How to configure

PIM SM using Static RP

on DGS-3630

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[Object]

In this post, we will see how to configure PIM-SM (sparse mode) with static RP configurations.

By default, members of a multicast group receive data from senders via a data distribution tree by the rendezvous point (RP). This type of distribution tree is called “Shared Tree” or “RP Tree”. If the leaf router on the shared tree switches the data distribution tree by the source. This type of distribution tree is called “Shortest Path Tree (SPT)” or “Source Tree”.

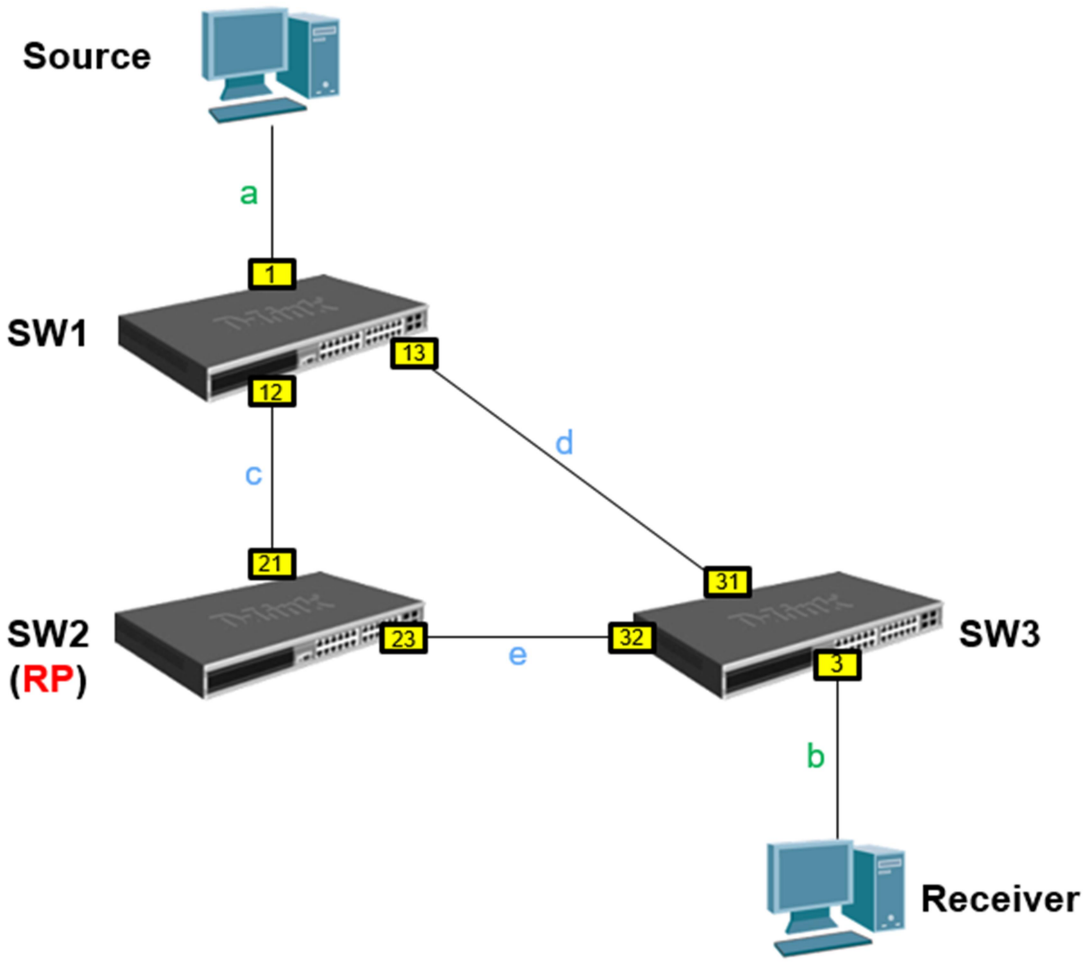
Comparing with RP Tree (Shared Tree), SPT can obtain lower latencies or more efficient bandwidth utilization, but SPT requires more memory than Shared Tree, that’s you should be careful.

[Overview]

1) Create VLAN base environment and check the connection between 2 Switches should be resident in the same VLAN, both with tagged or untagged ports.
2) Setup the routing protocol based on the VLAN environment, and the routing protocol can be applied by OSPF version 2.
3) Each Switch should ping to each other after building its own routing table.
4) Due to the different network segment, the multicast data will be forwarded by RPF via the routing table and be received by the group members in the end.

