Lecture 4:
Protocol Independent Multicast

7COM1030 – Multicast and Multimedia Networking

Dr. Xianhui Che (Cherry)

x.che@herts.ac.uk

School of Computer Science

University of Hertfordshire, UK

Topics

- Introduction to PIM
- PIM Dense Mode (PIM-DM)
- PIM Sparse Mode (PIM-SM)

Two Modes of PIM

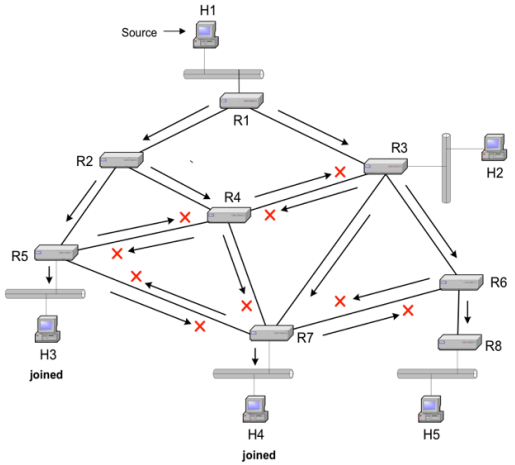
- **Protocol Independent Multicast (PIM):**
  - Runs in two modes: PIM Dense Mode (PIM-DM) and PIM Sparse Mode (PIM-SM).

- PIM-DM builds source-based trees using flood-and-prune
- PIM-SM builds core-based trees as well as source-based trees with explicit joins.
- Sources are considered **shortest-path** trees from the perspective of the **unicast** routing tables.

Revision

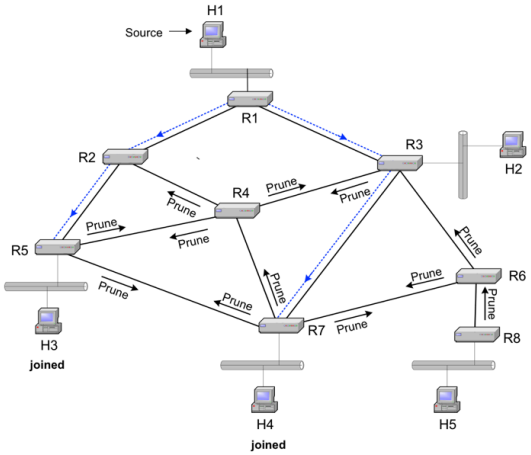
Flooding

- Forward packets on all non-RPF interfaces
- Receiver drops packets not received on RPF interface



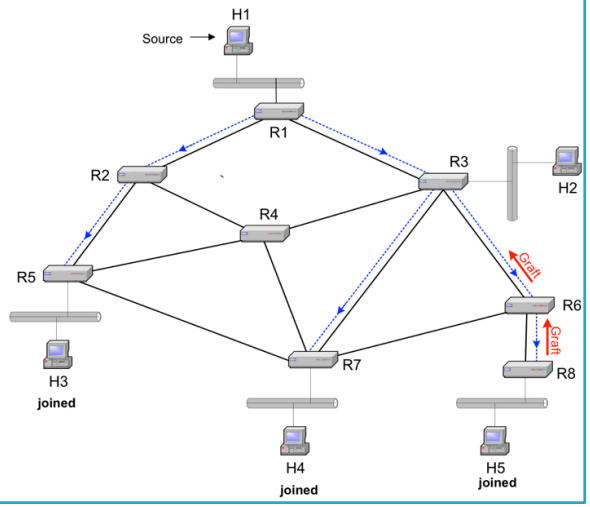
Pruning

- Prune message temporarily disables a routing table entry
- **Effect**: Removes a link from the multicast tree No multicast messages are sent on a pruned link
- Prune message is sent in response to a multicast packet
- *Question: Why is routing table only temporarily disabled?*



