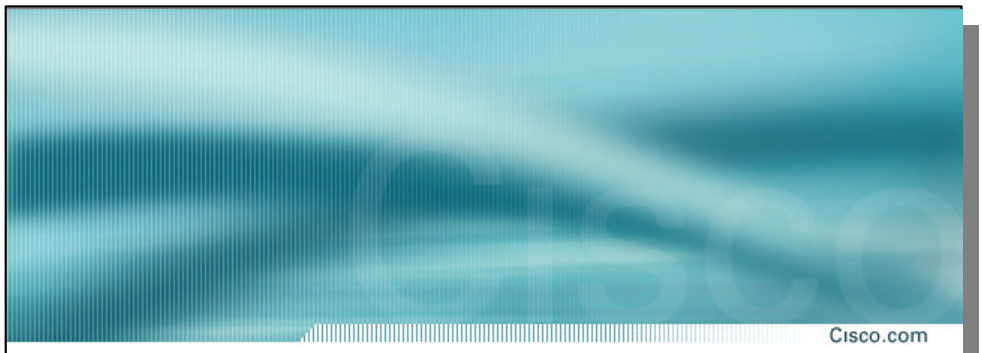

Basic Multicast Debugging

Module 4

Module Objectives

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- Introduction to IOS Command Line Interface (CLI) “tools”
- Understand usage and key information fields for IOS CLI tools in troubleshooting and monitoring the router and network
- Develop a Strategy for debugging multicast networks

Module Agenda

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- Router Command Review
- Debugging Strategies

Router Command Review

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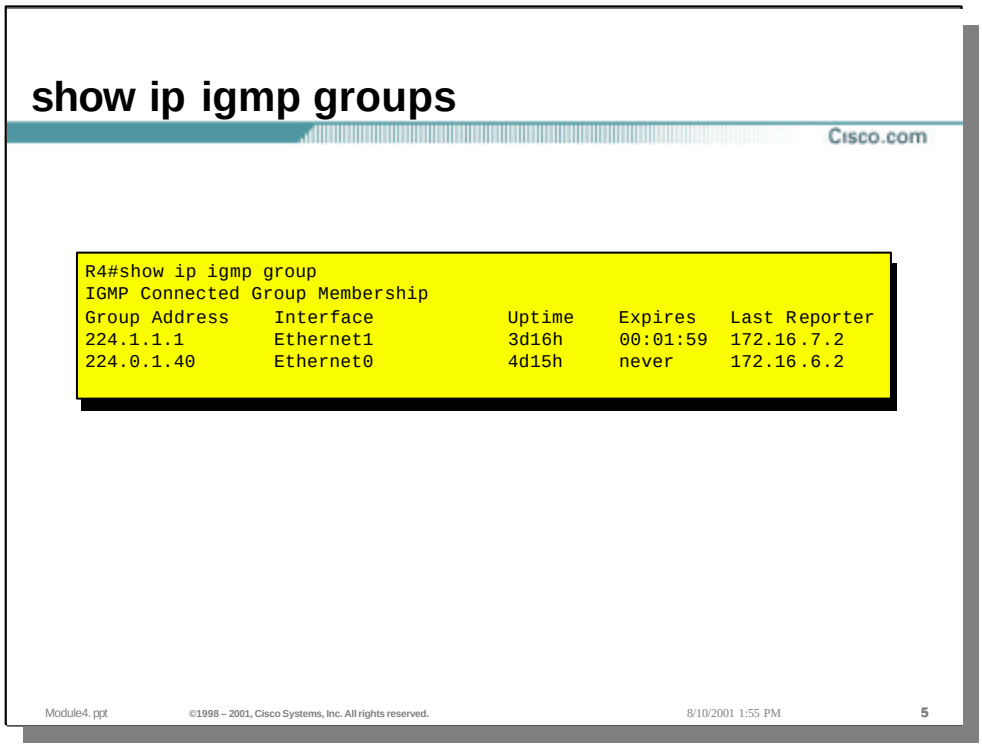
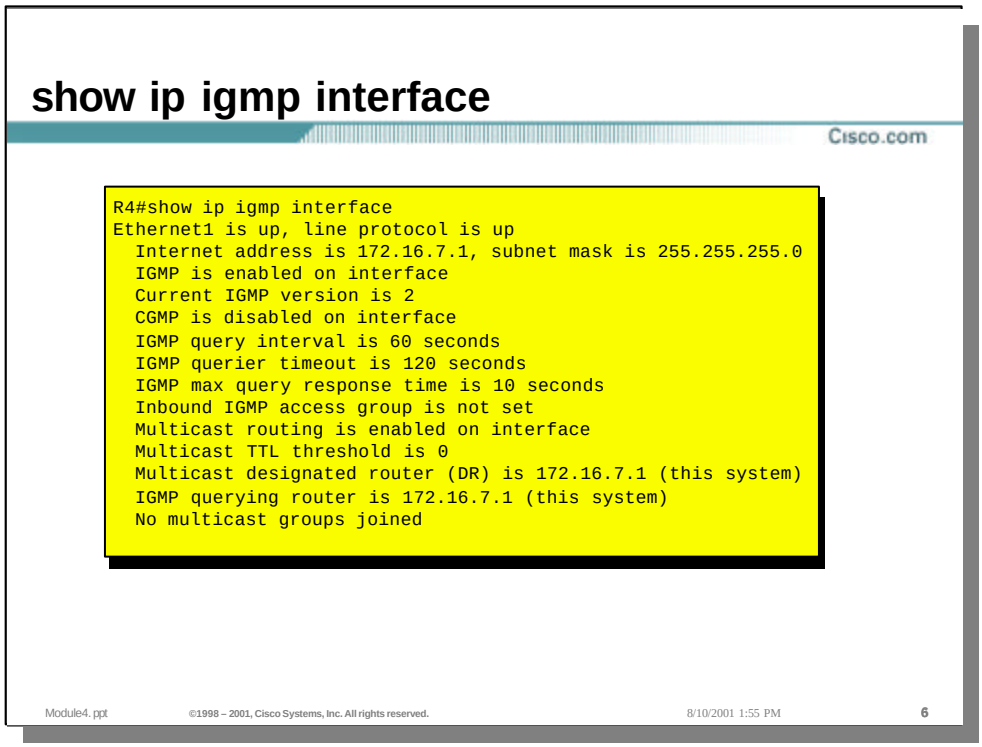
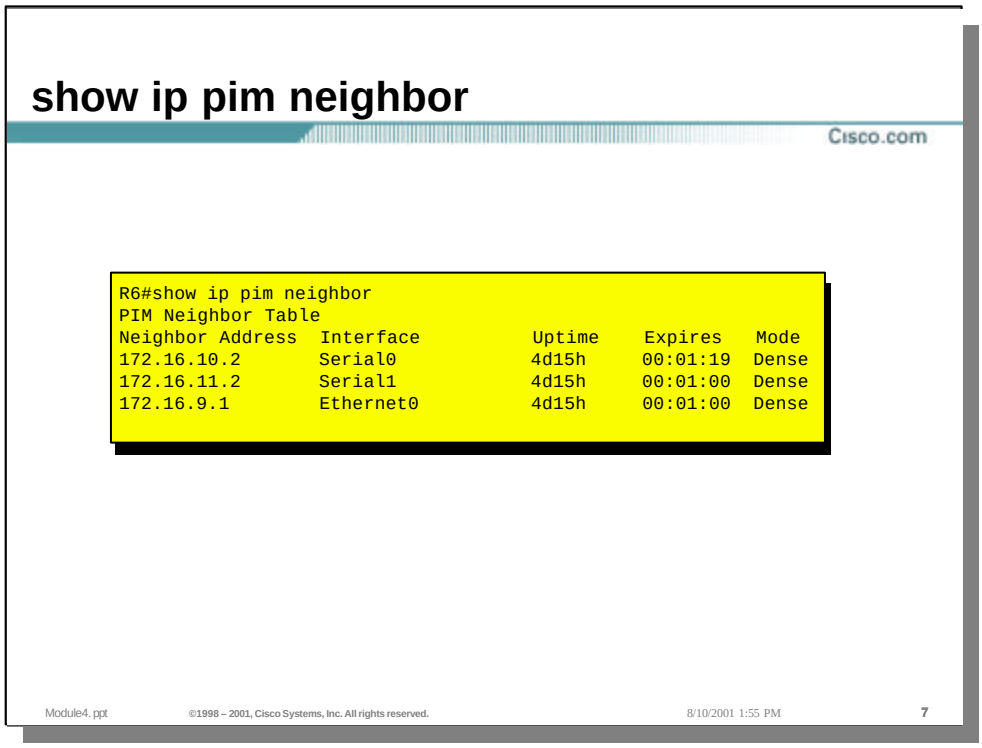
- **Show commands**
- **Debug commands**
- **Other useful commands**



