

CS640: Introduction to Computer Networks

Aditya Akella

Lecture 21 -
Multimedia Networking

Application Classes

- Typically sensitive to delay, but can tolerate packet loss (would cause minor glitches that can be concealed)
- Data contains audio and video content ("continuous media"), three classes of applications:
 - Streaming stored content
 - Unidirectional Real-Time
 - Interactive Real-Time

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Application Classes (more)

- Streaming stored content
 - Clients request audio/video files from servers and pipeline reception over the network and display
 - Interactive: user can control operation (similar to VCR: pause, resume, fast forward, rewind, etc.)
 - Streaming → start playing before all content arrives
 - Continuous playout: some delivery constraints

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Application Classes (more)

- **Unidirectional Real-Time:**
 - similar to existing TV and radio stations, but delivery on the network
 - Non-interactive, just listen/view
- **Interactive Real-Time:**
 - Phone conversation or video conference
 - More stringent delay requirement than Streaming and Unidirectional because of real-time nature
 - Video: < 160 msec acceptable
 - Audio: < 160 msec good, <400 msec acceptable

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Streaming Applications

- Important and growing application
 - Due to reduction of storage costs, increase in high speed net access from homes and enhancements to caching
- Audio/Video file is segmented and sent over either TCP or UDP
- Public segmentation protocol: Real-Time Protocol (RTP)
- User Interaction: Real-time Streaming protocol (RTSP)

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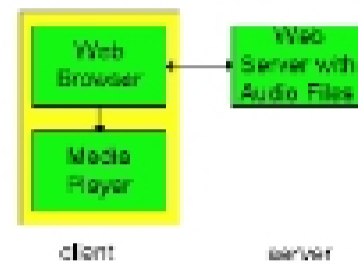
Streaming

- **Helper Application:** displays content, which is typically requested via a Web browser; e.g. RealPlayer; typical functions:
 - Decompression
 - Jitter removal
 - Error correction: use redundant packets to be used for reconstruction of original stream
 - GUI for user control

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Streaming From Web Servers

- Audio: in files sent as HTTP objects
- Video (interleaved audio and images in one file, or two separate files and client synchronizes the display) sent as HTTP object(s)
- A simple architecture is to have the Browser request the object(s) and after their reception pass them to the player for display
 - No pipelining



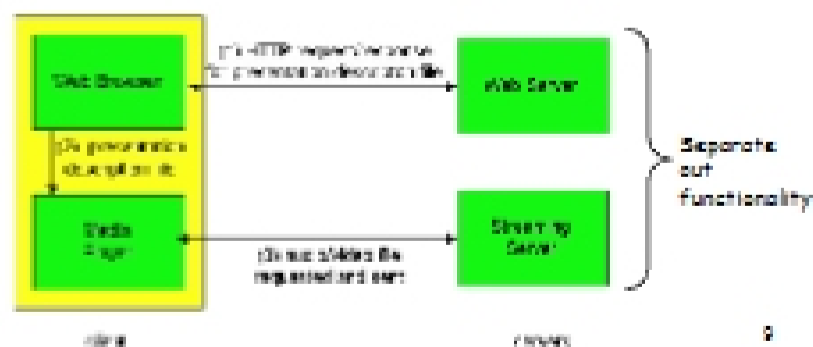
Streaming From Web Server

- Alternative: set up connection between server and player, then download
- Web browser requests and receives a Meta File (a file describing the object) instead of receiving the file itself;
- Browser launches the appropriate Player and passes it the Meta File;
- Player sets up a TCP connection with Web Server and downloads the file

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Using a Streaming Server

- This gets us around HTTP, allows use of UDP vs. TCP and the application layer protocol can be better tailored to Streaming; many enhancements options are possible ...



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