/0/10.0.56.5 to (*, 239.1.1.1), Forward state, by PIM *G Join
*May 21 14:56:43.248: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message for 239.1.1.1
*May 21 14:56:43.248: PIM(0): Insert (*,239.1.1.1) join in nbr 10.0.46.4's queue
*May 21 14:56:43.248: PIM(0): Building Join/Prune packet for nbr 10.0.46.4
*May 21 14:56:43.248: PIM(0): Adding v2 (10.20.20.20/32, 239.1.1.1), WC-bit, RPT-bit, S-bit Join
*May 21 14:56:43.248: PIM(0): Send v2 join/prune to 10.0.46.4 (Ethernet1/0)
```

R4 PIM RP는 R6에서 (*,G) 조인을 수신한 다음 소스 10.1.1.1에 대한 (S,G) 조인을 전송하며, 이 조인은 R6로 돌아갑니다.

R4#

```
*May 21 14:56:43.331: PIM(0): Received v2 Join/Prune on Ethernet1/0 from 10.0.46.6, to us
*May 21 14:56:43.331: PIM(0): Join-list: (*, 239.1.1.1), RPT-bit set, WC-bit set, S-bit set
*May 21 14:56:43.331: PIM(0): Check RP 10.20.20.20 into the (*, 239.1.1.1) entry
*May 21 14:56:43.331: PIM(0): Adding register decap tunnel (Tunnell) as accepting interface of (*, 239.1.1.1).
*May 21 14:56:43.331: PIM(0): Add Ethernet1/0/10.0.46.6 to (*, 239.1.1.1), Forward state, by PIM *G Join
*May 21 14:56:43.331: PIM(0): Adding register decap tunnel (Tunnell) as accepting interface of (10.1.1.1, 239.1.1.1).
*May 21 14:56:43.331: PIM(0): Insert (10.1.1.1,239.1.1.1) join in nbr 10.0.46.6's queue
```

R4#

```
*May 21 14:56:43.331: PIM(0): Building Join/Prune packet for nbr 10.0.46.6
*May 21 14:56:43.331: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), S-bit Join
*May 21 14:56:43.331: PIM(0): Send v2 join/prune to 10.0.46.6 (Ethernet1/0)
```

R6은 R4에서 (S,G) 조인을 수신한 다음 AS65000에서 R7에 (S,G) 조인을 보냅니다. R4에서 (S,G) 조인이 수신되면 R6은 (SGR) prune을 R4(9단계)로 보냅니다. 이는 R4에서 중복 패킷을 방지하기 위해 수행됩니다.

```
*May 21 14:56:43.248: PIM(0): Received v2 Join/Prune on Ethernet1/0 from 10.0.46.4, to us
*May 21 14:56:43.248: PIM(0): Join-list: (10.1.1.1/32, 239.1.1.1), S-bit set
*May 21 14:56:43.248: PIM(0): Add Ethernet1/0/10.0.46.4 to (10.1.1.1, 239.1.1.1), Forward state, by PIM SG Join
*May 21 14:56:43.248: PIM(0): Insert (10.1.1.1,239.1.1.1) join in nbr 10.0.67.7's queue
```

R6#

```
*May 21 14:56:43.248: PIM(0): Building Join/Prune packet for nbr 10.0.67.7
*May 21 14:56:43.248: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), S-bit Join
*May 21 14:56:43.248: PIM(0): Send v2 join/prune to 10.0.67.7 (Ethernet0/0)
```

R6#

```
*May 21 14:56:44.476: PIM(0): Insert (10.1.1.1,239.1.1.1) sgr prune in nbr 10.0.46.4's queue
*May 21 14:56:44.476: PIM(0): Building Join/Prune packet for nbr 10.0.46.4
*May 21 14:56:44.476: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), RPT-bit, S-bit Prune
*May 21 14:56:44.476: PIM(0): Send v2 join/prune to 10.0.46.4 (Ethernet1/0)
```

R7은 R6에서 (S,G) 조인을 수신한 다음 소스에 대한 경로를 따라 R2에 (S,G) 조인을 보냅니다.

R7#

