# Computer Networks
# Homework #6

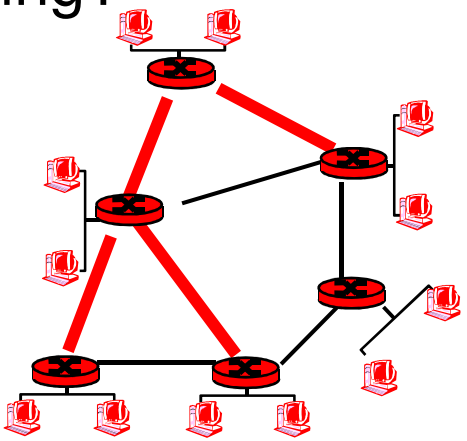
December 6th, 2012

computer NETWORKS

# Broadcast and multicast routing

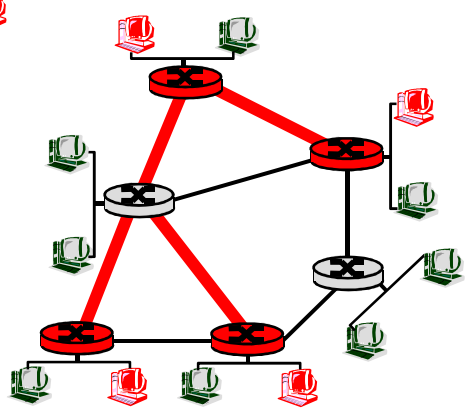
- Q: What is the difference between broadcast routing and multicast routing?

- Broadcast routing delivers data to all hosts in a particular network



Broadcast

- Multicast routing delivers data to a subset of hosts in a particular network

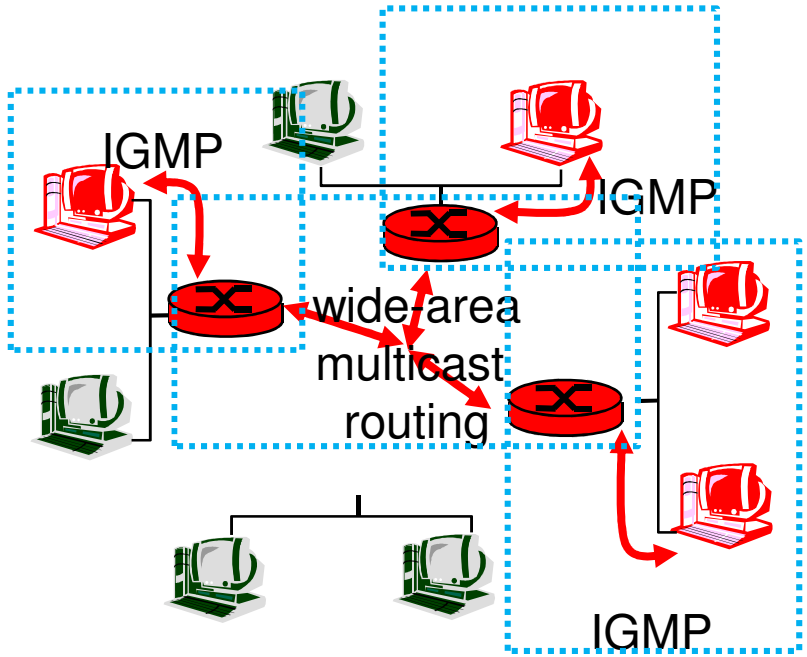


Multicast

# Joining a multicast group

Q: What are the two steps that are involved in joining a multicast group?

