

IP Multicasting

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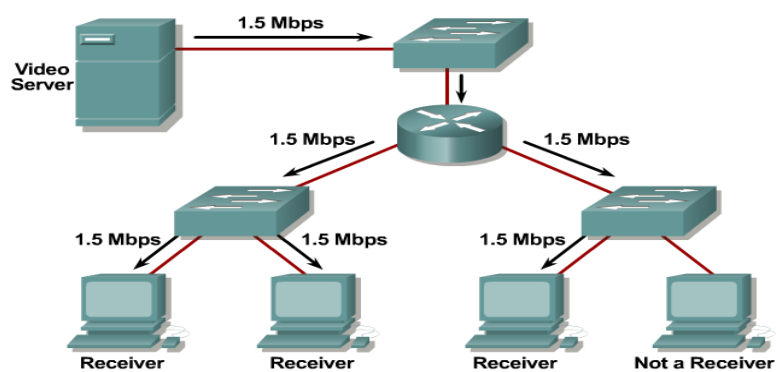


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Multicast



A multicast server sends out a single data stream to multiple clients using a special multicast address.

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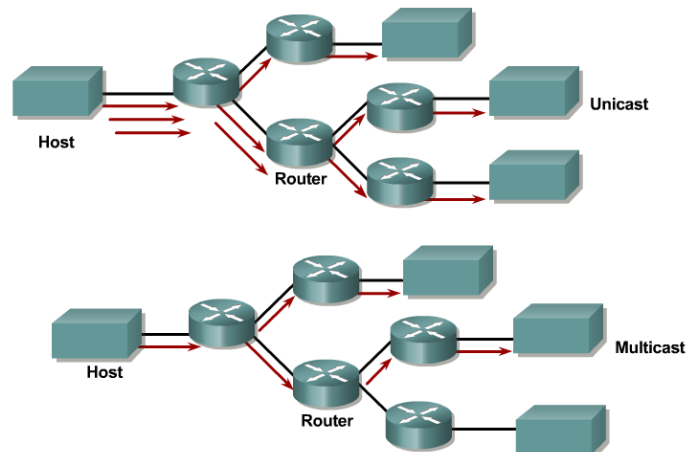
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Multicast

- Used when sending same data to multiple receivers
- Better bandwidth utilization
- Less host/router processing
- Used when receivers address unknown
- Used when simultaneous delivery for a group of receivers is required

Unicast versus Multicast



Advantages

- **Enhanced efficiency**
 - Multiple streams of data replaced with a single transmission
- **Optimized performance**
 - Fewer copies requires less forwarding and processing
- **Distributed applications**
 - Makes multipoint applications possible

Disadvantages

Multicast is UDP-based

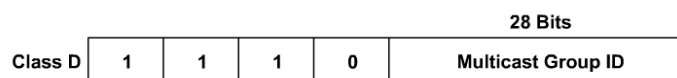
- **Best-effort delivery**
- **No congestion avoidance**
- **Duplicates**
- **Out-of-sequence delivery**

Types of multicast applications

- One-to-many
- Many-to-many
- Many-to-one

Basic IP Multicast Address

- Class D address
- Four most significant bits: 1110
- 28 bits for group address



Multicast Address Groups

- **Locally scoped (reserved link lokal) address**
 - 224.0.0.0 – 224.0.0.255
- **Globally scoped address**
 - 224.0.1.0 – 238.255.255.255.
- **Limited (administratively) scoped address**
 - 239.0.0.0 – 239.255.255.255

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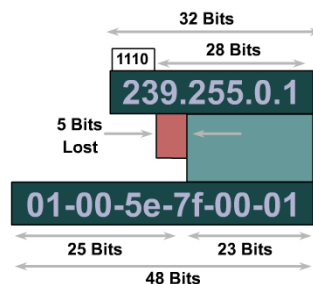
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Layer 2 Multicast Addressing

- **25 first bits fixed**
- **23 last bits corresponds to IP multicast group address**

