

CS 414 – Multimedia Systems Design
Lecture 41 –
Final Exam Review Session

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Spring 2008




Facts of MP4 and Competition

- Competition Finalists will have grading of MP4 **Tuesday, April 29, 3:30-5:30pm in 216 SC** (William will grade)
- Other teams (non-finalists) will have grading of their MP4 on **Wednesday, April 30, 3:30-5pm in 216 SC** (Klara will grade)
- **Competition happens on Wednesday, April 30, 5-7pm in 216 SC**
- Pizza will be served and winners of the competition will be announced on April 30 between 6:30-7pm.



Facts of Other Tasks

- **Class 11am, Wednesday April 30** – Invited Talk given by Thompson Company – they will present their **IPTV System**
- **Peer Evaluation** – May 5, 5pm – via email to klara@cs.uiuc.edu (see class website for peer evaluation guidelines)
- **¼ Unit Projects** – May 8, 5pm – via email to klara@cs.uiuc.edu
- **Grades** will be posted by May 12 in Banner and Compass systems



Thompson Presentation – April 30, 11am, 1103 SC

- **Abstract:** The presentation will contain a brief overview of Thomson and our involvement in IPTV worldwide. The main focus will be on our MXU200 product line, which is part of a system designed to reuse much of the infrastructure satellite service providers already have in place and converts the incoming satellite data stream distribution from RF to IP multicast. The multicasts are then shared by up to 1000 clients. These systems are deployed in a variety of local, dense housing such as apartment complexes, high rise buildings and master planned communities. Discussions about the system will include design considerations for this type of system, theory of operation and implementation challenges.



Thompson Presenter

- Ken Atherton is a 1993 graduate of Purdue University with a BS in Computer and Electrical Engineering. He has been involved with software development and software validation at Thomson, Inc. for 15 years in a wide range of consumer electronics products and test equipment. Since 1999 he has been involved with three generations of IPTV technology. Currently, he is the manager of Software Development and Validation for Thomson's Multi-Client Solutions group.



Final Exams Fact

- May 3, Saturday, 8-11am
- Students with last names **A-L** will go to **room 1103 SC**
- Students with last name **M-Z** will go to **room 1131 SC**
- Closed book and closed notes exam
- **You are allowed calculator**
- You are allowed a **A4-size sheet** with class material information



Final Exam Topics

- Reading List – Lectures
 - Slides from Lectures 20-40
 - Recommendation: review briefly the lectures 12-18 for background information on Quality of Service, admission control, reservation concepts, rate control and shaping
- Reading List – Multimedia Systems Book



Networks

■ Chapter 5

- 5.1 Service and Network requirements
- 5.2.1 Ethernet,
- 5.2.3 Token Ring
- 5.2.6 & 5.4. ATM

■ 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



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 Analysis 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 (from Homework)

■ 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: 1st, 6th, 11th, 16th, 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?



Networks

- Assume four stations (A,B,C,D) transmitting video streams as high-priority traffic. Assume the order A,B,C,D in terms of movement of the token, i.e., A gets the token first, then B, C, and D. Can we guarantee that video sent from station A can play at 30 frames per second? Can video sent from station D be played at 10 frames per second? Explain your answers. Note that there is no buffering at receiving stations and assume that one video frame fits into one Token Ring packet. Explain your answer in detail.



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: $e(I) = 10\text{ms} \pm 2\text{ms}$, $e(P) = 5\text{ms} \pm 1\text{ms}$, $e(B) = 2\text{ms} \pm 2\text{ms}$ (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 spec given in HW2 about synchronization
- Specify synchronization relations using time-axis specification.
- Specify synchronization relations using interval-based specification.



Other questions

- Why is ATM better suitable for multimedia traffic than Token Ring network? Give 4 reasons.



Other questions

```
Audio1 while(0,0) RecordedInteraction;  
Audio1 before(20) Video1;  
Video1 before(0) Video2;  
Video2 before(50) Video3;  
Video3 before(100) UserInteraction;  
Video3 before(30) Audio2;  
Audio2 delayed(0,400) Animation;  
Animation before(50) Video4;  
Slide1 before(10) UserInteraction;  
Slide1 before(0) Slide2;
```

Transform the interval-based specification into

- (5 Points) Time-axis specification and



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.