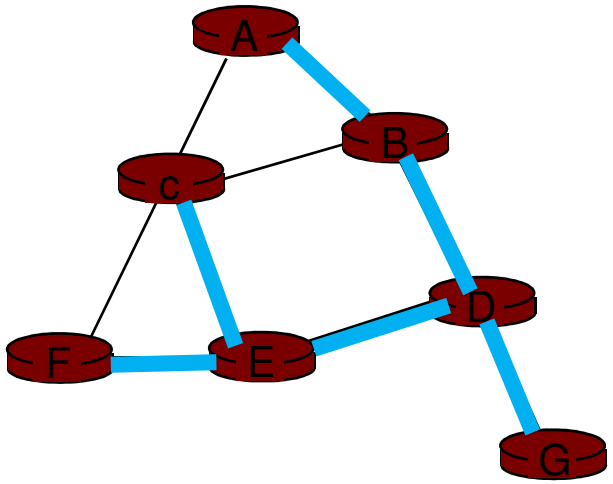
- (Local) Host informs local multicast router that it wants to join the group
  - E.g. IGMP
- (Wide area) Local router interacts with other routers to receive multicast stream
  - e.g. DVMRP, PIM



# Multicast concepts

Q: Briefly explain the following concepts of multicast routing:

- (Minimal) Spanning tree
  - Subgraph that includes all nodes but only least number of edges so that all nodes are connected without containing any loops.
  - Minimal spanning tree: spanning tree with minimal weight of edges (i.e. equal or less than any other spanning tree



# Multicast concepts (cont‘d)

- Shortest path tree
  - Spanning tree that minimizes path costs from given source to any other node
- Reverse path forwarding
  - Forwarding of a (multicast) packet only if it arrived on the same link that a node would use itself to send packets to the source
- Center-based tree
  - (Multicast) tree that is formed when participating nodes add links that connect them to a common source.

# Multicast concepts (cont‘d)

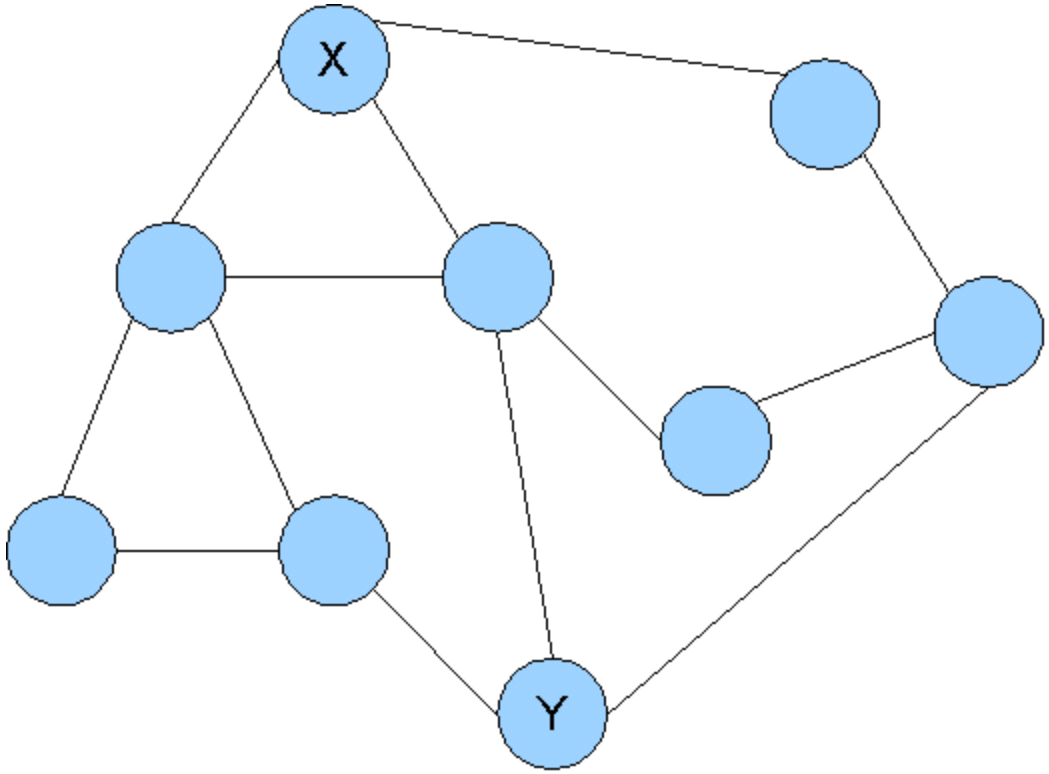
- (Group-) Shared tree
  - (Multicast) tree that is shared among different source nodes. In practice, a center-based approach is used to construct such a tree.