```

*May 21 14:56:43.241: PIM(0): Received v2 Join/Prune on Ethernet0/0 from 10.0.67.6,
to us
*May 21 14:56:43.241: PIM(0): Join-list: (10.1.1.1/32, 239.1.1.1), S-bit set
*May 21 14:56:43.241: PIM(0): Check RP 10.10.10.10 into the (*, 239.1.1.1) entry
*May 21 14:56:43.241: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune message
for 239.1.1.1
*May 21 14:56:43.241: PIM(0): Add Ethernet0/0/10.0.67.6 to (10.1.1.1, 239.1.1.1),
Forward state, by PIM SG Join
*May 21 14:56:43.241: PIM(0): Insert (10.1.1.1,239.1.1.1) join in nbr 10.0.27.2's queue
*May 21 14:56:43.241: PIM(0): Building Join/Prune packet for nbr 10.0.27.2
R7#
*May 21 14:56:43.241: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), S-bit Join
*May 21 14:56:43.241: PIM(0): Send v2 join/prune to 10.0.27.2 (Ethernet2/0)

```

R7#show ip mroute

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector

Outgoing interface flags: H - Hardware switched, A - Assert winner

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

```

(*, 239.1.1.1), 00:03:33/stopped, RP 10.10.10.10, flags: SP
Incoming interface: Ethernet1/0, RPF nbr 10.0.37.3
Outgoing interface list: Null

```

```

(10.1.1.1, 239.1.1.1), 00:03:33/00:02:56, flags: T
Incoming interface: Ethernet2/0, RPF nbr 10.0.27.2
Outgoing interface list:

```

```

Ethernet0/0, Forward/Sparse, 00:03:33/00:02:53

```

R2 R7에서 (S,G) 조인을 수신한 다음 소스에 대한 경로를 따라 R1에 (S,G) 조인을 보냅니다.

R2#

