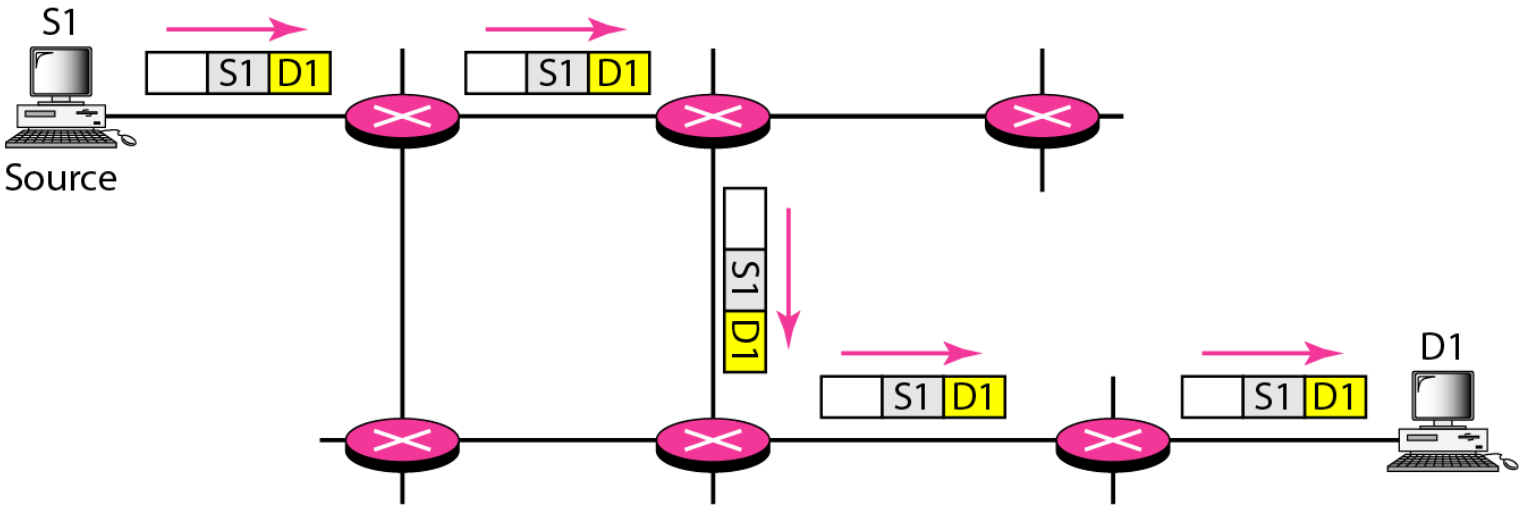
CS2031
Telecommunications II

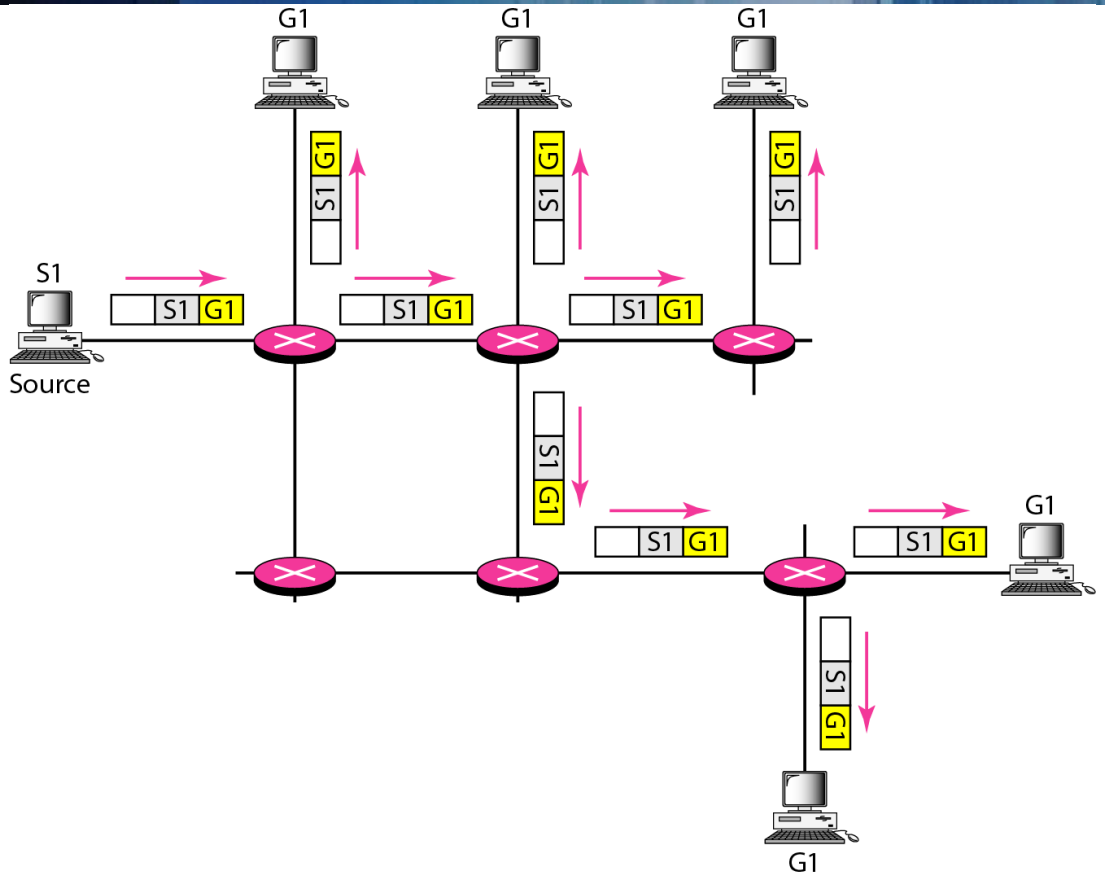
Multicast Routing

Routing & Unicast



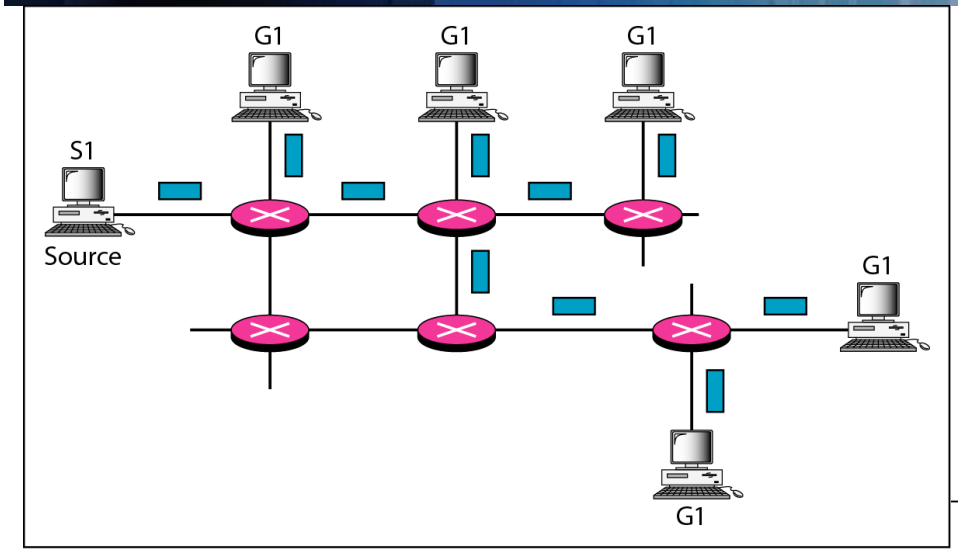
- Routers guide traffic towards destionation

Multicast

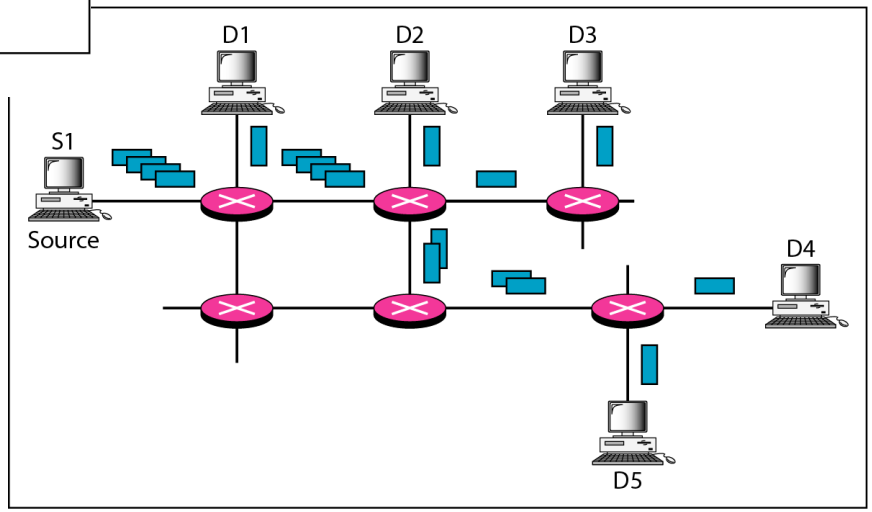


- G1= multicast address e.g. 230.0.0.1

Multicast vs Multiple Unicasts



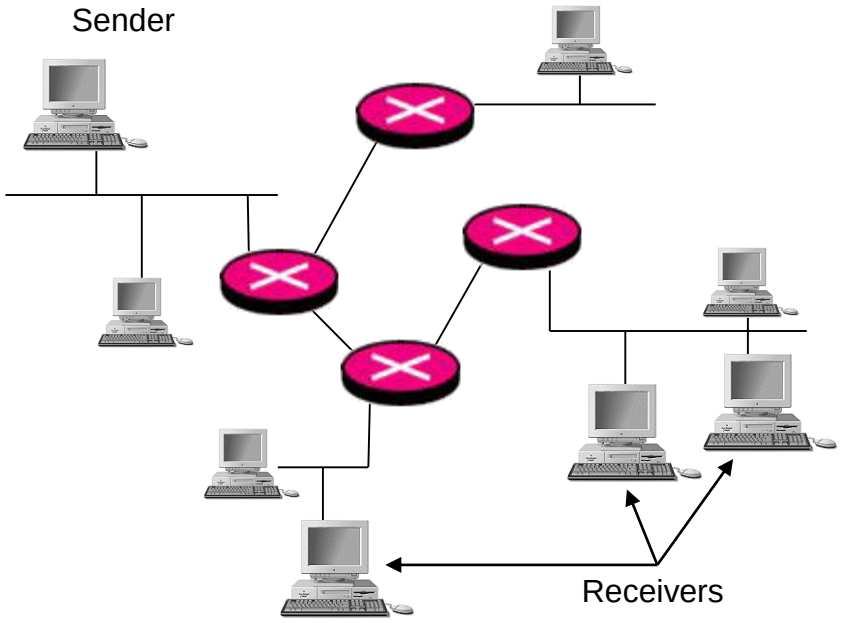
a. Multicasting



b. Multiple unicasting

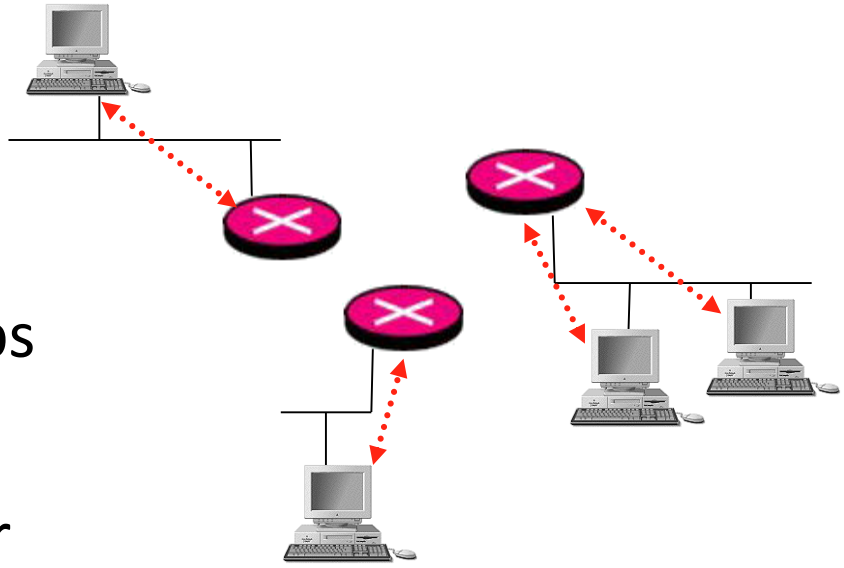
Multicast Overview

- Multicast requires group management
- Receivers join&leave multicast groups
- Multicast Addresses: 224.0.0.0 – 239.255.255.255 or 224.0.0.0/4