- Source-based tree
  - (Multicast) tree that is specific for any given source node. In practice, an RPF algorithm (with source node x) is used to construct such a tree.

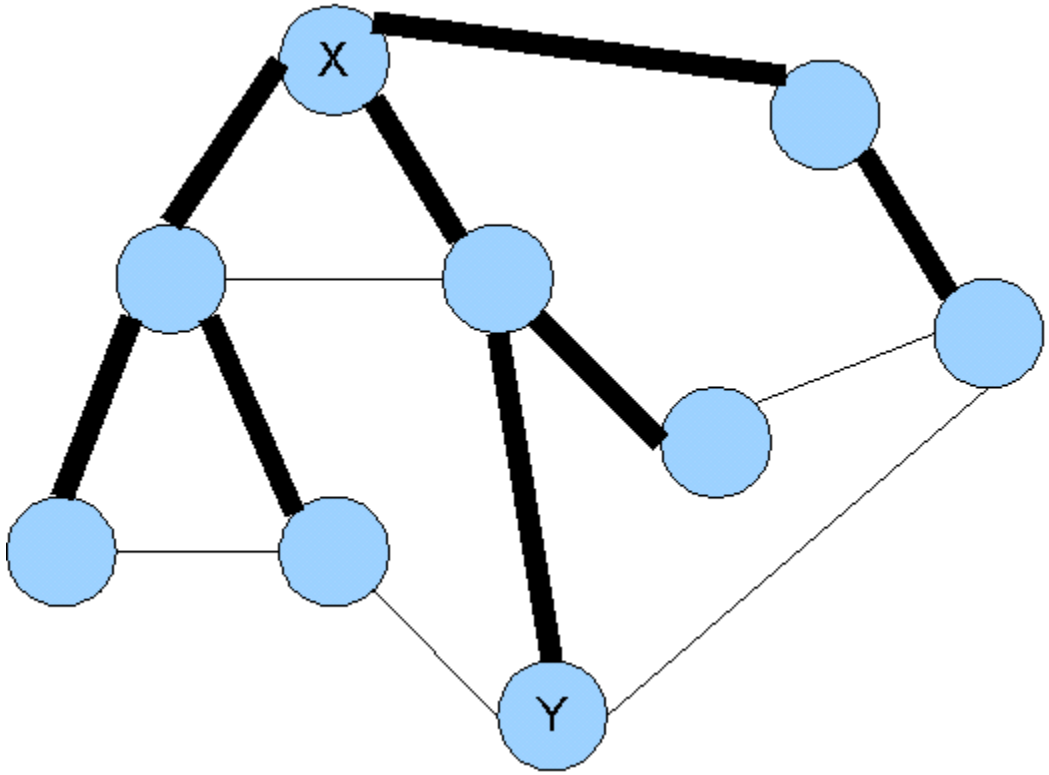
# Reverse Path Forwarding

- Q: Given the following network, use Reverse Path Forwarding to create a distribution tree with router X as the source. What happens if router Y does not have any attached nodes that are interested in the multicast data?
  - You can assume that all links have the same weight.