- Uptime - shows how long there has been membership for the listed group on that interface
- Expires - shows when membership interest will end - IGMP reports from client members of this group are what keep this timer from expiring - you should see this value reset and not timeout as long as there are members present. When this timer expires - the multicast routing protocol is notified to stop delivery of that group onto this interface
- Only the last IGMP reporter is listed - this is due to report suppression



- This is the command to verify IGMP and CGMP are enabled or disabled on the interface
- IGMP version can be verified with this command - this is important if you have a mixed environment of multicast routing protocols running or other routers that support different versions of IGMP - some IGMP configuration may be required
- IGMP timers can be verified here for tuning purposes
- The multicast designated router (DR) and IGMP querier for this link can also be determined with this command



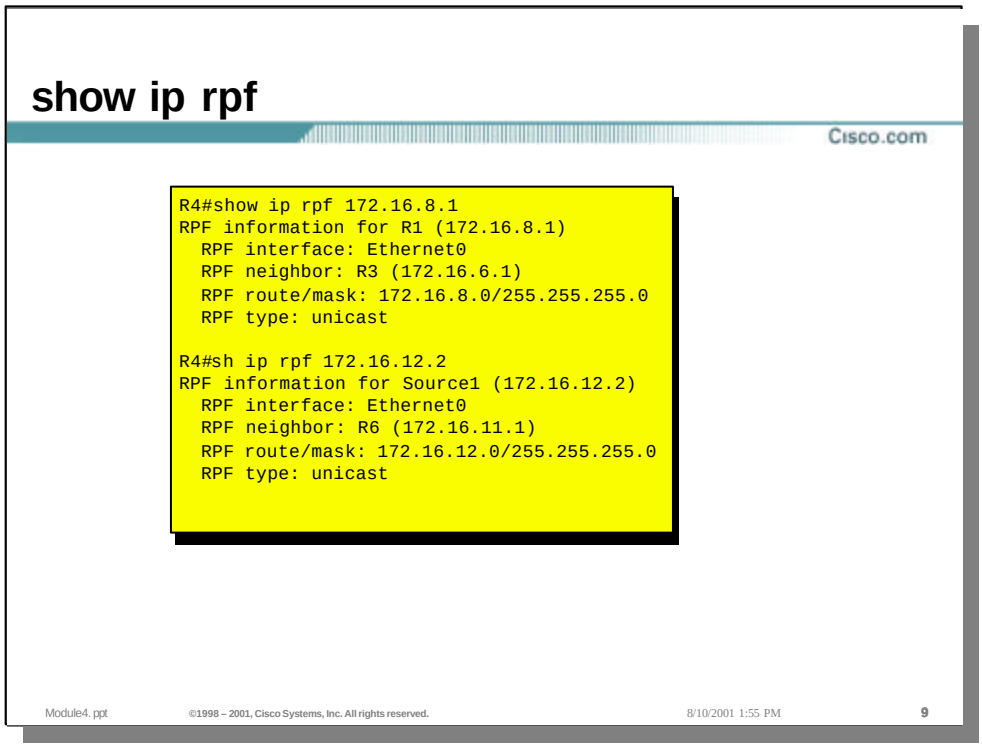
- Uptime - indicates how long the neighbor adjacency has existed
- Expires - indicates when the adjacency will timeout and be removed - PIM hellos maintain this adjacency
- Mode - indicates what mode the interface is running in

show ip pim interface

Cisco.com

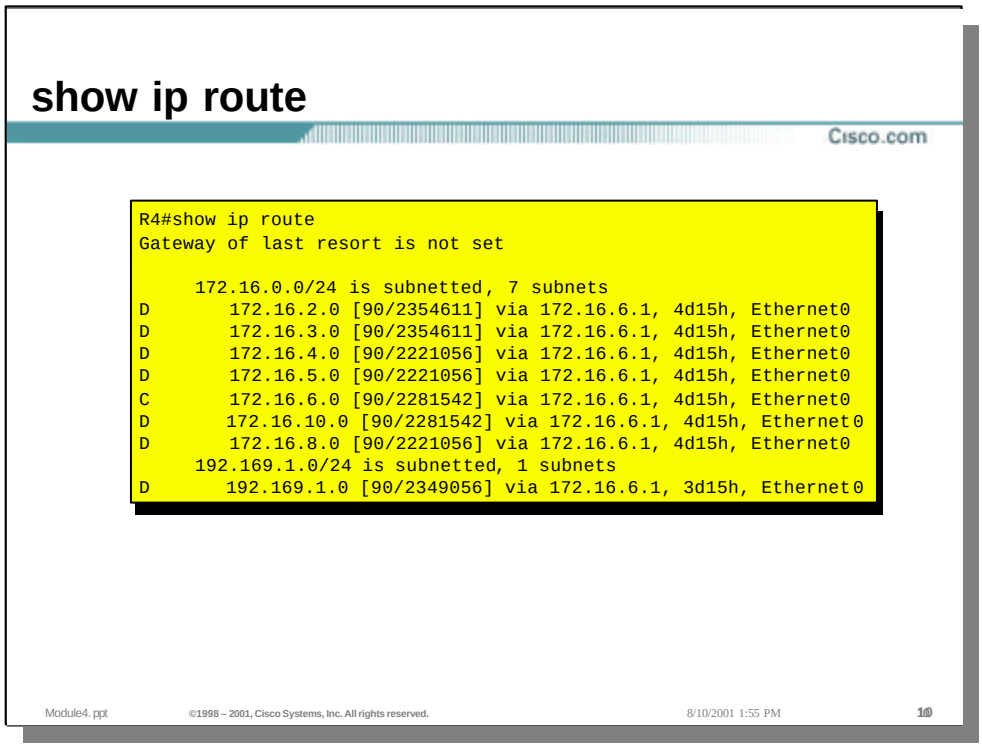
```
R6#show ip pim interface
Address          Interface          Mode         Nbr    Query     DR
                                                Count  Intvl
172.16.10.1      Serial0            Dense        1      30      0.0.0.0
172.16.11.1      Serial1            Dense        1      30      0.0.0.0
172.16.9.2       Ethernet0          Dense        1      30      172.16.9.2
```


- Nbr Count = number of neighbors on this link
- DR = 0.0.0.0 in this example because p2p links do not have DRs

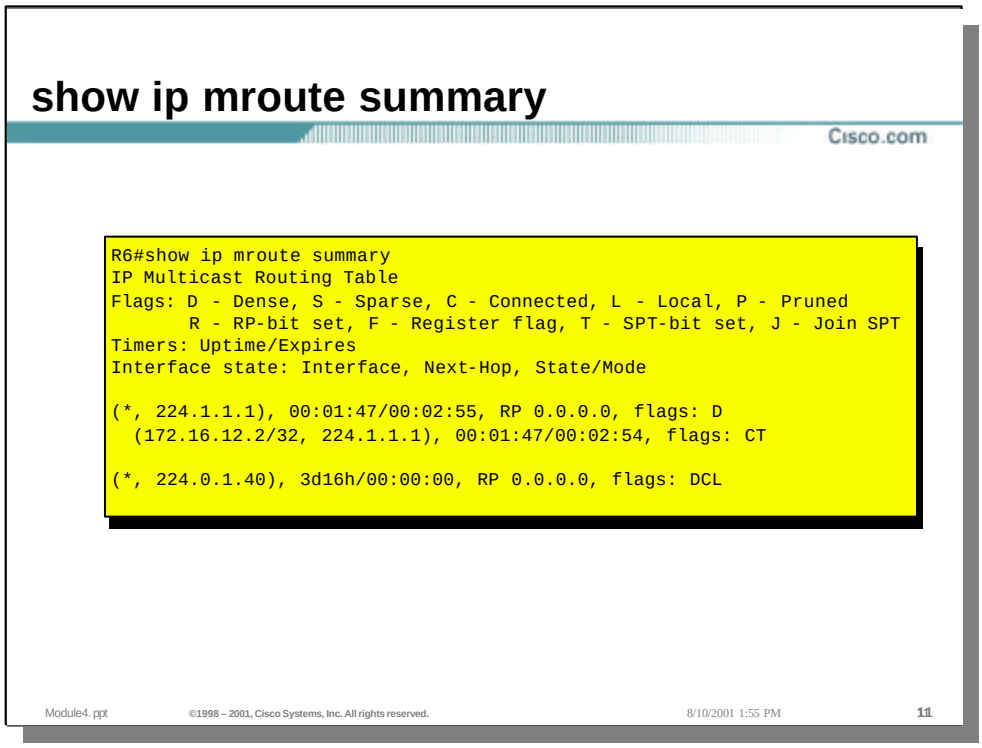


- Top example is obtaining RPF information for the RP (on R1)
- The RPF interface is the interface used to reach the target address (The RP itself in this example)
- Also shown is the RPF neighbor on the RPF interface and the route and mask used to reach the target address