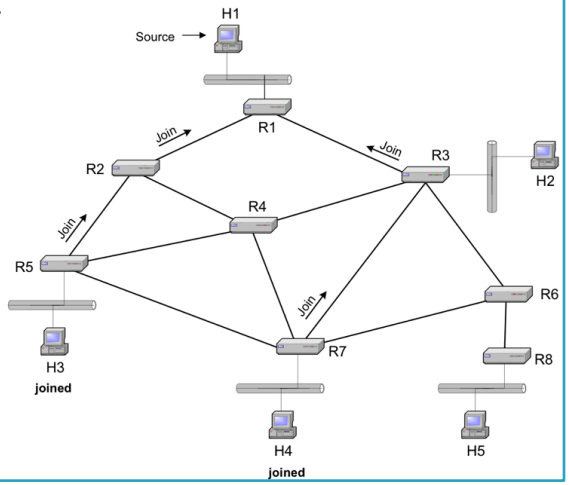
Grafting

- When a receiver joins, one needs to re-activate a pruned routing table entry
- Sending a *Graft* message disables prune, and re-activates routing table entry.



Alternative: Explicit Join

- This only works if the receiver knows the source
- Receiver sends a *Join* message to RPF neighbor
- Join message creates (S,G) routing table entry
- *Join* message is passed on