# Reverse Path Forwarding (cont'd)



# Reverse Path Forwarding (cont'd)



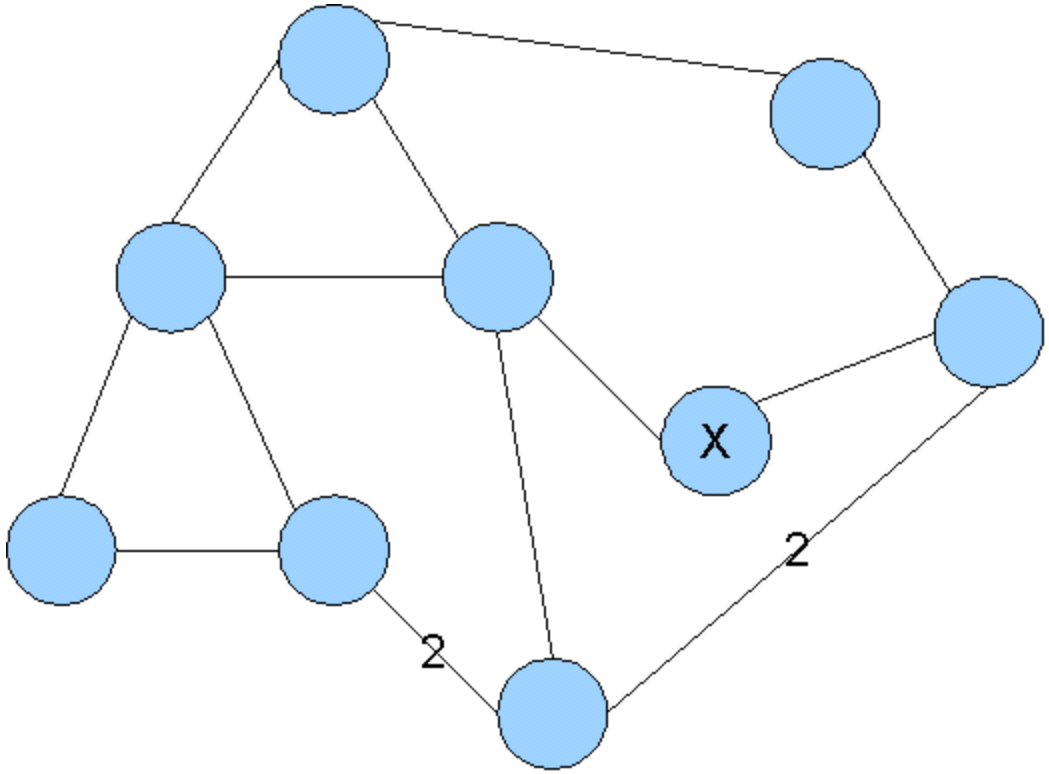
# Reverse Path Forwarding (cont'd)

- If router Y does not have any attached nodes that are interested in the multicast data, it will send a PRUNE message to it upstream node excluding itself from the tree

