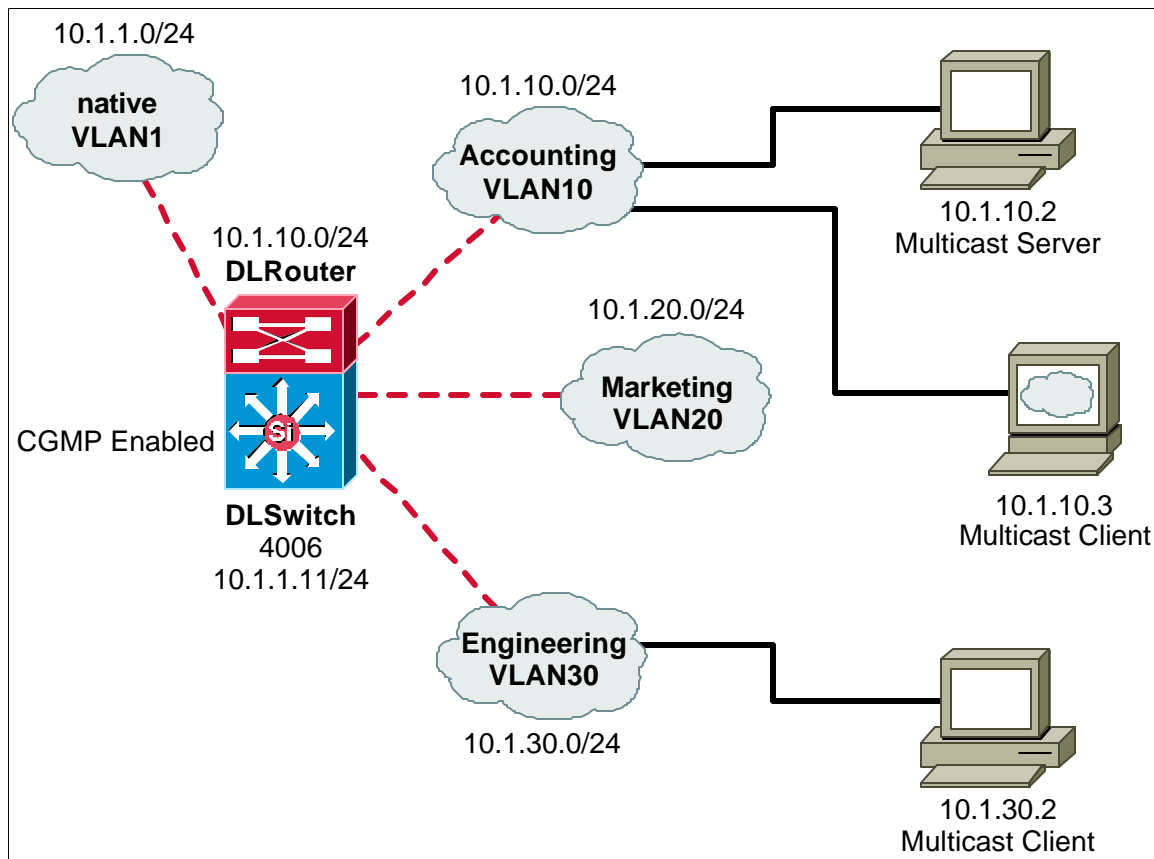


## Lab 9.5.4: Configure CGMP on Switches



### Objective:

Configure CGMP on switches.

### Scenario:

#### **Current Environment**

Your network switching equipment currently includes a 4006 switch segmented into four functional areas for better network management and traffic control. VLANs implemented throughout your Cisco switched network include "Accounting", "Marketing" and "Engineering" for the users and "default" used for the native VLAN for network management. Inter-VLAN routing has been implemented on the 4006 to allow individuals and servers on your Virtual LANs to exchange information.

#### **Enhancement**

The Accounting department operating on VLAN 10 would like you to implement a Cisco IP/TV multicast server that will facilitate the distribution of media streams throughout the company's network. It is important that clients from any VLAN on the company's network are able to receive both continuous streams and video on demand from the multicast server on VLAN 10.

