MULTICAST

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Overview

- One-to-many
  - Radio station broadcast
  - Transmitting news, stock-price
  - Software updates to multiple hosts
- Many-to-many
  - Multimedia teleconferencing
  - Online multi-player games
  - Distributed simulations

Why Multicast is Needed?

- Without support for multicast
  - A source needs to send a separate packet with the identical data to each member of the group
    - This redundancy consumes more bandwidth
    - Redundant traffic is not evenly distributed, concentrated near the sending host
  - Source needs to keep track of the IP address of each member in the group
    - Group may be dynamic
- To support many-to-many and one-to-many IP provides an IP-level multicast

Multicast Model

- Basic IP multicast model is many-to-many based on multicast groups
  - Each group has its own IP multicast address
  - Hosts that are members of a group receive copies of any packets sent to that group's multicast address
  - A host can be in multiple groups
  - A host can join and leave groups

Multicast Model

- Using IP multicast to send the identical packet to each member of the group
  - A host sends a single copy of the packet addressed to the group's multicast address
  - The sending host does not need to know the individual unicast IP address of each member
  - Sending host does not send multiple copies of the packet

Multicast Model

- A host signals its desire to join or leave a multicast group by communicating with its local router using a special protocol
  - In IPv4, the protocol is Internet Group Management Protocol (IGMP)
  - In IPv6, the protocol is Multicast Listener Discovery (MLD)

- The router has the responsibility for making multicast behave correctly with regard to the host

Multicast Routing

- A router's unicast forwarding tables indicate for any IP address, which link to use to forward the unicast packet
- To support multicast, a router must additionally have multicast forwarding tables that indicate, based on multicast address, which links to use to forward the multicast packet
- Unicast forwarding tables collectively specify a set of paths
- Multicast forwarding tables collectively specify a set of trees
  - Multicast distribution trees

Multicast Routing

- To support source specific multicast, the multicast forwarding tables must indicate which links to use based on the combination of multicast address and the unicast IP address of the source

- Multicast routing is the process by which multicast distribution trees are determined

Distance-Vector Multicast

- Each router maintains a table of Destination, Cost, NextHop tuples, and exchanges a list of Destination, Cost pairs with its directly connected neighbors
- 2 Stage Process
  - Broadcast mechanism that allows a packet to be forwarded to all the networks on the internet
  - Refine this mechanism so that it prunes back networks that do not have hosts that belong to the multicast group

Distance-Vector Multicast

- Each router already knows that shortest path to source S goes through router N.
- When receive multicast packet from S, forward on all outgoing links (except the one on which the packet arrived), iff packet arrived from N.
- Eliminate duplicate broadcast packets by only letting
  - "parent" for LAN (relative to S) forward
    - shortest path to S (learn via distance vector)
    - smallest address to break ties

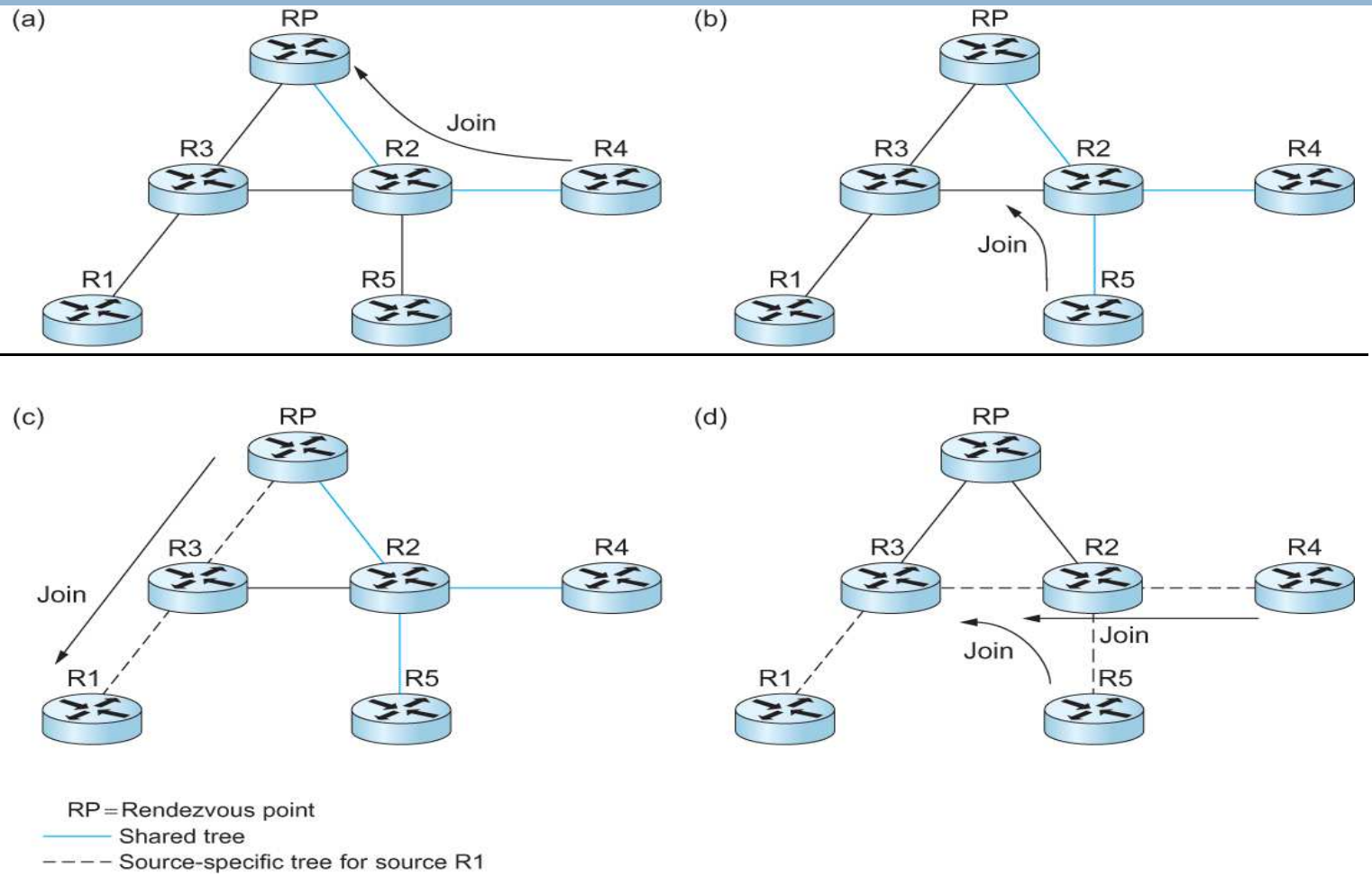
Reverse Path Broadcast (RPB)