- The second example is the RPF information for the source of the multicast group



- This slide for reference only for following slides - this table taken from R4
- Recall that multicast forwarding decisions are made based on the unicast routing table - make sure you understand the UNICAST topology and stability before looking at MULTICAST issues



- A summarized version of the multicast routing table

show ip mroute

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```
barrnet-gw>show ip mroute
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
Timers: Uptime/Expires
Interface state: Interface, Next-Hop, State/Mode
(*, 224.2.130.100), 00:18:53/00:02:59, RP 0.0.0.0, flags: D
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Fddi1/0, Forward/Dense, 00:09:20/00:02:38
    Hssi3/0, Forward/Dense, 00:18:53/00:00:00
(208.197.169.209/32, 224.2.130.100), 00:18:53/00:02:27, flags: T
  Incoming interface: Hssi3/0, RPF nbr 131.119.26.9
  Outgoing interface list:
    Fddi1/0, Forward/Dense, 00:16:16/00:02:38
(*, 239.100.111.224), 05:35:08/00:02:58, RP 171.69.10.13, flags: DP
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list: Null
```


- Partial output taken from a production router in Cisco's network for more interesting output…
- This is a generic multicast routing table
- Note the:
  - (*,G) and (S,G) entries
  - incoming interface
  - outgoing interface list (OIF)
  - RP (if any)
  - Flags
  - times - how long the entry has been in the table and when it will expire

show ip mroute active

Cisco.com

```
barrnet-gw>show ip mroute active
Active IP Multicast Sources - sending >= 4 kbps

Group: 224.2.154.118, Radio Bandit
   Source: 192.36.125.68 (falcon.pilsnet.sunet.se)
     Rate: 11 pps/30 kbps(1sec), 30 kbps(last 33 secs), 23 kbps(life avg)

Group: 224.2.246.13, UO Presents KWAX Classical Radio
   Source: 128.223.83.204 (d83-204.uoregon.edu)
     Rate: 24 pps/69 kbps(1sec), 72 kbps(last 2 secs), 70 kbps(life avg)

Group: 224.2.180.115, ANL TelePresence Microscopy Site
   Source: 146.139.72.5 (aem005.amc.anl.gov)
     Rate: 1 pps/5 kbps(1sec), 9 kbps(last 52 secs), 12 kbps(life avg)
...
```


- Shows all active groups with an aggregate bandwidth greater than the specified kbps (4kbps is the default)
- Listed in each entry is:
  - group address
  - session name
  - source address and domain name
  - averaged pps and kbps rates for this flow

show ip mroute count

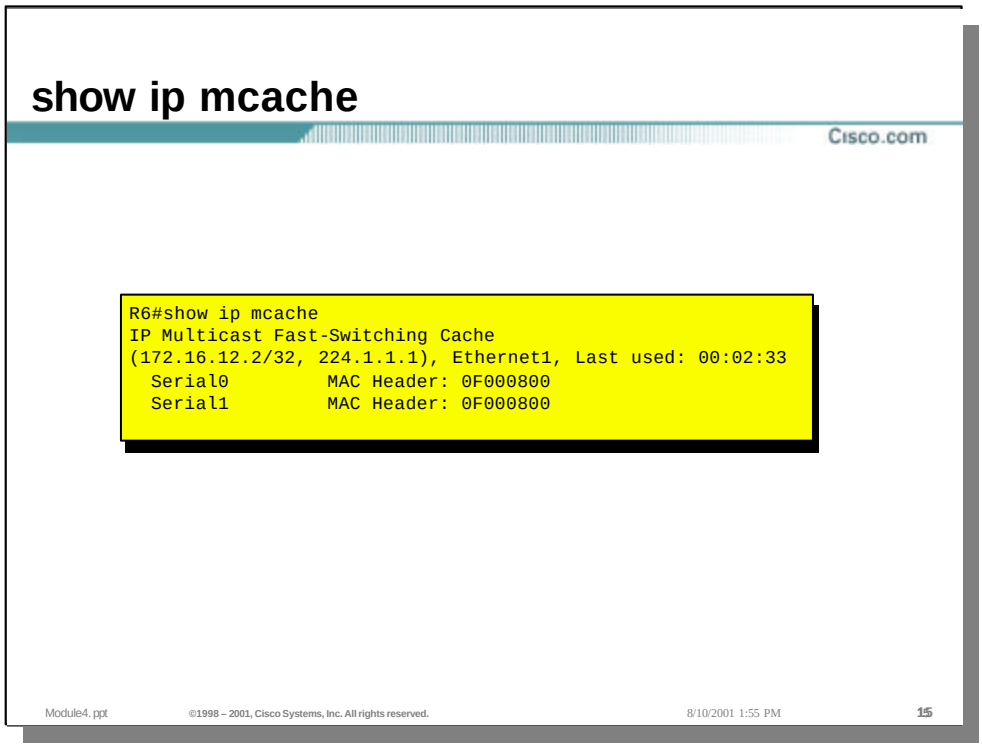
Cisco.com

```
sj-mbone> show ip mroute count
IP Multicast Statistics
1460 routes using 471528 bytes of memory
404 groups, 2.61 average sources per group
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second
Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)

Group: 224.2.234.11, Source count: 1, Group pkt count: 3244
  RP-tree: Forwarding: 3244/0/1198/0, Other: 3244/0/0
  Source: 171.69.235.123/32, Forwarding: 0/0/0/0, Other: 0/0/0

Group: 224.2.247.22, Source count: 3, Group pkt count: 369
  RP-tree: Forwarding: 366/0/92/0, Other: 366/0/0
  Source: 171.69.10.13/32, Forwarding: 0/0/0/0, Other: 0/0/0
  Source: 171.69.200.191/32, Forwarding: 0/0/0/0, Other: 19/0/19
  Source: 171.69.248.71/32, Forwarding: 3/0/112/0, Other: 239/123/113
          .
          .
          .
```


- Useful for seeing statistics on each routing entry



- Displays IPmc fast switching cache - useful for debugging fast switching bugs

sh ip pim rp mapping

Cisco.com

```
sjck-rp1>show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback1)

Group(s) 224.0.0.0/4
  RP 171.69.10.13 (sj-mbone-loopback0.cisco.com), v2v1
    Info source: 171.69.10.13 (sj-mbone-loopback0.cisco.com), via Auto-RP
         Uptime: 4w4d, expires: 00:02:55
Group(s) 239.192.111.0/24
  RP 192.168.165.15 (sjc25b-00rp-gw1-loop1.cisco.com), v2v1
    Info source: 192.168.165.15 (sjc25b-00rp-gw1-loop1.cisco.com), via Auto-RP
         Uptime: 1d18h, expires: 00:02:35
```


- This command lists the contents of the Group-to-RP Mapping Cache. In the example above, there are two group ranges covered by two different RPs, both of which have been learned via Auto-RP. (RP's can be learned either dynamically or by static configuration.)
- Note that there can be multiple RPs in the network each supporting a different multicast address range

show ip sdr

Cisco.com

```
dallas-gw>show ip sdr
SDR Cache - 450 entries

  *cisco 100k Field
  *cisco 100K Field Sales Office
  *cisco 500k San Jose & RTP
  *cisco 500k SJ and RTP
                .
                .
                .
```

By default, sdr cache entries are not deleted - use the command "*`ip sdr cache-timeout <minutes>`*" to remove cache entries after a period of time.

show ip sdr detail

Cisco.com

