Computer Networks

Streaming Media (§7.4.3)

David Wetherall (djw@uw.edu)
Professor of Computer Science & Engineering

UNIVERSITY *of* WASHINGTON
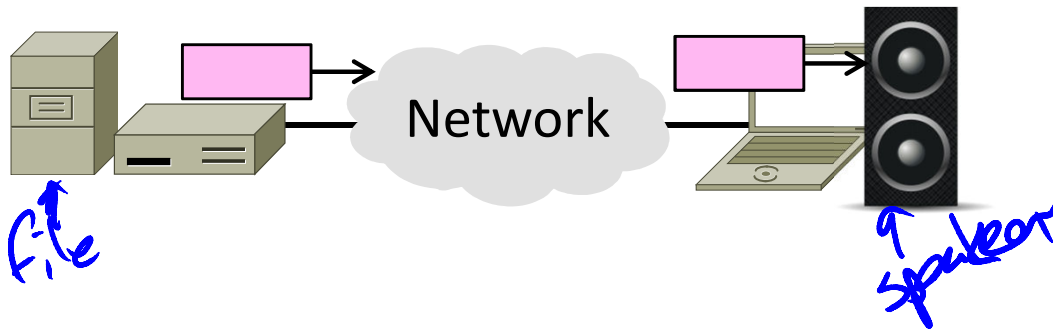
Topic

- Playback of media over the network
  - Using the best effort Internet
 - Coursera, YouTube, Netflix, etc.
  - Huge usage!

Network

Streamed vs. Interactive Media

- Streamed is less demanding case:
  - Only a single direction to consider
  - Low delay not essential; affects startup but not interactivity
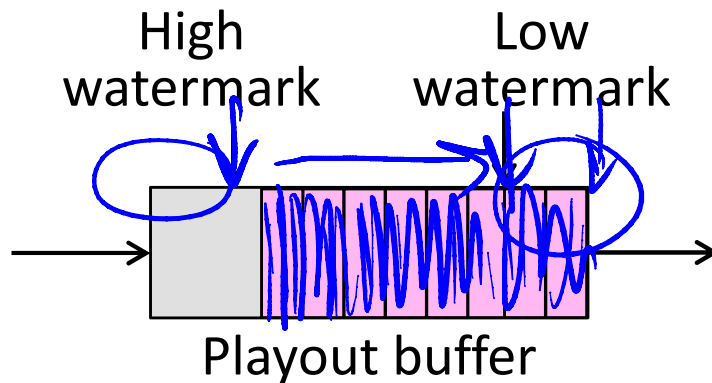 - Still need to handle bandwidth, jitter

Handling Jitter

- As before, buffer media at receiver until ready for playout time
 - Smooth out variable network delay
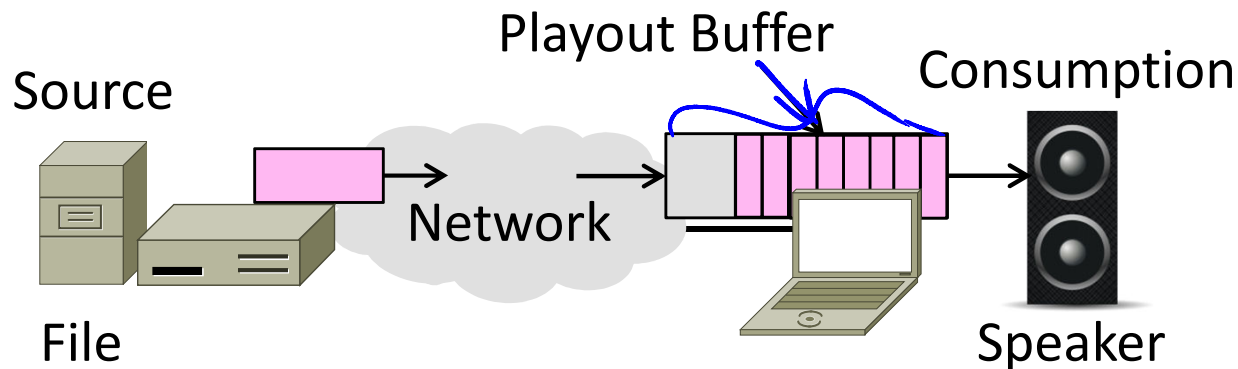
Handling Jitter (2)