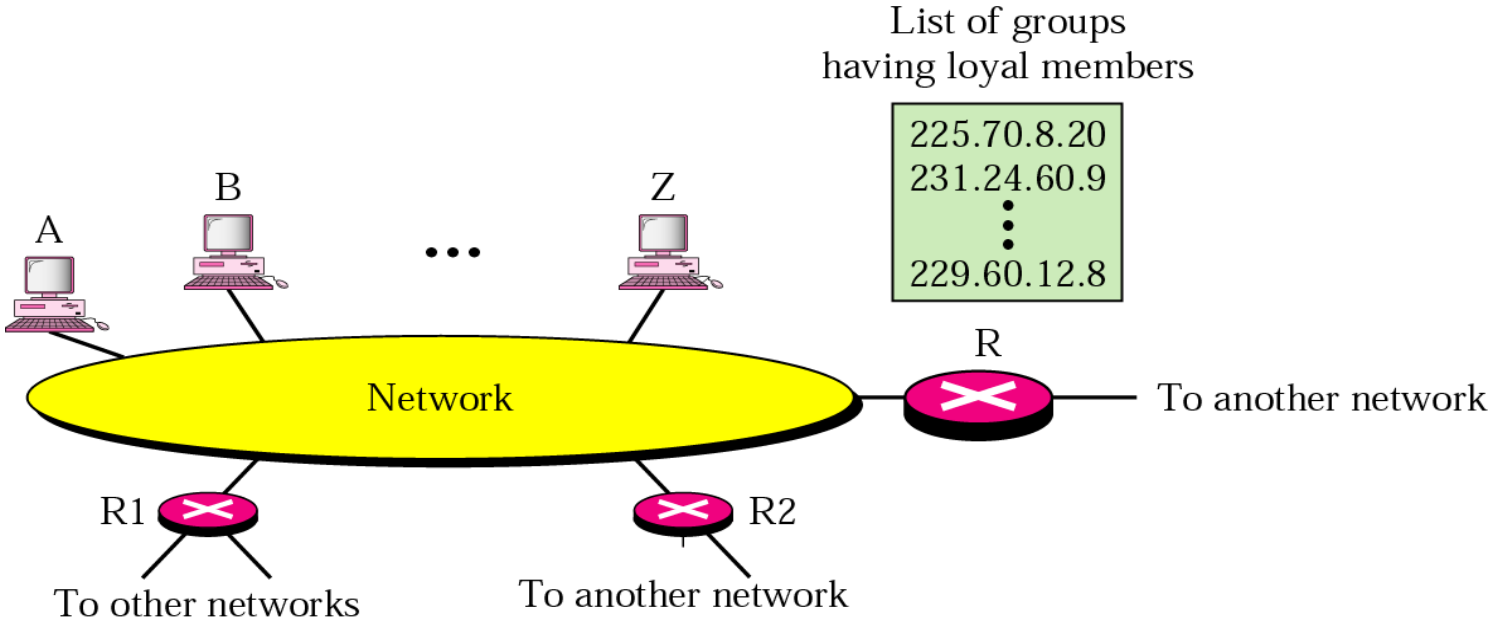


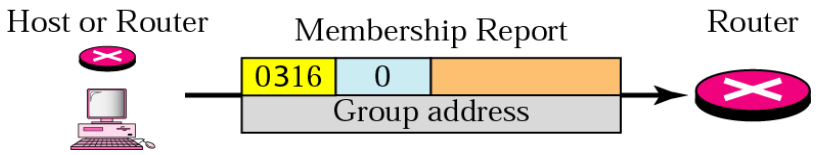
Internet Group Management Protocol (IGMP)

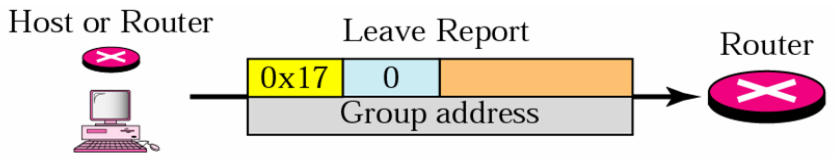
- Defines communication between hosts and router
- Specifies messages for hosts for joining and leaving groups
- Specifies query messages for routers

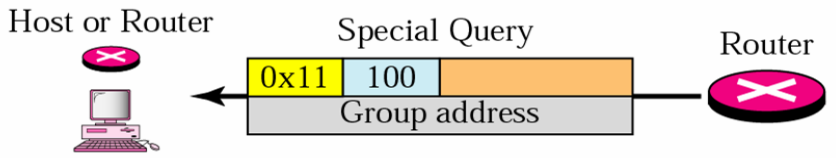


IGMP Operation



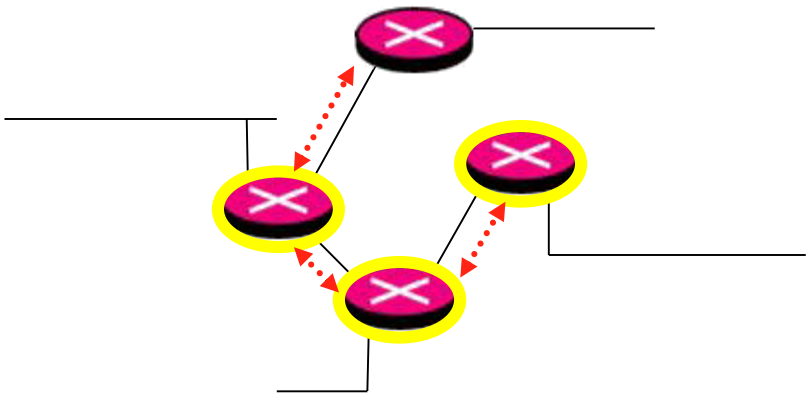




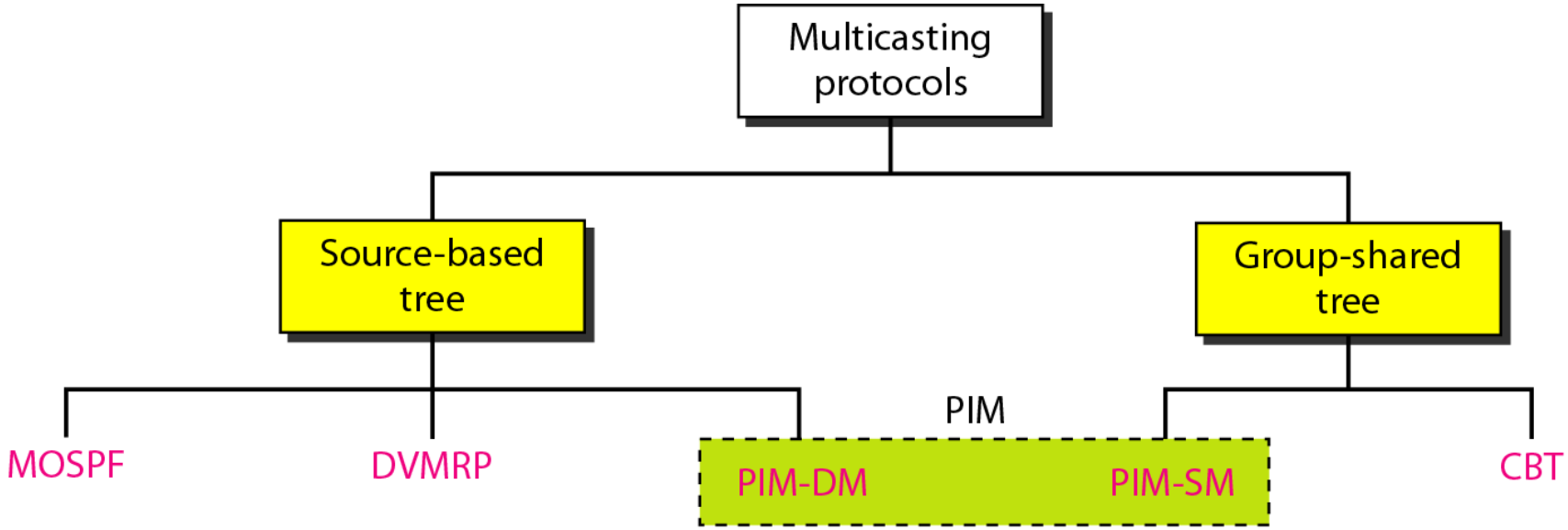


Network-Layer Multicast Protocols

- Distance Vector Multicast Routing Protocol (DVMRP)
- Multicast Open Shortest Path First protocol (MOSPF)
- Protocol Independent Multicast (PIM)



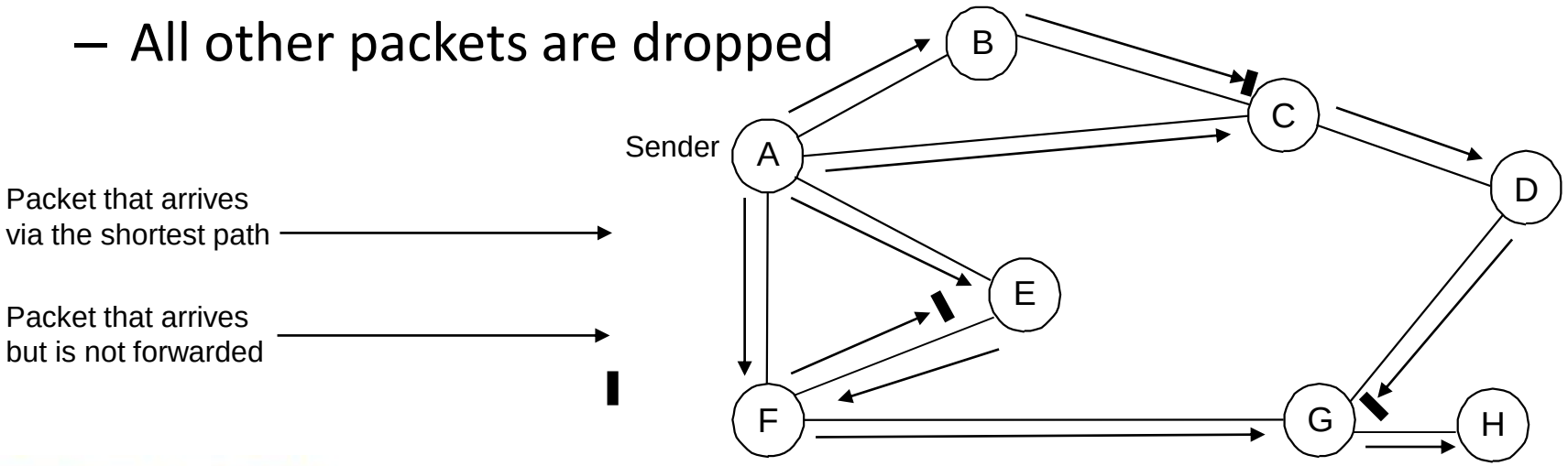
Multicast Routing Protocols



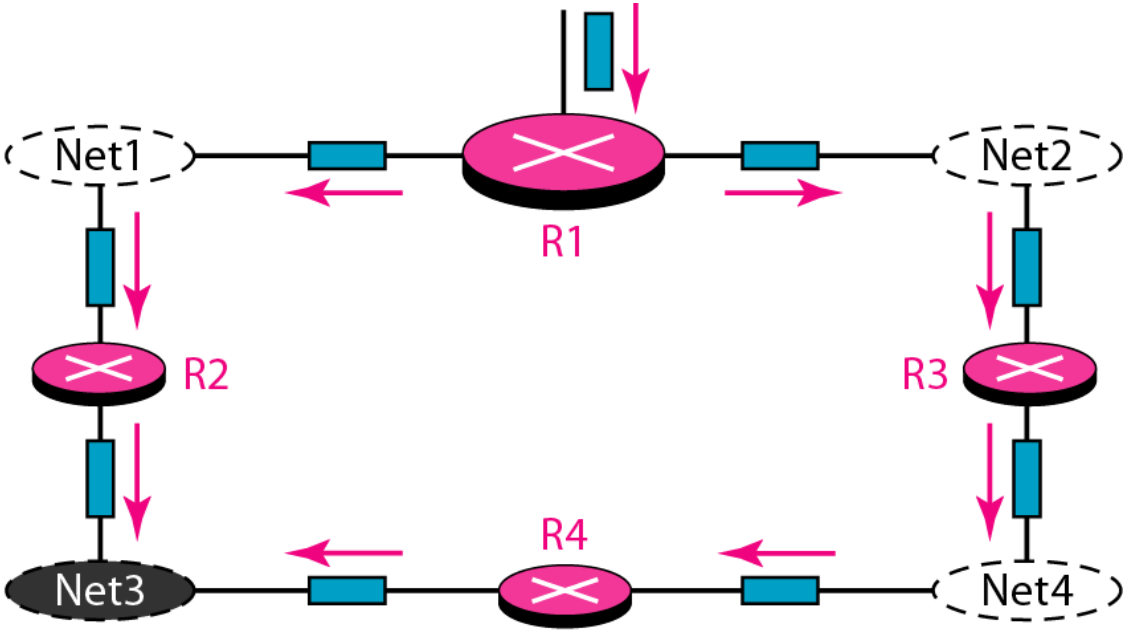
- Intra-AS
  - MOSPF
  - DVMRP
  - PIM
    - Sparse mode
    - Dense mode
- Inter-AS
  - MBGP + MSDP
  - BGMP + MASC

