CS 414 – Multimedia Systems Design
Lecture 40 – Final Exam Review Session

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To Do Tasks

- Peer Evaluation – Friday, May 8 – via email to klara@cs.uiuc.edu (see class website for peer evaluation guidelines)
- HW2 due today (Wednesday, May 6), midnight via email to hnguyen5@uiuc.edu or slide under door of 3104 SC
- Final Grades for the class will be posted latest by May 18 in Banner and Compass systems
- Class Evaluation Forms are online (you should have gotten an email with further instructions) – please, fill them out !!!

Final Exams Fact

- May 12, Tuesday, 7-10pm, 1109 SC
- Closed book and closed notes exam
- You are allowed calculator
- You are allowed a A4-size sheet with class material information (both sides)

Final Exam Topics

- Reading List – Lectures
  - Slides from Lectures 12-38
- Reading List – Multimedia Systems Book

Networks

- Chapter 2 – QoS
  - All topics except QoS routing
- Chapter 5
  - 5.1 Service and Network requirements
- Chapter 6
  - 6.1 requirements and constraints
  - 6.2.1-6.2.2 IPv4 and IPv6

Networks

- Chapter 6
  - 6.3 Traditional protocols and their support of MM
  - 6.3.1 TCP
  - 6.3.2 UDP
  - 6.4.3, 6.4.4 RSVP and IntServ
  - 6.5.2 RTP/RTCP
- Chapter 7
  - 7.4 Session Management
  - 7.5.1 SDP/SAP/SIP/RTSP

P2P Streaming

- M. Castro, P. Druschel, A-M. Kermarrec, A. Nandi, A. Rowstron and A.Singh, "SplitStream: High-bandwidth multicast in a cooperative environment ", SOSP'03,Lake Bolton, New York, October, 2003.
- H. Deshpande, M. Bawa, H. Garcia-Molina. "Streaming Live Media over Peers." Technical Report, Stanford InfoLab, 2002.
- N. Magharei, R. Rejaie. "PRIME: Peer-to-Peer Receiver-drIven MEsh-Based Streaming." INFOCOM 2007.
- N. Magharei, R. Rejaie, Y. Guo. "Mesh or Multiple-Tree: A Comparative Study of Live P2P Streaming Approaches." INFOCOM 2007.

Media Servers

- Chapter 4
  - 4.1 Architecture
  - 4.2 Storage Devices
  - 4.3 Disk Controller
  - 4.4 Storage Management
    - 4.4.1 disk management
    - 4.4.3 multimedia disk scheduling
    - 4.4.4 admission control
  - 4.5.3.3 Symphony
  - 4.6.1-4.6.4 Memory Management

Multimedia CPU Scheduling

- Chapter 3
  - 3.1.1-3.1.5 requirements, model of RT scheduling, scheduling policies
    - Rate monotonic scheduling and EDF
    - Comparison between RMS and EDF
    - DSRT

Buffer Management

- Chapter 3
  - 3.3.1-3.3.3 buffer management techniques, buffer management for client-server systems
  - Conditions of buffer management (starvation and overflow)

Synchronization

- Chapter 8
  - 8.1 introduction, basic concepts of open and closed LDU, intra and inter-synchronization,
  - 8.2 requirements in synchronization, lip sync,
  - 8.5 synchronization types
  - 8.7 reference models for multimedia synchronization,
  - 8.9 specification methods for multimedia synchronization
    - Interval-based, time-based, hierarchical, petri-nets, event-based

Applications (Read three required papers) - major concepts

- Flickner et al. "Query by image and video content: the QBIC system." *IEEE Computer*, 28(9), September 1995.
- S. Baset, H. Schulzrinne, "An Analasis of the Skype Peer-to-Peer Internet Telephony Protocol", 2004
- Liu et al. "Opportunities and challenges of peer-to-peer Internet video broadcast." *IEEE Special Issue on Recent Advances in Distributed Multimedia Communications*, 2007.

Sample Problems

- Buffer Management
- Consider the Felini multimedia file system. In this system, data for client requests are retrieved in cycles P (P refers to the common time period of the whole system, e.g., data for client are retrieved every P=100 ms). If a client '*i*' has the consumption rate f_i (in bits per second) and there are *k* bits in the buffer at the start of a cycle, then the admission controller checks at the start of each cycle if $k \geq P \times f_i$. With this admission test, what does the admission controller ensures? Explain.

Buffer Management

- Let us assume Video-on-Demand (VOD) service with one client and one server. Let us assume that the server sends the Motion JPEG video at 20 frames per second and the client receives 20 frames per second. Let us assume that the end-to-end delay between client and server is 50 ms (in both directions) including the computational overheads on client and server side. Let us assume that the movie in fast forward (FF) mode uses step-skipping method and step is equal to 5 (e.g. if FF mode is triggered from the beginning, only frames will be played: 1^{st}, 6^{th}, 11^{th}, 16^{th}, etc). Under the above assumption, consider the following scenario:
  - **The client receives streaming video and plays it on the screen. Suddenly somewhere in the middle of the movie, the client switches to fast forward operation.**

What is the minimal buffer size (in number of frames) at the client side for this scenario, so that the movie in fast forward mode will continue to play the FF frames at the rate of 20 frames per second?

Scheduling

- Let us assume retrieval of three MPEG-2 videos with the following Group of Pictures (GOP) IPBBP… Note that each movie is stored with the same GOP pattern at the media server. The processing time '*e*' of the individual frames fluctuates as follows: e(I) = 10ms +/- 2 ms, e(P) = 5 ms +/- 1ms, e(B) = 2ms +/- 2ms (the same execution time of I, P, B frames for each video). Let us assume that 'video 1' has the recorded frame rate 25 frames per second, 'video 2' has the recorded frame rate of 20 frames per second and 'video 3' has the recorded frame rate of 10 frames per second. Design the CPU soft-real-time scheduling framework for this workload to guarantee that the streams are schedulable at the media server. Specify admission control, reservation, scheduling policy, schedule how the tasks are scheduled and possibly adaptation policy in your scheduling framework if needed.

Synchronization

- Consider the following authored presentation: The presentation opens with Video and Audio playing concurrently for 10 minutes. After this play, slides are being shown one after another without any delays, narrated by audio in perfect sync. The presentation ends with animation and music that start concurrently, but then music continues to play for another 400 ms after animation finishes.
- Specify synchronization relations using time-axis specification.
- Specify synchronization relations using interval-based specification.

Other questions

(10 Points) Design a protocol which allows to switch two different movie channels. Let us assume that before the switch you can see and hear the active movie at 20 frames per second and the out-of-focus movie is played only at 5 frames-per-second. After the switch, you want the out-of-focus video to become active, play at 20 frames per second and be accompanied with its corresponding audio, and the active movie (before the switch) should become out-of-focus video played at 5 frames per second and without its corresponding audio. It means you need to specify (a) the control information that is exchanged before the switch occurs, (b) what data are sent before the switch and after the switch, and (c) what operations must be performed at the sender side (TV station) and the receiver side (TV receiver) immediately before the switch occurs.

Conclusion

- Good luck on your exam(s) !!!!
- Don’t forget to fill out the class evaluation forms online and give feedback what further improvements I and the TAs can do in this class
- Have a great summer !