

EIGRP 1 PIM-Dense Mode

The diagram illustrates a network topology for EIGRP PIM-Dense Mode. Key components and connections include:

- CORP 2600** (Router) connected to **Branch 2600** (Router) via a serial link (180k, 10.99.1.0/24).
- CORP 2600** connected to **WAN VLAN2** (10.1.2.0/24) via E0.
- Branch 2600** connected to **ALSwitch 2900XL** (Switch) via E0.
- ALSwitch 2900XL** connected to **IP/TV Client** (10.2.01.2/24) and **IP/TV Server** (10.1.10.2/24).
- DLRouter** (red box) connected to **WAN VLAN2** (10.1.2.0/24) via .1.
- DLRouter** connected to **DLSwitch 4006** (Switch) via .1.
- DLRouter** connected to **Native VLAN1** (10.1.1.0/24), **Marketing VLAN20** (10.1.20.0/24), **Accounting VLAN10** (10.1.10.0/24), and **Engineering VLAN30** (10.1.30.0/24) via dashed red lines.
- DLSwitch 4006** connected to **IP/TV Server** (10.1.10.2/24).

Configure multicast routing on the Route Switch Module using Sparse Mode Protocol-Independent Multicast.

Current Environment

Enhancement

Your LAN and WAN connections function well and your company executives have now decided to implement an IP/TV Multicast system throughout the LAN to include the access switch

connected to the branch router over the WAN. The branch LAN will facilitate only audio streams to reduce WAN congestion until a faster WAN connection can be purchased. The implementation calls for the IP/TV server to be connected to VLAN10 and clients connected to any Ethernet segment on the corporate LAN and branch office LAN as illustrated in the diagram. PIM-Sparse Mode has been selected as the multicast routing protocol for corporate WAN multicast traffic. The corporate 2600 router has been selected as the PIM-Sparse RP point device.

Design:

Switched Network VTP Configuration Information:

Switch	VTP Domain	VTP Mode	VTP Pruning
DLSwitch	CORP	Server	Enabled
ALSwitch	N/A	N/A	N/A

VLAN Configuration Information:

VLAN ID	VLAN Name	VLAN Subnet	VLAN Gateway
1	Default "Native"	10.1.1.0/24	10.1.1.1
2	WAN	10.1.2.0/24	10.1.2.1
10	Accounting	10.1.10.0/24	10.1.10.1
20	Marketing	10.1.20.0/24	10.1.20.1
30	Engineering	10.1.30.0/24	10.1.30.1

Other LAN/WAN Configuration Information:

Network	Description	Subnet	Gateway
Branch	Remote/LAN	10.2.1.0/24	10.2.1.1
WAN	Remote/WAN	10.99.1.0/24	N/A

Switch VLAN Port Assignments

Switch	VLAN 1	VLAN 2	VLAN 10	VLAN 20	VLAN 30	Trunk
DLSwitch	6-18	5	19-24	25-30	31-34	3,4
ALSwitch	N/A	N/A	N/A	N/A	N/A	N/A

Cisco 4006 DLRouter Interface Configuration Information:

Interface	IP Address	VLAN
PortChannel 1.1	10.1.1.1/24	Native 1
PortChannel 1.2	10.1.2.1/24	2
PortChannel 1.10	10.1.10.1/24	10
PortChannel 1.20	10.1.20.1/24	20
PortChannel 1.30	10.1.30.1/24	30

Cisco 2600 WAN Router Interface Configuration Information:

Interface	IP Address	Location
Serial 0/1 (DCE)	10.99.1.1	CORP
Serial 0/1	10.99.1.2	Branch
FastEthernet 0/0	10.1.2.2/24	CORP
FastEthernet 0/1	10.2.1.1/24	Branch

Routing Protocols

Description	Protocol	ID
LAN/WAN	EIGRP	1
MULTICAST	PIM-Sparse	RP=10.99.1.1

Notes:

Lab Tasks:

1. Cable the lab as shown in the diagram. This is a multicasting lab and as such we will focus on those commands necessary to implement and troubleshoot PIM-Sparse multicast routing. The LAB requires that the IP/TV multicast server and client or viewer workstations are installed and configured. We will change their IP addresses if necessary but it will not affect the operations of the software.
2. The first device to be configured will be the distribution layer switch **DLSwitch**. Access the switch through the console port and enter privileged mode. Clear your NVRAM and reload.

```
Switch> (enable) clear config all  
Switch> (enable) reset
```

After the switch resets, enter privileged mode and issue the command **show config**. Simply review the default configuration. It is often helpful to be aware of clean configurations settings as with all devices.