Reverse-Path Forwarding (RPF)

- Reverse-path forwarding simulates spanning tree routing without keeping state in the router
  - Each router knows shortest path to destination
  - Packets from A arriving on next hop to A are presumed to have followed shortest route from A, so they are forwarded on all other links
  - All other packets are dropped



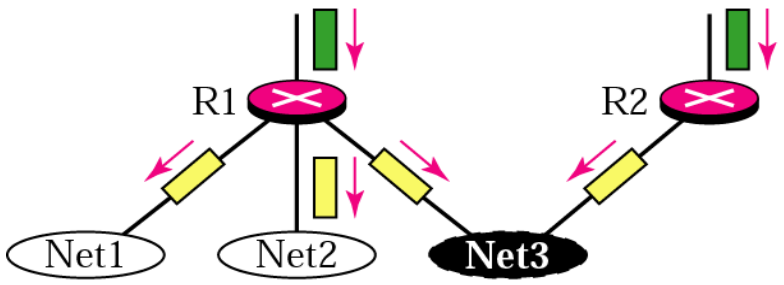
Problem with RPF



Net3 receives two copies of the packet

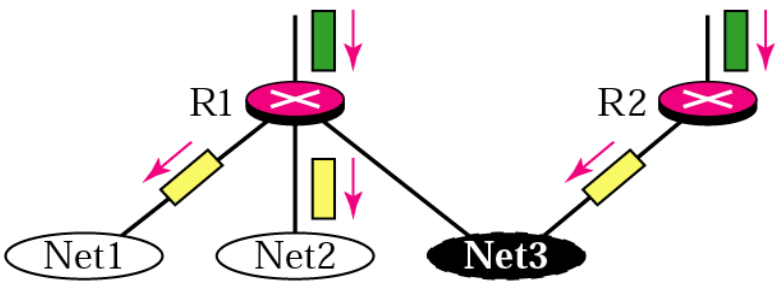
Reverse Path Broadcast/Multicast

- Reverse Path Broadcast



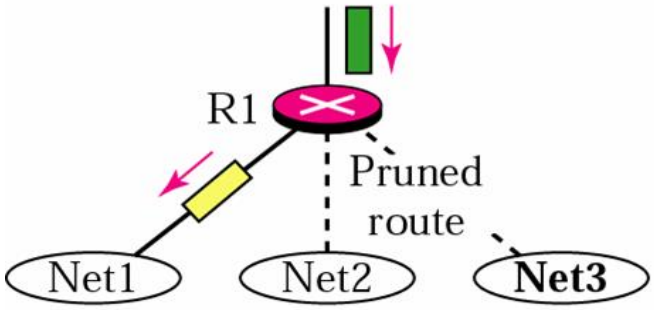
a. RPF

R1 is the parent of Net1 and Net2.
R2 is the parent of Net3.

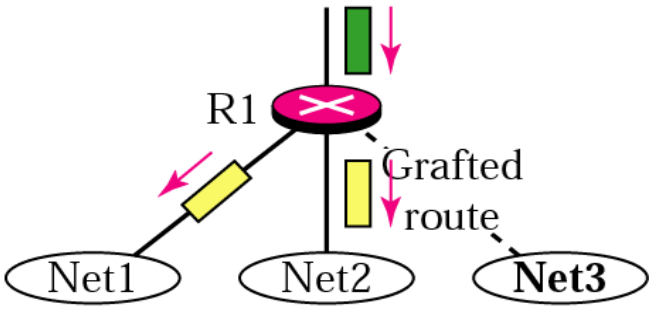


b. RPB

- Reverse Path Multicast



c. RPM (after pruning)



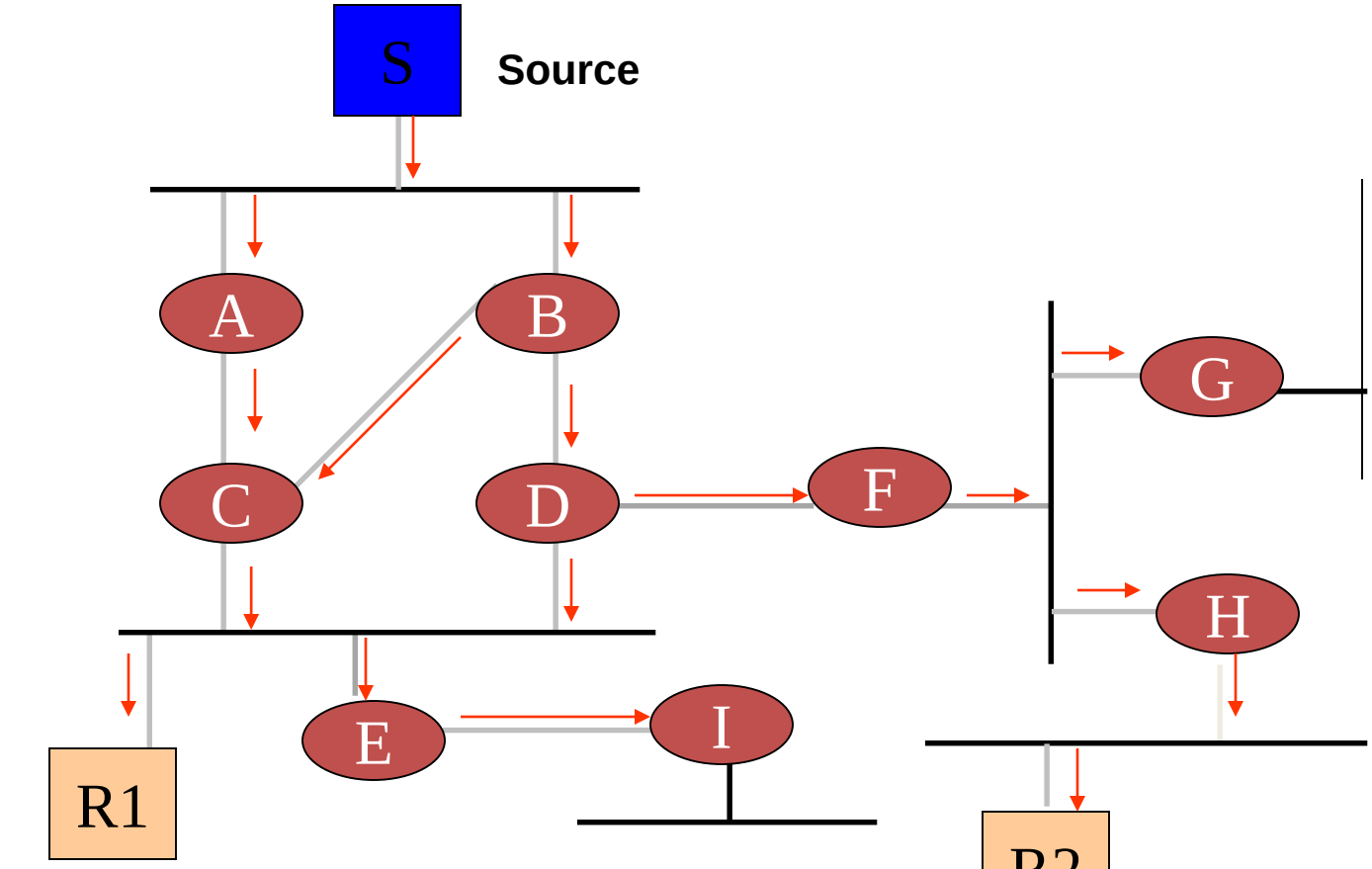
d. RPM (after grafting)

PIM – Dense Mode (DM)

- When it is likely that many routers are involved in multicast routing

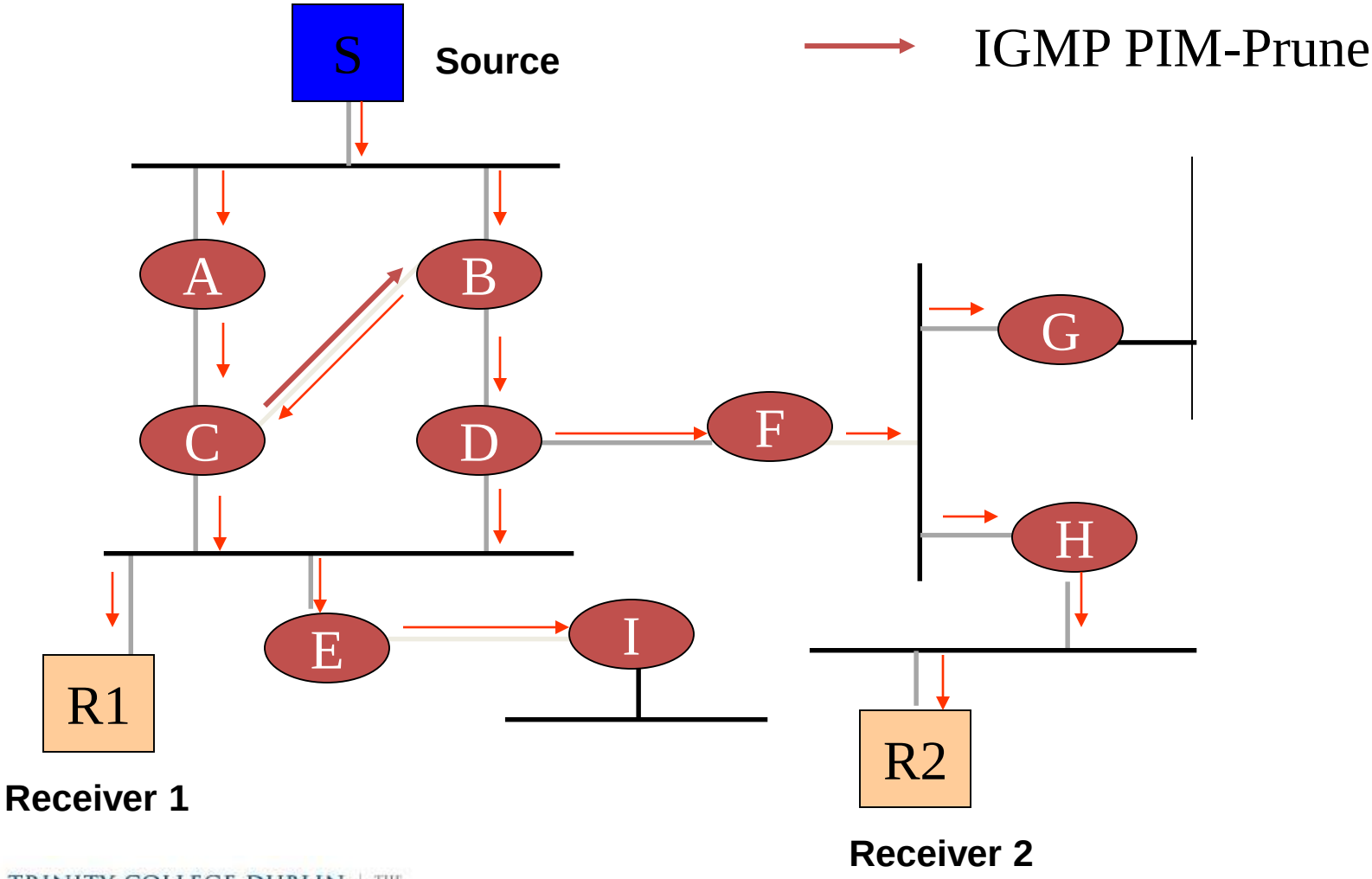
- Source tree created on demand based on RPF rule
- If the source goes inactive, the tree is torn down
- Branches that don't want data are pruned
- Grafts are used to join existing source tree