## Design:

Switched Network VTP Configuration Information:

Switch	VTP Domain	VTP Mode
DLSwitch	CORP	Server

VLAN Configuration Information:

VLAN ID	VLAN Name	VLAN Subnet	VLAN Gateway
1	default	10.1.1.0/24	10.1.1.1
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

Switch VLAN Port Assignments:

Switch	VLAN 1	VLAN 10	VLAN 20	VLAN 30	Trunk
DLSwitch	3-18	19-24	25-30	31-34	1,2

Cisco 4006 DLRouter Interface Configuration Information:

Interface	IP Address	VLAN
PortChannel 1.1	10.1.1.1/24	Native 1
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

## Notes:

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## Lab Tasks:

1. Cable the lab as shown in the diagram. We will expedite the basic switch configurations to focus on multicast processing within a VLAN environment.
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
```

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 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 switch IP address information and gateway. Again this is for management and is not required for switch functionality. It would be assumed that you might want to Telnet to the switch though.

```
DLSwitch> (enable) set interface sc0 up  
DLSwitch> (enable) set interface sc0 1 10.1.1.11/255.255.255.0  
10.1.1.255  
DLSwitch> (enable) set ip route 0.0.0.0/0.0.0.0 10.1.1.1
```

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

- e. Set port channel admin groups.

```
DLSwitch> (enable) set port channel 2/1-2 156
```

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

- f. 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 1 2/3-34
```

\* Note: The above command simply resets all ports on the switch to VLAN 1 or the native VLAN. Below we will specify several other assignments of various ports to different VLANs. Please take note of the assignments with connecting devices.

```
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*

- g. Establish VLAN trunking. These commands allow us to establish trunking preparation to the L3 Routing Switch module in the 4006 switch itself.

```
DLSwitch> (enable) set trunk 2/1 nonegotiate dot1q 1-1005  
DLSwitch> (enable) set trunk 2/2 nonegotiate dot1q 1-1005
```

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

- h. Establish Fast EtherChannel on trunking interfaces.

```
DLSwitch> (enable) set port channel 2/1-2 mode on
```

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

- i. Enable PortFast on ports 3 through 34. This block of ports will be reserved for end host device connections until otherwise configured.

```
DLSwitch> (enable) set spantree portfast 2/3-34 enable
```

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

- j. Establish switch passwords. Always a good idea and required for VTY sessions for management. We will use "cisco" throughout this lab for all passwords.

```
DLSwitch> (enable) set enablepass <enter>
```

\* You will be prompted to enter and confirm the password

```
DLSwitch> (enable) set password <enter>
```

\* You will be prompted to enter and confirm the password

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

4. The next device to be configured will be the distribution layer router DLRouter.

```
DLSwitch> (enable) session 2  
Router#clear start  
Router#reload
```

Note: If asked to save system information select "**N**"

After the card reset then go back into it:

```
DLSwitch> (enable) session 2
```

5. 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 privileged mode password. Good idea and required for Telnet access.

```
DLRouter(config)#enable password cisco
```

\* Note: Verify using *DLRouter#show run*

- c. Configure the VLAN interface addressing and trunking information.

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

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

\* 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

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

\* Note: Verify using *DLRouter#show run*

- f. Configure your telnet virtual terminal password information. Again recommended and necessary.

```
DLRouter(config)#line vty 0 4
DLRouter(config-line)#password cisco
DLRouter(config-line)#login
```

\* Note: Verify using *DLRouter#show run*

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

6. From the DLRouter, we will verify a number of configuration items.

- a. Verify your connection to the DLSwitch through the Port Channels. These may not match exactly but all the information should be represented to ensure proper functionality.

```
DLRouter#show cdp neighbors
```

```
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater
Device ID         Local Intrfce   Holdtme    Capability Platform  Port ID
JAB04290BND      Port-channell  154        T S        WS-C4006   2/1
JAB04290BND      Port-channell  154        T S        WS-C4006   2/2
```

- b. Interface status on DLRouter. These may not match exactly but all the information should be represented to ensure proper functionality.