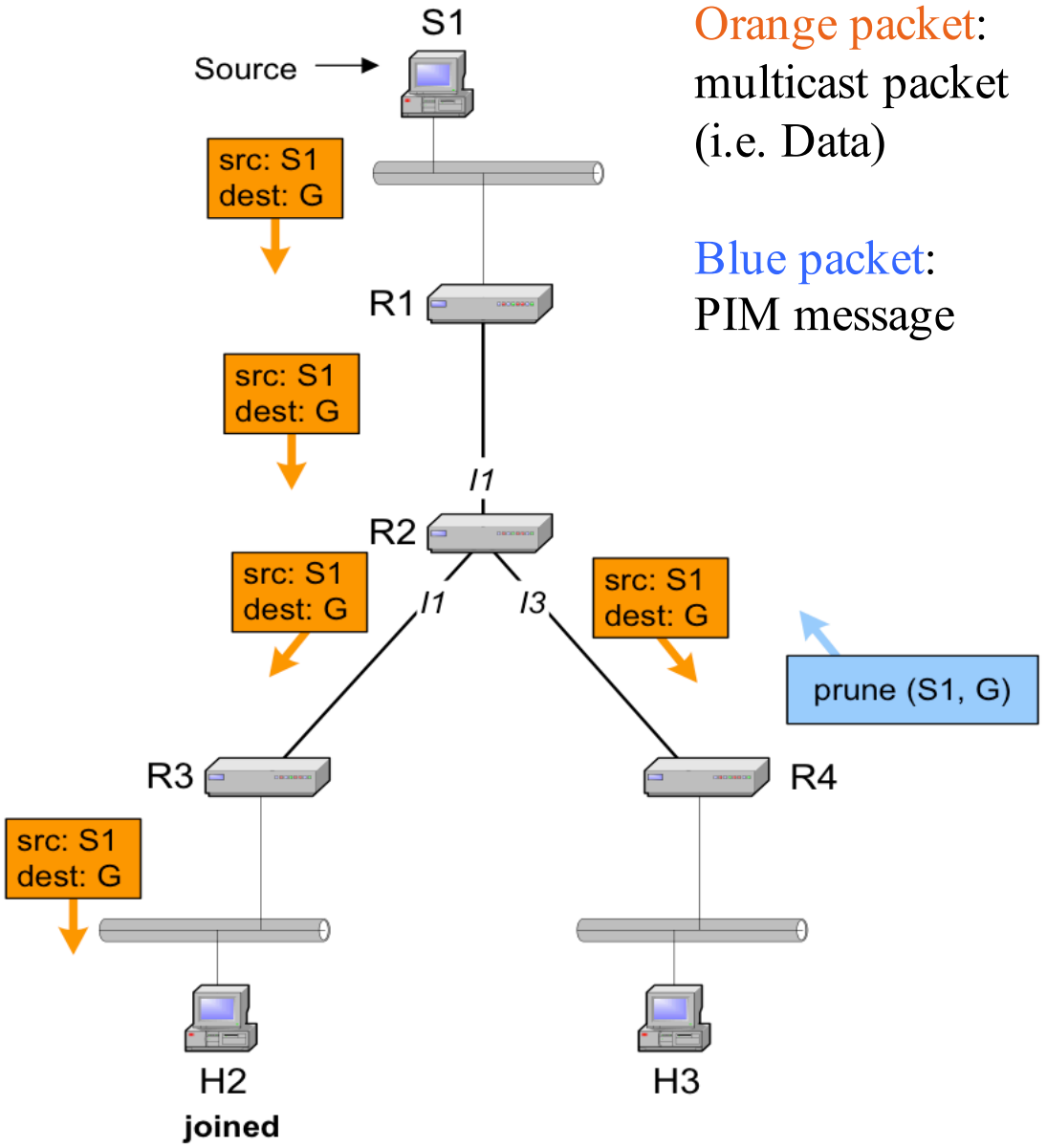


Topics

- Introduction to PIM
- PIM Dense Mode (PIM-DM)
- PIM Sparse Mode (PIM-SM)

PIM-DM

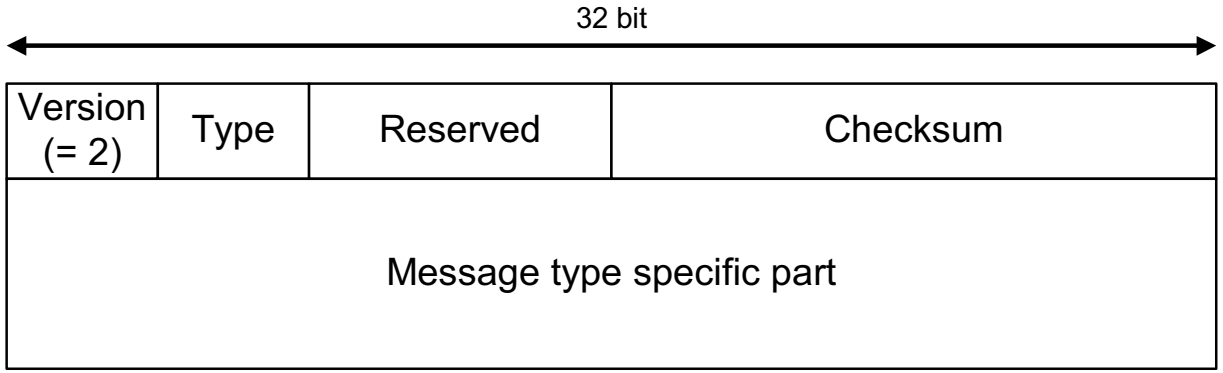
- Flood-and-Prune
- When building a source-based tree, routing tables are set according to RPF forwarding
- Send a *prune* message when a packet is received on a non-RPF interface or when there are no receivers downstream



Orange packet: multicast packet (i.e. Data)

Blue packet: PIM message

PIM Messages (PIM version 2)



PIM messages	Type	PIM-DM	PIM-SM
Hello	0	✓	✓
Register	1		✓
Register-Stop	2		✓
Join/Prune	3	✓	✓
Bootstrap	4		✓
Assert	5	✓	✓
Graft	6	✓	
Graft-Ack	7	✓	
Candidate-RP-Advertisement	8		✓

- Encapsulated in IP datagrams with protocol number 103.
- PIM messages can be sent as unicast or multicast packet
- 224.0.0.13 is reserved as the *ALL-PIM-Routers* group

Hello Messages

- PIM Hello messages are sent periodically on each PIM-enabled interface.
- They allow a router to learn about the neighboring PIM routers on each interface.
- Hello messages are also the mechanism used to elect a Designated Router (DR), and to negotiate additional capabilities.
- A router must record the Hello information received from each PIM neighbor.