```
dallas-gw>show ip sdr detail
SDR Cache - 450 entries
Session Name: *cisco 100K Field
  Description: 100K Video Continuous Test Channel
  Group: 0.0.0.0, ttl: 0, Contiguous allocation: 1
  Uptime: 3w0d, Last Heard: 00:09:44
  Announcement source: 171.68.224.10
  Created by: - 27981 25 IN IP4 171.68.224.8
  Phone number: TRC <(408) 526-8888>
  Email:
  URL: http://171.68.223.153/CustAdv/InfoSys/TRC/guides/webcast.html
  Media: video 54002 RTP/AVP 31 32 96
    Media group: 224.2.247.65, ttl: 15
    Attribute: quality:8
    Attribute: framerate:20
    Attribute: rtpmap:96 WBIH/90000
  Media: audio 23704 RTP/AVP 3 0 14 5 96 97 98 99 100 101 102 103
    Media group: 224.2.220.101, ttl: 15
    Attribute: rtpmap:96 L8/22050/2
    Attribute: rtpmap:97 L8/22050
    Attribute: rtpmap:98 L8/11025/2
    ...
```


- show ip sd [group | "session-name" | detail]
- Displays the contents of the session directory cache
- Example shown is an advertisement of a Cisco- internal IP/TV broadcast

Router Command Review

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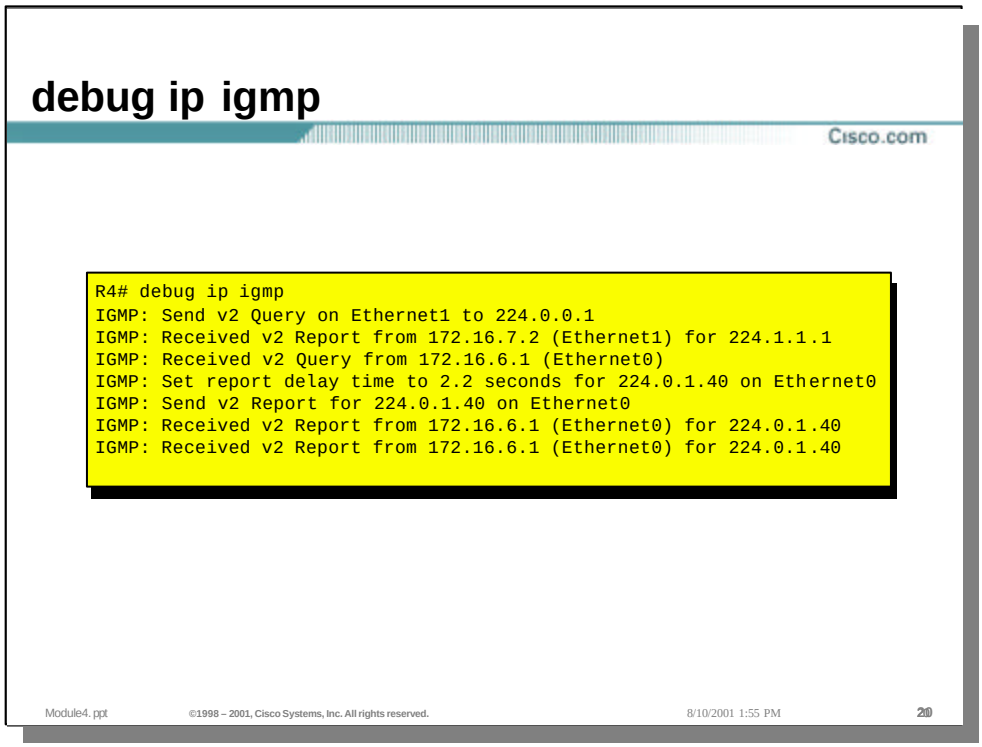
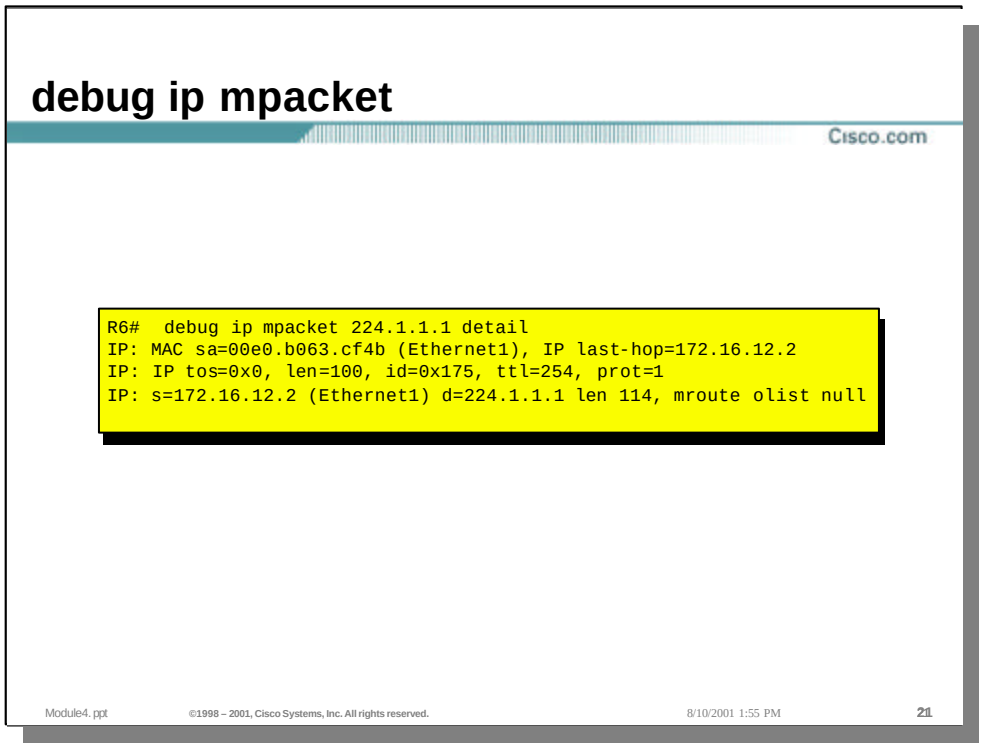
- Show commands
- Debug commands
- Other useful commands



- This is a useful debug to make sure you are sending queries and to determine the query interval
- It is also useful for figuring out what IGMP version the clients are using - when the report back when queried



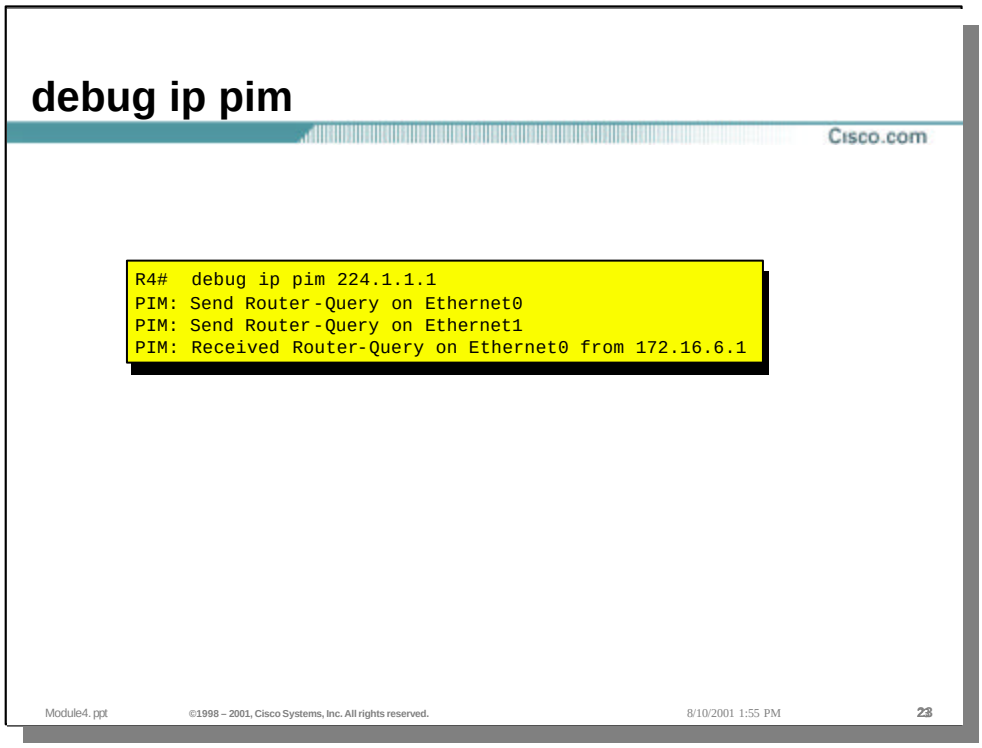
- “Decode” of a multicast packet
- USE CAUTION - when turning on packet level debugging especially when the router is servicing high multicast loads!

debug ip mroute

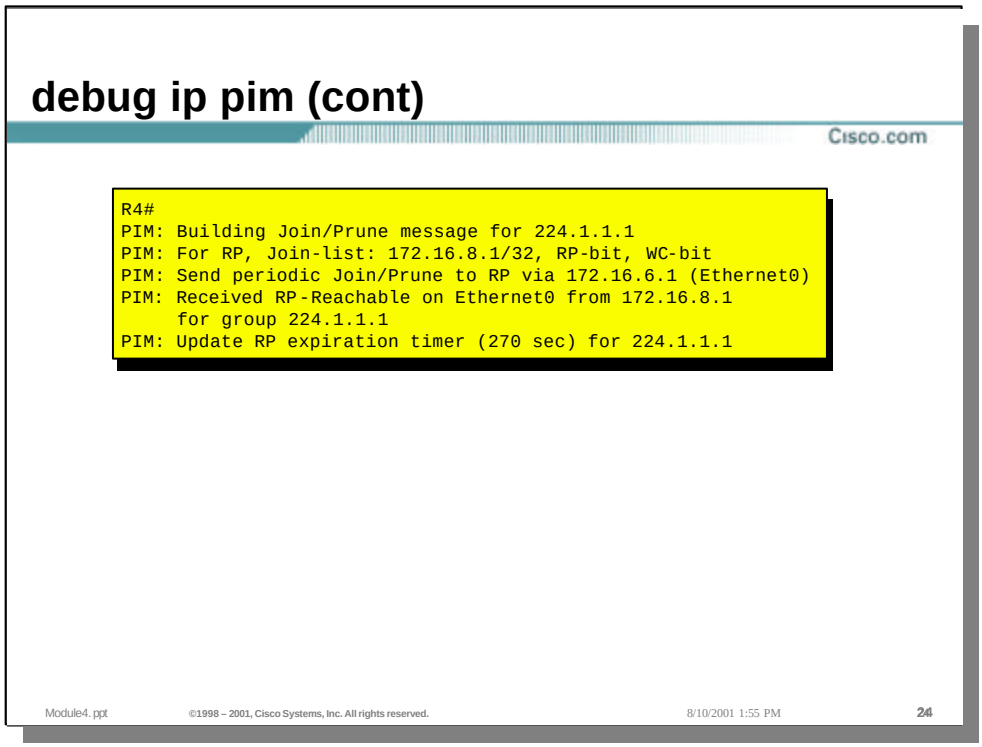
Cisco.com