PIM-DM - Initial flood of data



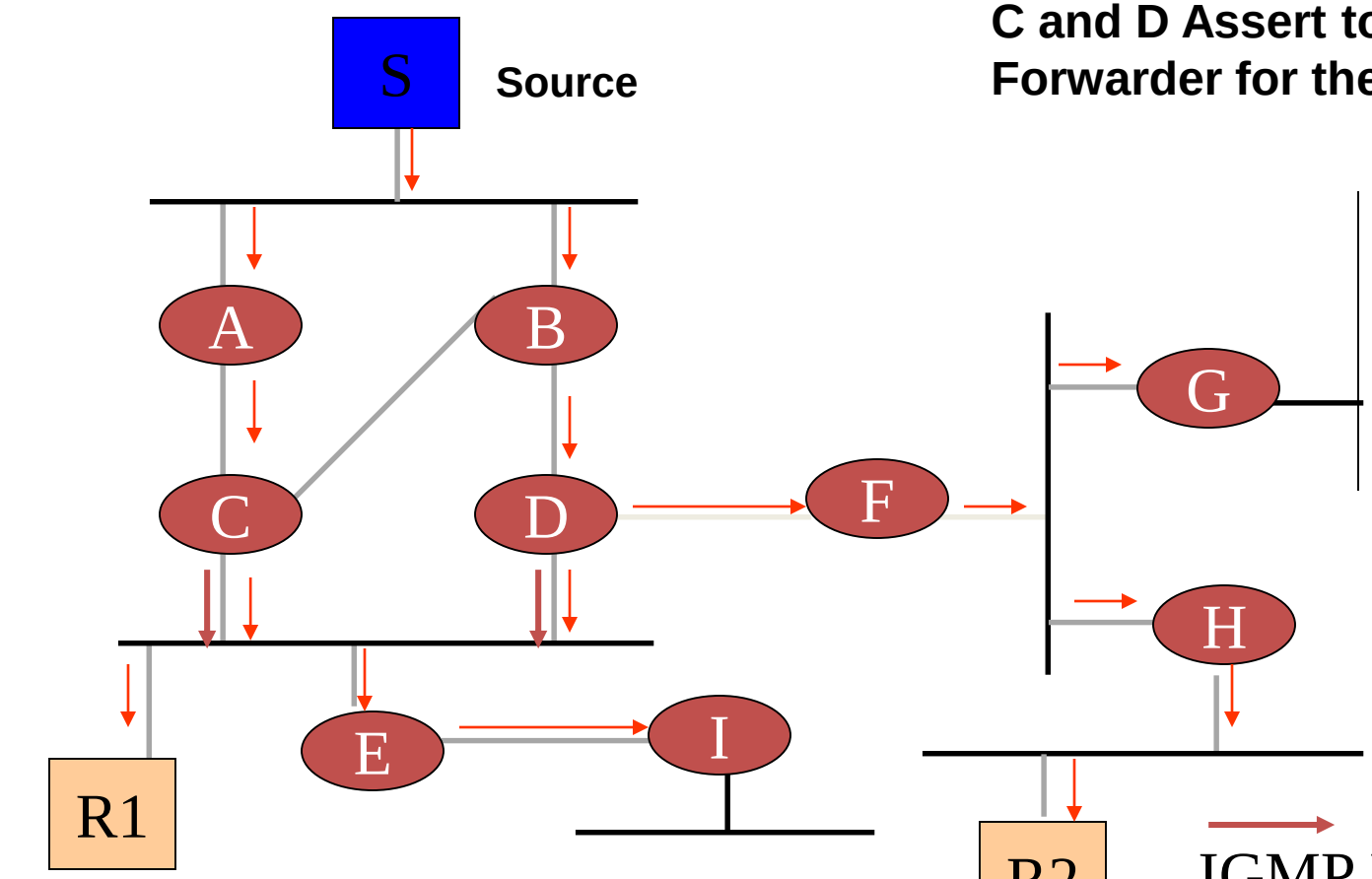
* Taken from J. Murai, Wisconsin

PIM-DM - Prune non-RPF P2P link



* Taken from J. Murai, Wisconsin

PIM-DM

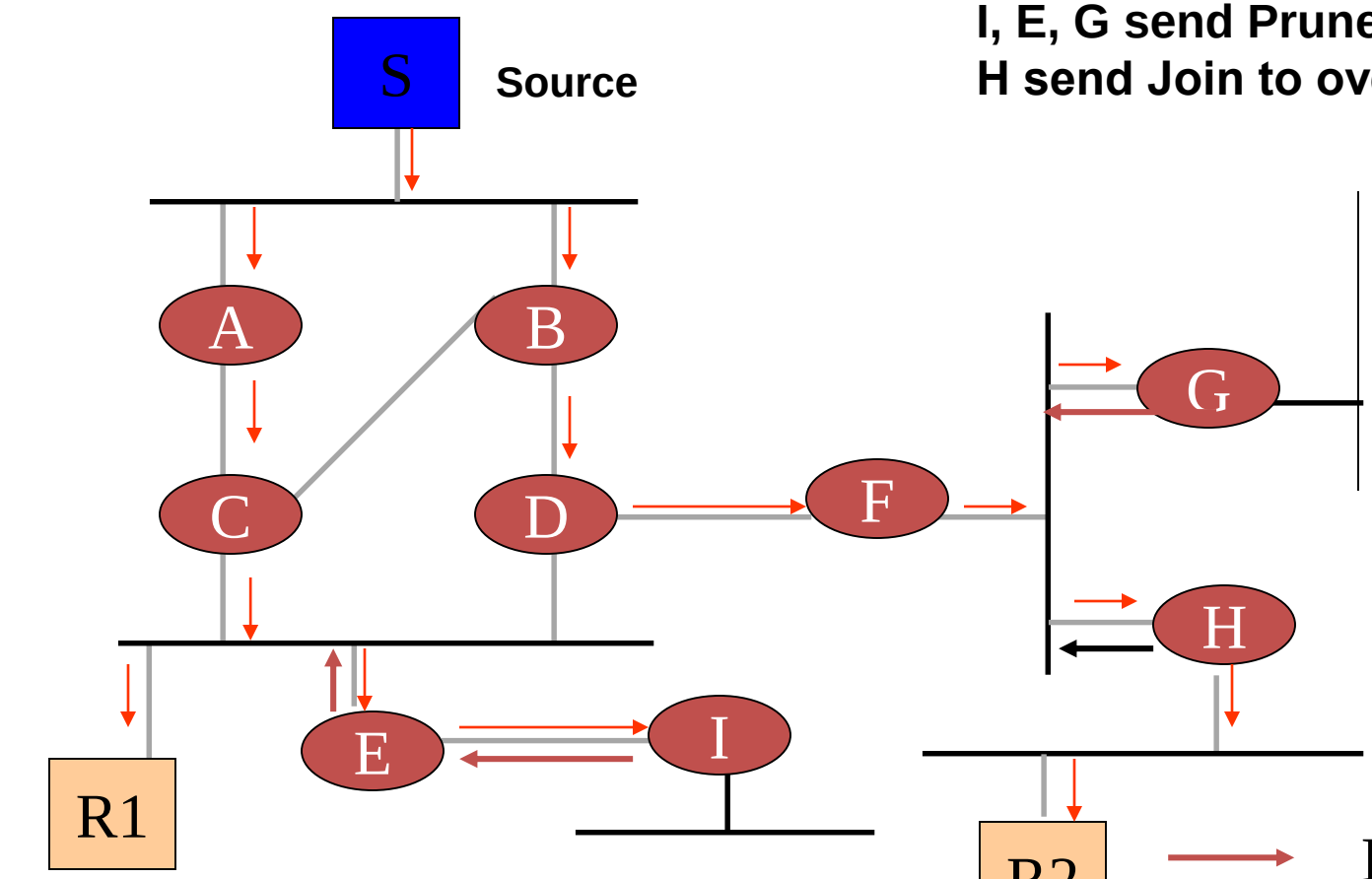


C and D Assert to Determine Forwarder for the LAN, C Wins

IGMP PIM-Assert with its own IP address

* Taken from J. Murai, Wisconsin

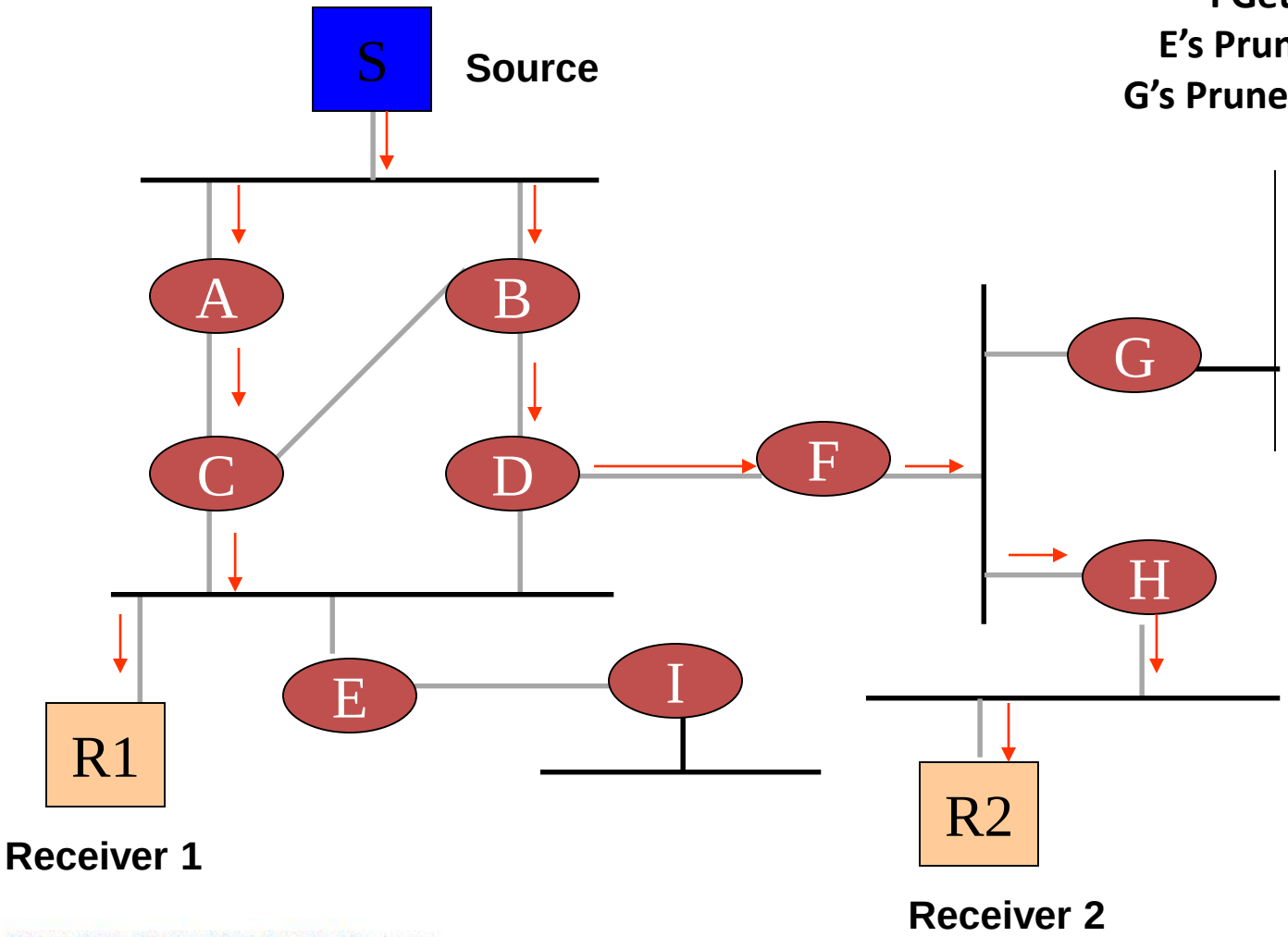
PIM-DM



I, E, G send Prune
H send Join to override G's Prune

* Taken from J. Murai, Wisconsin

PIM-DM



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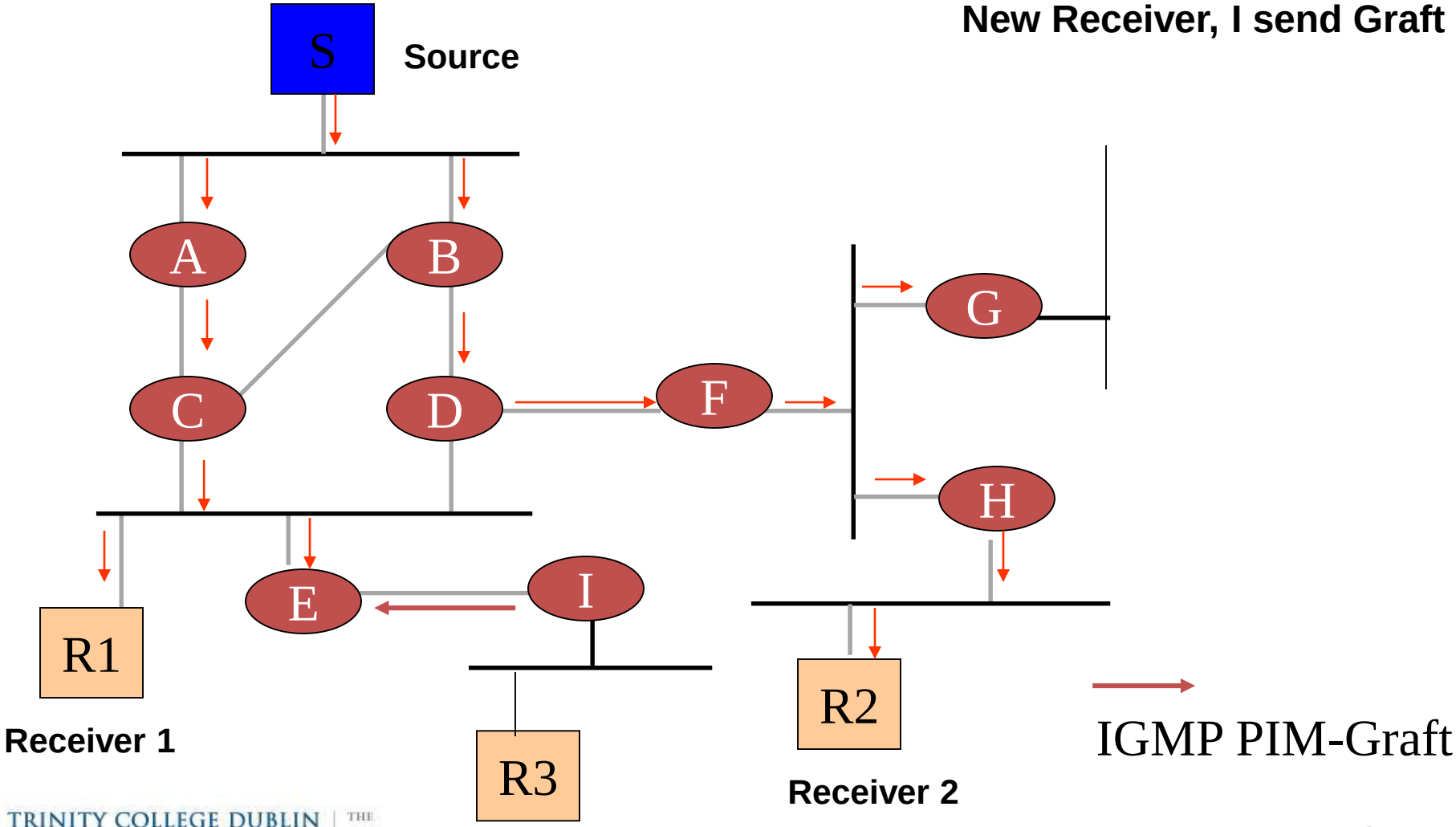