Topics

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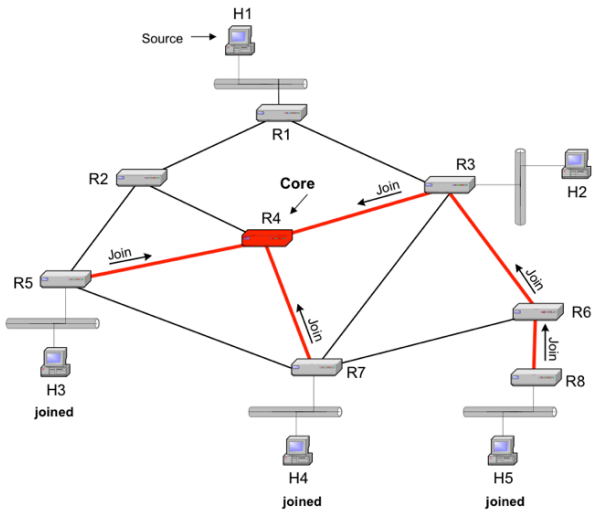
- PIM Sparse Mode (PIM-SM)

Revision

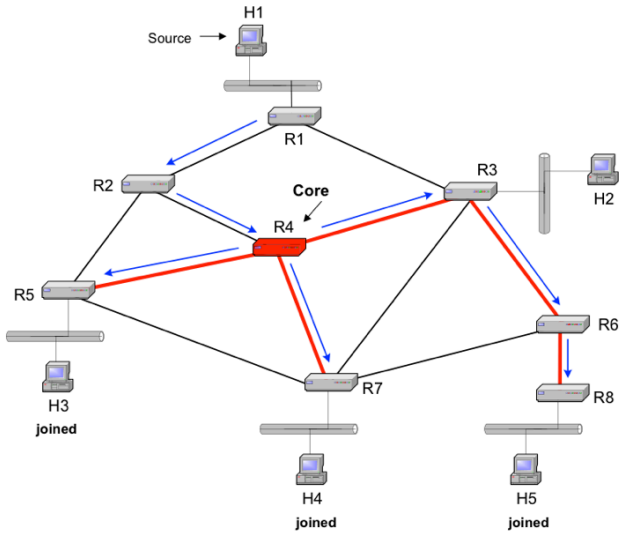
Core-Based Tree

- Core is called rendezvous-point **(RP)**
- Receivers know RP (statically configured or dynamically elected)
- Receiver sends a *Join* message to RPF neighbour with respect to core
- *Join* message creates (*, G) routing table entry