IP Multicast MAC Address Mapping Ethernet



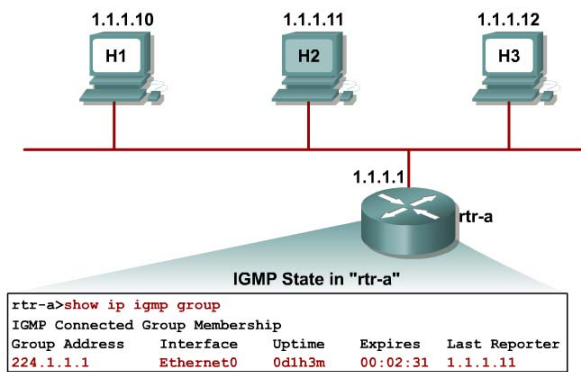
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IGMPv2 - Joining a Group

- H2 send join group message for group 224.1.1.1

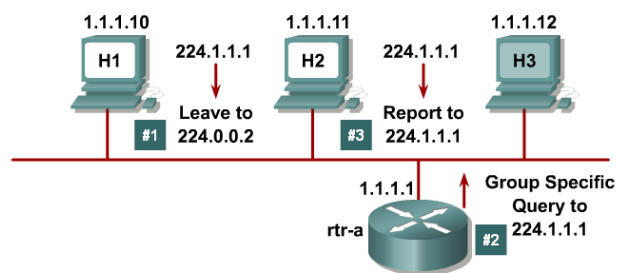


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IGMPv2 - Leaving a group



- Host H2 leaves the group and announces the departure by sending a leave message to multicast group 224.0.0.2 (all multicast routers).
- Router rtr-a sends a group-specific query to 224.1.1.1 to see if any other group members are present.
- Host H3 has not left the multicast group 224.1.1.1 yet, therefore it responds with a report message.

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IGMPv3

- **Receive traffic from particular sources within a multicast group**
- **Filter multicasts based on source**
- **Utilization of routing resources more efficient**

Multicast Frame Switching

- **L2 switches treat multicast traffic as broadcasts and must flood the frame to every port**
- **Static entries used to specify multicast groups – not scalable**
- **Dynamic configuration may reduce administration**

Multicast Switching Solutions

- **Cisco Group Management Protocol (CGMP)**
 - Cisco proprietary protocol
 - Multicast router inform the switch
- **IGMP Snooping**
 - Switch examine every multicast data packet
 - Update MAC table accordingly

Cisco Group Management Protocol - CGMP

- **Most Common multicast switching solution**
- **Based on client/server model**
 - Router = server
 - Switch = client
- **Router informs switch when host join/leave multicast group**
- **Switch update CAM table**

IGMP Snooping

- **Switch becomes IGMP aware**
- **Identify a copy of all IGMP packets**
- **Examine contents of IGMP messages**
 - Which ports want what traffic
- **Special hardware required**

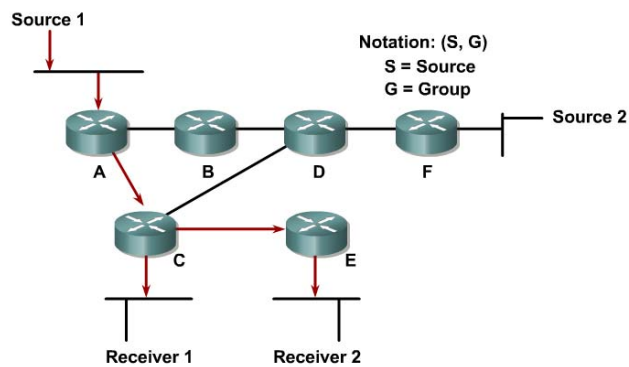
Multicast Distribution Trees

- **Multicast distribution trees define the path from source to receivers over which multicast traffic flows**
- **Two types of multicast distribution trees:**
 - **Source trees. Traffic forwarded via the shortest path from the source**
 - **Shared trees. Traffic is forwarded via a meeting point for this group**