```

*May 21 14:56:43.253: PIM(0): Received v2 Join/Prune on Ethernet1/0 from 10.0.27.7,
to us
*May 21 14:56:43.253: PIM(0): Join-list: (10.1.1.1/32, 239.1.1.1), S-bit set
*May 21 14:56:43.253: PIM(0): Check RP 10.10.10.10 into the (*, 239.1.1.1) entry
*May 21 14:56:43.253: PIM(0): Building Triggered (*,G) Join / (S,G,RP-bit) Prune
message for 239.1.1.1
*May 21 14:56:43.253: PIM(0): Add Ethernet1/0/10.0.27.7 to (10.1.1.1, 239.1.1.1),
Forward state, by PIM SG Join
*May 21 14:56:43.253: PIM(0): Insert (10.1.1.1,239.1.1.1) join in nbr 10.0.12.1's queue
*May 21 14:56:43.253: PIM(0): Building Join/Prune packet for nbr 10.0.12.1
R2#
*May 21 14:56:43.253: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), S-bit Join
*May 21 14:56:43.253: PIM(0): Send v2 join/prune to 10.0.12.1 (Ethernet0/0)

```

R2#show ip mroute

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector

Outgoing interface flags: H - Hardware switched, A - Assert winner

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.1.1.1), 00:01:27/stopped, RP 10.10.10.10, flags: SP

Incoming interface: Ethernet1/0, RPF nbr 10.0.27.7

Outgoing interface list: Null

(10.1.1.1, 239.1.1.1), 00:01:27/00:01:32, flags: T

Incoming interface: Ethernet0/0, RPF nbr 10.0.12.1

Outgoing interface list:

Ethernet1/0, Forward/Sparse, 00:01:27/00:03:01

R1은 R2에서 (S,G) 조인을 수신하고 인터페이스를 발신 인터페이스 목록에 추가합니다.

*May 21 14:56:43.261: PIM(0): Received v2 Join/Prune on Ethernet0/0 from 10.0.12.2, to us

*May 21 14:56:43.261: PIM(0): Join-list: (10.1.1.1/32, 239.1.1.1), S-bit set

*May 21 14:56:43.261: PIM(0): Add Ethernet0/0/10.0.12.2 to (10.1.1.1, 239.1.1.1),

Forward state, by PIM SG Join

R1#show ip mroute

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,

L - Local, P - Pruned, R - RP-bit set, F - Register flag,

T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,

X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,

U - URD, I - Received Source Specific Host Report,

Z - Multicast Tunnel, z - MDT-data group sender,

Y - Joined MDT-data group, y - Sending to MDT-data group,

G - Received BGP C-Mroute, g - Sent BGP C-Mroute,

Q - Received BGP S-A Route, q - Sent BGP S-A Route,

V - RD & Vector, v - Vector

Outgoing interface flags: H - Hardware switched, A - Assert winner

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.1.1.1), 00:03:25/stopped, RP 10.10.10.10, flags: SPF

Incoming interface: Ethernet0/0, RPF nbr 10.0.12.2

Outgoing interface list: Null

(10.1.1.1, 239.1.1.1), 00:03:25/00:03:24, flags: FT

Incoming interface: Ethernet0/1, RPF nbr 0.0.0.0

Outgoing interface list:

Ethernet0/0, Forward/Sparse, 00:00:50/00:02:39

이 시점에서 데이터는 소스에서 수신기로 이동합니다. 데이터 패킷을 수신하면 R5가 (*,G) 트리에서 (S,G) 트리로 전환됩니다.

R5#

*May 21 14:56:44.494: PIM(0): Insert (10.1.1.1,239.1.1.1) join in nbr 10.0.56.6's queue

*May 21 14:56:44.498: PIM(0): Building Join/Prune packet for nbr 10.0.56.6

*May 21 14:56:44.498: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), S-bit Join

*May 21 14:56:44.498: PIM(0): Send v2 join/prune to 10.0.56.6 (Ethernet0/0)

R5#show ip mroute

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector

Outgoing interface flags: H - Hardware switched, A - Assert winner

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.1.1.1), 00:02:47/stopped, RP 10.20.20.20, flags: SJCL

Incoming interface: Ethernet0/0, RPF nbr 10.0.56.6

Outgoing interface list:

Ethernet0/1, Forward/Sparse, 00:02:47/00:02:14

(10.1.1.1, 239.1.1.1), 00:02:45/00:00:14, flags: LJT

Incoming interface: Ethernet0/0, RPF nbr 10.0.56.6

Outgoing interface list:

Ethernet0/1, Forward/Sparse, 00:02:45/00:02:14

R6은 R5에서 (S,G) Join을 수신하고 E2/0에서 R5로 데이터 패킷을 전달합니다.

R6#

*May 21 14:56:44.496: PIM(0): Received v2 Join/Prune on Ethernet2/0 from 10.0.56.5,
to us

*May 21 14:56:44.496: PIM(0): Join-list: (10.1.1.1/32, 239.1.1.1), S-bit set

*May 21 14:56:44.496: PIM(0): Update Ethernet2/0/10.0.56.5 to (10.1.1.1, 239.1.1.1),
Forward state, by PIM SG Join

*May 21 14:56:49.056: PIM(0): Received v2 Join/Prune on Ethernet1/0 from 10.0.46.4,
to us

*May 21 14:56:49.056: PIM(0): Prune-list: (10.1.1.1/32, 239.1.1.1)

*May 21 14:56:49.056: PIM(0): Prune Ethernet1/0/239.1.1.1 from (10.1.1.1/32, 239.1.1.1)
- deleted

R6#show ip mroute

IP Multicast Routing Table

Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector

Outgoing interface flags: H - Hardware switched, A - Assert winner

Timers: Uptime/Expires

Interface state: Interface, Next-Hop or VCD, State/Mode

(* , 239.1.1.1), 00:03:43/00:02:42, RP 10.20.20.20, flags: S

Incoming interface: Ethernet1/0, RPF nbr 10.0.46.4

Outgoing interface list:

Ethernet2/0, Forward/Sparse, 00:03:43/00:02:42

(10.1.1.1, 239.1.1.1), 00:03:43/00:02:46, flags: T

Incoming interface: Ethernet0/0, RPF nbr 10.0.67.7

Outgoing interface list:

R4 PIM RP 정리해제(S,G) 12단계

마지막으로, R4 PIM RP는 (S,G) prune을 R6로 전송합니다. mroute(MSDP Created 항목)에 "M" 플래그가 있습니다.