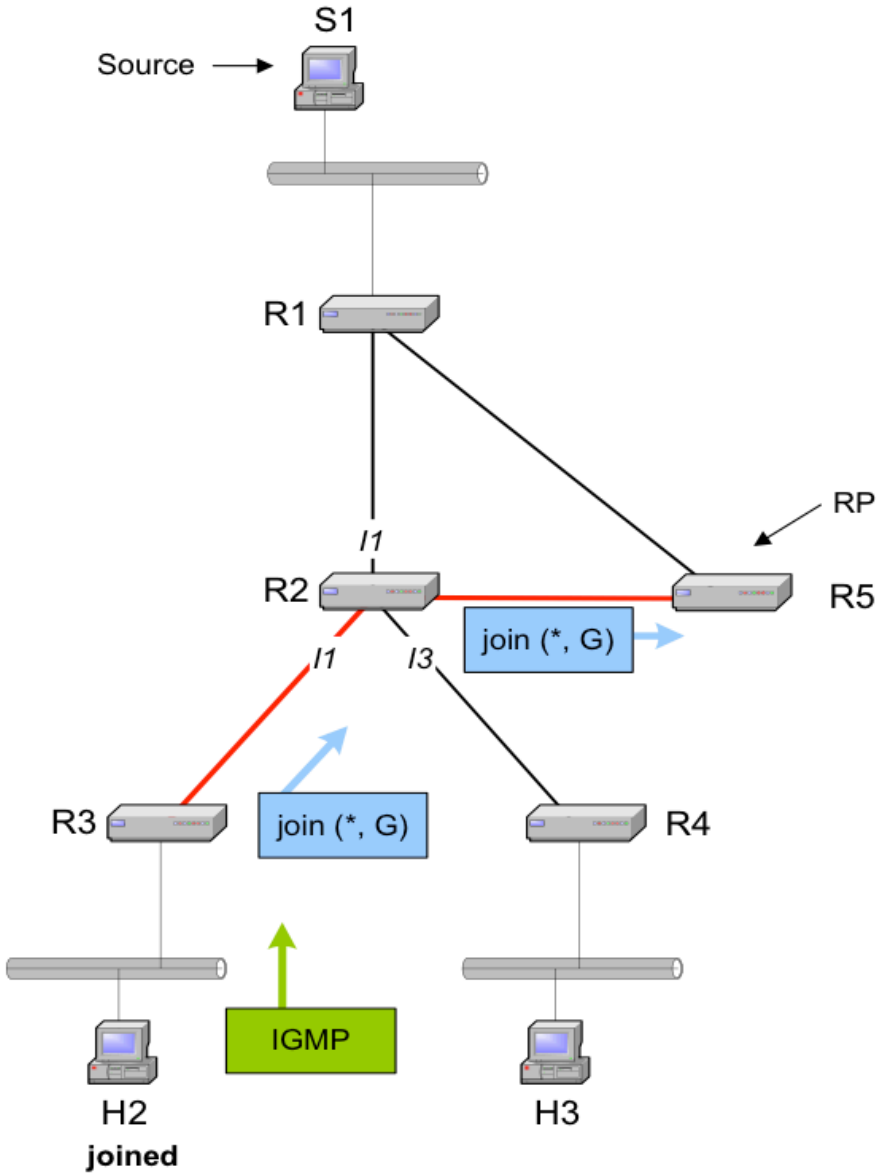
Core-Based Tree

- Source sends data to the core
- Core forwards data according to routing table entry