Key point: RP should have one route toward the source data at least and Receiver may not know where the source data is.

[Topology]



VLAN

VID	Link	Tagged port	Untagged port
1	a, b	-	SW1 eth1/0/1, SW3 eth1/0/3
12	c	SW1 eth1/0/12, SW2 eth1/0/21	-
13	d	SW1 eth1/0/13, SW3 eth1/0/31	-
23	e	SW2 eth1/0/23, SW3 eth1/0/32	-

IPv4

Network	Link	Connected Interface
10.10.10.0/24	a	SW1 eth1/0/1(.1), Source(.100)
192.168.12.0/24	c	SW1 eth1/0/12(.1), SW2 eth1/0/21(.2)
192.168.13.0/24	d	SW1 eth1/0/13(.1), SW3 eth1/0/31(.3)
192.168.23.0/24	e	SW2 eth1/0/23(.2), SW3 eth1/0/32(.3)
30.30.30.0/24	b	SW3 eth1/0/3(.3), Receiver(.100)

[Note]

In this document, we will show you PIM-SM by using OSPFv2 protocol on DGS-3630-MI image. Because of SI image only support “RIP routing protocol”, If you want to setup PIM-SM on DGS-3630-SI image, you should use “RIP” in the environment.
Also, PIM-SM with RIP config file is in the attachment, please refer to it.

[Device]

DGS-3630 Series FW 2.00.020 X 3:

1) SW1 = DGS-3630-52PC (MI)
2) SW2 = DGS-3630-28SC (MI)

3) SW3 = DGS-3630-52TC (MI)

IXIA port with IxNetwork-FT X 2:

1) Source = IXIA card 12 port 3
2) Receiver = IXIA card 12 port 4

[Configure]

Step 1

Create VLANs and two connected interfaces of the same link should have the equal tagged (or untagged) VID.

#SW1

```
configure terminal
prompt SW1
vlan 12,13
exit
interface ethernet 1/0/12
switchport mode trunk
switchport trunk allowed vlan 12
exit
interface ethernet 1/0/13
switchport mode trunk
switchport trunk allowed vlan 13
exit
```

#SW2

```
configure terminal
prompt SW2
vlan 12,23
exit
interface ethernet 1/0/21
switchport mode trunk
switchport trunk allowed vlan 12
exit
interface ethernet 1/0/23
switchport mode trunk
```

switchport trunk allowed vlan 23

exit

#SW3

configure terminal

prompt SW3

vlan 13,23

exit

interface ethernet 1/0/31

switchport mode trunk

switchport trunk allowed vlan 13

exit

interface ethernet 1/0/32

switchport mode trunk

switchport trunk allowed vlan 23

exit

Step 2

Create IP version 4 interfaces with the corresponding VLANs.

#SW1

configure terminal

interface vlan 1

ip address 10.10.10.1 255.255.255.0

exit

interface vlan 12

ip address 192.168.12.1 255.255.255.0

exit

interface vlan 13

ip address 192.168.13.1 255.255.255.0

exit

#SW2

configure terminal

interface vlan 12

ip address 192.168.12.2 255.255.255.0

exit

interface vlan 23

ip address 192.168.23.2 255.255.255.0

exit

#SW3

configure terminal

interface vlan 1

ip address 30.30.30.3 255.255.255.0

exit

interface vlan 13

ip address 192.168.13.3 255.255.255.0

exit

interface vlan 23

ip address 192.168.23.3 255.255.255.0

exit

Step 3

Apply OSPF version 2 for IP routing on the connected interfaces, all interfaces are resident in Backbone (Area 0.0.0.0). SW1 has Router ID 1.1.1.1, SW2 has Router ID 2.2.2.2 and SW3 has 3.3.3.3 Router ID.

#SW1

configure terminal

router ospf 1

router-id 1.1.1.1

network 192.168.12.0 255.255.255.0 area 0.0.0.0

network 192.168.13.0 255.255.255.0 area 0.0.0.0

network 10.10.10.0 255.255.255.0 area 0.0.0.0 <= Advertise the route toward Source for RP.

exit

#SW2

configure terminal

router ospf 1

router-id 2.2.2.2

network 192.168.12.0 255.255.255.0 area 0.0.0.0

network 192.168.23.0 255.255.255.0 area 0.0.0.0

exit

#SW3

configure terminal

router ospf 1

router-id 3.3.3.3

network 192.168.13.0 255.255.255.0 area 0.0.0.0

network 192.168.23.0 255.255.255.0 area 0.0.0.0

exit

Step 4

Setup PIM-SM for IP version 4 on connected interfaces. Since SW2 will be the RP of this distribution tree of the multicast data, make sure SW2 has the lowest priority of BSR and RP.

