Home assignment set 6: Multimedia

October 6, 2018

Problem 1

You need to play our video using a very small device, that can store the frame that is presented and one additional one. Frames arrive according to a Poission process, with rate $\lambda = 25$ frames per second. Frames are presented for a fixed interval of $T = 1/\lambda$, independently from the state of the buffer.

a) Define a discrete time Markov model of the system, where the state of the system is given by the number of frames stored at the device at the departure instant (that is at the completion of the presentation of a frame). Note, this model is very similar to the one in the "Adaptive playout strategies" paper. Also note, that at the departure instant, the device may store 0 or 1 frames, that is the Markov Chain will have two states. Give the state transition probabilities of the discrete time Markov Chain.

b) Calculate the stationary state probabilities.

c) To evaluate the performance of this small playout buffer, calculate the average frame-freeze time. In the considered playout scheme, there is no frame-freeze if the buffer stores a frame at the departure instant, and the frame-freeze time is the time until the next frame arrival, if the buffer is empty.

d) Calculate also the probability of frame loss. Frames are lost, because during the presentation of a frame only one arriving frame can be stored, if more arrives, they are dropped.

If you have not solved (b), give parametric solution for the last two questions.

Problem 2

Consider media dependent FEC with parameters n and k.

a) Give the definition of the parameters. Consider the case of $n = 1$, $k = 3$. Assume Bernoulli packet loss process with loss probability $p = 0.2$. What is the probability that once the original information is lost, it can not be reconstructed from the redundant copies?

b) You notice that the packet loss process is bursty and therefore you model the loss process with a two-state Gilbert model, where the packet loss rate is $p = 0.2$, and the average loss burst length is 2.5 packets. Define the parameters of the Gilbert model and give the probability that once the original information is lost, it can not be reconstructed from the redundant copies. What is the effect of the bursty loss process?

Problem 3

Consider media independent FEC, with parameters FEC(3,2).

Explain the meaning of the parameters. Consider Bernoulli packet loss model with loss probability p. Express the probabilities that $j = 0, 1, 2, 3$ packets are lost within a FEC block. Express the expected number of lost packets within a block (after error correction is performed). Express the expected number of lost information packets in a block, and finally the probability that an information packet is lost if this FEC(3,2) scheme is used. Calculate all the above probabilities if $p = 0.2$. (The Gilbert model paper and the notes from the class may help you to solve this problem.)