Multicast Transport

CSE 561 Lecture 14, Spring 2002.
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Overview

- Last time: multicast routing
  - How to get packets from a sender to a set of receivers

- This time: multicast transport
  - What’s the equivalent of “TCP” for multicast?

- Case study of two multimedia apps and protocols
  - *vic*, video conferencing; key issue: congestion control
  - *wb*, a shared whiteboard; key issue: reliability
Multicast Congestion Control

- What are the bandwidth needs of multicast applications?
  - E.g., software distribution versus conferencing
  - They must still be matched to the network even if not elastic.

- Key Issue: Heterogeneity
  - Different receiver bandwidths mean no single answer is sufficient
  - So how do we match receivers w/o separate unicasting?

- Key Approach: Layered Coding
  - Send at several rates and let receivers select the best
  - Rates can carry separate or layered information
RLM (McCanne 95)

• How do receivers select “the best” layers?
  – Want to avoid overwhelming the network

• One solution:
  – Imagine if routers implemented priority drop (and FQ) …
  – Source could just send and “best layers” would fall out
  – But routers are best effort drop-tail with one class of service!

• RLM approach:
  – Have receivers learn (by join experiments) what layers suit them
  – Implement using one IP multicast group per layer
Binary Exponential Backoff (BEB)

- Ethernet collisions are the classic example
  - Double interval over which retransmission timer is chosen
  - Reset interval once successful

- The technique is generally useful for adapting to an environment (e.g., network conditions)
  - TCP timeouts
  - RLM
  - SRM
  - Damping flapping links (BGP, AutoNet skeptics)?
Application Level Framing (ALF)

- Clark and Tennenhouse (SIGCOMM’90)
- A design principle that calls for applications to send data in terms of units meaningful to them and lower layers to preserve these boundaries.

- Why?
  - Consider lost/reordered data
  - Consider manipulation inside the network 😊
RLM Discussion

• Scalability
  – Shared join experiments
  – One receiver can learn when a layer will fail, but not succeed.

• Security
  – What are the interactions?
Multicast Reliability

• Scaling problems: why is multicast reliability hard, different from TCP?
  – Straightforward use of ACKs doesn’t scale
  – Nor do NACKs due to *implosion*
  – Centralized retransmissions become a scaling bottleneck
  – Receiver orientation if IP multicast semantics

• Approaches to distribute work and hence scale
  – Use all group members for error recovery
  – Randomization (to avoid implosion)
  – FEC/parity coding (one retransmission for different losses)
SRM (Floyd et. al. 96)

• Approach is to *distribute* retransmissions over group
  – Challenge is to minimize repair requests/responses

• Consider different topologies:
  – Chain – use network distance to suppress duplicates
  – Star – use randomization to suppress duplicates
  – Trees – a mixture

• Adaptive learning
  – Tune timer parameters to network conditions
SRM Discussion

• Scalability
  – What are the problems?
  – How well does local recovery work?
  – Do we need network support for local recovery?

• Security
  – Cooperation is an underlying assumption
  – What about incentives?