3. Configure the **DLSwitch** with the following information:

- a. Configure the prompt DLSwitch on the 4006 switch.

```
Switch> (enable) set prompt DLSwitch>
```

or
Switch> (enable) **set system name DLSwitch>**

* Note: Verify using *DLSwitch> (enable) show config*

- b. Configure VTP information on the 4006 switch.

DLSwitch> (enable) **set vtp domain CORP**
DLSwitch> (enable) **set vtp mode server**

* Note: Verify using *DLSwitch> (enable) show vtp domain*

- c. Create corporate VLAN's.

DLSwitch> (enable) **set vlan 1 name default**
DLSwitch> (enable) **set vlan 2 name WAN**
DLSwitch> (enable) **set vlan 10 name Accounting**
DLSwitch> (enable) **set vlan 20 name Marketing**
DLSwitch> (enable) **set vlan 30 name Engineering**

* Note: Verify using *DLSwitch> (enable) show vlan*

- d. Set port channel admin groups.

DLSwitch> (enable) **set port channel 2/1-2 156**
DLSwitch> (enable) **set port channel 2/3-4 157**

* Note: Verify using *DLSwitch> (enable) show config*

- e. Assign port VLAN memberships. If you use the **show vlan** command you will see that all VLANs default to VLAN 1. We can easily set blocks of ports to specific vlans. Unlike the XL series where we have to set each individually.

DLSwitch> (enable) **set vlan 2 2/5**
DLSwitch> (enable) **set vlan 10 2/19-24**
DLSwitch> (enable) **set vlan 20 2/25-30**
DLSwitch> (enable) **set vlan 30 2/31-34**

* Note: Verify using *DLSwitch> (enable) show vlan*

- f. Establish VLAN trunking.

DLSwitch> (enable) **set trunk 2/1 nonegotiate dot1q 1-1005**
DLSwitch> (enable) **set trunk 2/2 nonegotiate dot1q 1-1005**
DLSwitch> (enable) **set trunk 2/3 nonegotiate dot1q 1-1005**
DLSwitch> (enable) **set trunk 2/4 nonegotiate dot1q 1-1005**

* Note: the **show trunk** command will not yet display necessary information because the trunk links may not yet be active. Ensure the **config** commands are entered though.

- g. Establish Fast EtherChannel on trunking interfaces.

DLSwitch> (enable) **set port channel 2/1-2 mode on**
DLSwitch> (enable) **set port channel 2/3-4 mode on**

* Note: Verify using *DLSwitch> (enable) show channel*

- h. Set the spanning tree portfast option enabled on the 4006 for the port that will connect to our external router.

```
DLSwitch> (enable) set spantree portfast 2/5 enable
```

- i. Enable CGMP on the switch. CGMP enables the switch to process multicast requests.

```
DLSwitch> (enable) set cgmp enable
```

- j. We'll also enable CGMP leave processing, this is not required but will increase CGMP join and unjoin efficiency.

```
DLSwitch> (enable) set cgmp leave enable
```

- k. Verify complete configuration using *DLSwitch> (enable) show config*.

4. Configure the **DLRouter** with the following information:

- a. Configure the hostname DLRouter on the 4006 L3 module.

```
Router(config)#hostname DLRouter
```

* Note: Verify using *DLRouter#show run*

- b. Configure the DLRouter on the 4006 L3 module for multicast routing.

```
Router(config)#ip multicast-routing
```

