Announcements

• Midterm on Wednesday

• Project 1 due today
  – Email submissions to achadha@gradient.cis.upenn.edu
Today

• **Wrap up discussion of networks**
  – Quality of service
  – Advanced Networking
  – Ethereal

• **Review for Exam**
Integrated Services (RSVP)

• Proposed in 1995-1997
• Service Classes
  – Guaranteed arrival service
    • For delay intolerant applications
    • Guarantee a maximum delay
  – Controlled Load
    • For loss tolerant, adaptive applications
    • Emulate lightly loaded network
Implementation Mechanisms

• Flowspecs
  – Describe the kind of service needed
    • “I need maximum delay of 100ms”
    • “I need to use controlled load service”

• Admission Control
  – Network decides whether it can provide the desired service

• Resource Reservation Protocol (RSVP)
  – Mechanism to exchange info about requests
  – Soft state approach

• Packet Scheduling
  – Manage queuing and scheduling.
Advanced Networking Topics

• Multicast
  – Send the same message to a collection of receivers
  – How to do so efficiently?
  – Multicast trees
(Distributed) Denial of Service

• Flood a server with bogus requests
  – TCP SYN packet flood
  – Up to 600,000 packets per second
  – Uses up server’s resources, causing legitimate users to be denied service

• Detection & Assessment?
  – 12,800 attacks at 5000 hosts in 3 week period!
  – IP Spoofing (forged source IP address)

• Prevention?
  – Filtering?
  – Decentralized file storage?
Peer-to-Peer networking

- Gnutella – distributed file sharing
  - (Unlike Napster, which uses centralized servers)
- Freenet
  - Anonymous, decentralized file storage
- Distributed storage infrastructure
  - PAST (Rice and Microsoft Research, routing substrate - *Pastry*)
  - OceanStore (U.C.Berkeley, routing substrate - *Tapestry*)
  - Publius (AT&T)
  - Farsite (Microsoft Research)
  - CFS (MIT, routing substrate - *Chord*)
  - GRCD (UC Berkeley, builds on *CAN*)
Ad-hoc Networking

- Wireless Networks
- No fixed structure
- How to do routing?
  - Grid Project http://www.pdos.lcs.mit.edu/grid/
  - Make use of Geographic data
Active Networking

• Treat packets as *programs*

• The programs
  – Specify routing requests
  – Can check link state
  – Can make decisions based on network conditions

• Routers interpret these *active packets*

• Penn’s switchware project
  – http://www.cis.upenn.edu/~switchware/