PIM-DM



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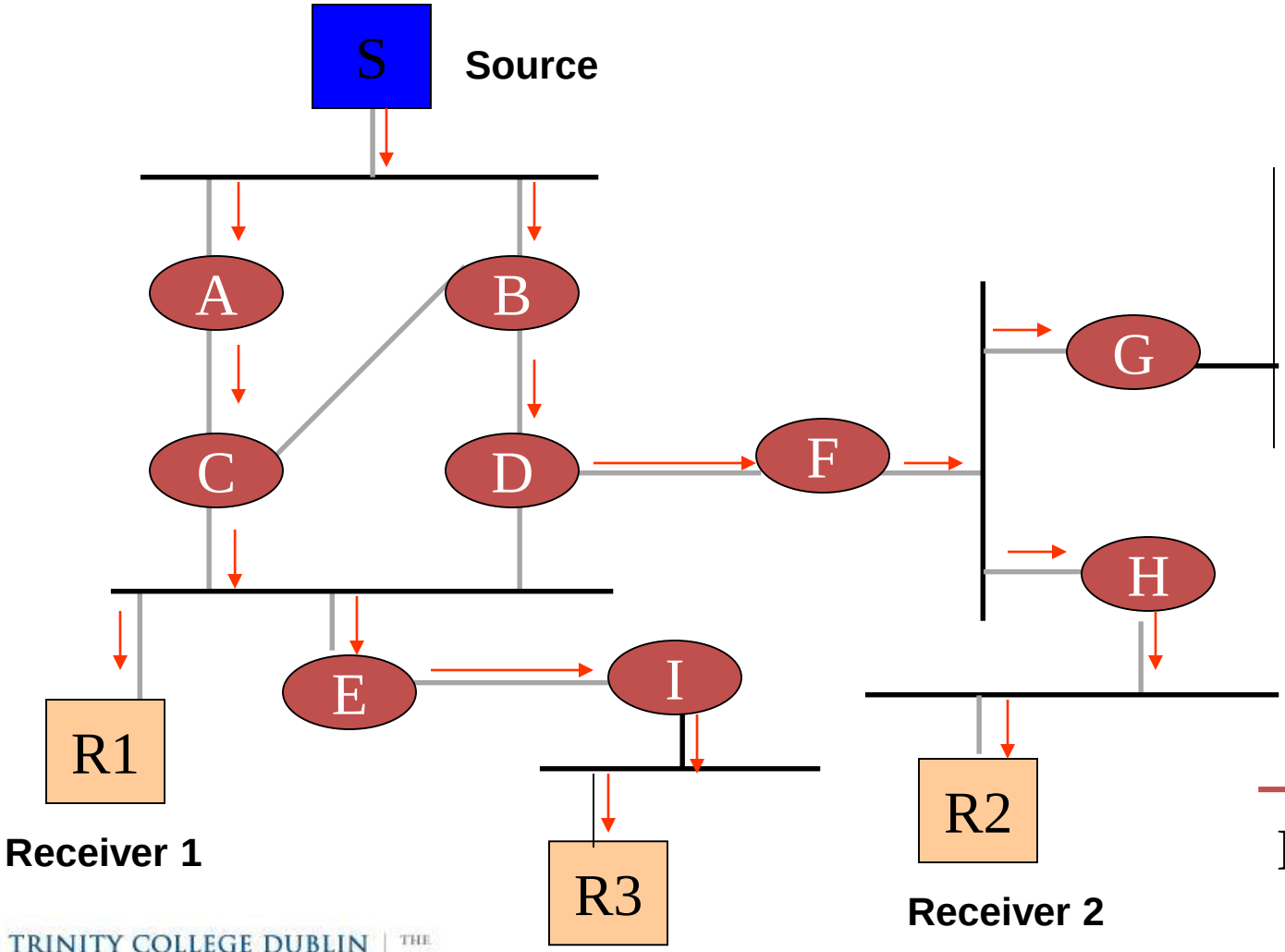
PIM-DM



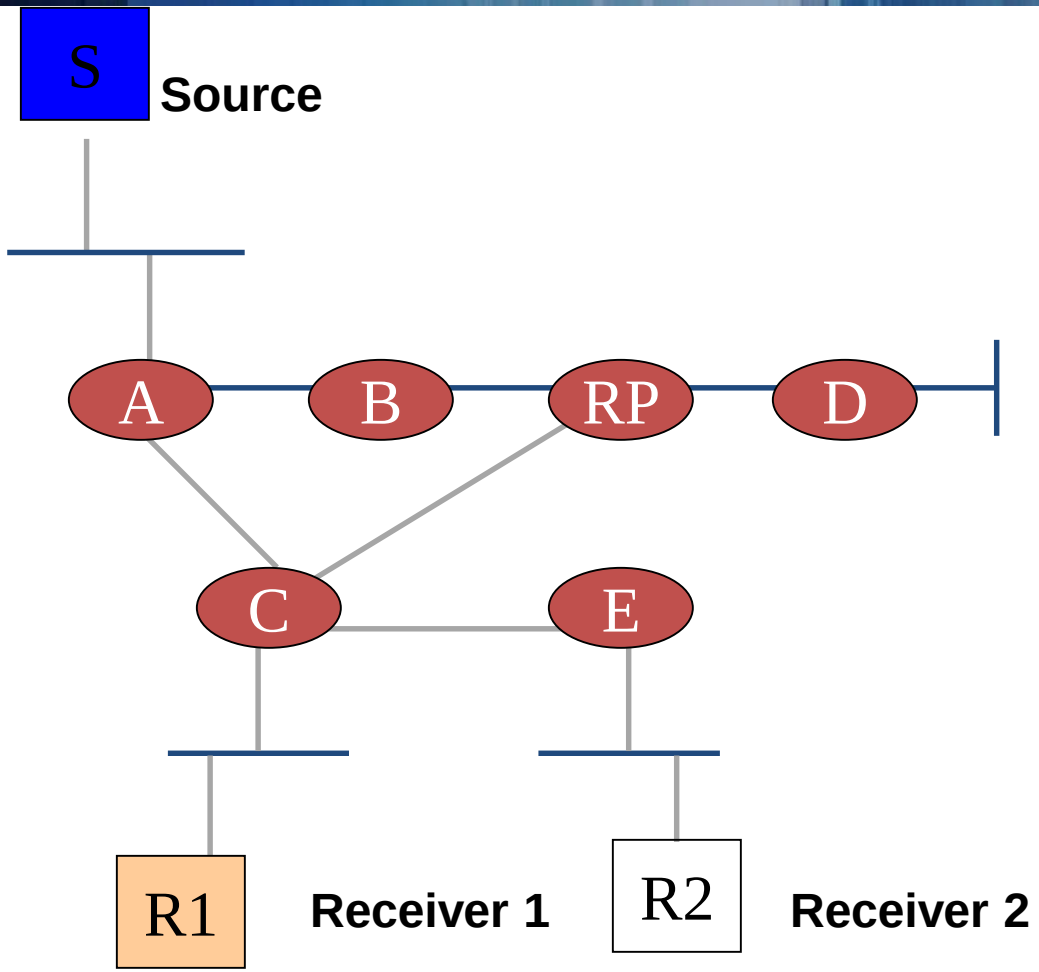
* Taken from J. Murai, Wisconsin

PIM – Sparse Mode (SM)

- When it is likely that many routers are involved in multicast routing

- One Rendez-Vous Point (RP) per group
- Explicit Join Model
  - Receivers send Join towards the RP
  - Sender Register with RP
  - Last hop routers can join source tree if the data rate warrants by sending joins to the source
- Dedicated “All-PIM-Routers” (224.0.0.13, ff02::d) multicast group