```
R6# debug ip mrouting 224.1.1.1
MRT: Create (*, 224.1.1.1), RPF Null, PC 0x6032D254
MRT: Create (172.16.12.2/32, 224.1.1.1), RPF Ethernet1/0.0.0.0, PC x6032D378
```

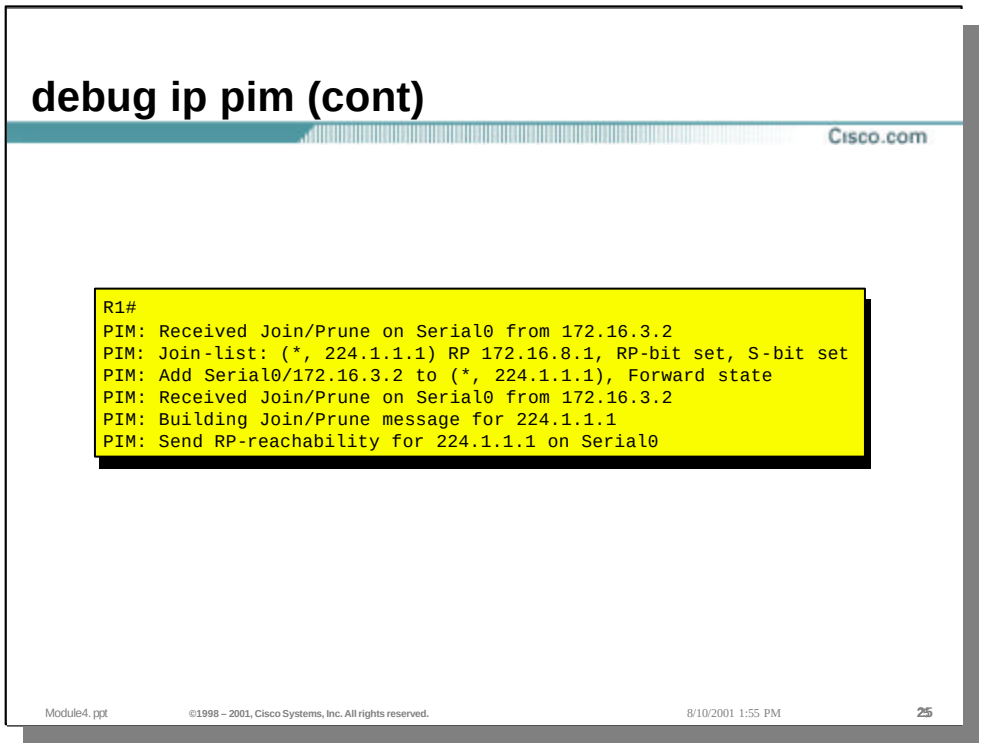

- Useful for watching multicast routing table maintenance



- Periodic Router-Query messages used to keep track of PIM neighbors. This creates and maintains neighbor adjacencies. There is no other PIM router on E1/1 but R3 is seen on E0/0



- Here, the router is configured with the RP's address and hence sends out a periodic JOIN towards the RP. The RP in turn sends back an RP-Reachable message in return. The WC bits indicates (*,G) state setup.



- On R1, which the RP for the Group 224.1.1.1
- The RP receives periodic JOIN's for the (*,G) which is the pre-existing state in PIM Sparse mode. The RP updates its OIF for the (*,G) and sends back an RP-Reachability message.

debug ip pim (cont)

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```
R6#
PIM: Check RP 172.16.8.1 into the (*, 224.1.1.1) entry
PIM: Send Register to 172.16.8.1 for 172.16.12.2, group 224.1.1.1
PIM: Received RP-Reachable on Serial1 from 172.16.8.1
PIM: Received RP-Reachable on Serial2 from 172.16.8.1


PIM: Received Join/Prune on Ethernet0 from 172.16.9.1
PIM: Join-list: (172.16.12.2/32, 224.1.1.1), S-bit set
PIM: Add Ethernet0/172.16.9.1 to (172.16.12.2/32, 224.1.1.1), Forward state
PIM: Building Join/Prune message for 224.1.1.1
PIM: No sources in join or prune list
PIM: Received Join/Prune on Serial1 from 172.16.11.2
PIM: Join-list: (172.16.12.2/32, 224.1.1.1), S-bit set
PIM: Add Serial1/172.6.11.2 to (172.16.12.2/32, 224.1.1.1), Forward state


PIM: Send Null Register to 172.16.8.1
PIM: Received Register-Stop on Ethernet0 from 172.16.8.1
```


- Taken from R4 (router connected to the source) - this will show the initiation of the shared tree in PIM sparse mode
- Part 1 - When the Source initiates transmission to Group 224.1.1.1 R4 uses its (*,G) entry and sends the data to the RP encapsulated in Register packets for the Source 172.16.12.2.
- Part 2 - It then creates a (S,G) entry of the form (172.16.12.2/24,224.1.1.1) JOIN's from its PIM Neighbors come in causing the interfaces on which the JOIN's are received to be added to the OIF-list in the Mroute table.
- Part 3 - R4 now starts sending periodic Null Register messages to the RP and receives Register-Stop messages. This is for maintenance of the tree.

debug ip pim (cont)

