Protocols for Video Transmission

Motivation

- Multimedia servers service clients in *periodic rounds*
- Servers employ double buffering
  - Data retrieved from disk in one round is transmitted over the network in the next round
- Transmission is *unicast*
  - N active clients $\rightarrow$ total bandwidth required is n times the bandwidth of one stream
  - Unicast transmission is expensive

Saving on Network Bandwidth

- Observation: Popularity of video access follows the Zipf distribution
- Implication: Most of the bandwidth is consumed by popular (hot) videos
  - Cold videos consume a small fraction of the total bandwidth
- Approach: Focus mostly on popular video items
- *Question:* How can we reduce bandwidth requirements of popular videos?

Simple Techniques

- Solution 1: Multicast each popular video items
  - Server transmits (multicasts) only one stream
  - Potentially large savings in transmission bandwidth
-
- Problem: Multicast requires all clients to arrive simultaneously
  - Clients arrive asynchronously in time

Staggered Broadcast

- Solution 2: Staggered Broadcasting (multicast)
- Start a new multicast transmission even T time units
- Batch clients over T time units and use a single multicast transmission
  - use one multicast stream for a group
  - Increases initiation latency for clients
  - More popular videos use smaller T
- Problem: Number of simultaneous transmissions is large (L/T for a video of length L)

Asynchronous Multicast

- **Goal:** Leverage multicast while allowing asynchronous multicast access
- **Exploit:**
  - Client buffering
  - Ability to listen to multiple unicast/multicast channels simultaneously
- Two ideas: Periodic Broadcast and patching

Periodic Broadcast

- Divide each video into k segments of increasing sizes
- Transmit each segment over a different channel
- Length of the first segment determines initiation latency

Harmonic Broadcast

- Divide each video into k segments of increasing sizes
- Transmit each segment over a different channel
- First segment is sent at same bit rate as original stream
- Segment i is transmitted at a bit rate b/i
- Lower bandwidth requirements than periodic broadcast
- Client need to listen to more segments simultaneously