* Note: Verify using *DLRouter#show run*

- c. Configure the VLAN interface addressing and trunking information. Take note that on interface 1.2 we could use IP PIM SPARSE-DENSE-MODE. This would allow the external router to run either PIM sparse or dense for greater flexibility.

```
DLRouter(config)#interface Port-channel1
DLRouter(config-if)#ip address 10.1.1.1 255.255.255.0
DLRouter(config-if)#ip pim sparse-mode
DLRouter(config-if)#ip cgmp
DLRouter(config-if)#no shutdown
```

```
DLRouter(config)#interface Port-channel1.2
DLRouter(config-if)#encapsulation dot1Q 2
DLRouter(config-if)#ip address 10.1.2.1 255.255.255.0
DLRouter(config-if)#ip pim sparse-mode
DLRouter(config-if)#ip cgmp
```

```
DLRouter(config)#interface Port-channel1.10
DLRouter(config-if)#encapsulation dot1Q 10
DLRouter(config-if)#ip address 10.1.10.1 255.255.255.0
DLRouter(config-if)#ip pim sparse-mode
DLRouter(config-if)#ip cgmp
```

```
DLRouter(config)#interface Port-channel1.20
DLRouter(config-if)#encapsulation dot1Q 20
DLRouter(config-if)#ip address 10.1.20.1 255.255.255.0
DLRouter(config-if)#ip pim sparse-mode
DLRouter(config-if)#ip cgmp
```

```
DLRouter(config)#interface Port-channel1.30
DLRouter(config-if)#encapsulation dot1Q 30
DLRouter(config-if)#ip address 10.1.30.1 255.255.255.0
DLRouter(config-if)#ip pim sparse-mode
DLRouter(config-if)#ip cgmp
```

* Note: Verify using *DLRouter#show run*

- d. Assign the PortChannel to the Gigabit interfaces channeling to the switch.

```
DLRouter(config)#interface GigabitEthernet3
DLRouter(config-if)#channel-group 1
```

```
DLRouter(config)#interface GigabitEthernet4
DLRouter(config-if)#channel-group 1
```

* Note: Verify using *DLRouter#show run*

- e. Configure your corporate routing protocol. This is now an absolute necessity. The PIM routing protocol used for dense or sparse can be carried via several IGP routing protocols. EIGRP and OSPF are of course very popular. In this lab we will be using the EIGRP routing protocol. This is fairly subjective. Setting it to EIGRP will ensure that only Cisco devices will be able to read the L3 routing table if necessary. Of course here we will place the entire 10.x.x.x network in to cover and read all sub-networks.

```
DLRouter(config)#router eigrp 1
DLRouter(config-router)#network 10.0.0.0
```

* Note: Verify using *DLRouter#show run*

- f. Set the PIM Rendezvous Point (RP) address. The path to every receiver in the multicast group from the RP is the shortest path tree. Assume the RP is the receiver of the multicast traffic.

```
DLRouter(config)#ip pim rp-address 10.99.1.1
```

- g. Verify complete configuration using *DLRouter#show run*.

5. Configure the **CORP** router with the following information:

- a. Configure the hostname CORP on the external 2600.

```
Router(config)#hostname CORP
```

* Note: Verify using *DLRouter#show run*

- b. Enable IP Multicast routing on CORP

```
CORP(config)#ip multicast-routing
```

* Note: Verify using *DLRouter#show run*

- c. Configure each interface including necessary IP PIM processing information for the PIM Sparse-Mode routing protocol.

```
CORP(config)#interface FastEthernet0/0
CORP(config-if)#ip address 10.1.2.2 255.255.255.0
CORP(config-if)#ip pim sparse-mode

CORP(config)#interface Serial0/1
CORP(config-if)#ip address 10.99.1.1 255.255.255.0
CORP(config-if)#ip pim sparse-mode
CORP(config-if)#clockrate 128000
```

* Note: Verify using *CORP#show run*

- d. Configure the EIGRP routing protocol on the 2600. This will carry the PIM-SM multicast routing information. We will also add in a gateway of last resort.

```
CORP(config)#router eigrp 1
CORP(config-router)#network 10.0.0.0
CORP(config-router)#redistribute static metric 64 20000 255 1 1500

CORP(config)#ip route 0.0.0.0 0.0.0.0 10.99.1.2
```

* Note: Verify using *CORP#show run*

- 6. Configure the **Branch** router with the following information:

- a. Configure the hostname Branch on the external 2600.

```
Router(config)#hostname Branch
```

* Note: Verify using *Branch#show run*

- b. Enable IP Multicast routing on Branch.

```
Branch(config)#ip multicast-routing
```

* Note: Verify using *Branch#show run*

- c. Configure each interface including necessary IP PIM processing information for the PIM Sparse-Mode routing protocol.

```
Branch(config)#interface FastEthernet0/0
Branch(config-if)#ip address 10.2.1.1 255.255.255.0
Branch(config-if)#ip pim sparse-mode

Branch(config)#interface Serial0/1
Branch(config-if)#ip address 10.99.1.2 255.255.255.0
Branch(config-if)#ip pim sparse-mode
```

