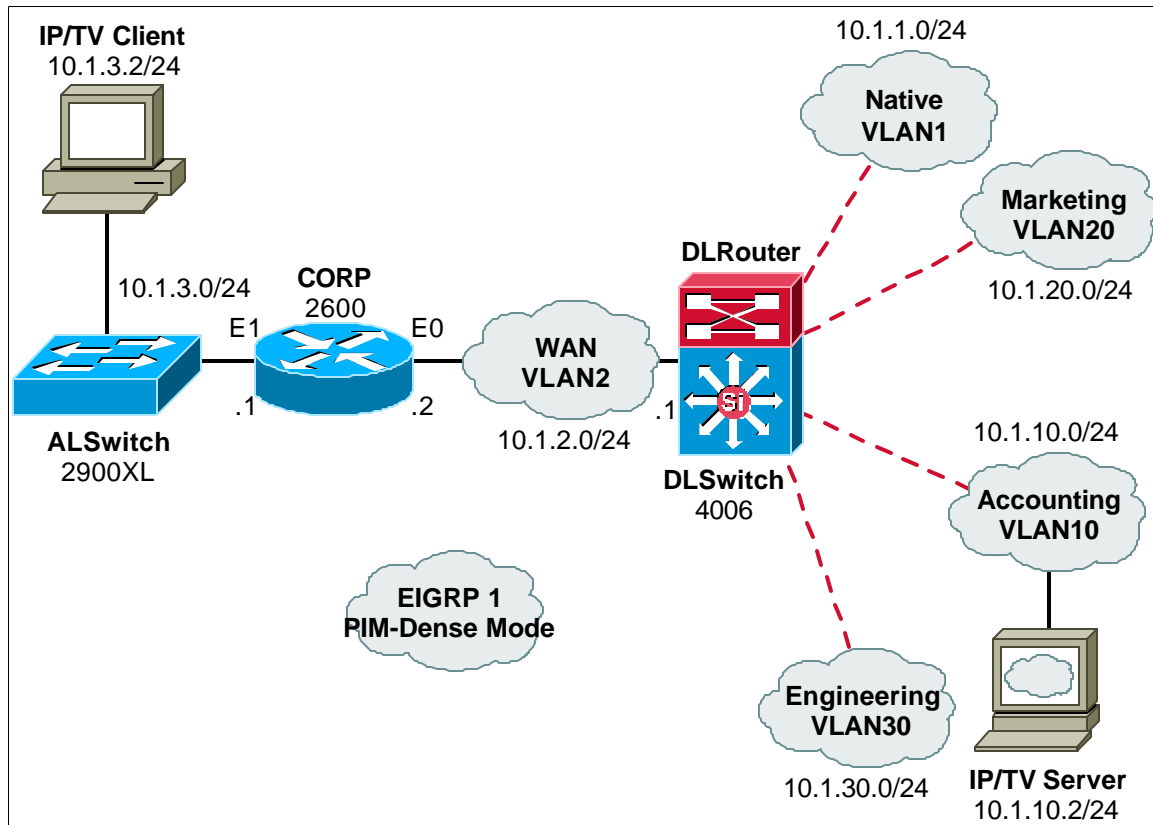


Lab 9.5.2: Configure Multicast Routing on the RSM using the PIM DM Protocol



Objective:

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

Scenario:

Current Environment

Your network switching equipment currently includes a 4006 Core switch, 2900XL access switch and a Cisco 2600 series external access router. Your network is segmented into four functional VLANs for better network management. VLANs include "Accounting", "Marketing" and "Engineering" for the users and "default" used for the native VLAN network management. Inter-VLAN routing has been implemented using a Layer-3 routing switch module for the 4006 to allow individuals and servers on your Virtual LANs to exchange information. No VLAN-trunking to the external router has been configured. Also, the WAN connection has not been connected because company is waiting for the ISP to get their job done.

Enhancement

Your LAN functions 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 external access WAN router (as illustrated in the diagram). The implementation calls for the IP/TV server to be connected to VLAN10 and clients connected to any Ethernet segment on the corporate LAN

including the external access router as illustrated in the diagram. PIM-Dense Mode has been selected as the multicast routing protocol for corporate LAN multicast traffic.

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 Configuration Information:

Network	Description	Subnet	Gateway
3	External	10.1.3.0/24	10.1.3.1

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 Internet Router Interface Configuration Information:

Interface	IP Address	NAT
Serial 0/0	N/A	N/A
Serial 0/1	N/A	N/A
FastEthernet 0/0	10.1.2.2/24	N/A
FastEthernet 0/1	10.1.3.1/24	N/A

Routing Protocols

Description	Protocol	ID
LAN/WAN	EIGRP	1
MULTICAST	PIM-Dense	N/A

Notes:

Lab Tasks:

1. Cable the lab as shown in the diagram. We will not spend time in this lab reviewing or answering questions on basic LAN configurations, as this lab will focus on multicasting. Also this LAB requires that you have already performed the IP/TV installation and configuration LAB provided by your instructor and that both the server and viewer are available for use.
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.

```
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.

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

- k. Verify complete configuration using *DLSwitch> (enable) show config*. Your main focus is to verify that the switch will function as directed.

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. This is a bit tricky. Port-channel1 is inherently talking to the native VLAN through a trunk. Simply setting an IP address allows accessing the Router for management. However, all other VLANs are required to be set up as sub-interfaces into the PortChannel along with the trunking encapsulation, VLAN ID and IP address. Take note that on sub-interface 1.2 or actually any we could have used IP PIM SPARSE-DENSE-MODE. This would allow the external router to run either PIM sparse or dense for greater flexibility. Of course PIM DENSE would be ok on its own but introducing you to added variations of commands provides you with a better-rounded background.

