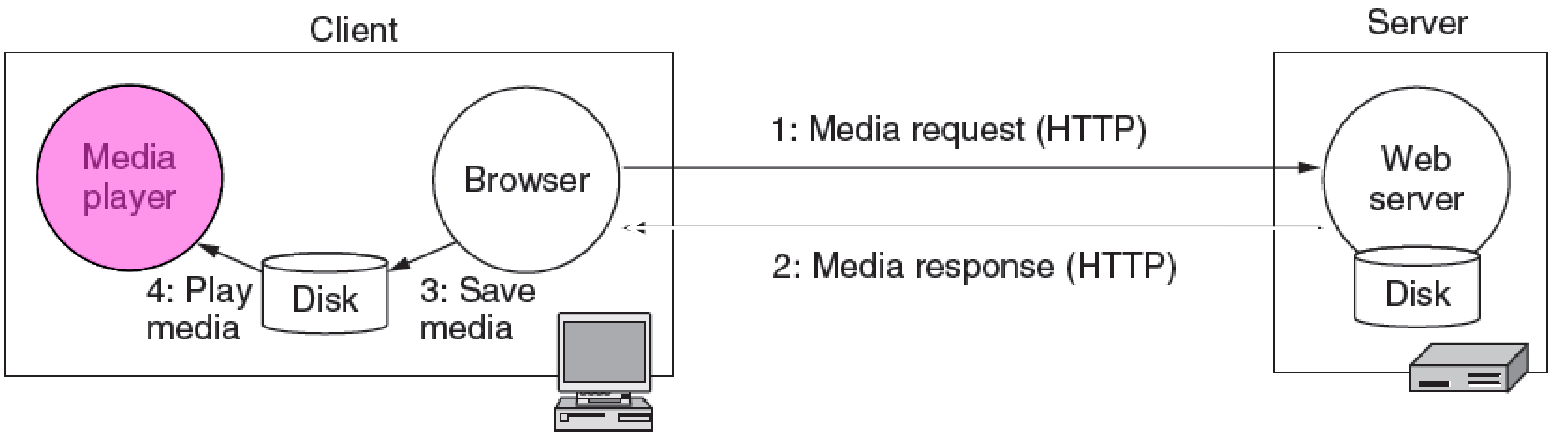
Application Layer Contd

Internet Technologies
COMP90007

Multimedia Systems

- What is different with Multimedia data?
- Why focus on it at the Application layer?
  - Higher bandwidth requirements
  - Higher QoS requirement
    - ***delay sensitivity***

A Basic Model for Multimedia on the Web



Problems with the Basic Model

- The entire media file must be transmitted over the network before playback starts
  - Imagine waiting for the whole movie to come to your side for everything you wanted watch
  - That is just not tolerable

Problems with Basic Model Contd

- Basic model assumes mainly point-to-point data distribution rather than a point-to-multipoint (broadcast) distribution model
  - Recall special methods for efficient multicast

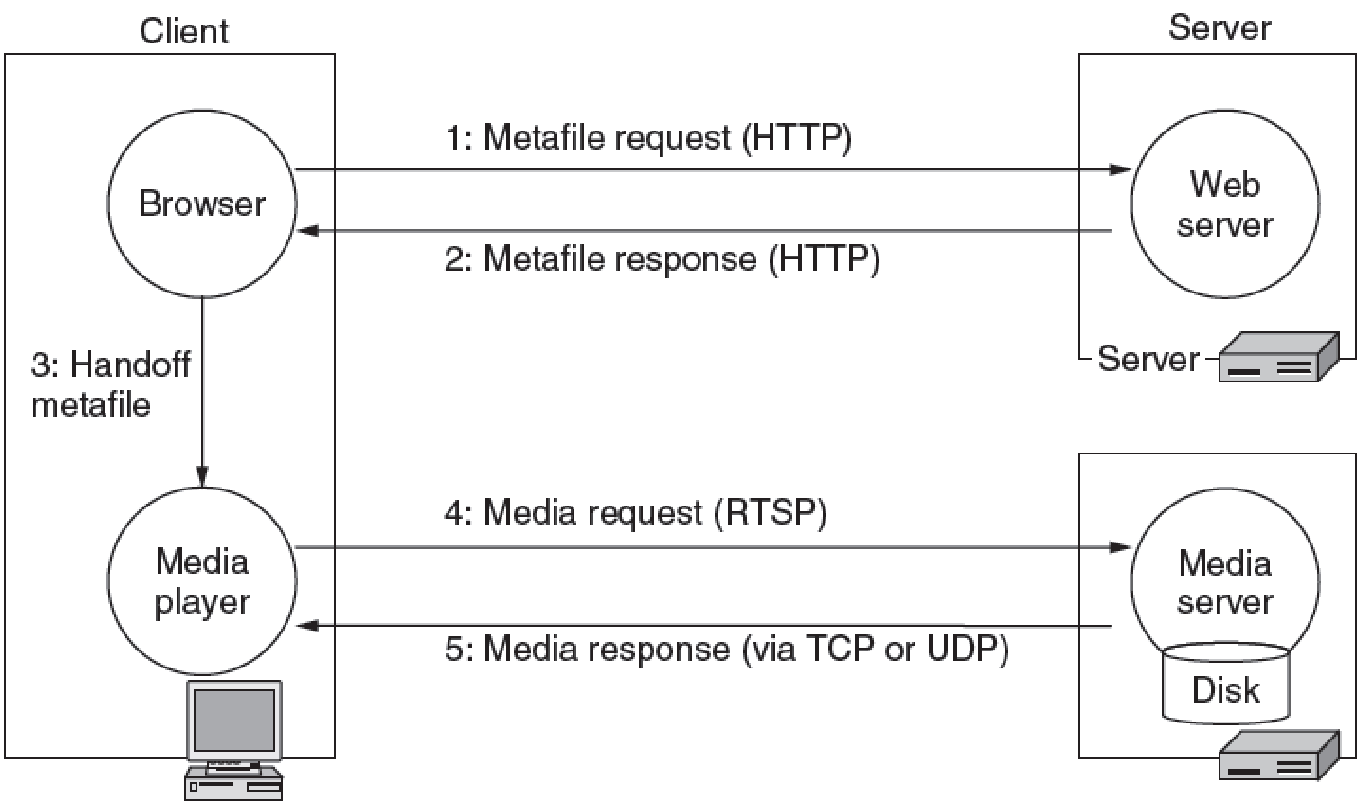
Lets Add Specialized Multimedia Software