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```
R1# PIM: Received Register on Ethernet1 from 172.16.9.2
PIM: Forward decapsulated data packet for 224.1.1.1 on Serial0
-----
PIM: Send Join on Ethernet1 to 172.16.8.2 for (172.16.12.2/32, 224.1.1.1)
PIM: Received Join/Prune on Serial0 from 172.16.3.2
PIM: Join-list: (172.16.12.2/32, 224.1.1.1), S-bit set
PIM: Add Serial0/172.16.3.2 to (172.16.12.2/32, 224.1.1.1), Forward state
PIM: Send RP-reachability for 224.1.1.1 on Serial0
-----
PIM: Received Join/Prune on Serial0 from 172.16.3.2
PIM: Join-list: (*, 224.1.1.1) RP 172.16.8.1, RP-bit set, S-bit set
PIM: Add Serial0/172.16.3.2 to (*, 224.1.1.1), Forward state
-----
PIM: Building Join/Prune message for 224.1.1.1
PIM: For 172.16.8.2, Join-list: 172.16.12.2/32
PIM: Send periodic Join/Prune to 172.16.8.2 (Serial0)
-----
PIM: Received Register on Ethernet1 from 172.16.9.2
PIM: Send Register-Stop to 172.16.9.2 for 0.0.0.0, group 0.0.0.0
-----
PIM: Received Join/Prune on Serial0 from 172.16.8.2
PIM: Prune-list: (172.16.12.2/32, 224.1.1.1) RP-bit set
```


- On R1 (the RP)
- The RP receives the Register messages from Router R4, it decapsulates the data from the Source and forwards it down the tree towards the Receiver using the pre-existing (*,224.1.1.1) state.
- Sends a JOIN towards the Source for (S,G)-> (172.16.12.2,224.1.1.1) This builds the (S,G) mtree from the RP to the Source. (the stop the encapsulated data flow to a native IPmc flow)
- Meanwhile the (*,G) is periodically renewed by the routers on the Receiver side of the mtree.
- The RP continues to send out periodic JOIN's for (S,G) to maintain state.
- The RP continues to receive the Null Register messages sent out by R6.
- The RP then receives a PRUNE from R5 for (S,G) with the RP bit set. The RP bit indicates that the tree is switching from a Shared tree to the Shortest Path tree (SPT). The S bit also signifies the switch.

Router Command Review

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- Show commands
- Debug commands
- Other useful commands

mtrace and mstat commands

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- Based on Unix “mtrace” command
- Split into two separate commands
- Both use the same mechanism
  - draft-ietf-idmr-traceroute-ipm-xx.txt

mtrace/mstat—How it works

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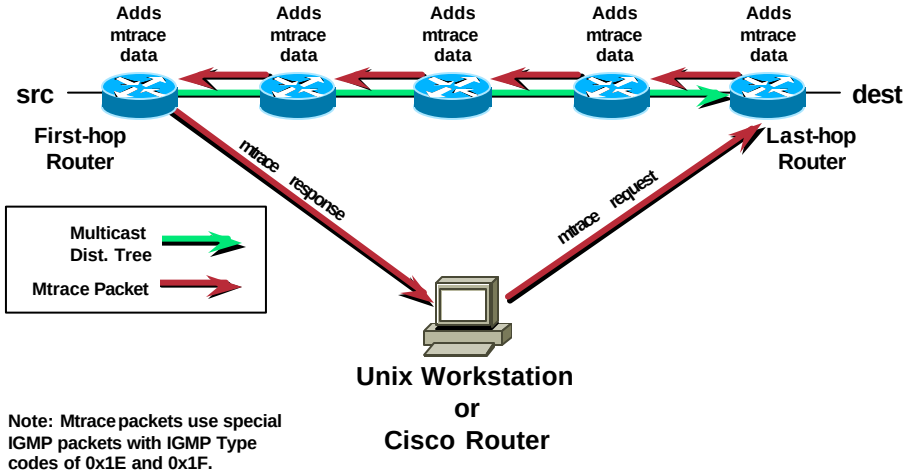
Mtrace Packet Flow



Note: Mtrace packets use special IGMP packets with IGMP Type codes of 0x1E and 0x1F.

mtrace/mstat—How it works

Cisco.com

- Uses a special IGMP packet type
  - IGMP type 0x1F = Queries/Requests
  - IGMP type 0x1E = Response
- Requestor sends Query/Request packet
  - Sent to last-hop router of destination
  - Can be initiated by 3rd Party
- Last-hop router rcv's Query packet
  - Converts packet to "traceroute" Request
  - Unicasts to upstream router toward source

mtrace/mstat—How it works

Cisco.com

- **Each hop adds data to packet**
  - **Query arrival time**
  - **Incoming Interface**
  - **Outgoing Interface**
  - **Prev. Hop Router address**
  - **Input packet count**
  - **Output packet count**
  - **Total packets for this Source/Group**
  - **Routing Protocol**
  - **TTL Threshold**
  - **Forwarding/Error Code**

mtrace/mstat—How it works

Cisco.com

- 1st Hop router receives Request
  - Adds own response data
  - Converts packet to Response type
  - Sends response back to Requestor
- Request receives Response packet
  - Packet contains hop-by-hop trace info

mtrace

Cisco.com

- **Shows:**
  - **Multicast path from source to receiver.**
    - **Similar to unicast “trace” command**
    - **Trace path between any two points in network**
    - **TTL Thresholds & Delay shown at each node**
- **Troubleshooting Usage:**
  - **Find where multicast traffic flow stops.**
    - **Focus on router where flow stops**
  - **Verify path multicast traffic is following.**
    - **Identify sub-optimal paths.**

mtrace

Cisco.com

```
dallas-gw>mtrace bloom-iptv-svr bwilliam-ss5 224.2.156.43
Type escape sequence to abort.
Mtrace from 172.17.67.43 to 171.68.37.121 via group 224.2.156.43
From source (?) to destination (bwilliam-ss5.cisco.com)
Querying full reverse path...
 0  bwilliam-ss5 (171.68.37.121)
-1  dallas-gw (171.68.37.1) PIM  thresh^ 0  3 ms
-2  wan-gw4 (171.68.86.193) PIM  thresh^ 0  32 ms
-3  bloomington-mn-gw (171.68.27.2) PIM  thresh^ 0  717 ms
-4  bloom-mnlab (171.68.39.28) PIM  thresh^ 0  730 ms
-5  bloom-iptv-svr (172.17.67.43)
dallas-gw>
```


- **Shows all active groups with an aggregate bandwidth greater than the specified kbps (4kbps is the default)**
- **Listed in each entry is:**
  - group address
  - session name
  - source address and domain name
  - averaged pps and kbps rates for this flow

mstat

Cisco.com

- **Shows:**
  - **Multicast path in pseudo graphic format.**
    - **Trace path between any two points in network**
    - **Drops/Duplicates shown at each node**
    - **TTLs & Delay shown at each node**
- **Troubleshooting Usage:**
  - **Locate congestion point in the flow.**
    - **Focus on router with high drop/duplicate count**
    - **Duplicates indicated as “negative” drops**

mstat

Cisco.com

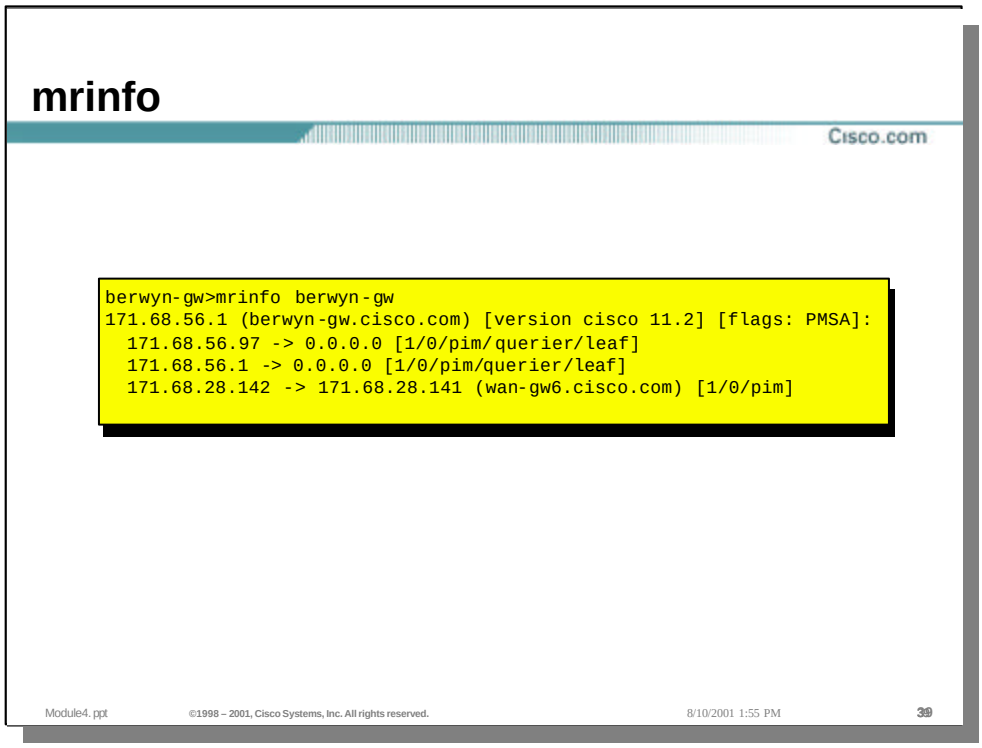
```
dallas-gw>mstat 172.17.67.43 bwilliam-ss5 224.2.156.43
  Source        Response Dest    Packet Statistics For     Only For Traffic
172.17.67.43    171.68.86.194    All Multicast Traffic     From 172.17.67.43
     |       __/  rtt 547  ms   Lost/Sent = Pct  Rate     To 224.2.156.43
     v      /     hop 547  ms   ---------------------     --------------------
172.17.67.33
171.68.39.28    bloom-mnlab
     |     ^      ttl   0
     v     |      hop -409 ms    -11/168 = --%  16 pps     0/67 = 0%  6 pps
171.68.39.1
171.68.27.2     bloomington-mn-gw
     |     ^      ttl   1
     v     |      hop 379  ms    -9/170 = --%   17 pps    -3/67 = --%  6 pps
171.68.27.1
171.68.86.193   wan-gw4
     |     ^      ttl   2
     v     |      hop 28   ms    -3/195 = --%   19 pps     0/70 = 0%   7 pps
171.68.86.194
171.68.37.1     dallas-gw
     |      \__   ttl   3
     v         \  hop 0    ms        196        19 pps          70    7 pps
171.68.37.121   171.68.86.194
  Receiver      Query Source
```


- **Shows all active groups with an aggregate bandwidth greater than the specified kbps (4kbps is the default)**
- **Listed in each entry is:**
  - group address
  - session name
  - source address and domain name
  - averaged pps and kbps rates for this flow

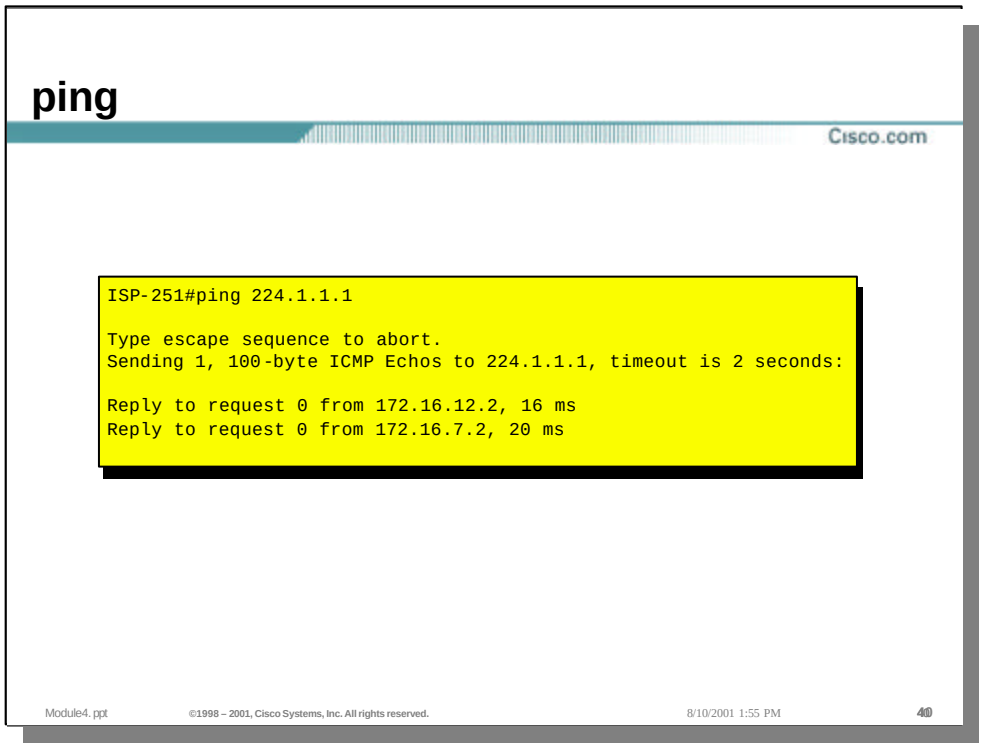
mstat

Cisco.com