```
DLRouter(config)#interface Port-channel1  
DLRouter(config-if)#ip address 10.1.1.1 255.255.255.0  
DLRouter(config-if)#ip pim dense-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 dense-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 dense-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 dense-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 dense-mode
DLRouter(config-if)#ip cgmpp
```

* Note: Verify using *DLRouter#show run*

- d. Assign the PortChannel to the Gigabit interfaces channeling to the switch. This is required for the VLANs to establish communication to the Switch. We are channeling through 2 Gigabit links so communication will be optimized. Since all VLANs are part of PortChannel 1 then we will assign PortChannel 1 to both Gigabit interfaces.

```
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 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. Verify complete configuration using *DLRouter#show run*. Go ahead and compare it to the configuration at the end of the lab. Don't worry about little differences because the router will place a number of its own configuration commands in.

5. Configure the **CORP** 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 *Corp #show run*

- c. Configure each interface including necessary IP PIM processing information for the PIM Dense-Mode routing protocol. Of course you recall that IP MULTICASTING is already enabled.

```
Corp(config)#interface FastEthernet0/0
```

```
Corp(config-if)#ip address 10.1.2.2 255.255.255.0
Corp(config-if)#ip pim dense-mode
```

```
Corp(config)#interface FastEthernet0/1
Corp(config-if)#ip address 10.1.3.1 255.255.255.0
Corp(config-if)#ip pim dense-mode
```

* Note: Verify using *DLRouter#show run*

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

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

* Note: Verify using *DLRouter#show run*

6. 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 you 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 here but simply illustrates the 2900XL's CGMP capabilities.

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

* Note: Verify using *ALSwitch#show run*

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

- a. 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.

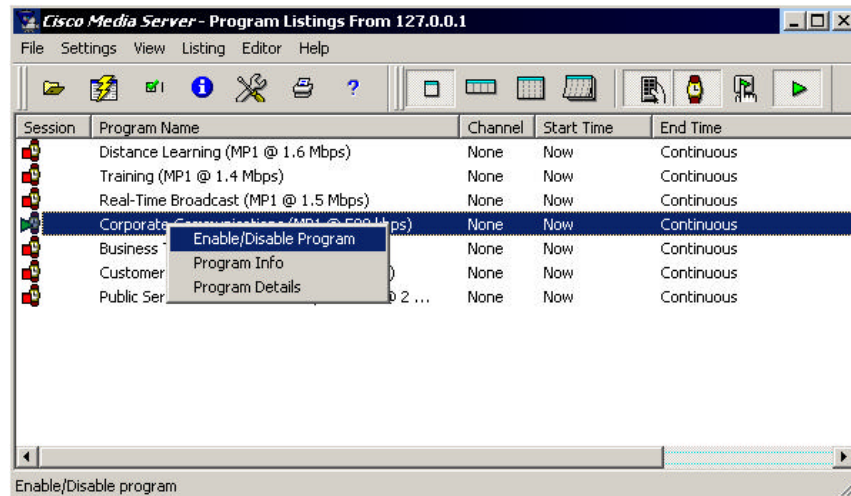
Use the **IPCONFIG** command from the DOS prompt to verify your entries.

- b. 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 external network ID 3 gateway 10.1.3.1.

```
C:\>PING 10.1.10.1
and
C:\>PING 10.1.3.1
```

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

- c. 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.



- d. Connect the IP/TV **multicast client** PC to any port on the ALSwitch. Since we are not trunking to the ALSwitch, all ports should represent the same VLAN that is isolated to that switch. Ensure the IP address of the client PC is changed to 10.1.3.2/24 with a gateway of 10.1.3.1.

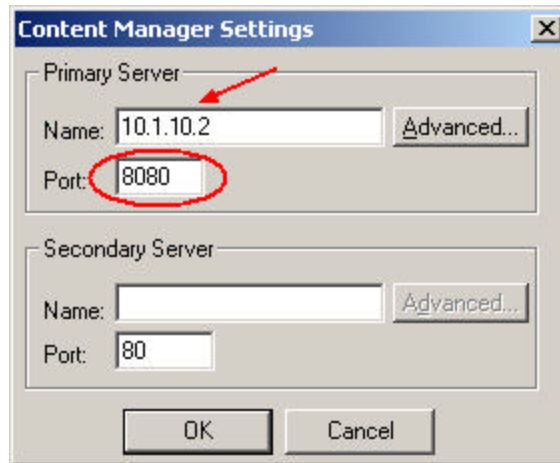
Use the **IPCONFIG** command from the DOS prompt to verify your entries.