PIM-SM



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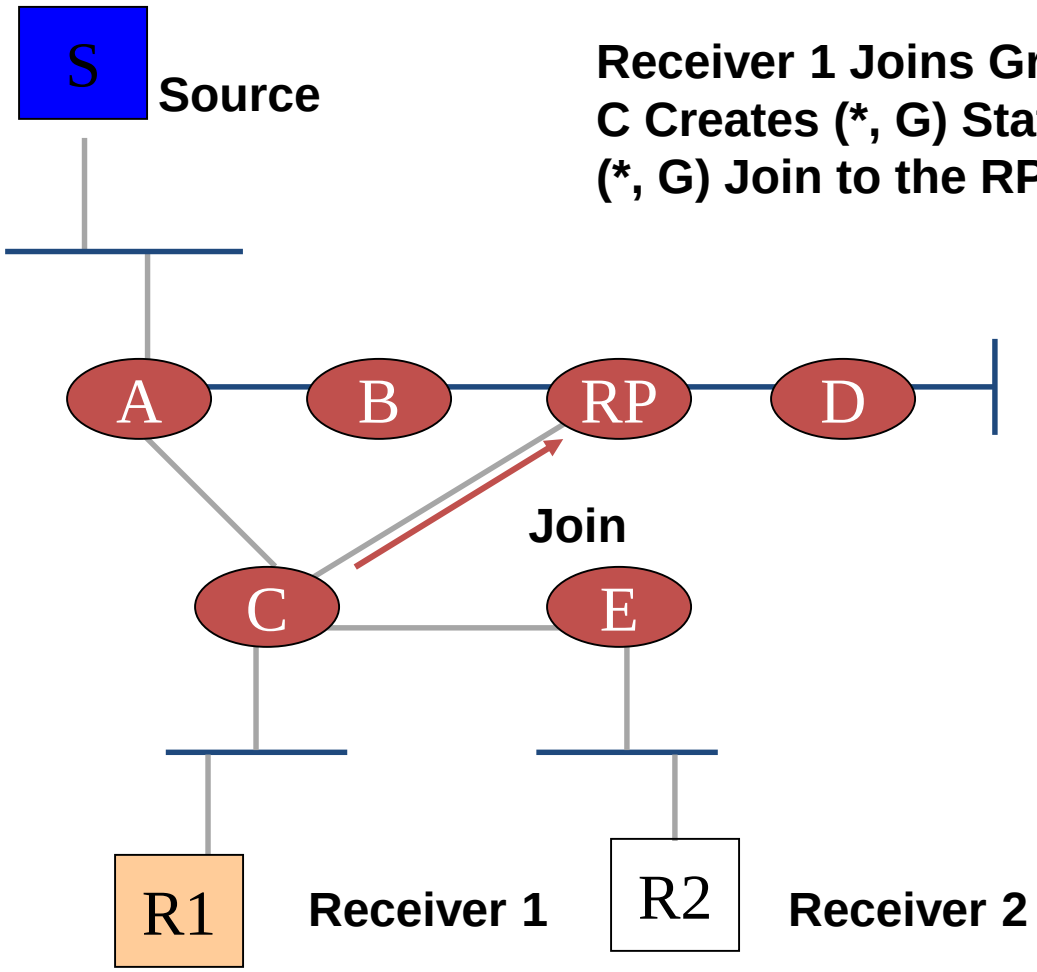
PIM-SM



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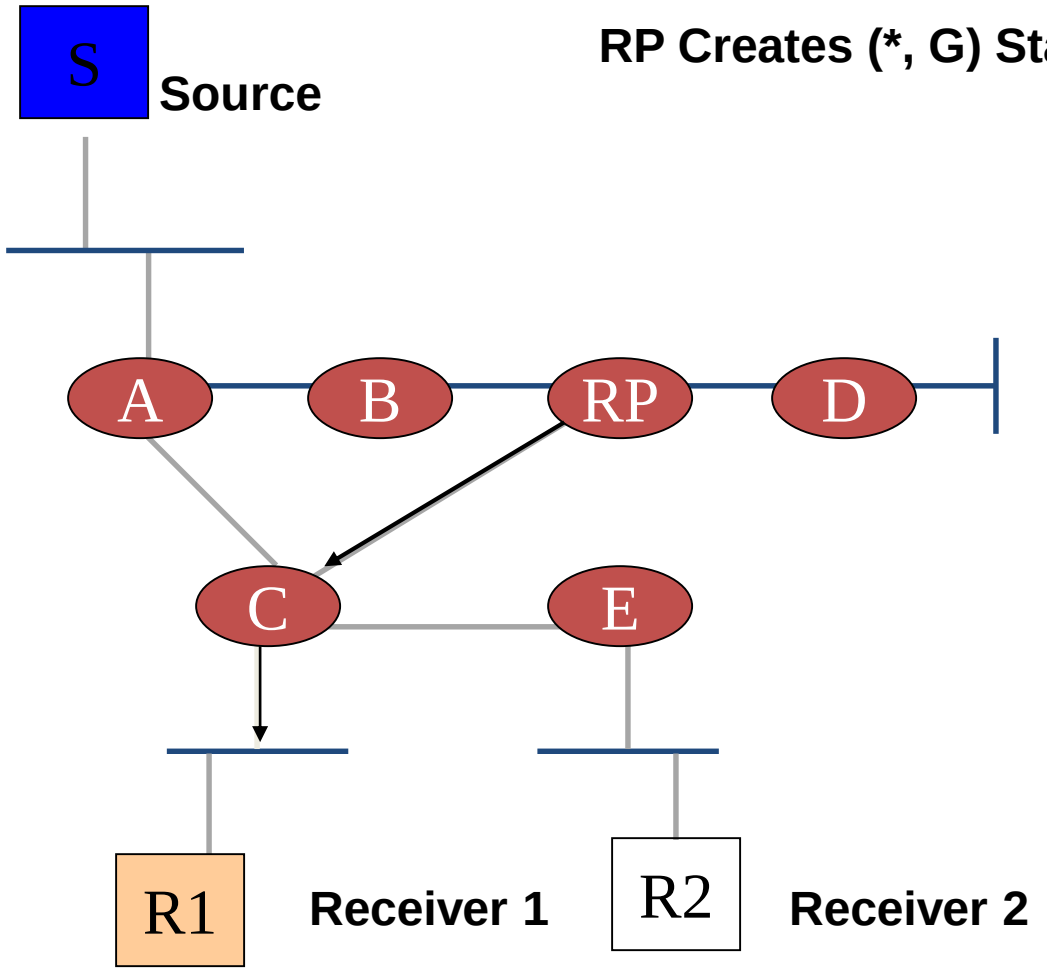
PIM-SM



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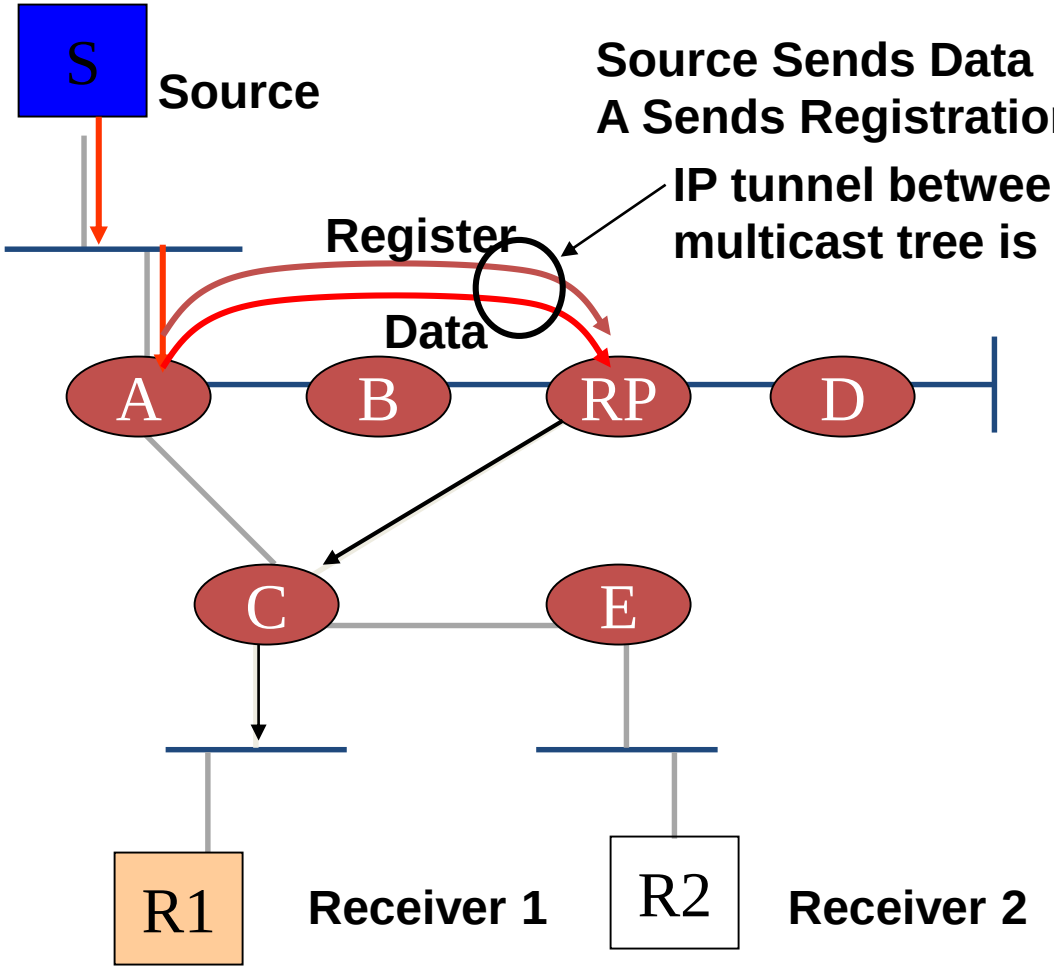
PIM-SM