#SW1

configure terminal

ip multicast-routing <= Enable multicast routing

ip pim rp-address 192.168.12.2 <= Enable RP static address

interface vlan 1

ip pim sparse-mode

exit

interface vlan 12

ip pim sparse-mode

exit

interface vlan 13

ip pim sparse-mode

exit

#SW2

configure terminal

ip multicast-routing <= Enable multicast routing

ip pim rp-address 192.168.12.2 <= Enable RP static address

interface vlan 12

ip pim sparse-mode

exit

interface vlan 23

ip pim sparse-mode

exit

#SW3

configure terminal

ip multicast-routing <= Enable multicast routing

ip pim rp-address 192.168.12.2 <= Enable RP static address

ip pim spt-threshold infinity <= Enable SPT on the last-hop, “0” is SPT, “infinity” is Shared

interface vlan 1

ip pim sparse-mode
exit
interface vlan 13
ip pim sparse-mode
exit
interface vlan 23
ip pim sparse-mode
exit

Step 5

Only the last-hop Switch should apply IGMP to forward the join message from Reciever.

#SW3

configure terminal
interface vlan 1
ip igmp enable
exit

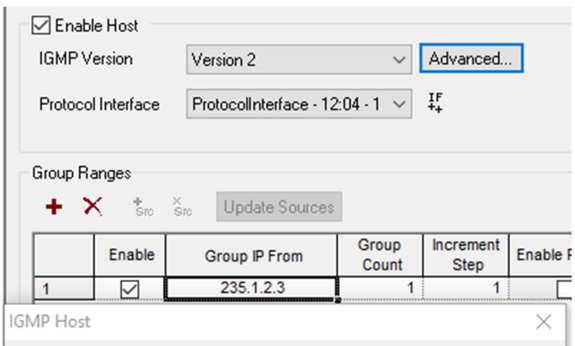
[Verification]

IXIA Setup

Source: IxExplorer

Destination MAC	01 00 5E 01 02 03
Source MAC	00 00 03 00 0C 00
Protocol	UDP
Destination IP	235.1.2.3
Source IP	10.10.10.100
Stream Rate	Continually 3000 fps
Packet size	70 bytes

Receiver: IxNetwork-FT



Test 1: Shared Tree (Default, spt-threshold = infinity)

1) After building the topology, Source starts to send the multicast data. We can see SW1 Flags status: ST (Note. S = PIM-SM mode , T = SPT process “ON”)
   Incoming interface is **interface vlan 1**
   Outing interface is **interface vlan 12**

```
SW1#show ip mroute

IP Multicast Routing Table
Flags: D - PIM-DM, S - PIM-SM, V - DVMRP, s - SSM Group, F - Register flag
       P - Pruned, R - (S, G) RPT-bit set, T - SPT-bit set
Outgoing interface flags: W - Assert winner
Timers: Uptime/Expires

(10.10.10.100, 235.1.2.3), 0DT00H00M39S/0DT00H03M24S, Flags: ST
  Incoming interface: vlan1, RPF neighbor: NULL
  Outgoing interface list:
   vlan12, Forwarding 0DT00H00M05S/0DT00H03M24S
```

2) Receiver sends MLD Report to join this multicast group, we can see the multicast routing info on SW2 (RP):
   For source,
   Incoming interface is **interface vlan 12**
   Outing interface is **interface vlan 23**
   RP address is **192.168.12.2**

```
SW2#show ip mroute

IP Multicast Routing Table
Flags: D - PIM-DM, S - PIM-SM, V - DVMRP, s - SSM Group, F - Register flag
       P - Pruned, R - (S, G) RPT-bit set, T - SPT-bit set
Outgoing interface flags: W - Assert winner
Timers: Uptime/Expires

(10.10.10.100, 235.1.2.3), 0DT00H08M44S/0DT00H02M04S, Flags: ST
  Incoming interface: vlan12, RPF neighbor: 192.168.12.1
  Outgoing interface list:
   vlan23, Forwarding 0DT00H05M53S/null

(*, 235.1.2.3), 0DT00H05M53S/0DT00H02M36S, RP is 192.168.12.2, Flags: S
  Incoming interface: vlan12, RPF neighbor: NULL
  Outgoing interface list:
   vlan23, Forwarding 0DT00H05M53S/0DT00H02M36S

Total Entries: 2
```