```
DLRouter#show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
FX1000:1	unassigned	YES	unset	up	up
FastEthernet1	unassigned	YES	NVRAM	down	down
GigabitEthernet1	unassigned	YES	NVRAM	down	down
GigabitEthernet2	unassigned	YES	NVRAM	down	down
GigabitEthernet3	unassigned	YES	NVRAM	up	up
GigabitEthernet4	unassigned	YES	NVRAM	up	up
Controller5	unassigned	YES	unset	up	up
Port-channell	10.1.1.1	YES	NVRAM	up	up
Port-channell.10	10.1.10.1	YES	NVRAM	up	up
Port-channell.20	10.1.20.1	YES	NVRAM	up	up
Port-channell.30	10.1.30.1	YES	NVRAM	up	up

\* Note: You may notice that the protocol on some of the PortChannel VLANs are down. This will happen if there are no active hosts connected to the VLAN. Most of the time we do not have that because there is at least one switch trunking to all VLANs that would make the Protocol go up. In this lab we do not have any 2900's connected to the 4006 so some may be down until hosts are connected.

- c. From DLSwitch, verify neighbors through CDP information. Again, we are simply verifying functionality.

```
DLSwitch> (enable) show cdp neighbors
```

```
* - indicates vlan mismatch.
# - indicates duplex mismatch.
Port      Device-ID          Port-ID          Platform
-----
2/1       DLRouter           GigabitEthernet3 cisco Cat4232
2/2       DLRouter           GigabitEthernet4 cisco Cat4232
2/2       DLRouter           Port-channell    cisco Cat4232
```

7. Test your connections from DLSwitch:

- a. DLSwitch> (enable) ping 10.1.1.1

```
10.1.1.1 is alive
```

- b. DLSwitch> (enable) ping 10.1.1.11

```
10.1.1.11 is alive
```

8. Test your connections from DLRouter. Sample output has been provided for you.

a. DLRouter#**ping 10.1.1.1**

```
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:  
!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
```

b. DLRouter#**ping 10.1.1.11**

```
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 10.1.1.11, timeout is 2 seconds:  
!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/7/8 ms
```

9. Connect your Windows multicast Client and Server workstations. Configure their IP addresses as illustrated. Verify their connectivity and their ability to ping each other. Remember the default gateway for each client as well as the IP address. We could have configured DHCP in the 4006 L3 module **IF** it supported DHCP it but it does not so for now we'll have to go static. After all are configured verify with the following tests.

- a. From EACH Windows workstation on VLANs 10, 20 and 30 perform the following tests.

```
C:\>ping 10.1.20.1  
C:\>ping 10.1.20.2  
C:\>ping 10.1.20.3  
C:\>ping 10.1.30.1  
C:\>ping 10.1.30.2
```

10. Configure, connect and test IP multicast devices and software. In this step we will configure the Multicast Server and Clients to function within a single broadcast domain. The next section continued at step 11 will enable CGMP to forward multicast requests throughout the other routed VLANs. So lets begin.

- a. Connect the IP/TV multicast server workstation 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.

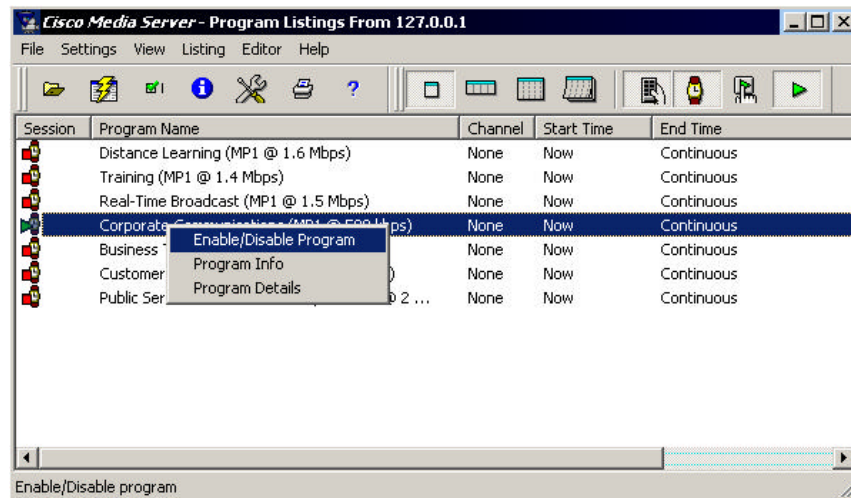
Use the **IPCONFIG** command from the DOS prompt to verify your entries.