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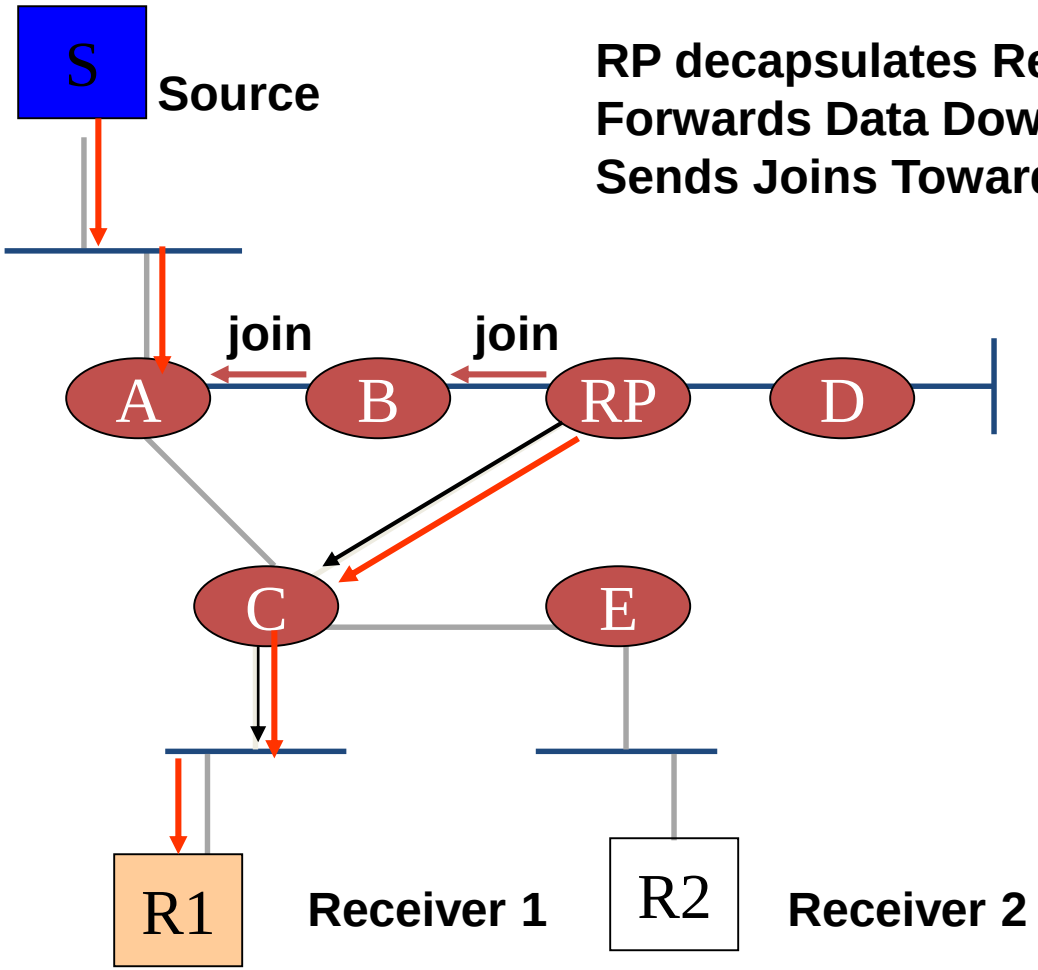
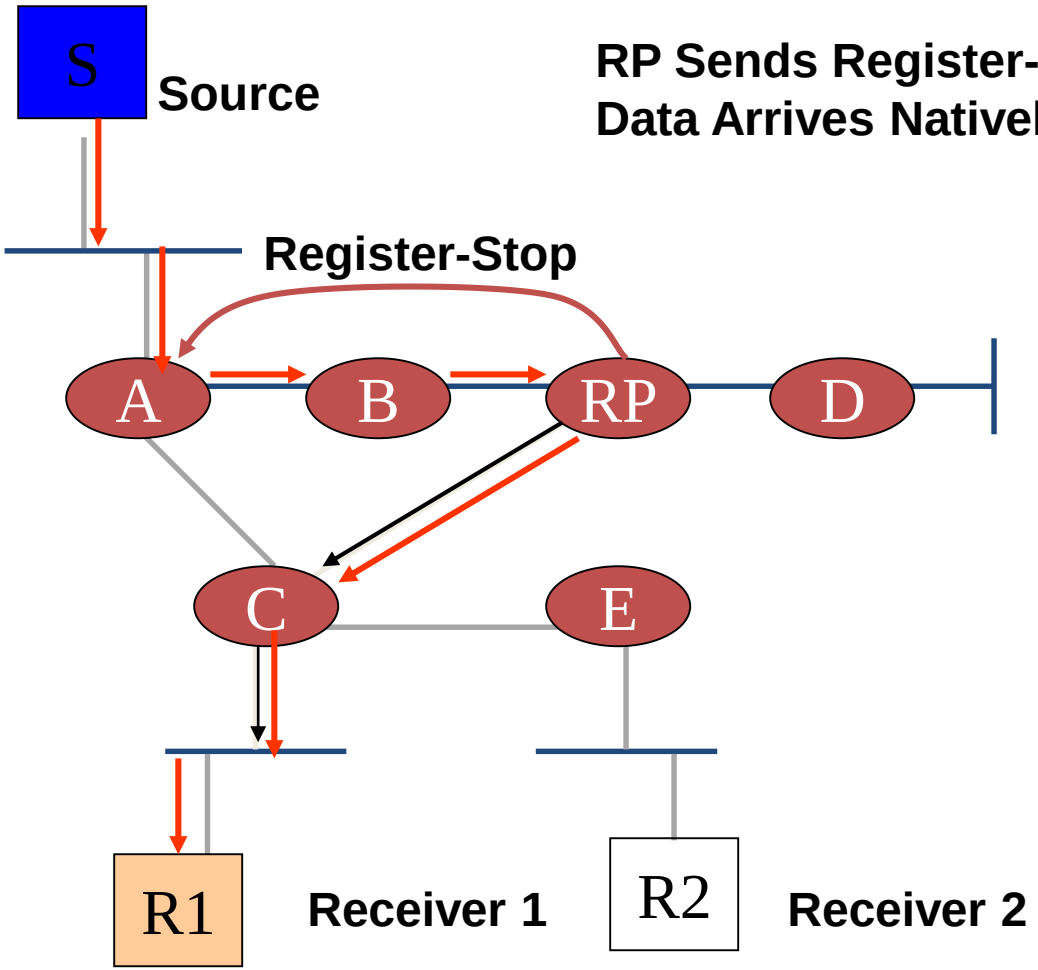
PIM-SM



RP decapsulates Registration
Forwards Data Down the Shared Tree
Sends Joins Towards the Source

* Taken from J. Murai, Wisconsin

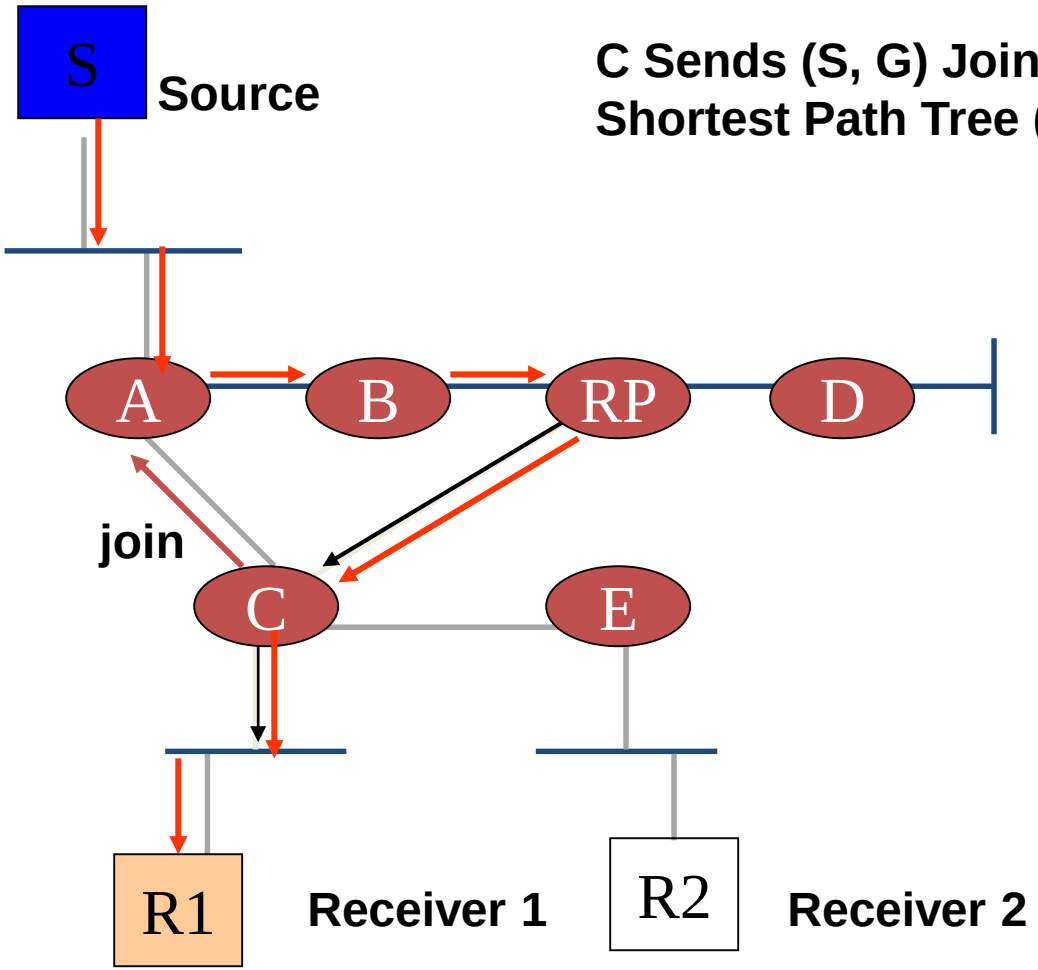
PIM-SM



* Taken from J. Murai, Wisconsin

SPT Switchover

PIM-SM



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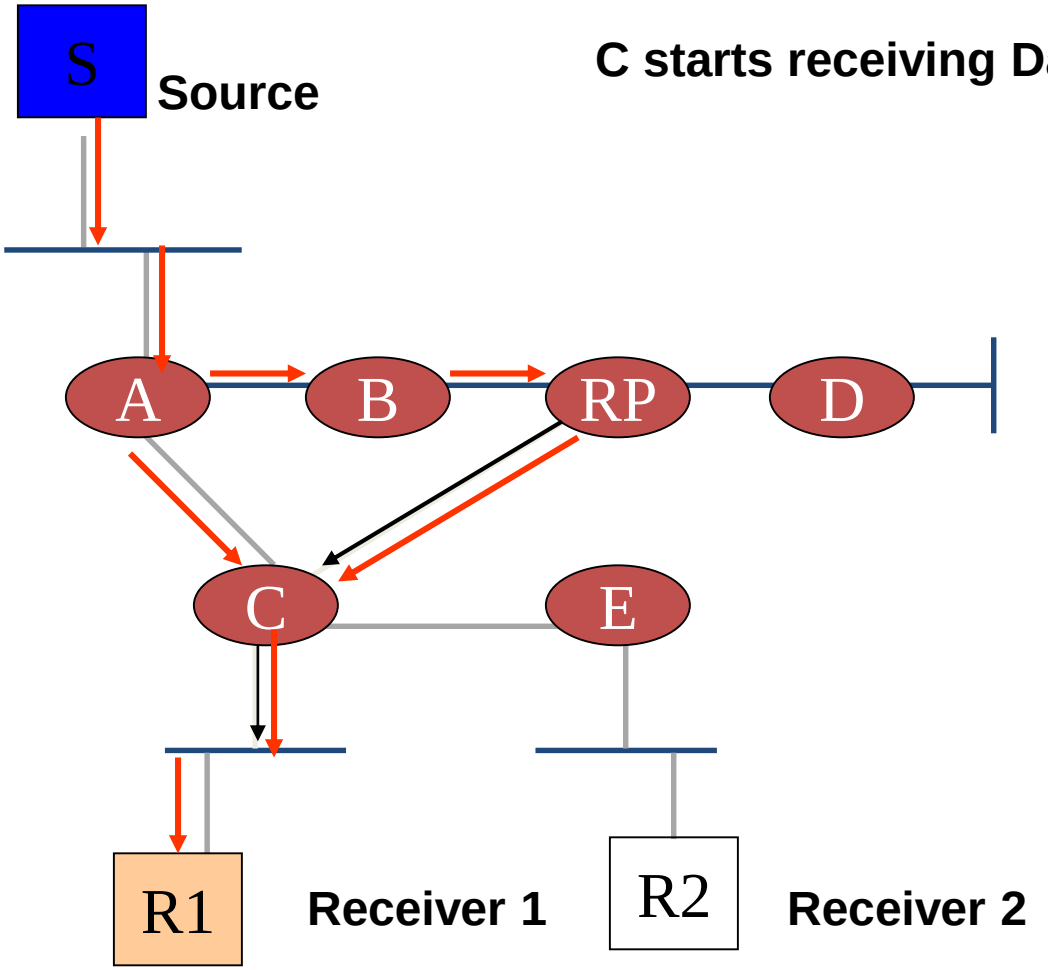
PIM-SM