Source Tree

- Separate tree is built for each source to all members of its group

Shortest Path or Source Distribution Tree



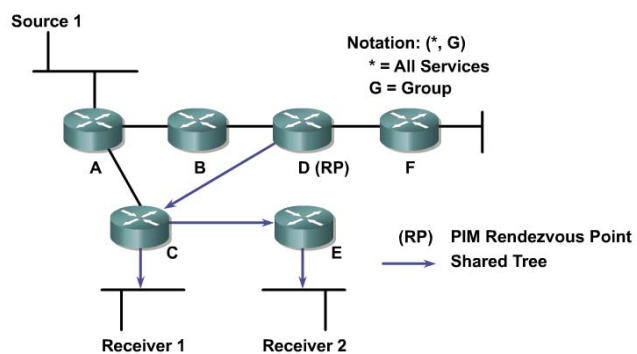
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Shared Tree

- Router D is root

Shared Distribution Tree



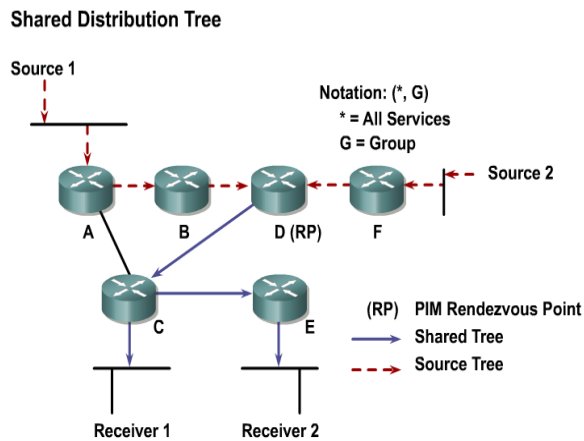
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Shared Tree (cont.)

- Multicast sent from source to RP, towards receivers



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IP Multicast Routing

- Multicast routing works the opposite way of unicast routing:
 - Unicast routing concerned where packet is going
 - Multicast routing concerned where packet comes from
- Multicast routing uses Reverse Path Forwarding (RPF) to prevent forwarding loops

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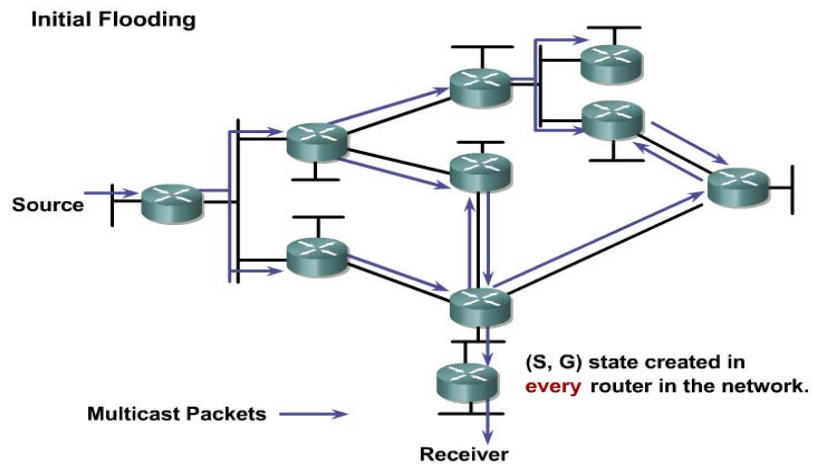
Types of Multicast Protocols

- **Dense mode protocols**
 - Flood traffic to all parts of network
- **Sparse mode protocols**
 - Use an explicit join mechanism

Protocol-Independent Multicast (PIM)

- **PIM dense mode (PIM-DM)**
 - Flood traffic out of all non-RPF interfaces where PIM-DM neighbor or member of group exists
 - PIM-DM prune packets sent to stop unwanted traffic
- **PIM sparse mode (PIM-SM)**
 - Use an explicit join mechanism

