Second Exam (12/4, 11:00-12:50)
Closed-book, 1 sheet of notes (single or double sided) allowed, no peeking into neighbors!

1. 10 pt)
   a) Describe the major components in the US DTV system and the method used for each component.
   b) Repeat the same for the Europe DVB system.

2. 10 pt)
   a) Why does MPEG-2 video coder encode a frame using the I-mode periodically? What does it enable? What does it sacrifice?
   b) Consider a video encoded at 30 frames/second, using a structure that contains 14 P-pictures and 1 I-picture in each GOP. What is the longest time a user has to wait after issuing a channel switching command before seeing the video frames in the switched channel? What is the shortest time that a user has to wait?

3. 15 pt)
   a) Describe how to map digital signal to analog waveform using 4-ASK. For the following sequence of bits, 11011000, sketch the resulting analog signal.
   b) 4-ASK and 4-QAM both encode 2 bits in one sinusoidal waveform. Which is more resistant to fading in wireless channels (fading refers to attenuation of signal strength)

4. 10 pt) What are the major differences in the QoS requirements between video streaming and Internet video telephony? What are the respective application-layer protocols that have been developed for these two applications? What transport-layer protocols can be used?

5. 15 pt) What is the primary function of the RTP protocol? What is the primary function of the RTCP protocol? What does RTP/UDP combination offer beyond the UDP? How does this combination differ from TCP?

NOTE: More questions continued on the back!
6. 10 pt) Figure below shows a typical session of video transport, where each packet containing data for one video frame. The left staircase line indicates when the packets are sent, the right staircase line indicates when these packets arrive at the receiver. Also shown on the figure are two lines indicating playout schedules based on two different playout delays, \( d_1 \) and \( d_2 \). For each playout schedule, determine whether there are any packets that will be dropped because they arrive too late and which ones? Which playout delay requires more memory space in the smoothing buffer?

7. (15 pts) Describe the similarity and differences between watermarking and steganography, in terms of intended applications, design objectives, and techniques involved. For ease of discussion, assume the cover media is an image.

8. (15 pts) Propose a possible retrieval scheme that a search engine may employ to answer query like “finding me videos showing people skiing”. Assume that the stored video in the database do NOT have high-level labels attached which tell whether a video contains skiing shots or not, but each video does have low-level descriptors attached that describe the color and motion attributes of the video (similar to MPEG-7 visual descriptors). Also, assume that the search engine can be taught (through interaction with the user who enter the query) to learn that “ski” video contains certain low-level features with “and” or “or” or “either” relations. Describe specifically what type of color and motion features may be used to describe and retrieve a “ski” shot. *(There is no unique answer to this question. Use your imagination and be creative!)*