```
dallas-gw>mstat 172.17.67.43 bwilliam-ss5 224.2.156.43
  Source        Response Dest    Packet Statistics For     Only For Traffic
172.17.67.43    171.68.86.194    All Multicast Traffic     From 172.17.67.43
     |       __/  rtt 399  ms   Lost/Sent = Pct  Rate     To 224.2.156.43
     v      /     hop 399  ms   ---------------------     ---------------------
172.17.67.33
171.68.39.28    bloom-mnlab
     |     ^      ttl   0
     v     |      hop 119  ms    77/694 = 11%  69 pps    0/65 = 0%    6 pps
171.68.39.1
171.68.27.2     bloomington-mn-gw
     |     ^      ttl   1
     v     |      hop -150 ms    395/609 = 65% 60 pps    44/65 = 68%  6 pps
171.68.27.1
171.68.86.193   wan-gw4
     |     ^      ttl   2
     v     |      hop 30   ms    -8/39 = --%    3 pps    -1/21 = --%  2 pps
171.68.86.194
171.68.37.1     dallas-gw
     |      \__   ttl   3
     v         \  hop 0    ms        39         3 pps          22    2 pps
171.68.37.121   171.68.86.194
  Receiver      Query Source
```



- Used to query a peering router about multicast information
- Example shown is from the Cisco internal network on a remote office router - when no arguments are given - the router queries itself



- “Ping” is the easiest way to generate multicast traffic in the lab and test the multicast tree
- Pings all members of the group - all members respond

Caching IP Multicast Packet Headers

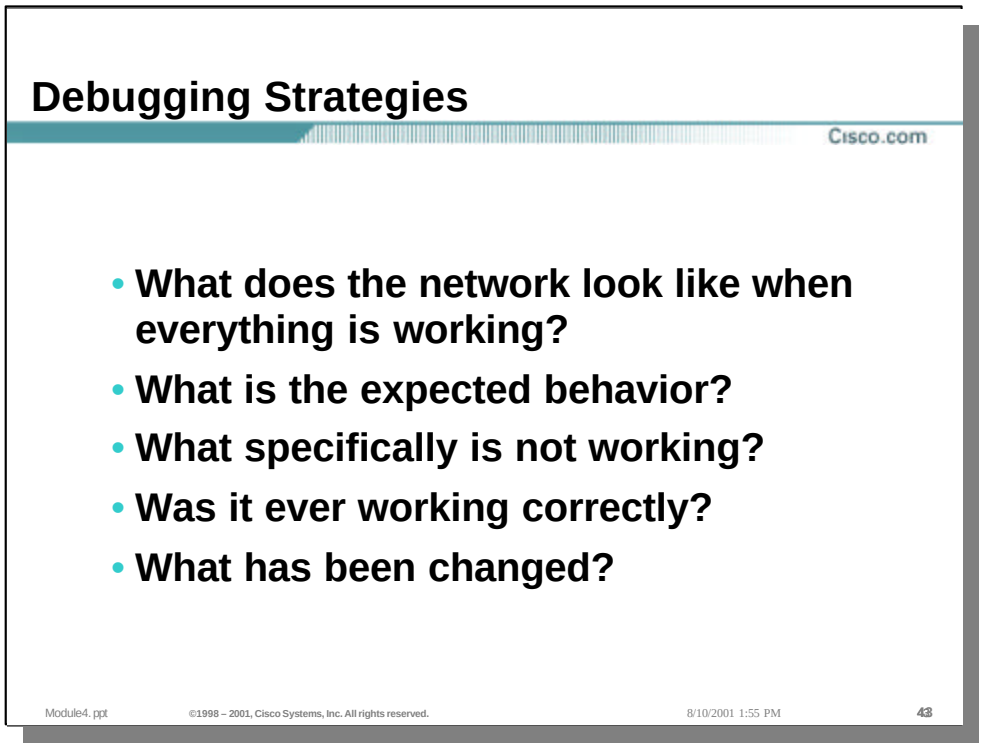
Cisco.com

- You can view {source, group} traffic pairs
- IP ident and ttl
- Inter-packet delay
- Commands
  - `ip multicast cache-headers`
  - `show ip mpacket <source> <group> [detail]`

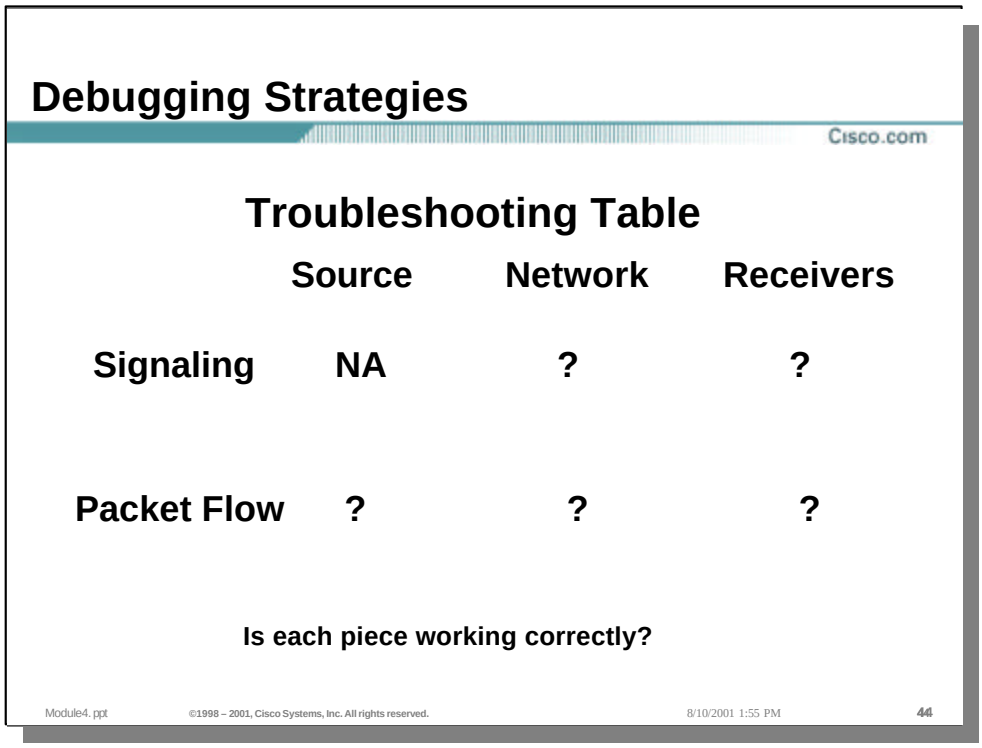
Caching IP Multicast Packet Headers (Cont.)

Cisco.com

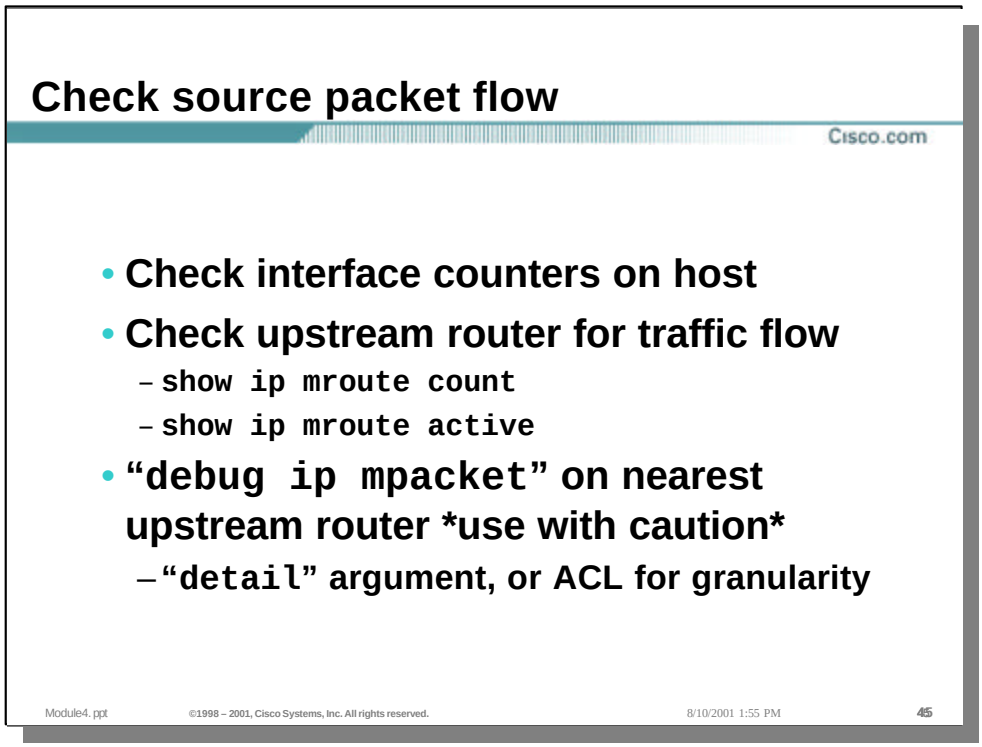
```
dino-cisco-fr#show ip mpacket cisco-beta
IP Multicast Header Cache - entry count: 29, next index: 30
Key: id/ttl timestamp (name) source group