- 4 main tasks of the multimedia playback software
  - First is to deal with the user interface side of the story
    - Functions such as volume control, playback, next, etc..
    - This is commonly what most people want/see/know today

Specialized Multimedia Software Contd

- Others are:
  - Handle transmission errors in conjunction with transport protocols
    - RTP can be used which is built over UDP, has timestamps, seq no, etc
    - Using RTP errors will likely occur and the app has to deal with it, playback software must manage/mask them gracefully
  - Eliminate jitter: Buffers need to be managed
    - Small buffer, quick playback but susceptible to high jitter/delay
    - Large buffer, delay at start of playback while buffer fills, but less susceptible to high delay/jitter
  - Sometimes compress and almost always decompress the multimedia files to deal with size and using bandwidth carefully

Specialized Model



Handling Errors

<u>Forward Error Correction (FEC)</u> can be used for the error-correcting encoding of data

For every X data packets Y **<u>new packets are added similar to checksum etc methods we have seen</u>**

These contains **<u>redundant bits that are used to deal with errors</u>**

Methods use **<u>parity or exclusive-OR</u>** sums of the bits in each of the data packets

Examples are **<u>Reed-Solomon, Tornado codes</u>**, etc: they are more complex than methods we saw so far…

Handling Errors: Other Directions

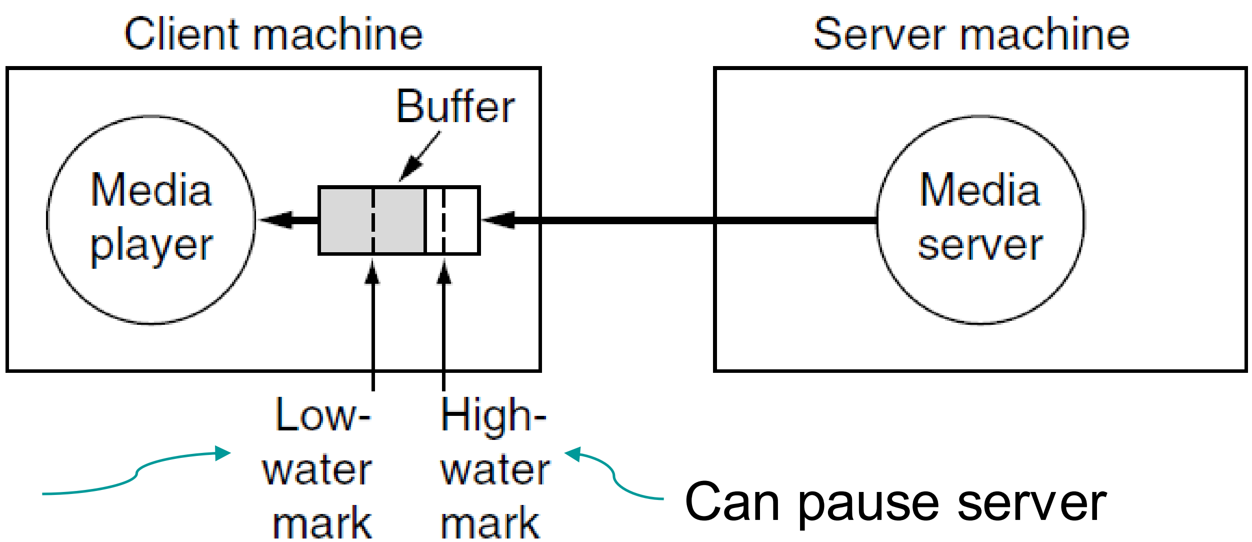
Error Resilience: Remarking for re-sync so that a packet loss does not create a total loss, mainly on sender side

Error Concealment: Done by the receiver e.g., interpolation between frames to reduce displeasing experiences

Retransmission: Less meaningful for streaming data but for watching a movie this can be deployed for larger loss of packets

Jitter Management is Crucial

Jitters happen because of variable bandwidth and loss/retransmissions. So ***<u>we use buffering…</u>***

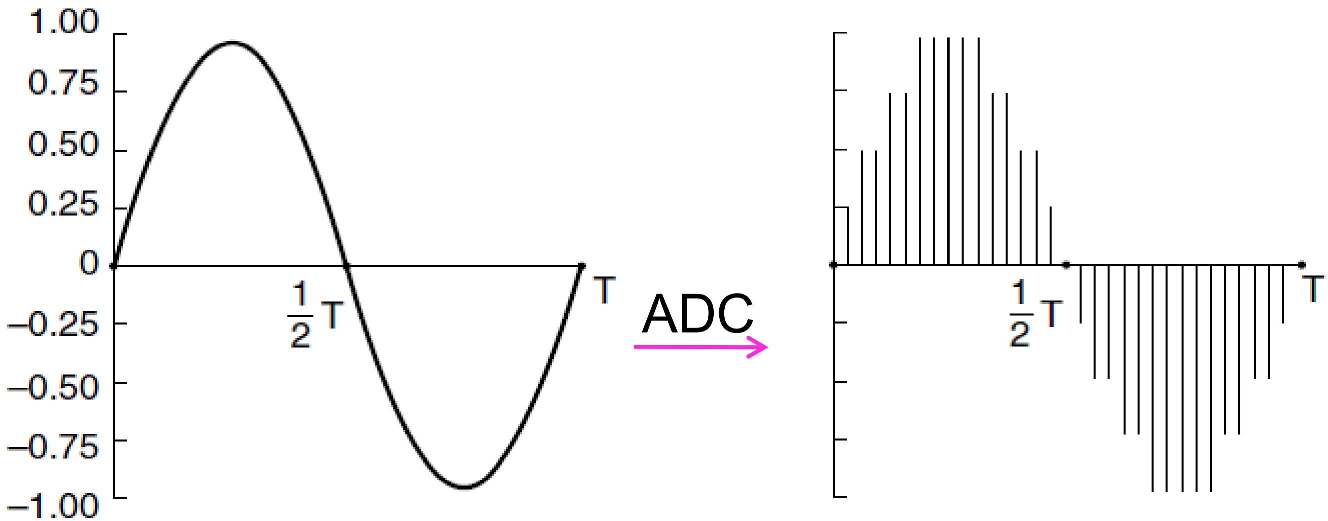


Safety margin, to avoid a stall

Can pause server

Large File leads to Compression

First: ADC (Analog-to-Digital Converter) produces digital data, say from a microphone, which leads to other ways to process data



Continuous audio (sine wave)

Digital audio (sampling theory in play)

Compression Process Contd

- *We can use Nyquist and Shannon theorems: to convert analog data to digital*

- *Also apply techniques to eliminate some of the data as follows…*

  For example: **<u>perceptual coding</u>** is that some data can mask other data, e.g., in audio, which can be used to eliminate some of the data

  - **<u>Frequency masking</u>**: Some sounds mask/hide others so there is no point encoding them

  - **<u>Temporal masking</u>**: Human ears can miss soft sounds immediately after loud sounds, takes time for the ear to adjust, no need to store them either

An Example Format: MP3

- MP3 is MPEG Audio Layer 3
- MP3's compression is **based on perceptual coding**
- MP3 audio compression results in significant **file size savings without a perceived loss of audio quality**
- Typical MP3 audio compression rates for CD level quality audio reduce the need for bandwidth **from 1.4Mbps for stereo down to 96-128Kbps**

For Digital Video

- Video is digitized as pixels
  - TV quality: 640x480 pixels, 24-bit color, 30 times/sec ~ 200Mbs uncompressed
- Video is sent compressed due to its large bandwidth requirements
  - Lossy compression exploits human perception
    - E.g., JPEG for still images, MPEG for video
  - Large compression ratios achieved (often x50 for video)

Compression with JPEG

- JPEG lossy compression
- JPEG often provides compression ratios around 20:1
- JPEG compression is **symmetric, decoding takes as long as encoding**
- This is not the case in all types of compression

MPEG

- MPEG - Motion Picture Experts Group
- MPEG can compress both audio and video together
- The evolution of MPEG:
  - MPEG-1: VCR quality at 1.2 Mbps (40:1)
  - MPEG-2: Broadcast quality at 4-6Mbps (200:1)
  - MPEG-4: DVD quality at 10Mbps (1200:1)