Lecture 20
IP Multicast Routing Protocols

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Announcements

Lectures 1-20 are available.
Homework 5 will be out soon.
I’ll be grading all your homeworks next week.

Joel Gottlieb from AT&T Research is giving the guest lecture on Tuesday the 19th.

Al Broscius from Morgan-Stanley may be giving the guest lecture on Thursday the 21st.
Sparse vs. Dense Topologies

- Protocol performance depends on “density”.
- Dense topology: large fraction of hosts belong to multicast groups.
  - DVMRP
  - MOSPF
  - PIM-DM
- Sparse topology: small fraction of hosts belong to multicast groups.
  - CBT
  - PIM-SM
Joins

• How do group members join a WAN Multicast group?
• Implicit joins:
  – Sender-initiated.
• Explicit joins:
  – Client-initiated.
Implicit Joins

- Sender initiates session.
- Router uses reverse-path-broadcasting.
  - Sends packets to all interfaces but the upstream.
- Initially, all internet routers get the traffic.
- When a router with no group members in its attached LANs, and no downstream routers gets a packet, it sends back a *prune message.*
- Prune messages propagate back to the source.
- Taking entire branches off the multicast tree.
Implicit Joins: RPB
Implicit Joins: Prunes
Implicit Joins: Resulting Tree

Traffic

Prune messages
Implicit Joins, cont’d

• Each router is in either the *prune* or the *forward* state.
• Prune state has timer.
• When timer expires, router moves to forward state.
  – This way new group additions can be discovered.

• B&P is better suited to dense topologies.
• Maintenance of prune states results in high resource utilization.
  – Why should a router that would never have any multicast members have to know about all this?

• DVMRP and PIM-DM are implicit-join protocols.
Explicit Joins

- Router gets IGMP message from one of its nodes.
- Sends a *graft* message upstream.
  - Propagated further upstream all the way to the source.
  - Routers in the path join the tree.
- Source must be known.
- When no more nodes remain, router prunes itself from the tree.

- Better suited to sparse topologies.

- MOSPF, PIM-SM, and CBT are explicit-join protocols.
Source-Based vs. Shared Trees

- **Source-based** trees: rooted at the source.
  - Separate tree for each multicast source.

- But: multicast group membership changes.
- Sources can also change.
- Or there can be multiple sources.

- However: there will usually be a shared subtree.
Shared Trees

• Many multicast trees share some routers.
• Tree is rooted at a shared router: *Rendezvous Point (RP)*.
  – Or *core*.
• Source registers with RP.
  – Source’s router may have to find best path to RP.
  – RP may have to find path to each source.

• Shared trees are more scalable:
  – Preferred for sparse topologies (PIM-SM and CBT).
Multicast Scoping

• Some traffic may not be of interest to the entire network.
• TTL (ab)used to specify the scope of traffic.
  – 0: host
  – 1: subnet
  – 15: site
  – 63: region
  – 127: worldwide
  – 191: worldwide limited bandwidth
  – 255 Unrestricted

• Administrative scoping: RFC2365 (similar to IPv6 scoping).
Scoping in IPv6

- IPv6 multicast addresses are in the FF00::/8 range.
- FF00::/12 are well-known addresses
- FF10::/12 are transient addresses
- Scope:
  - 0, 3, F: reserved
  - 1: interface-local
  - 2: link-local
  - 4: admin-local
  - 5: site-local
  - 8: organization-local
  - E: global
  - 6, 7, 9, A, B, C, D: unassigned.