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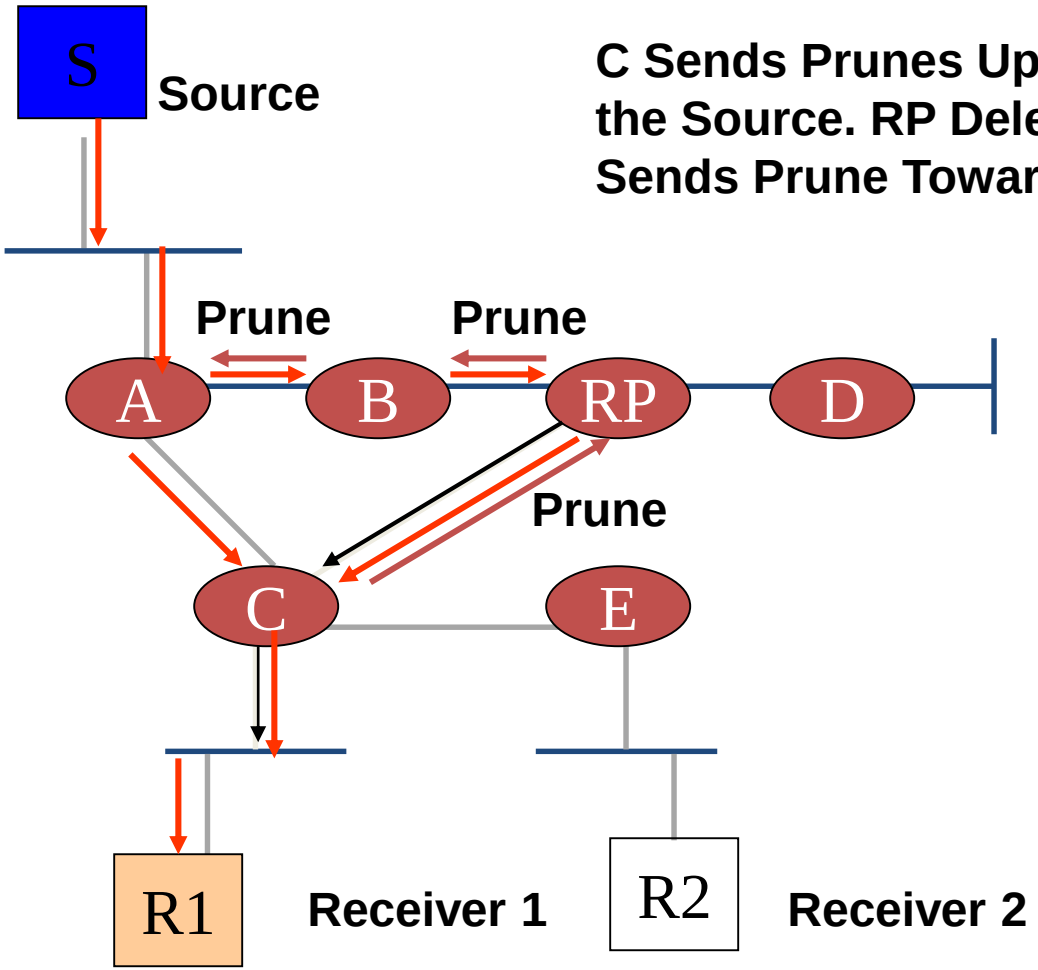
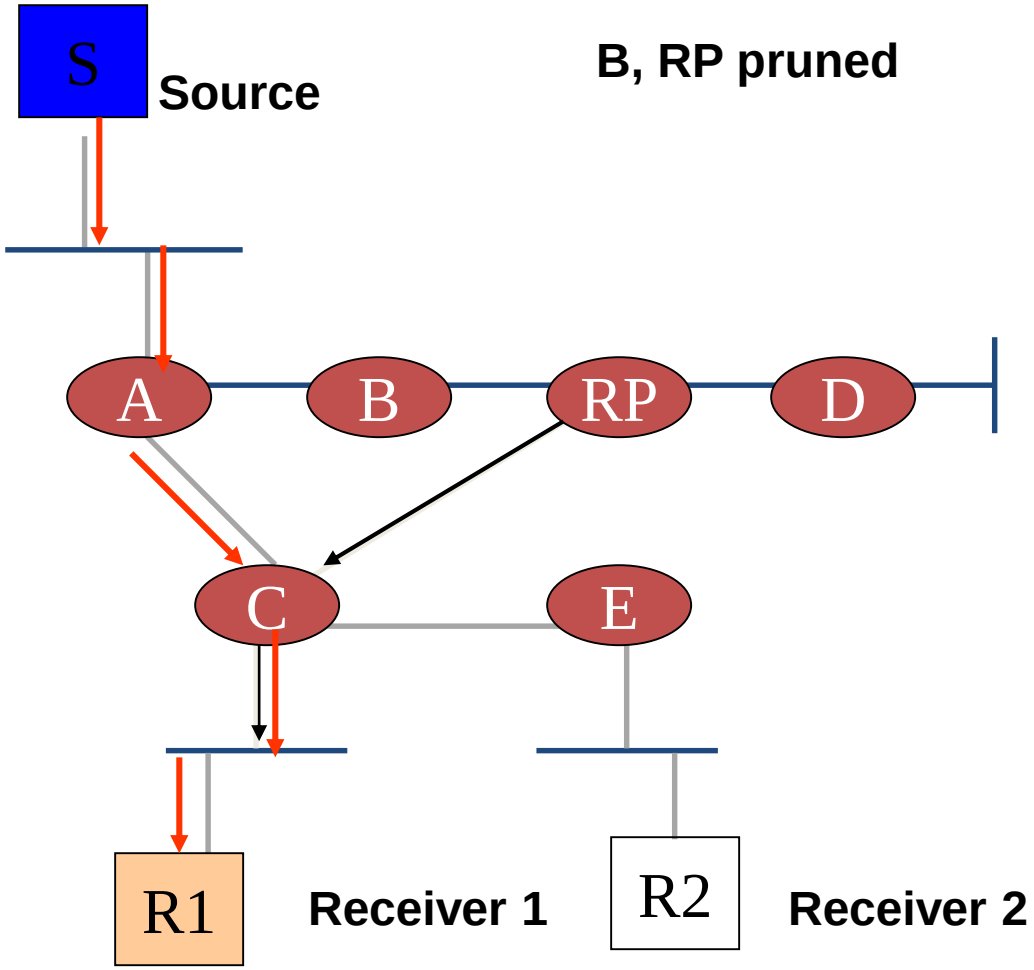


C Sends Prunes Up the RP tree for the Source. RP Deletes (S, G) OIF and Sends Prune Towards the Source

* Taken from J. Murai, Wisconsin

PIM-SM



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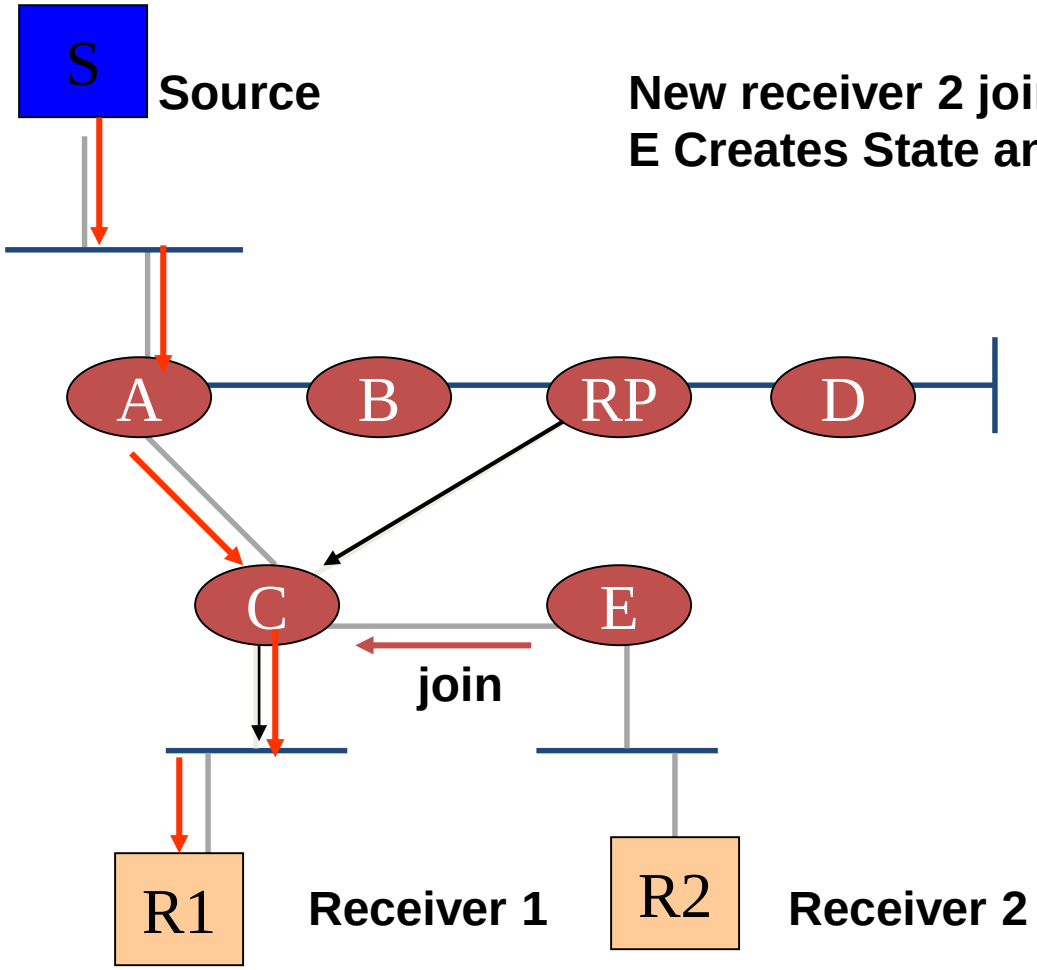
PIM-SM



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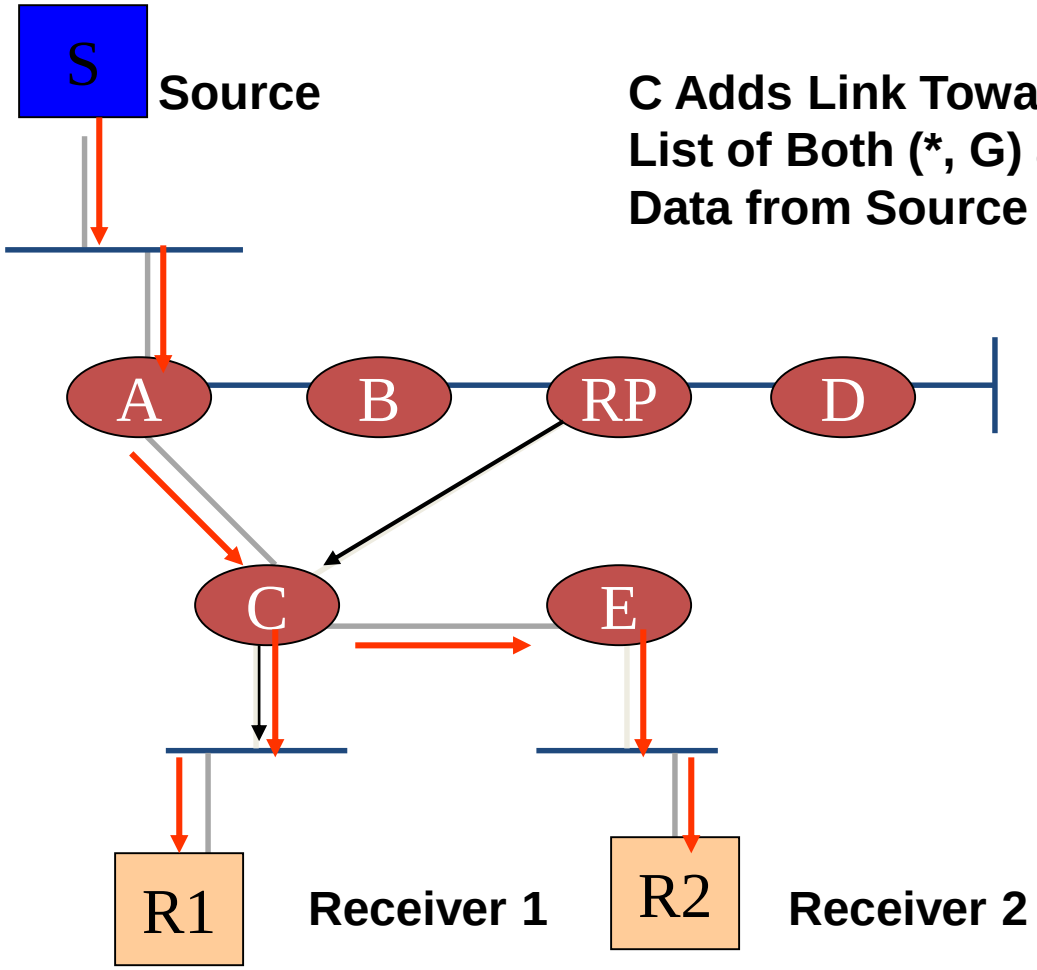
PIM-SM



C Adds Link Towards E to the OIF List of Both (*, G) and (S, G) Data from Source Arrives at E

* Taken from J. Murai, Wisconsin

Summary: Multicast Routing

- Internet Group Management Protocol (IGMP)
  - Join&leave messages from hosts to routers
- Most protocols based on source trees
  - Reverse-Path Forwarding/Broadcast
  - Prune – remove subtree from tree
  - Graft – join subtree to tree
- Protocol Independent Multicast (PIM)
  - Dense Mode (DM)
  - Sparse Mode (SM)


That's all folks
Telecomms II