```
R4#
*May 21 14:56:44.559: PIM(0): Received v2 Join/Prune on Ethernet1/0 from 10.0.46.6,
to us
*May 21 14:56:44.559: PIM(0): Prune-list: (10.1.1.1/32, 239.1.1.1) RPT-bit set
*May 21 14:56:44.579: PIM(0): Removing register decap tunnel (Tunnel1) as accepting
interface of (10.1.1.1, 239.1.1.1).
*May 21 14:56:44.579: PIM(0): Installing Ethernet1/0 as accepting interface for
(10.1.1.1, 239.1.1.1).

*May 21 14:56:46.107: MSDP(0): (10.1.1.1/32, 239.1.1.1), accepted

*May 21 14:56:49.139: PIM(0): Insert (10.1.1.1,239.1.1.1) prune in nbr 10.0.46.6's queue
*May 21 14:56:49.139: PIM(0): Building Join/Prune packet for nbr 10.0.46.6
*May 21 14:56:49.139: PIM(0): Adding v2 (10.1.1.1/32, 239.1.1.1), S-bit Prune
*May 21 14:56:49.139: PIM(0): Send v2 join/prune to 10.0.46.6 (Ethernet1/0)
```

```
R4#show ip mroute
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report,
Z - Multicast Tunnel, z - MDT-data group sender,
Y - Joined MDT-data group, y - Sending to MDT-data group,
G - Received BGP C-Mroute, g - Sent BGP C-Mroute,
Q - Received BGP S-A Route, q - Sent BGP S-A Route,
V - RD & Vector, v - Vector

Outgoing interface flags: H - Hardware switched, A - Assert winner
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```
(* , 239.1.1.1), 00:02:15/00:03:12, RP 10.20.20.20, flags: S
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:
Ethernet1/0, Forward/Sparse, 00:02:15/00:03:12
```

```
(10.1.1.1, 239.1.1.1), 00:02:15/00:02:46, flags: PMT
Incoming interface: Ethernet1/0, RPF nbr 10.0.46.6
Outgoing interface list: Null
```

여기서 OIF(Outgoing Interface) E1/0-R4는 R6에서 제거됩니다.

```
R6#
*May 21 14:56:49.056: PIM(0): Received v2 Join/Prune on Ethernet1/0 from 10.0.46.4,to us
*May 21 14:56:49.056: PIM(0): Prune-list: (10.1.1.1/32, 239.1.1.1)
*May 21 14:56:49.056: PIM(0): Prune Ethernet1/0/239.1.1.1 from (10.1.1.1/32, 239.1.1.1)
- deleted
R6#
```

요약

MSDP는 각각 자체 RP를 사용하는 서로 다른 PIM 도메인을 상호 연결하기 위한 방법을 제공합니

다. 이 문서는 이 문서에서 다루지 않은 "Anycast RP"를 구현하는 데 일반적으로 사용됩니다.
.MSDP와 PIM은 한 도메인의 수신자가 다른 도메인의 소스에서 트래픽을 수신할 수 있도록 함께 작동합니다. MSDP SA 메시지를 사용하면 다른 RP가 다른 PIM 도메인의 소스에 대해 학습할 수 있지만 PIM은 멀티캐스트 트리를 구축하는 데 사용됩니다.

프로토콜 작업에 대한 자세한 내용은 관련 정보에 언급된 RFC를 참조하십시오.

관련 정보

- PIM RFC

<https://tools.ietf.org/html/rfc4601>

- MSDP RFC

<https://tools.ietf.org/html/rfc3618>