Outline

- Congestion Control for Streaming Media over Internet

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Streaming Data

- Predictable jitter and delay
- Certain bandwidth
- Multicast/Unicast
- Efficient encoding/limited complexity
- Real time/stored
- Video/audio: precision is not vital

Why Control Congestion?

- No or little support by current coders
  - RealPlayer, windows media player, etc
- Network stalls if there is no congestion control
- Weighted round robin is not a solution

Congestion Control for Streams

- Two basic mechanisms involved
- Rate control:
  - Determines the required coding rate
- Rate shaping:
  - Adapts the rate of the stream to target rate

Source Based Rate Control

- Probe based
  - Probe the network for more bandwidth
- Model based
  - Throughput of a conformant TCP
    \[ \lambda = \frac{1.22 \times MTU}{RTT \times \sqrt{\rho}} \]
TCP Friendliness

- TCP traffic dominates internet
- TCP users play by the rules
  - Greedy but cooperative
- What if you don’t?

Source based rate control

- Efficiency vs. Bandwidth
  - Multicast
  - Unicast
  - BW efficiency
  - Flexibility

- Receiver side rate control

Receiver Based Rate Control

- Sender is unaware of network
- Applied to multicast
- Model based
  - Similar to sender side
  - TCP friendly
- Probe based

Receiver Side Probing

- Receiver driven layered multicast
- Sender sends layers of streams
- Two types of layers
  - Self buildable
  - Cumulative

Receiver Driven Layered Multicast

- Receivers join by “experiments”
- Experiments are performed at well-chosen times
  - Join timers
- IP multicast and IGMP take care of multicasting

Layers

- Example layering:
RDLM in Action

- Example session

Layer #

1 2 3 4

RDLM Issues

- More users → more experiments → more congestion due to experiments
- Experiments effect other experiments
- Shared learning
- Quality difference

Rate Shaping

- How to adjust to target rate?
- Real time/stored video/audio
- Keep server side simple
- Soln.: Filters

Filters

- Additional processing of stream
  - Drop layers
  - Recode at target rate
  - Drop frames

Filters (ctn’d)

- End to end
  - Between application layer and transport/network layer
- Can be on routers
  - RTP already includes concept of bridges

Filter Issues

- Additional burden to routers
- Delay should be low for real time streams
- QoS
Conclusion

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