- 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 multicast clients.

```
C:\>PING 10.1.10.1  
C:\>PING 10.1.10.3  
C:\>PING 10.1.30.2
```

\* 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 in VLAN 10. Ensuring the IP address of the client PC is changed to 10.1.10.3/24 with a gateway of 10.1.10.1.

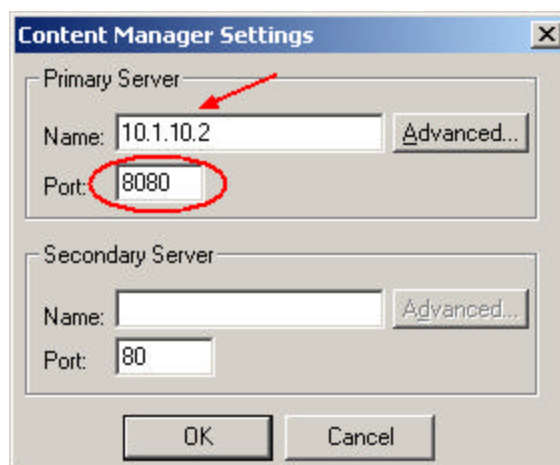
Use the **IPCONFIG** command from the DOS prompt to verify your entries.

- 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 Setting is configured as follows.



- g. Refresh the screen on the IP/TV viewer and double-click the Corporate Communications stream. 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.

11. So we are now multicasting within a single broadcast domain, VLAN 10. But we will not be able to receive streams through the router 4006 L3 module.
  - a. Now, configure the second IP/TV Viewer workstation as indicated on VLAN 30. Perform the same steps as indicated above to get the multicast Viewer working. **At the end you'll find the software is installed but you are not able to link into any multicast streams.** Why? Because in this layer 3 environment multicast routing and CGMP processing must be enabled and configured for the multicast VLAN traffic to communicate between VLAN's.
  - b. Let's look at some important areas to verify the CGMP is not running.

```
DLRouter#sh ip igmp group
```

```
IGMP Connected Group Membership
Group Address      Interface          Uptime      Expires      Last Reporter
```

What Group Address and interface would you have expected to see above from the IP/TV server had CGMP been enabled?

Group Address \_\_\_\_\_ Interface \_\_\_\_\_

Group Address \_\_\_\_\_ Interface \_\_\_\_\_

12. Enable CGMP on the DLRouter and DLSwitch for routing multicast traffic between VLAN's. CGMP is the framework for Inter-VLAN multicast routing. CGMP must be enabled on the switch and the router using the `ip cgmp` command on each router interface and the `set cgmp enable` on each switch. Make sure that the Corporate Communication stream IS running before going forward.
  - a. First, let's enable IP Multicasting on DLRouter. This is a requirement for Inter-VLAN routing of Multicast traffic.