3) Receiver sends MLD Report to join this multicast group, we can see the multicast routing info on SW3 :
   Incoming interface is **interface vlan 23**
   Outing interface is **interface vlan 1**
   RP address is **192.168.12.2**
   Flag is **S** (it means **PIM-SM mode**)

```
SW3#show ip mroute

IP Multicast Routing Table
Flags: D - PIM-DM, S - PIM-SM, V - DVMRP, s - SSM Group, F - Register flag
       P - Pruned, R - (S, G) RPT-bit set, T - SPT-bit set
Outgoing interface flags: W - Assert winner
Timers: Uptime/Expires

(*, 235.1.2.3), 0DT00H16M14S/0DT00H03M59S, RP is 192.168.12.2, Flags: S
  Incoming interface: vlan23, RPF neighbor: 192.168.23.2
  Outgoing interface list:
   vlan1, Forwarding 0DT00H16M14S/0DT00H03M59S

Total Entries: 1
```

Flow on SW2

```
SW2#sho interfaces utilization

Port            TX packets/sec     RX packets/sec     Utilization
--------------  -----------------  -----------------  -----------
eth1/0/21       1                  3001               1
eth1/0/23       3001               1                  1
```

Flow on SW3

```
SW3#sho interfaces utilization

Port            TX packets/sec     RX packets/sec     Utilization
--------------  -----------------  -----------------  -----------
eth1/0/3        3001               0                  1
eth1/0/32       0                  3002               1
```

IXIA ports statistics

	A	B	C
1	Name	**Source**	**Receiver**
2	Link State	Link Up	Link Up
3	Line Speed	1000 Mbps	1000 Mbps
4	Duplex Mode	Full	Full
5	Frames Sent	1,771,897	5
6	Frames Sent Rate	3,000	0
7	Valid Frames Received	146	1,649,077
8	Valid Frames Received Rate	0	3,000
9	Bytes Sent	124,032,790	320
10	Bytes Sent Rate	209,991	0
11	Bytes Received	10,304	115,435,328
12	Bytes Received Rate	0	210,005

4) Then, we could know the path of the multicast data from Source to Receiver is:

Source→(eth1)**SW1**(eth12)→(eth21)**SW2**(eth23)→(eth32)**SW3**(eth3)→**Receiver**

Test 2: Shortest Path Tree (spt-threshold = 0)

1) After building the same topology, Source starts to send the multicast data. We can see SW1 outgoing interface was changed as below:
   Incoming interface is **interface vlan1**
   Outing interface is **interface vlan 13**

```
SW1#show ip mroute

IP Multicast Routing Table
Flags: D - PIM-DM, S - PIM-SM, V - DVMRP, s - SSM Group, F - Register flag
       P - Pruned, R - (S, G) RPT-bit set, T - SPT-bit set
Outgoing interface flags: W - Assert winner
Timers: Uptime/Expires

(10.10.10.100, 235.1.2.3), 0DT01H59M39S/0DT00H03M24S, Flags: ST
  Incoming interface: vlan1, RPF neighbor: NULL
  Outgoing interface list:
   vlan13, Forwarding 0DT00H03M31S/0DT00H02M58S

Total Entries: 1
```

2) Receiver sends MLD Report to join this multicast group, we can see the multicast routing info on SW2 (RP) and SW3:
   Flag is SRP (S = PIM-SM, R = (S,G), P= Pruned that means the route is pruned)
   # SW2 mroute table

```
SW2#show ip mroute

IP Multicast Routing Table
Flags: D - PIM-DM, S - PIM-SM, V - DVMRP, s - SSM Group, F - Register flag
       P - Pruned, R - (S, G) RPT-bit set, T - SPT-bit set
Outgoing interface flags: W - Assert winner
Timers: Uptime/Expires

(10.10.10.100, 235.1.2.3), 0DT02H01M51S/0DT00H02M59S, Flags: SRP
  Incoming interface: vlan12, RPF neighbor: 192.168.12.1
  Outgoing interface list:
   vlan23, Pruned 0DT00H06M02S/0DT00H03M26S

(*, 235.1.2.3), 0DT00H06M02S/0DT00H03M26S, RP is 192.168.12.2, Flags: S
  Incoming interface: vlan12, RPF neighbor: NULL
  Outgoing interface list:
   vlan23, Forwarding 0DT00H06M02S/0DT00H03M26S

Total Entries: 2
```