PIM-DM Initial Flooding

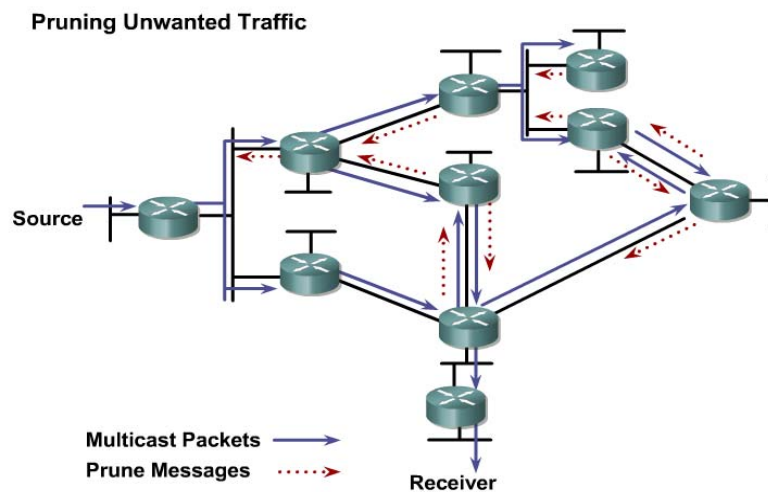


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PIM-DM Pruning Unwanted Traffic



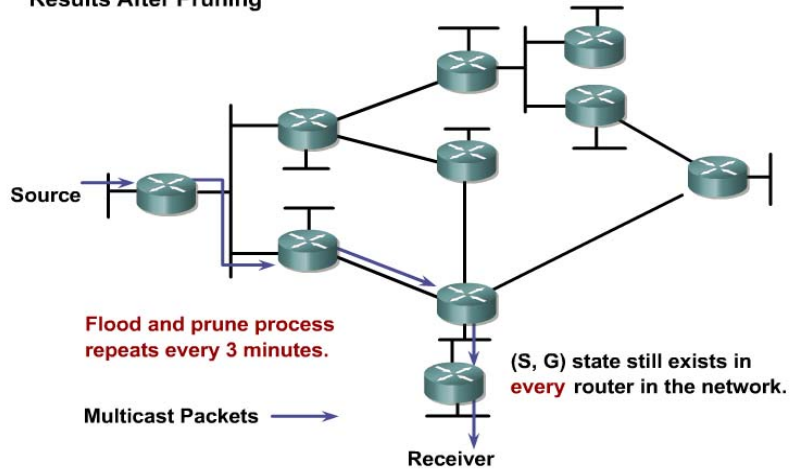
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PIM-DM Results After Pruning

Results After Pruning

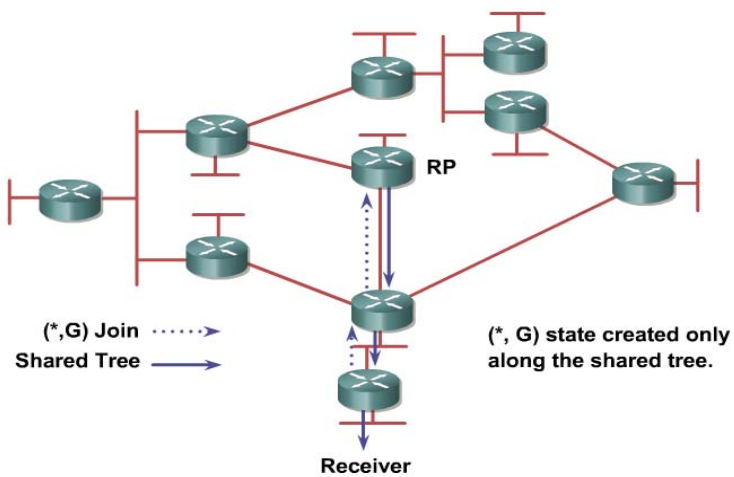


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PIM-SM



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PIM Sparse-Dense-Mode

Shared Distribution Tree