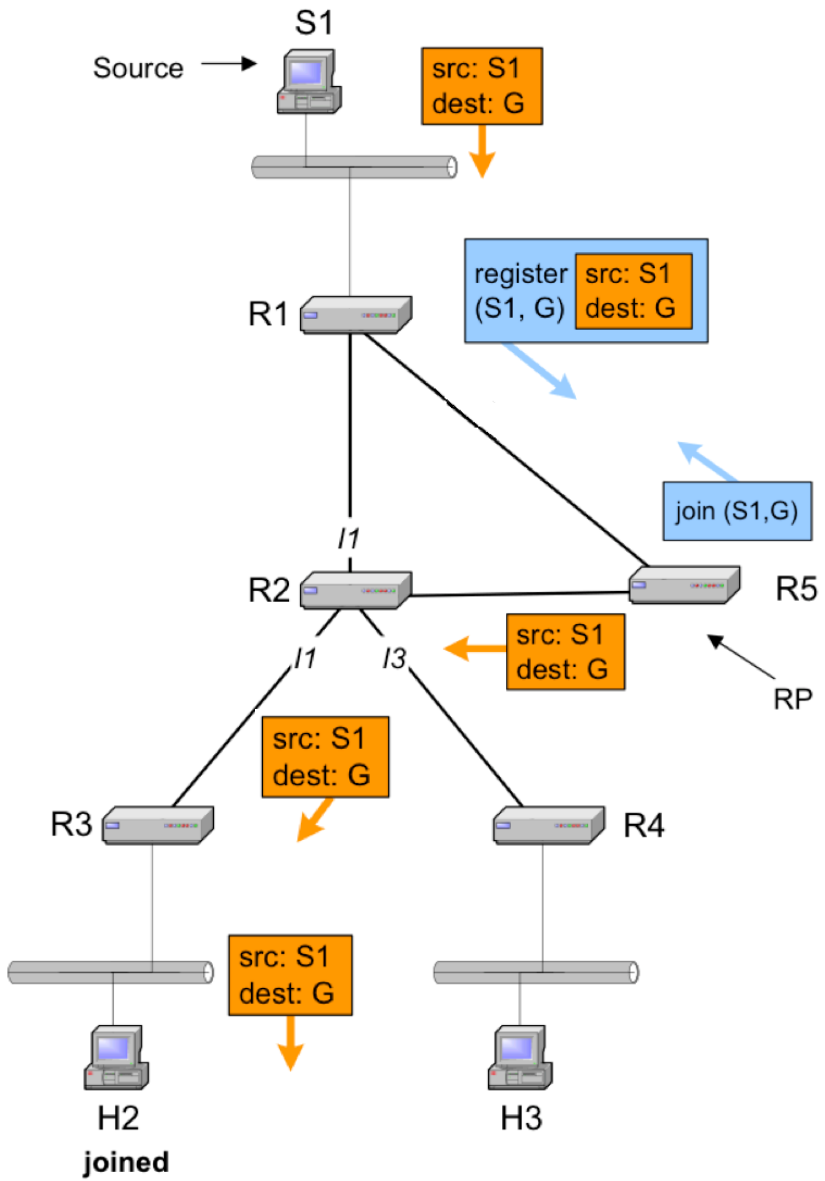
PIM-SM: Initial Phase

- Initially, a multicast receiver expresses its interest in joining a multicast group via IGMP.
- One of the receiver's local routers is elected as the DR for that subnet.
- On receiving the receiver's expression of interest, the DR then sends a PIM *Join* message towards the RP for that multicast group.