- Use HIGH and LOW watermarks to control source over/underfill
  - Start pulling media at low level
  - Stop pulling media at high level

High watermark   Low watermark

Playout buffer

Handling Bandwidth

- Send file in one of multiple encodings
  - Higher quality encodings require more bandwidth
  - Select best encoding given available bandwidth

Higher quality
More bandwidth

(JPEG example)

Lower quality
Less bandwidth

15:1   23:1   46:1   144:1
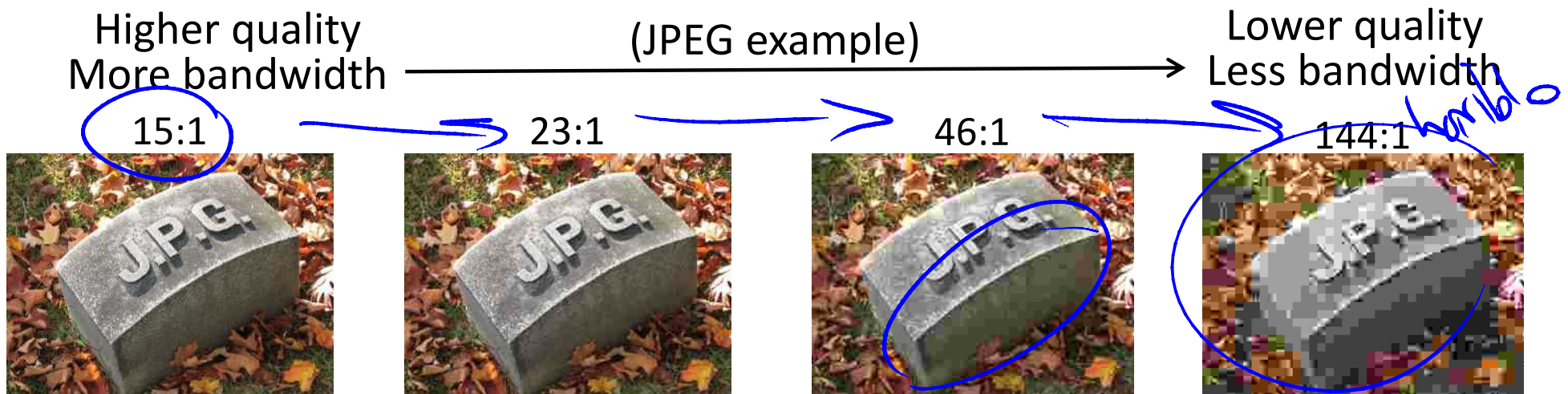
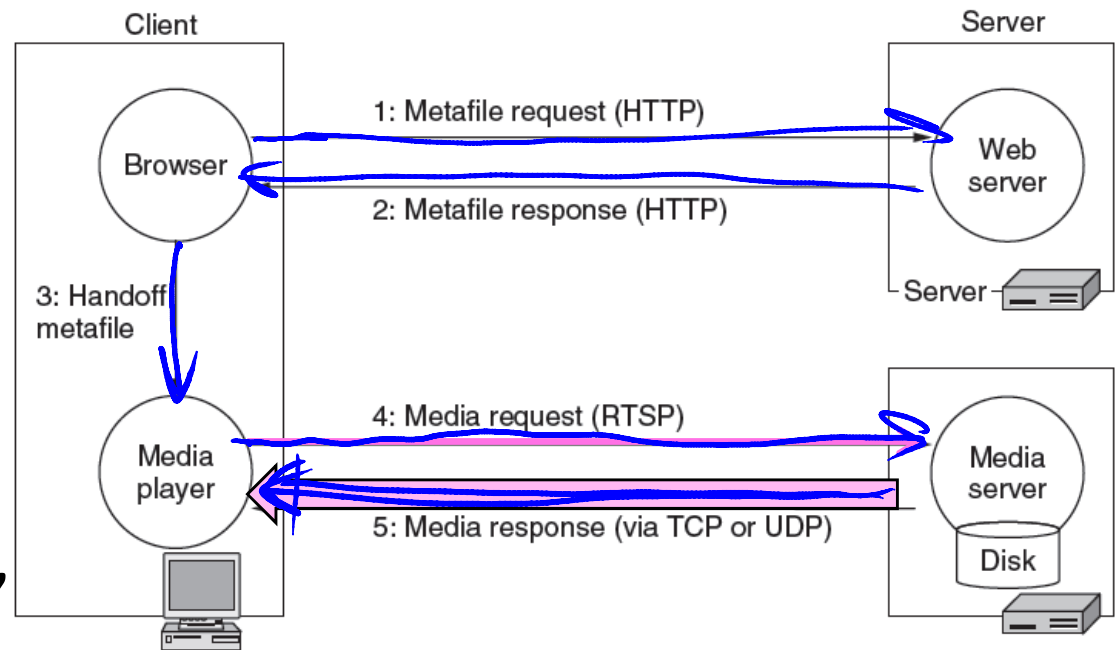By Toytoy, CC-BY-SA-3.0, from Wikimedia Commons

