Computer Networks

Multimedia and Multicast

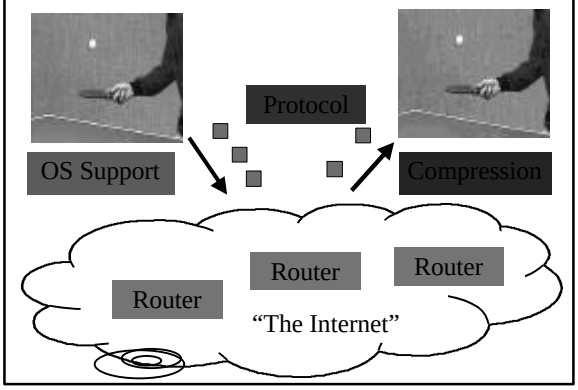
Outline

- Multimedia Overview
- Receiver-Driven Layered Multicast
- UDP Sockets (coming soon)
- IP Multicast (coming soon)
- Misc (coming soon)

Multimedia Overview

- Talking about *continuous* media
  - RealAudio, RealVideo, Internet Phone
- Typically thought of as high-bandwidth
  - raw video 30 Mbps
  - but not necessarily true
    - compressed audio 8 Kbps
    - compressed video 2 Mbps
- New computer is "multimedia ready"
  - plenty of CPU power
  - special devices (MMX, video chips …)
- So … what's the problem?

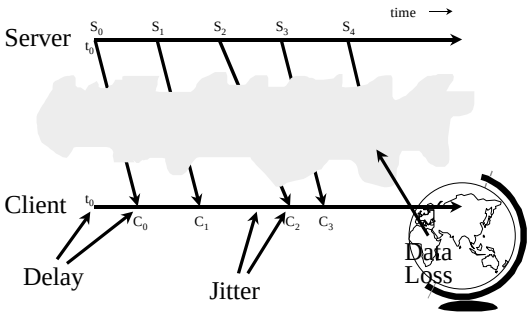
Multimedia on the Internet



Multimedia Overview

- Today, just about every new computer is "multimedia ready"
  - plenty of CPU power
  - special devices (MMX, video chips …)
- So … what's the problem?

Multimedia Performance



Internet Shortcomings

- Designed for "text-based" applications
  - *without* strict timing constraints
  - *with* strict loss constraints
- "Bursty" traffic
  - high variance in delay
  - periods of heavy packet loss
- Limited network protocols for applications

Internet Protocols

- TCP
  - delivers every byte
    - unbounded delay!
  - stream semantics
  - fixed flow control
  - unicast
  - … big bleah!
- UDP
  - "best-effort" delivery
    - unbounded loss!
  - packet semantics
  - no flow control
  - *multicast* add-on
  - … bleah!

"Sigh. I guess I'll use UDP since it is better than TCP. Or … not?"

The Internet Today

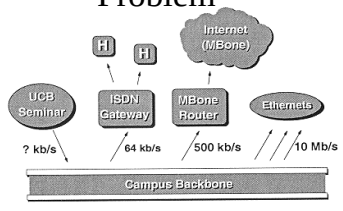
- Mostly TCP traffic
  - 96%: ftp, telnet, nntp, smtp… (tcplib'92)
- Optimized for TCP
  - "Thinner" OS protocol stacks
  - Vegas, Reno, Tahoe …
- Punish "non-responsive" flows
  - UDP
  - RED, ECN

Receiver-driven Layered Multicast

Steven McCanne, Van Jacobson and Martin Vetterli

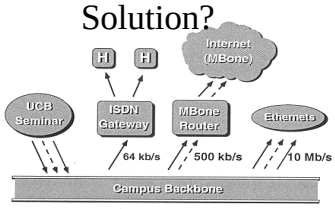
ACM SIGCOMM, Stanford CA, August 1996

Problem



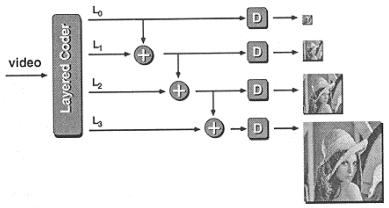
- Network heterogeneity
- One output to multiple users with varied capabilities
- Who decides the rate?
- What is the network capacity ?

Solution?



- Multiple levels of quality across multiple network channels
- Receivers decide their own rates of reception
- Note, requires layered media streams

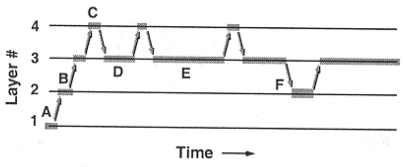
Layered Stream



The RLM Protocol

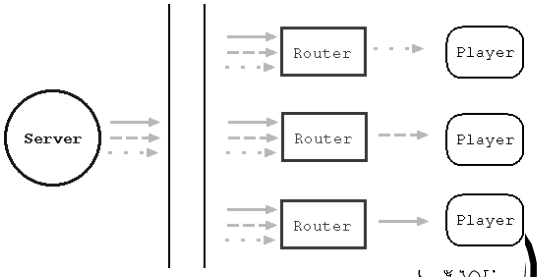
- High level abstraction
  - on congestion, drop a layer
  - on spare capacity, add a layer
- Q : How does the receiver decide ?
  - detection time
  - capacity inference

Event Sequence



- At a well-chosen time conduct a join experiment
- If congestion is experienced, leave the new group
- If no congestion, try to join next higher group

Tiny RLM



Tiny Movies

Taking a Walk	Taking a Walk	Taking a Walk
0	0	0
|	|	|
|	/ \	|

- Text-based frames
- One frame per second
  - sleep! alarm! setitimer!