EP2210 – Performance evaluation of communication networks

Test questions

2012

Test 1 – Traffic models

1. In a study network traffic is modeled on flow level, considering the flow arrival process and the flow length distribution. What else should be given?

2. Please model a traffic source with a two state MMPP. The average packet generation rate is 100 packets per second in high intensity periods and 10 packets per second in low intensity periods. The average time in high respectively low intensity periods is 10-10 seconds. Give the MMPP model of the source.

3. A measurement study shows that the auto-correlation function of the traffic load on a link has a form of $r(k)=e^{-2k}$. Is this traffic long-range dependent? Prove your answer. Can you give an analytic model for this traffic?

Test 2 – Medium Access Control

1. Consider an FDMA and a TDMA system where M users generate fixed size packets according to a Poisson process. What is the minimum delay (from generation to reception) a packet can experience in the two systems? How does this delay depend on M? (Use parameters for channel bitrate, packets size, etc. if needed.)

2. Consider a slotted Aloha system with Poisson arrivals. Draw a scenario with packet arrivals and transmissions when the length of a busy period is exactly one time-slot. What is the probability that a busy time slot is followed by an idle one?

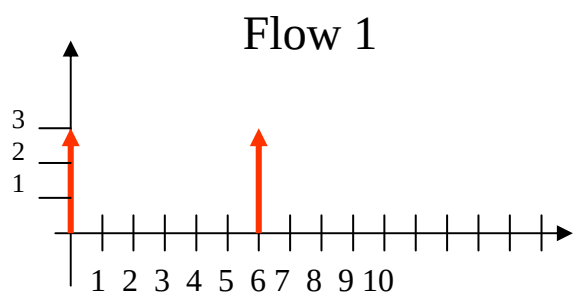
3. What happens in a CSMA system if the nodes that would like to transmit to the same destination can not sense each other's signal because of large distance or some object/wall standing between them? How does the throughput change? Why? (No equations needed.)

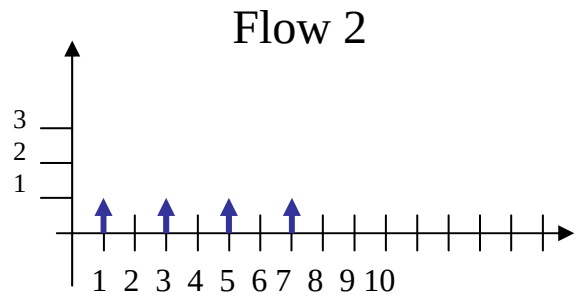
Test 3 – Congestion and Rate control

- You design a fixed window based congestion control. The estimated round trip time (rtt) if the network is lightly loaded is 20-30msec. The packet transmission time is 1ms. How would you select the window size so that the transmission rate is not limited when the network is not congested? Draw a diagram of the transmission rate as a function of the rtt.
- Consider TCP based congestion control. Compare the throughput of two connections, that experience the same packet loss, but have different round trip times. Give an intuitive explanation on why the throughputs of the connections differ.
- Consider the “Modeling TCP Reno Performance” paper. Explain briefly how losses are modeled and motivate the modeling decisions.

Test 4 – Scheduling

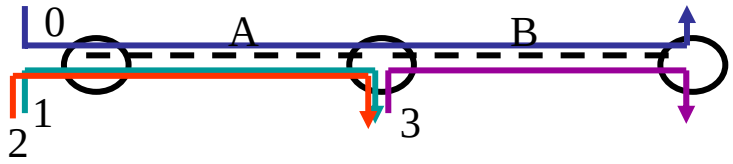
1. Consider a link with capacity C=6. Three flows share the link, the capacity is allocated to provide max-min fairness. Calculate the fair rates if the maximum rate of the flows are r(1)=1, r(2)=2, r(3)=4. Explain, what max-min fairness means.
2. Consider two flows sharing a link. Packet arrivals and sizes are shown on the figure. Draw a figure explaining how the packets are served with GPS and give the finishing time of each packet.
3. How are the same packets transmitted under PGPS (packet based GPS)?





Test 5 – Fairness and multimedia

1. Is the allocation below max-min fair? