

CSc 461/561

Multimedia Systems

Multimedia Networking

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App-oriented view (again)

- Multimedia applications
 - normally applications involving audio/video
 - with timeliness constraints
 - and interactivity requirements
- Networked multimedia applications
 - multimedia app delivered over networks
 - usually over the Internet
 - with potentially many concurrent users

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Multimedia applications

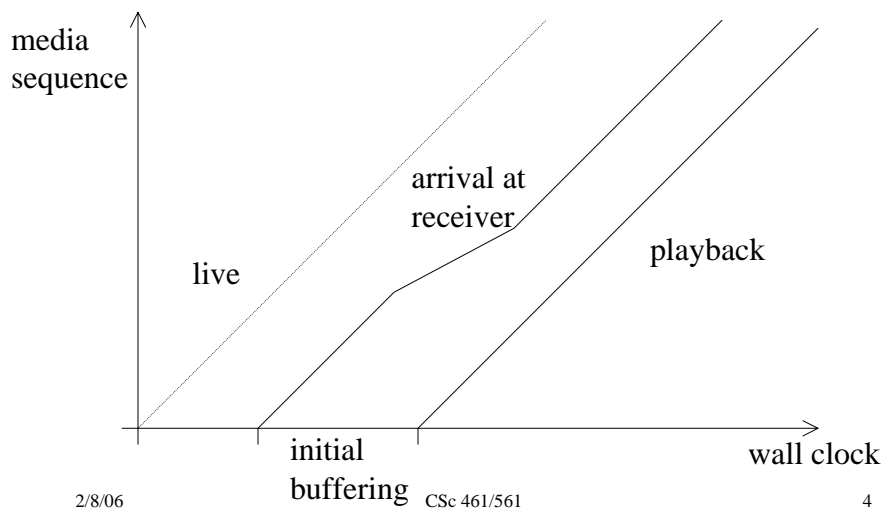
- Networked multimedia applications
 - stored media streaming
 - e.g., VoD
 - live media streaming
 - e.g., webcast
 - interactive multimedia
 - e.g., IP telephony, video conferencing
 - and many more

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Multimedia streaming



Multimedia app requirements

- The amount of multimedia data is huge
 - many need certain (minimum) bandwidth
 - some can tolerate packet loss to a certain extent
- Multimedia applications often interactive
 - many have upper bound on end-to-end delay
 - some are sensitive to delay variance (jitter)
- Multimedia may involve multiple endpoints
 - some need multicast, session management

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More specifically

- In addition to min bandwidth, max delay
 - stored media streaming
 - pause (hold), fast forward, fast rewind, etc
 - initial buffering allowed, interruption undesired
 - live media streaming
 - pause (skip), etc
 - smaller initial delay, fewer interruptions
 - interactive media
 - more stringent delay budget to allow interactivity

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The (traditional) Internet

- Best-effort service
 - no admission control
 - no guarantee on bandwidth, delay, loss
- Mainly point-to-point transmission
 - one sender and one receiver
- Mostly client-server transaction
 - request/reply between client and server
 - in-band signaling

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A (better) Internet

- Integrated service (IntServ/RSVP)
 - flow-level QoS guarantee
- Differentiated service (DiffServ)
 - a much coarser level of QoS provisioning
- Better than best-effort service
 - over-provision when affordable
 - client-proxy-server, peer-to-peer
 - application-layer QoS, multicast support

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Multimedia, mobility, multicast

- IP multicast support
 - IP multicast, multicast routing
 - group management
- Application-layer multicast support
- IP mobility support
 - Mobile IP
 - MIP routing optimization
- Application-layer mobility support

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TCP and multimedia

- | | |
|---|--|
| <ul style="list-style-type: none">• TCP<ul style="list-style-type: none">– point-to-point– window-based flow control– retransmission error recovery– embedded congestion control | <ul style="list-style-type: none">• Multimedia<ul style="list-style-type: none">– multi-point– min bandwidth– max delay/jitter– loss tolerant– smooth playback• There're TCP-based streaming apps, but there're tricks! |
|---|--|

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New protocol support

- “Real-time” transport protocol (RTP)
 - payload type (i.e., *multimedia*)
 - sequence number
 - timestamp (i.e., *temporal* information)
- RTCP: control companion
 - receiver report: packet loss, inter-arrival, etc
 - sender report: information about sent data
 - *out-of-band* control information exchange

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More protocols

- Session initiation protocol (SIP)
 - a session may contain many media streams
 - SIP: like SS7 for PSTN, essential!
 - coordinate caller and callee
 - negotiate media streams
 - SDP: session description protocol
 - maintain ongoing session
 - add/change media, hold/transfer calls, etc

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This lecture

- Introduction to multimedia networking
 - why multimedia is different
 - enhancement to Internet architecture
 - addition to layered protocols
 - link, network, transport, session, application, etc
- Explore further
 - multimedia streaming with TCP!
 - RTSP: real-time streaming protocol [RFC2326]

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Next lecture

- Multicast [Ref CHW]
 - Internetworking Multimedia
 - by Jon Crowcroft, Mark Handley, Ian Wakeman
 - <http://www.cs.ucl.ac.uk/staff/jon/mmbook/book/book.html>

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