- Goal: Prune networks that have no hosts in group G
- Step 1: Determine of LAN is a *leaf* with no members in G
  - leaf if parent is only router on the LAN
  - determine if any hosts are members of G using IGMP
- Step 2: Propagate "no members of G here" information
  - augment **<Destination, Cost>** update sent to neighbors with set of groups for which this network is interested in receiving multicast packets.
  - only happens when multicast address becomes active.

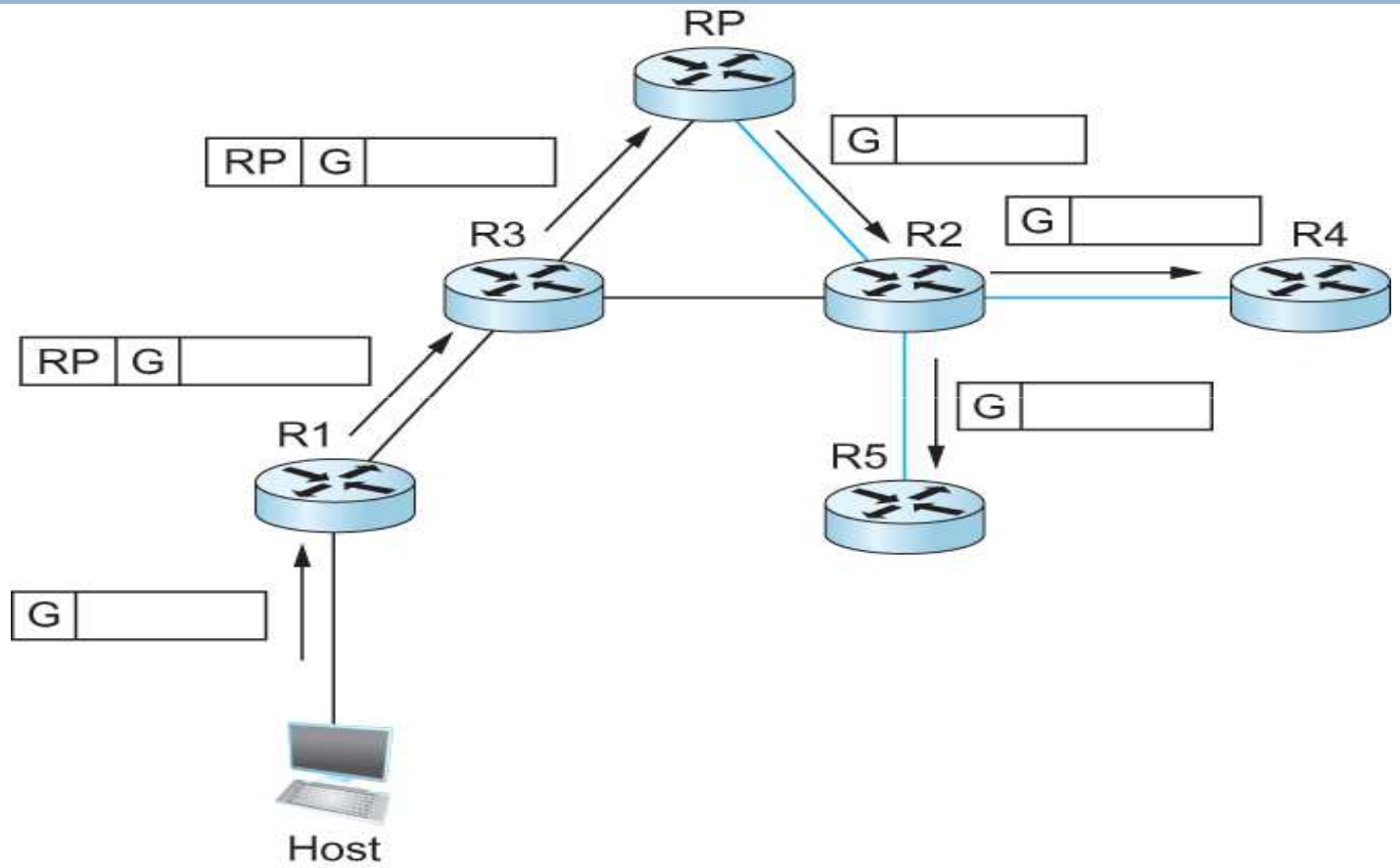
Protocol Independent Multicast (PIM)

Shared Tree

Source specific tree



Protocol Independent Multicast (PIM)



Delivery of a packet along a shared tree. R1 tunnels the packet to the RP, which forwards it along the shared tree to R4 and R5.

Inter-domain Multicast

Multicast Source Discovery Protocol (MSDP)