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

\* Note: Verify using `DLRouter#show run`
  - b. Next, let's insert the required `ip cgmp` on each router interface for each VLAN. You will notice that in addition to the `ip cgmp` command we will also have to insert the `ip pim dense-mode` command. PIM is a multicast routing protocol and in this case is simply required as a prerequisite to the `ip cgmp` command. `ip pim dense-mode` would come more into play if we had added routers in our LAN environment that required multicast information. For now we'll simply add the statement as a functional requirement.

```
DLRouter(config)#interface Port-channel1.10
DLRouter(config-if)#ip pim dense-mode
DLRouter(config-if)#ip cgmp
```

```
DLRouter(config)#interface Port-channel1.20
DLRouter(config-if)#ip pim dense-mode
DLRouter(config-if)#ip cgmp
```

```
DLRouter(config)#interface Port-channel1.30
DLRouter(config-if)#ip pim dense-mode
DLRouter(config-if)#ip cgmp
```

\* Note: Verify using *DLRouter#show run*

- c. Next, lets go to the DLSwitch command prompt and enable the switch for multicast processing. It is actually very simple. We will use the **set cgmp enable** command to enable cgmp. We will also add the **set cgmp leave enable** command. This command is not required but with CGMP Leave enabled on the switch, the switch will process the IGMPv2 Leave messages and not forward them to the router. If the switch is aware that other multicast receivers for the group are on the same port or VLAN, no further action is required. If the switch knows that the last receiver leaves the group, the IGMP Leave message will be sent to the router. This is a typical setting and assists in reducing the router process overhead. It can be disabled at any time.

```
DLSwitch(config)#set cgmp enable
DLSwitch(config)#set cgmp leave enable
```

\* Note: Verify using *DLSwitch#show config*

- d. Next, lets test our multicast processing. Your client on VLAN 30 should now be able to see the multicast traffic. So lets fire up the IP/TV server and enable the Corporate Communications continuous stream. Then lets got to the client viewer on VLAN 30 and do a quick PING to the IP/TV server to test Unicast traffic. Lets then start the Viewer, and assuming you followed instructions on the Viewer install and configuration, you should have a list of streams. Lets view the Corporate Communications. It should be functioning properly.
- e. We can now run some tests to monitor the IGMP and CGMP processes we have in place. We will use a few of the more common monitoring commands. You do not have to enter them now as we will in the next few steps. Sometimes it helps to have a summarized list of multicast troubleshooting commands.

```
DLRouter#debug ip cgmp
DLRouter#debug ip igmp
DLRouter#sh ip igmp group
DLRouter#show ip igmp interface
```

```
DLSwitch> (enable) show cam dynamic
DLSwitch> (enable) show cam static
DLSwitch> (enable) show cgmp statistics 2
```

- f. Verify the router sending a join to the switch. You may have to wait a bit for this traffic. Sample output has been provided for comparison.

```
DLRouter#debug ip cgmp
```

```
CGMP debugging is on
01:55:10: CGMP: Sending self Join on Port-channel1.2
01:55:10:      GDA 0000.0000.0000, USA 0002.b90b.a80a
01:55:10: CGMP: Sending self Join on Port-channel1.10
01:55:10:      GDA 0000.0000.0000, USA 0002.b90b.a80a
```

```

01:55:10: CGMP: Sending self Join on Port-channel1.20
01:55:10: GDA 0000.0000.0000, USA 0002.b90b.a80a
01:55:10: CGMP: Sending self Join on Port-channel1.30
01:55:10: GDA 0000.0000.0000, USA 0002.b90b.a80a
01:55:11: CGMP: Received IGMP Report on Port-channel1.30
01:55:11: from 10.1.30.2 for 224.1.0.1
01:55:11: CGMP: Sending Join on Port-channel1.30
01:55:11: GDA 0100.5e01.0001, USA 0040.9630.d71d
01:55:12: CGMP: Sending Join on Port-channel1.20
01:55:12: GDA 0100.5e00.0118, USA 0040.0541.440a
01:55:14: CGMP: Sending self Join on Port-channel1.30
01:55:14: GDA 0100.5e00.0128, USA 0002.b90b.a80a
01:55:14: CGMP: Received IGMP Report on Port-channel1.30
01:55:14: from 10.1.30.1 for 224.0.1.40
01:55:14: CGMP: Sending Join on Port-channel1.30
01:55:14: GDA 0100.5e00.0128, USA 0002.b90b.a80a

```

```

DLRouter#no debug ip cgmp
CGMP debugging is off

```

- g. Verify the receipt of group membership reports to the router. Sample output is provided that will not match yours but will be similar in presentation. If no output is displayed then there will be a problem.

```

DLRouter#debug ip igmp