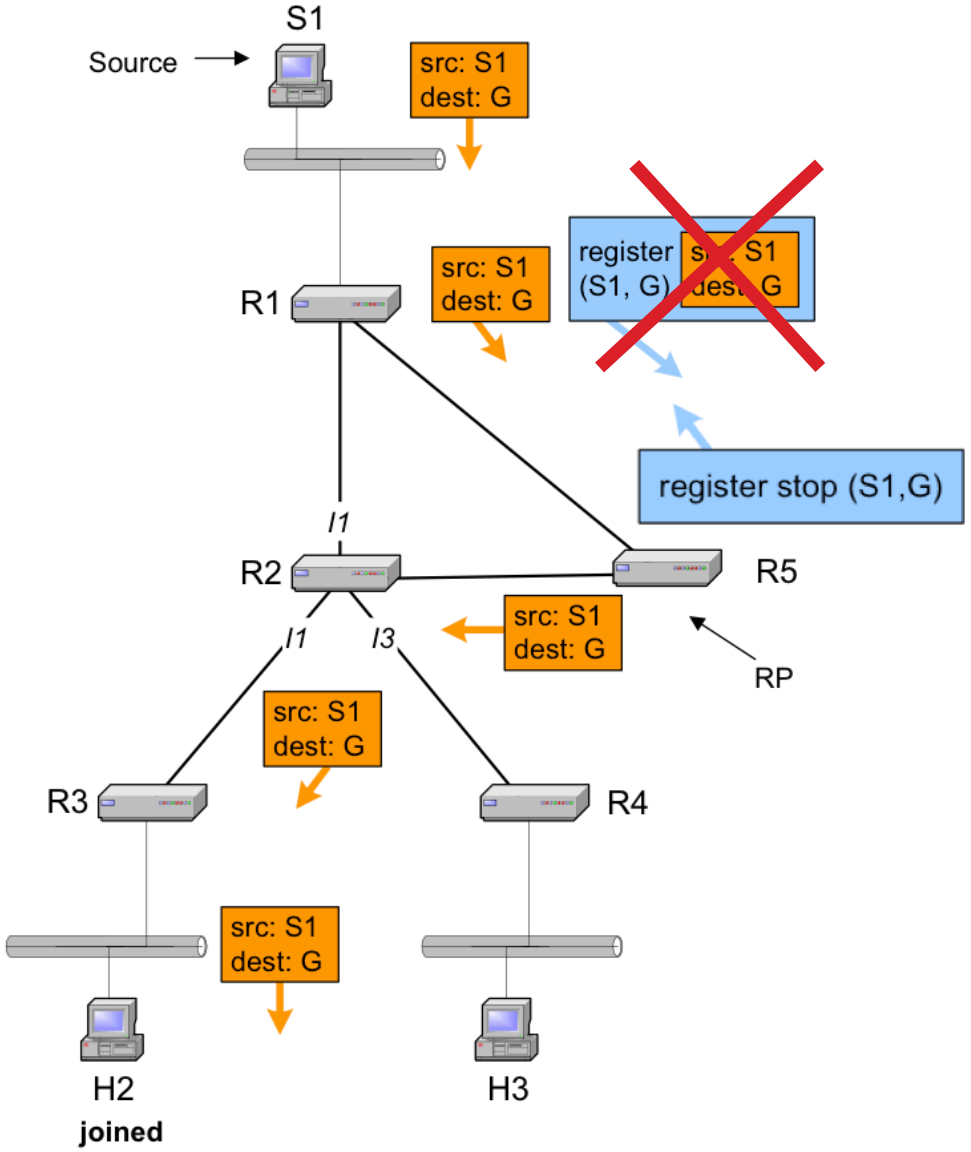
PIM-SM: Data transmission

- Source sends multicast packet to RP
- Packet is attached to an *RP Register* message
- When packet reaches RP, it is forwarded in the tree
- Also: RP sends a *Join* message on reverse path to S1



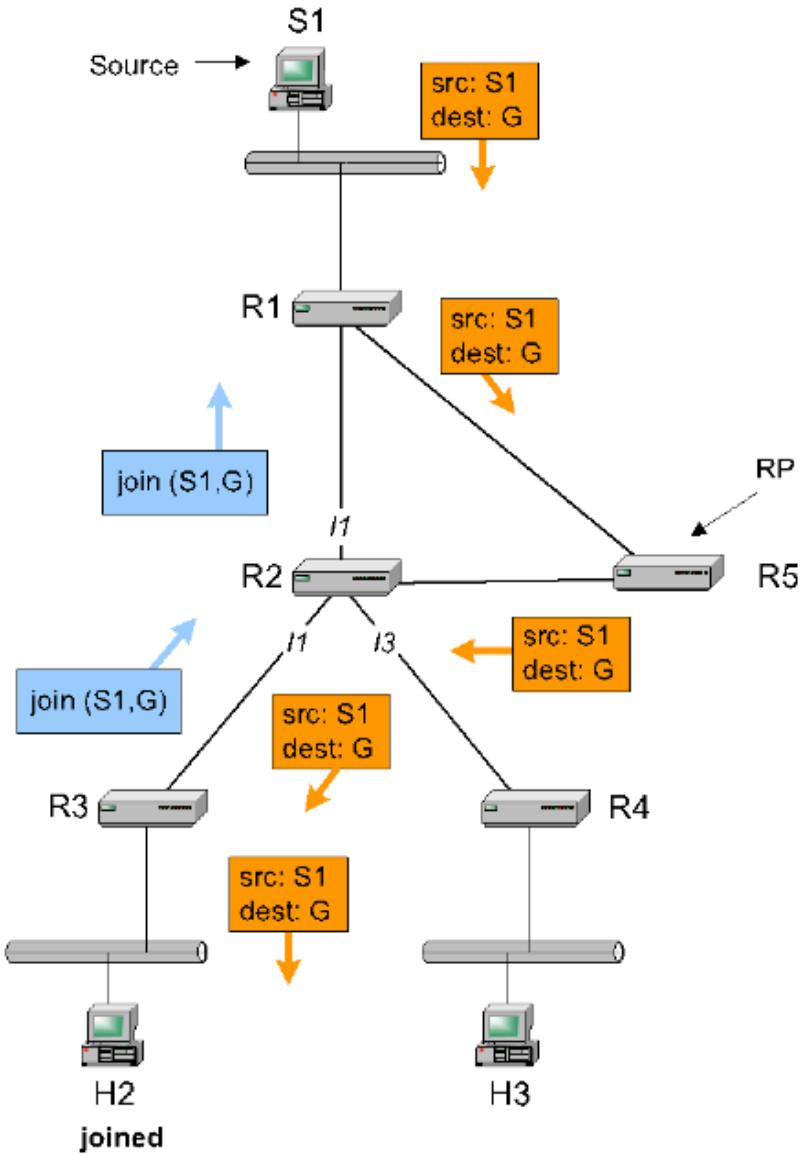
PIM-SM: Data transmission

- When *Join* messages reaches R1, it sends a native multicast packet to the RP (in addition to the packet attached to the register message)
- When RP receives native multicast packet it sends a *register stop* message to R1. This message stops the transmission of register messages from R1.