* Note: Verify using *Branch#show run*

- d. Configure the EIGRP routing protocol on the 2600. This will carry the PIM-SM multicast routing information.

```
Branch(config)#router eigrp 1
Branch(config-router)#network 10.0.0.0
```

* Note: Verify using *Branch#show run*

- e. Set the PIM Rendezvous Point (RP) address. The path to every receiver in the multicast group from the RP is the shortest path tree. Assume the RP is the receiver of the multicast traffic.

```
Branch(config)#ip pim rp-address 10.99.1.1
```

* Note: Verify using *Branch#show run*

7. Configure the **ALSwitch** with the following information:

- a. Clear you NVRAM and reset your switch to start a clean configuration.

```
Switch#clear start
Switch#reload
```

* Note: If asked to save your system configuration select “N” for NO.

- b. Configure the hostname **ALSwitch** on the external 2600.

```
Switch(config)#hostname ALSwitch
```

* Note: Verify using *ALSwitch#show run*

- c. Configure CGMP leave processing on the 2900XL. This is actually not necessary but simply illustrates the 2900XL’s CGMP capabilities.

```
ALSwitch(config)#cgmp leave-processing
```

* Note: Verify using *ALSwitch#show run*

8. Configure, connect and test IP multicast devices and software.

- a. Verify the routing tables on routers Branch and CORP. You should see entries from all networks. By looking at the Branch routing table, we can verify that DLRouter is functioning properly as well. Please review the examples provided below. Your table should reflect these closely. We did not display the table of DLRouter because it is obvious it would be functioning properly if BRANCH received network notification for networks directly connected to DLRouter.

```
CORP#sh ip route
```

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
       area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
```


Gateway of last resort is 10.99.1.2 to network 0.0.0.0

```
10.0.0.0/24 is subnetted, 6 subnets
D    10.1.10.0 [90/28416] via 10.1.2.1, 01:09:18, FastEthernet0/0
C    10.1.3.0 is directly connected, FastEthernet0/1
D    10.2.1.0 [90/20514560] via 10.99.1.2, 00:40:30, Serial0/1
C    10.1.2.0 is directly connected, FastEthernet0/0
D    10.1.1.0 [90/28416] via 10.1.2.1, 01:09:18, FastEthernet0/0
C    10.99.1.0 is directly connected, Serial0/1
S*   0.0.0.0/0 [1/0] via 10.99.1.2
```

Branch#**sh ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
* - candidate default, U - per-user static route, o - ODR
P - periodic downloaded static route

Gateway of last resort is 10.99.1.1 to network 0.0.0.0