Streaming over TCP or UDP?

- UDP minimizes message delay for interactive, real-time sessions

- TCP is typically used for streaming
  - Low delay is not essential; startup
  - Loss recovery simplifies presentation
  - HTTP/TCP passes through firewalls

Components of Streaming Media

- Session consists of several parts:
  - Signaling, e.g., with RTSP **»**
  - Media transport, e.g., with HTTP **»**
  - Media playout, with buffer
  - Evolving standards, e.g., HTML5

- Typically to an individual party
 - Use CDNs to reach many viewers

Streaming with RTSP

- Video started using HTTP to get metafile
- Invokes media player
  - Talks RTSP (Real-Time Streaming Protocol) to media server
- Media sent with, e.g., RTP over TCP/UDP

Client

Browser

3: Handoff metafile

Media player

1: Metafile request (HTTP)

2: Metafile response (HTTP)

4: Media request (RTSP)

5: Media response (via TCP or UDP)

Server

Web server

Server

Media server

Disk

Streaming with HTTP

- Fetch media description data
  - Gives index of clips, rates
- Fetch small segments
  - Put in playout buffer
- Adapt selection of encoding
  - Based on buffer occupancy

- Evolving standards, e.g., DASH
  - Leverages HTTP and HTML5
  - Server is otherwise stateless

client

server

GET INDEX

GET MEDIA

GET MEDIA

GET MEDIA

GET MEDIA

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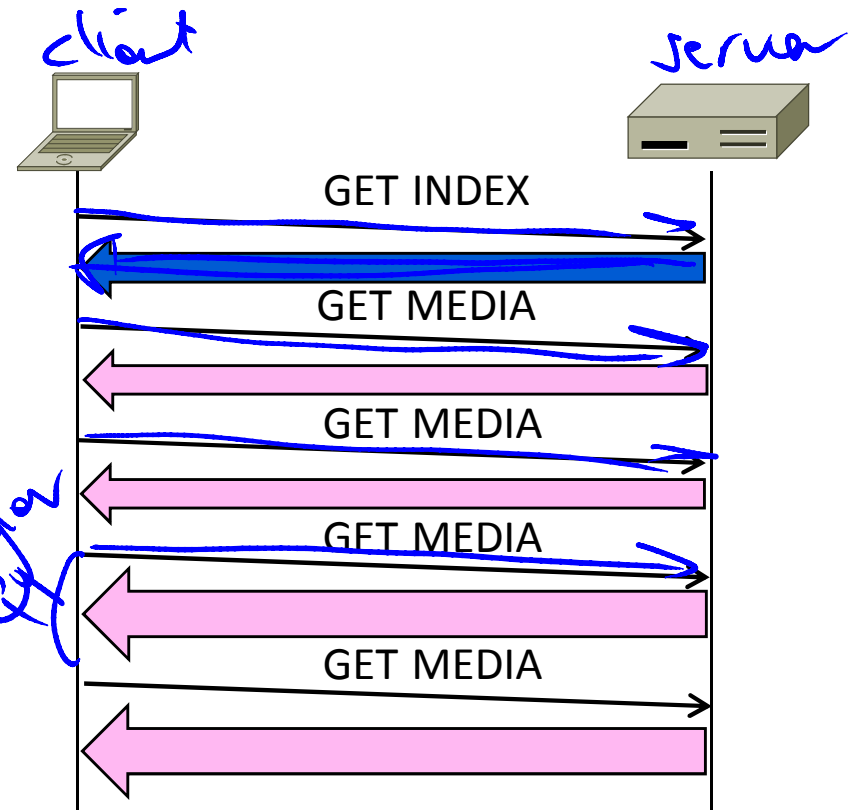
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