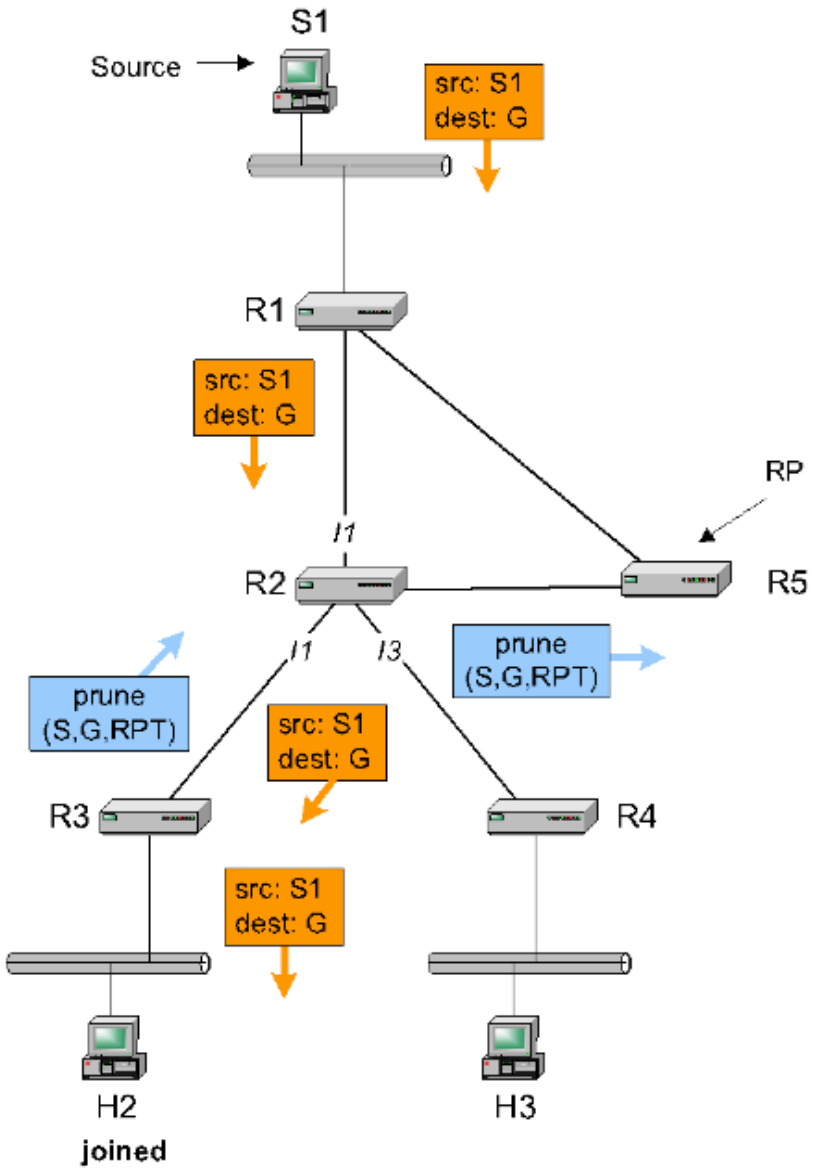
PIM-SM: Switching to Source-Based Tree

- When data to receivers exceeds a threshold, routers switch to a source-based tree
- This is done by sending an *explicit Join* message to the source
- There may be duplicate packets being sent for some time



PIM-SM: Switching to source-based tree

- When data arrives from source (as opposed to RP), a *Prune* message is sent to the RPT
- Now: data is forwarded only along the shortest-path tree



Questions?

- **Email:** x.che@herts.ac.uk
- **Office:** LB218
- **Tel:** 01707 286206