```
10.0.0.0/24 is subnetted, 6 subnets
D    10.1.10.0 [90/20514816] via 10.99.1.1, 00:49:28, Serial0/1
D    10.1.3.0 [90/20514560] via 10.99.1.1, 00:49:28, Serial0/1
C    10.2.1.0 is directly connected, FastEthernet0/0
D    10.1.2.0 [90/20514560] via 10.99.1.1, 00:49:28, Serial0/1
D    10.1.1.0 [90/20514816] via 10.99.1.1, 00:49:28, Serial0/1
C    10.99.1.0 is directly connected, Serial0/1
D*EX 0.0.0.0/0 [170/45632000] via 10.99.1.1, 00:49:28, Serial0/1
```

- b. Connect the IP/TV multicast server to any port on the 4006 associated to VLAN10 (ports 2/19-24). Ensure the IP address of the multicast server is changed to 10.1.10.2/24 with a gateway of 10.1.10.1.

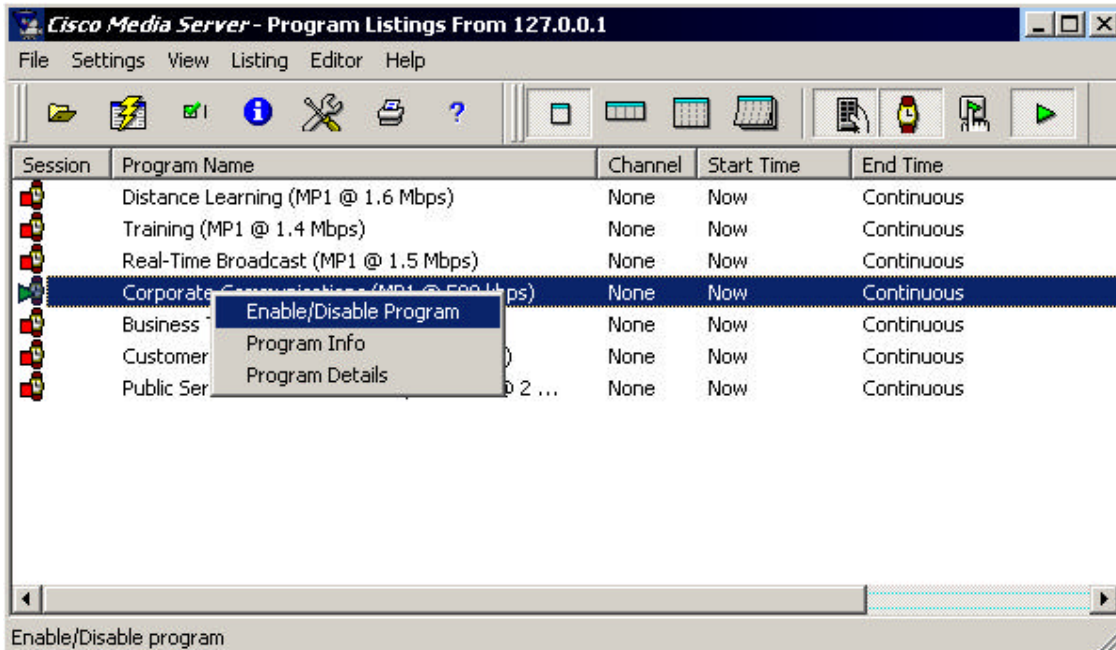
Use the **IPCONFIG** command from the DOS prompt to verify your entries.

- c. From a command prompt on the multicast server, use the **PING** command to test your ability to reach the gateway IP address 10.1.10.1 and the Branch network gateway address.

```
C:\>PING 10.1.10.1
and
C:\>PING 10.2.1.1
```

* Note: If these **PING** commands do not function you will need to perform basic network troubleshooting to correct before continuing.

- d. On the IP/TV multicast server, activate the IP/TV media server software. "ENABLE" the multicast stream "Corporate Communications". Ensure the Green activation indicator is displayed on the software management screen as indicated in the graphic below.



- e. Connect the IP/TV multicast client PC to any port on the ALSwitch. Ensure the IP address of the client PC is changed to 10.2.1.2/24 with a gateway of 10.2.1.1.

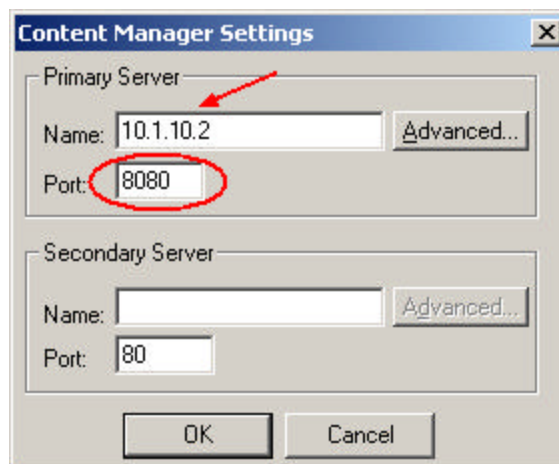
Use the **IPCONFIG** command from the DOS prompt to verify your entries.

- f. From a command prompt on the multicast client, use the **PING** command to test your ability to reach the multicast server IP address 10.1.10.2.

C:\>**PING 10.1.10.2**

* Note: If these **PING** commands do not function you will need to perform basic network troubleshooting to correct before continuing.

- g. On the IP/TV multicast client, activate the IP/TV viewer software. Ensure the Content Manager Setting are configured as follows.



- h. Refresh the screen on the IP/TV viewer. Now. Remember that we only want to receive **audio only**. Right click and click select stream Uncheck Video and leave only Audio selected. Click ok. John Chambers speech should start playing the stream produced by the server. Congratulations, you are multicast routing.

Note: If the stream does not start playing, you may want to stop and restart the stream from the IP/TV server. If it still does not start then there is a problem. Use the next section to help in your troubleshooting, as multicast routing is fairly straightforward but sometimes difficult to troubleshoot.

9. Investigate and troubleshooting multicast processing. Note that you should have the stream activated on the client before executing these commands. This will give you the full effect of the troubleshooting information.
- a. Show the multicast routing table on **DLRouter**, **CORP** and **Branch**. Showing the multicast routing table helps assist greatly in troubleshooting. It will display several items including routing, PIM information and stream information.

DLRouter#**sh ip mroute**

What is the RP point for DLRouter?

What would happen if nothing displayed?

CORP#**sh ip mroute**

Branch#**sh ip mroute**

- b. Show PIM neighbor information. This command allows us to verify the PIM mode used along with the modes used by neighbors.

DLRouter#**sh ip pim nei**

What is the PIM neighbor displayed?

DLRouter#sh ip pim nei int

Complete the following table?

Address	Interface	Version/Mode	Nbr Count	Query Intvl	DR
_____	Port-channel1	v2/Sparse	0	30	_____
_____	Port-channel1.2	v2/Sparse	1	30	_____
_____	Port-channel1.10	v2/Sparse	0	30	_____
_____	Port-channel1.20	v2/Sparse	0	30	_____
_____	Port-channel1.30	v2/Sparse	0	30	_____

CORP#**sh ip pim nei**

What are the PIM neighbors displayed?