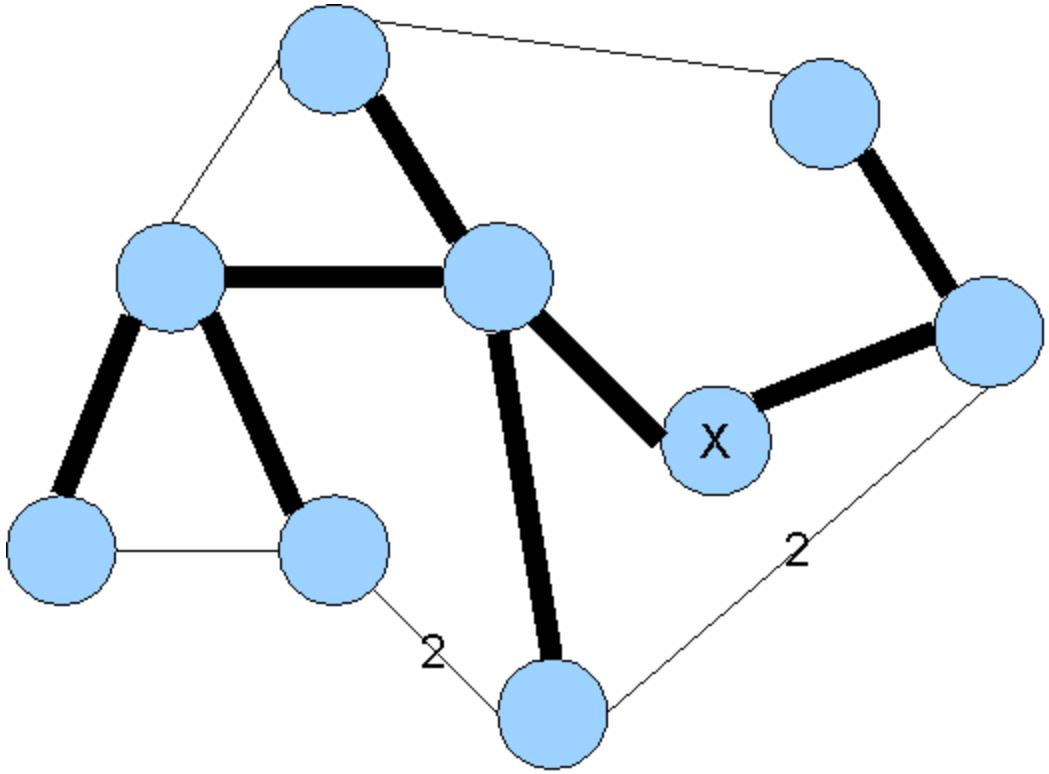
# Center-based distribution tree

- Q: Given the following network, create a center-based distribution tree using router X as the center.
  - Unless noted otherwise, all links have a weight of 1.

# Center-based distribution tree (cont'd)



# Center-based distribution tree (cont'd)



# Internet Group Management Protocol

- In IGMP: how does a host join a multicast group? How does it leave the multicast group again?

- Joining:
  - Answer a **`membership_query`** with a **`membership_report`**

- Leaving:
  - Not answer the next **`membership_query`**
  - (optional)Send a **`leave_group`** message.

# Protocol Independent Multicast

- Q: Compare the two multicast distribution scenarios in Protocol Independent Multicast (PIM).

- Sparse mode
  - The number of routers with attached group members is small with respect to the total number of routers.
  - Membership upon explicitly join request
  - **Receiver- driven** distribution tree (e.g., center-based)
  - Conservative bandwidth usage
  - Low processing requirements for non-group routers

# Protocol Independent Multicast (cont'd)

- Dense mode
  - Many or most of the routers in the area need to be involved in routing multicast datagrams.
  - Membership "by default" until explicit prune
  - **Data-driven** distribution tree (e.g., RPF)
  - Increased bandwidth usage
  - Considerable processing requirements for non-group-routers

# Protocol Independent Multicast (cont'd)

- Q: Which one is more suited for networks that only have a small ratio of routers that are interested in multicast routing?

- Sparse mode as it puts less strain on the non-involved nodes in the network

# Mobility

- Q: Considering mobility, compare the direct routing approach with the indirect routing approach in terms of location privacy, deployability (i.e. which nodes need to be upgraded), and robustness (i.e. what happens if the mobile node moves).

# Mobility (cont'd)

- Location privacy
  - Direct routing: Correspondent node gets informed about current care-of-address of mobile node
  - Indirect routing: Correspondent node only knows home address of mobile node

- Deployability
  - Direct routing: Needs to be supported by Correspondent node and mobile node
  - Indirect routing: Needs to be supported only by mobile node

# Mobility (cont'd)

- Robustness
  - Direct routing: Mobile node needs to notify home agent as well as every correspondent node
    - What happens if correspondent node hasn't established connection yet?
  - Indirect routing: Mobile node only needs to notify home agent

# Agent discovery

- Q: How does a mobile node discover a mobility agent in it's current network and how can it obtain a care-of address?

- Agents (foreign agent & home agent) send out periodic ICMP messages (type 9)
  - They are called agent advertisement messages

# Agent discovery (cont'd)

- Advertisements of foreign agent include a list of available care-of addresses
  - Mobile node sends registration request for specific care-of address
  - Foreign agent acknowledges with registration reply message