```

```

IGMP debugging is on
00:43:06: IGMP: Send v2 Query on Port-channel1.10 to 224.0.0.1
00:43:06: IGMP: Set report delay time to 8.2 seconds for 224.0.1.40 on Port-channel1.10
00:43:07: IGMP: Send v2 Query on Port-channel1.30 to 224.0.0.1
00:43:08: IGMP: Received v2 Report from 10.1.10.2 (Port-channel1.10) for 224.2.127.254
00:43:10: IGMP: Received v2 Report from 10.1.10.2 (Port-channel1.10) for 239.255.151.121
00:43:12: IGMP: Received v1 Report from 10.1.30.2 (Port-channel1.30) for 224.1.0.1
00:43:12: IGMP: Starting old host present timer for 224.1.0.1 on Port-channel1.30
00:43:12: IGMP: Received v2 Report from 10.1.10.2 (Port-channel1.10) for 239.255.156.133

```

```

DLRouter#no debug ip igmp

```

```

IGMP debugging is off

```

- h. Verify that the router has created an entry for the group. Sample output has been provided for comparison.

```

DLRouter#sh ip igmp group

```

```

IGMP Connected Group Membership
Group Address      Interface      Uptime        Expires      Last Reporter
239.255.156.133    Port-channel1.10  00:04:17      00:02:40     10.1.10.2
239.255.255.255    Port-channel1.10  00:04:13      00:02:44     10.1.10.2
224.2.127.254      Port-channel1.10  00:04:17      00:02:36     10.1.10.2
224.0.1.40         Port-channel1.10  00:04:23      never        10.1.10.1
224.1.0.1          Port-channel1.30  00:04:19      00:02:40     10.1.30.2
239.255.151.121    Port-channel1.10  00:04:19      00:02:38     10.1.10.2

```

- i. Verify that CGMP is in fact enabled on the router. Your results may differ but you should see CGMP enable on your VLAN interfaces. Answer the following questions.

```

DLRouter#show ip igmp interface

```

Complete the following table:

Description	VLAN10	VLAN20	VLAN30
IGMP Enabled			
CGMP Enabled			
IGMP Query Interval			
IGMP Query Timeout			
Designated Router			
IGMP Query Router			

- j. Verify that the router has created an entry for the group

```
DLRouter#sh ip igmp group
```

What multicast addresses represent the Audio and Video streams?

---

- k. Verify that the switch has created cam entries for each port. Sample output has been provided for comparison.

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

```
* = Static Entry. + = Permanent Entry. # = System Entry. R = Router Entry.
X = Port Security Entry
```

```
VLAN  Dest MAC/Route Des      [CoS]  Destination Ports or VCs / [Protocol Type]
-----
1      00-02-b9-0b-a8-0a          2/1 [ALL]
2      00-02-b9-0b-a8-0a          2/1 [ALL]
10     00-02-b9-0b-a8-0a          2/1 [ALL]
20     00-02-b9-0b-a8-0a          2/1 [ALL]
20     00-90-27-7b-40-dc          2/27 [ALL]
30     00-02-b9-0b-a8-0a          2/1 [ALL]
30     00-40-96-30-d7-1d          2/33 [ALL]
30     00-40-96-31-84-c8          2/33 [ALL]
Total Matching CAM Entries Displayed = 8
```

- l. Verify that the switch has created cam entries for each port. Sample output has been provided for comparison.

```
DLSwitch> (enable) show cgmp statistics 2
```

```
CGMP enabled
CGMP statistics for vlan 2:
valid rx pkts received      46
invalid rx pkts received    0
valid cgmp joins received   45
valid cgmp leaves received  1
valid igmp leaves received  0
valid igmp queries received 0
igmp gs queries transmitted 0
igmp leaves transmitted    1
failures to add GDA to EARL 0
topology notifications received 2
```

13. Review the following configurations to ensure you understand the configuration process.