```
Branch#sh ip pim nei
```

What is the PIM neighbor displayed?

```
Branch#sh ip pim nei int
```

Complete the following table?

Address	Interface	Version/Mode	Nbr	Query Count	DR Intvl
_____	FastEthernet0/0	v2/Sparse	0	30	_____
_____	Serial0/1	v2/Sparse	1	30	_____

- c. Show PIM RP information. This command allows us to verify the PIM group to RP mappings for the data streams.

```
Branch#sh ip pim rp mapping
```

What are the group multicast addresses?

-
- d. Check out MISC information. These commands are often used in addition to the above commands for multicast troubleshooting. We will not ask any added questions on these commands however you should compare your results and identify items that may assist you in multicast troubleshooting.

```
DLRouter#sh ip pim int count
```

```
State: * - Fast Switched, D - Distributed Fast Switched
       H - Hardware Switched
Address      Interface      FS  Mpackets In/Out
10.1.1.1     Port-channel1      *   0/0
10.1.2.1     Port-channel1.2    *  989/909
10.1.10.1    Port-channel1.10   *   909/8
10.1.20.1    Port-channel1.20   *   0/0
10.1.30.1    Port-channel1.30   *   0/0
```

```
CORP#sh ip pim int
```

Address	Interface	Version/Mode	Nbr Count	Query Intvl	DR
10.1.2.2	FastEthernet0/0	v2/Dense	1	30	10.1.2.2
10.1.3.1	FastEthernet0/1	v2/Dense	0	30	10.1.3.1
10.99.1.1	Serial0/1	v2/Sparse	1	30	0.0.0.0

```
CORP#sh ip pim int count
```

```
State: * - Fast Switched, D - Distributed Fast Switched
       H - Hardware Switched
Address      Interface      FS  Mpackets In/Out
10.1.2.2     FastEthernet0/0   *  206330/1202
10.1.3.1     FastEthernet0/1   *   441/90576
10.99.1.1    Serial0/1         *  1418/108439
```

```
CORP#sh ip igmp groups
```

```
IGMP Connected Group Membership
Group Address      Interface          Uptime    Expires    Last Reporter
224.0.1.40         FastEthernet0/1    01:11:19  never      10.1.3.1
```

CORP#**sh ip igmp groups**

```
IGMP Connected Group Membership
Group Address      Interface          Uptime    Expires    Last Reporter
224.0.1.40         FastEthernet0/1    01:11:21  never      10.1.3.1
```

CORP#**debug ip pim auto-rp**

PIM Auto-RP debugging is on

Branch#**sh ip pim int count**

```
State: * - Fast Switched, D - Distributed Fast Switched
       H - Hardware Switched
```

```
Address      Interface          FS  Mpackets In/Out
10.2.1.1     FastEthernet0/0    *   710/25787
10.99.1.2    Serial0/1          *   26575/706
```

Branch#**sh ip igmp groups**

```
IGMP Connected Group Membership
Group Address      Interface          Uptime    Expires    Last Reporter
224.0.1.40         Serial0/1          00:40:25  never      0.0.0.0
239.255.151.121   FastEthernet0/0    00:32:25  00:02:54  10.2.1.2
```

- e. What commands have you determined would be the most helpful in troubleshooting multicast processing?