D782/117 206416.908 (all-purpose-gunk.near.net) 199.94.220.184 224.2.231.173
7302/113 206417.172 (speedy.rrz.uni-koeln.de) 134.95.19.23 224.2.231.173
6CB2/114 206417.412 (wayback.uoregon.edu) 128.223.156.117 224.2.231.173
D786/117 206417.868 (all-purpose-gunk.near.net) 199.94.220.184 224.2.231.173
E2E9/123 206418.488 (dino-ss20.cisco.com) 171.69.58.81 224.2.231.173
1CA7/127 206418.544 (dino-ss2.cisco.com) 171.69.129.220 224.2.231.173
1CAA/127 206418.584 (dino-ss2.cisco.com) 171.69.129.220 224.2.231.173
1CAC/127 206418.624 (dino-ss2.cisco.com) 171.69.129.220 224.2.231.173
1CAF/127 206418.664 (dino-ss2.cisco.com) 171.69.129.220 224.2.231.173
1CB0/127 206418.704 (dino-ss2.cisco.com) 171.69.129.220 224.2.231.173
1CB2/127 206418.744 (dino-ss2.cisco.com) 171.69.129.220 224.2.231.173
2BBB/114 206418.840 (crevenia.parc.xerox.com) 13.2.116.11 224.2.231.173
3D1D/123 206419.380 (dalvarez-ss20.cisco.com) 171.69.60.189 224.2.231.173
2BC0/114 206419.672 (crevenia.parc.xerox.com) 13.2.116.11 224.2.231.173
7303/113 206419.888 (speedy.rrz.uni-koeln.de) 134.95.19.23 224.2.231.173
7304/113 206420.140 (speedy.rrz.uni-koeln.de) 134.95.19.23 224.2.231.173
2C7E/123 206420.360 (lwei-ss20.cisco.com) 171.69.58.88 224.2.231.173
```



- **Debugging Strategies**
  - These are standard questions to consider when debugging anything, including multicast



- **Debugging Strategies**
  - Signaling is the process of setting up (and tearing down) the multicast session
  - Packet flow is the actual sending, replication, and reception of the multicast packets based on the forwarding tables created by the signalling processes
  - Each section of the table needs to be working for the application to work
  - A similar table could be developed for unicast IP or other technologies, but the tools used to troubleshoot each case are different



- **Checking source packet flow**
  - How can we tell if the source is actually "sourcing" packets?
  - First, check the interface counters on the source host to see if *it* thinks it is sending packets - if it doesn't, then it probably isn't. Check for misconfiguration or bugs in the host stack and application.
  - Next, check the first upstream router or switch to see if it sees multicast packets from the source, using "show" commands
  - Only if necessary, run "debug ip mpacket" on the route. This could have a serious performance impact on other traffic, so use with caution. The "detail" parameter for this command can be used to include packet headers in the debug output, and access lists can be used in conjunction with this command to check for traffic from specific sources.

Check Network signaling

Cisco.com

- Most complex piece
- Depends of protocol, mode, etc.
- Check initial flow creation
- Check for pruning and timer expiration during session

Network signaling (continued)

Cisco.com

- **`show/debug ip mroute` commands**
- **`show/debug ip pim` commands**
- **`show/debug ip dvmrp` commands**
- **`show ip rpf`**
  - **watch oilist for null entries**
- **hop-by-hop process - use `mtrace`**

PIM Sparse mode troubleshooting

Cisco.com

- **`show ip pim rp [<group>]`**
  - **indicates RP for the group**
- **`show ip pim rp mapping`**
  - **indicates RP for the group**
- **`debug ip pim auto-rp`**

DVMRP troubleshooting

Cisco.com

- **`show ip dvmrp route`**
  - **can include address or interface arguments**
- **`debug ip dvmrp`**
  - **Optional arguments are:**
  - **`detail` - to capture headers**
  - **`ACL` - to specify specific routes**
  - **`in | out` - transmitted or rec'd only**
  - **`pruning` - watch pruning and grafting only**

Check Network packet flow

Cisco.com

- `mstat` command
- `ping` command
- `show ip mroute count`
- `show ip mroute active`
- `debug ip mpacket`
  - Be Careful with this one!

Check Receiver signaling

Cisco.com

- `show ip igmp interface`
- `show ip igmp groups`
- `debug ip igmp / cgmp`
- IGMPv1 vs. IGMPv2

Check Receiver packet flow

Cisco.com

- Check receiver interface stats
- Is the stack installed and configured properly?
- Is the application installed and configured properly?
- Watch for duplicates
  - performance implication