- e. 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.

- f. On the IP/TV multicast client, activate the IP/TV viewer software. Ensure the Content Manager Settings are configured as follows. Be sure to change the Port and IP address as indicated.



- g. Refresh the screen on the IP/TV viewer and double-click the Corporate Communications stream. John Chambers's speech should start playing the stream produced by the server. Congratulations, you are multicast routing over PIM-Dense Mode

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.

8. 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 CAM entries in the DLSwitch. The *content addressable memory* (CAM) table on the switch contains a mapping of Ethernet address to ports that the switch uses to forward traffic. A port can have multiple mappings. It is important to know that these are manually set to prevent traffic from going everywhere. However, Cisco's CGMP will dynamically take care of establishing this table.

```
DLSwitch> (enable) show cam dynamic
```

How many CAM entries are in your table?

- b. Show the CGMP statistics. This command displays CGMP activity information. Complete the following table:

```
DLSwitch> (enable) show cgmp statistics
```

```
CGMP enabled
```

```
CGMP statistics for vlan 1:
valid rx pkts received      _____
invalid rx pkts received    _____
valid cgmp joins received   _____
valid cgmp leaves received  _____
valid igmp leaves received  _____
valid igmp queries received _____
```

```

igmp gs queries transmitted _____
igmp leaves transmitted _____
failures to add GDA to EARL _____
topology notifications received _____

```

DLSwitch> (enable) **sh cgmp statistics 2**

```

CGMP enabled

CGMP statistics for vlan 2:
valid rx pkts received _____
invalid rx pkts received _____
valid cgmp joins received _____
valid cgmp leaves received _____
valid igmp leaves received _____
valid igmp queries received _____
igmp gs queries transmitted _____
igmp leaves transmitted _____
failures to add GDA to EARL _____
topology notifications received _____

```

- c. Lets explore our PIM information existing on **DLRouter**. Recall we are using PIM-Dense mode. Complete the following tables.

DLRouter#**show ip pim neighbor**

PIM Neighbor Table						
Neighbor Address	Interface	Uptime	Expires	Ver	Mode	
_____	_____	00:10:18	00:01:18	v2	_____	

DLRouter#**sh ip pim int**

Address	Interface	Version/Mode	Nbr Count	Query Intvl	DR
_____	Port-channel_____	_____	0	30	_____
_____	Port-channel_____	_____	0	30	_____
_____	Port-channel_____	_____	0	30	_____
_____	Port-channel_____	_____	0	30	_____
_____	Port-channel_____	_____	0	30	_____

DLRouter#**sh ip pim int count**

How many Multicast packets have been sent and received on each interface?

DLRouter#**debug ip pim**

What router is sending PIM reports to DLRouter?

DLRouter#**sh ip igmp group**

What are the two streams identified in the group memberships?

- d. Lets explore our PIM information existing on **CORP**. Recall we are using PIM-Dense mode. For most of the commands we will provide samples of the output. The numbers may not match but these are useful troubleshooting tools.

```
corp#sh ip pim nei
```

From the table, who are your PIM neighbors?

```
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

```
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	*	46539/231
10.1.3.1	FastEthernet0/1	*	231/41443

```
corp#sh ip igmp groups
```

IGMP Connected Group Membership					
Group Address	Interface	Uptime	Expires	Last Reporter	
239.255.156.133	FastEthernet0/1	00:10:20	00:02:40	10.1.3.2	
224.0.1.40	FastEthernet0/1	00:17:00	never	10.1.3.1	
239.255.151.121	FastEthernet0/1	00:10:20	00:02:36	10.1.3.2	

```
corp#debug ip cgmp
```

CGMP debugging is on

```
corp#debug ip igmp
```

IGMP debugging is on

```
00:18:01: IGMP: Send v2 Query on FastEthernet0/1 to 224.0.0.1
00:18:01: IGMP: Set report delay time to 8.8 seconds for 224.0.1.40 on
00:18:06: IGMP: Received v2 Report from 10.1.3.2 (FastEthernet0/1) for
239.255.151.121
00:18:06: IGMP: Received v2 Report from 10.1.3.2 (FastEthernet0/1) for
239.255.156.133
00:18:10: IGMP: Send v2 Report for 224.0.1.40 on FastEthernet0/1
00:18:10: IGMP: Received v2 Report from 10.1.3.1 (FastEthernet0/1) for
224.0.1.40
```

- e. Show the multicast routing table on **DLRouter** and **Corp**. 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
```

Can you identify the Multicast Streams?

```
corp#sh ip mroute
```

Can you identify the Multicast Streams?

- f. Unplug the multicase server, and repeat the last step.

```
DLRouter#sh ip mroute
```

```
corp#sh ip mroute
```

Can you identify any Multicast Streams?