SW3 mroute table

Incoming interface is **interface vlan13**

Outing interface is **interface vlan 1**

```
SW3#show ip mroute

IP Multicast Routing Table
Flags: D - PIM-DM, S - PIM-SM, V - DVMRP, s - SSM Group, F - Register flag
       P - Pruned, R - (S, G) RPT-bit set, T - SPT-bit set
Outgoing interface flags: W - Assert winner
Timers: Uptime/Expires

(10.10.10.100, 235.1.2.3), 0DT00H10M48S/0DT00H03M11S, Flags: ST
  Incoming interface: vlan13, RPF neighbor: 192.168.13.1
  Outgoing interface list:
   vlan1, Forwarding 0DT00H10M48S/0DT00H02M36S

(*, 235.1.2.3), 0DT00H10M48S/0DT00H02M36S, RP is 192.168.12.2, Flags: S
  Incoming interface: vlan23, RPF neighbor: 192.168.23.2
  Outgoing interface list:
   vlan1, Forwarding 0DT00H10M48S/0DT00H02M36S

Total Entries: 2
```

3) The packet flow (3,000 fps) on each SW and IXIA ports are:

Flow on SW1

```
SW1#sh interfaces utilization

Port            TX packets/sec    RX packets/sec    Utilization
--------------  ----------------- ----------------- -----------
eth1/0/1        0                 3000              1
eth1/0/13       3001              0                 1
```

Flow on SW2 (No traffic)

```
SW2#sh interfaces utilization

Port            TX packets/sec    RX packets/sec    Utilization
-------------   ----------------- ----------------- -----------
eth1/0/21       0                 1                 1
eth1/0/23       0                 0                 1
```

Flow on SW3

```
SW3#sho interfaces utilization

Port            TX packets/sec    RX packets/sec    Utilization
-------------   ----------------- ----------------- -----------
eth1/0/3        3000              0                 1
eth1/0/31       0                 3001              1
```

IXIA ports statistics

	A	B	C
1	Name	**Source**	**Receiver**
2	Link State	Link Up	Link Up
3	Line Speed	1000 Mbps	1000 Mbps
4	Duplex Mode	Full	Full
5	Frames Sent	803,718	4
6	Frames Sent Rate	3,000	0
7	Valid Frames Received	19	696,675
8	Valid Frames Received Rate	0	3,000
9	Bytes Sent	56,260,260	256
10	Bytes Sent Rate	210,018	0
11	Bytes Received	1,356	48,767,246
12	Bytes Received Rate	0	209,976

4) Then, we could know the path of the multicast data from Source to Receiver is:
Source→(eth1)**SW1**(eth13)→ (eth31)**SW3**(eth3)→**Receiver**

Thus, the data flow does not pass through SW2 (RP), just by the shortest path.

[Troubleshooting]

The following useful commands can help to check the status or debug the root cause if the problem occurred.

1) VLAN info

show vlan

⇨ Summary VLAN setup including tagged and untagged ports.

show vlan interface eth 1/0/1

⇨ Detail VLAN setup on the specific port.

2) IP info

show ip interface brief

⇨ Summary IP interface status link up or down.

show ip interface vlan1

⇨ Detail IP setup on the specific VLAN interface.

3) Routing info

show ip route

⇨ The total routing table, to check if any routes lost.

show ip ospf

⇨ Overview of OSPFv2 setup.

show ip ospf neighbor

⇨ Check if the neighbor is the “FULL” state for OSPFv2.

show ip ospf interface

⇨ Check if the VLAN interface enabled OSPFv2.

4) PIM info

show ip pim

⇨ Overview of PIM setup.

show ip pim interface

⇨ Check if the VLAN interface enabled SM mode of PIM.

show ip pim mroute

⇨ Check if the multicast routing is correct.

[Reference]

RFC-3973 Protocol Independent Multicast – Dense Mode (PIM-DM): Protocol Specification (Revised)

RFC-4601 Protocol Independent Multicast – Sparse Mode (PIM-SM): Protocol Specification (Revised)

[Attachment]

The complete configuration of SW1, SW2 and SW3:
(Note. If SI model, please use PIM with RIP routing config file)

PIM-OSPF_ for MI_config.txt

PIM-RIP_for SI_config.txt