

Multicast - Sending message to many

- **Internet radio**
- **Stock quote information**
- **Internet multi-way chat / video conferencing**
- **Multi-player games**

What's wrong with sending data to each recipient? (link *stress*)

A Multicast service model

- **Receivers join a multicast group G**
- **Senders send packets to address G**
- **Network routes and delivers packets to all members of G**

LAN Multicast

- Easy on a shared medium.
- Ethernet multicast address range
00:00:5e:[0-7]x:xx:xx
- Set low 23-bits of Ethernet address to low bits of IP address

What about the Internet?

Use trees to scale to limit stress

- Each recipient forwards data to several others
- What about receivers with little upstream b/w?
- Messages travel over more hops for many recipients
- Added latency is known as *stretch*

Eliminating stretch

- Optimize topology of your tree. How?
- Make *routers* form the branch points.
- This is what IP Multicast does.
- Class D addresses (start 1110) – 224-239.x.x.x

Source Specific vs Shared Trees

- **Source-specific trees — best tree for each source**
- **Shared trees — single spanning tree over recipient**
- **Hard to find one shared tree that's best for many senders**
- **State in routers much larger for source-specific**

Multicast Routing: LS

- Each host on a LAN periodically announces the groups it belongs to using IGMP
- Augment update message (LSP) to include set of groups that have members on a particular LAN
- Each router uses Dijkstra's algorithm to compute shortest-path spanning tree for each source/group pair
- Each router caches tree for currently active source/group pairs

Multicast Routing: DV

- **Reverse Path Broadcast**
 - Each router already knows that shortest path to S goes through router N
 - When receive multicast packet from S, forward on all outgoing links (except one it arrived on), iff packet arrived from N
 - Eliminate duplicate broadcast packets by letting only “parent” for LAN (relative to S) forward
- **shortest path to S (learn from distance vector)**
- **smallest address to break ties**

DV (cont)

- **Reverse Path Multicast**
- **Goal: prune networks that have no hosts in group G**
- **Step 1: determine if LAN is a leaf w/ 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

PIM-SM: Internet Scale

- **Protocol Independent Multicast — Not linked to DV/LS**
- **Sparse Mode – Scales well for small groups**
- **Name an explicit Rendezvous Point (RP)**
- **Send Join message (*,G) to the RP**
- **Routers note the join.**
- **Source specific Joins (S,G) when needed**

IP Multicast Problems

IP Multicast is not widely deployed.

- **Address space**
- **Economic**
- **Lack of “killer app”**
- **Unreliable**
- **Poor building block**

MBone

- Connect Multicast enabled regions with *tunnels*.
- Encapsulate multicast packets in unicast.
- An overlay network

Coming up

- Today: HW2 out
- Thu: Error detection and correction.
- **Tue, Mar 10th: Midterm**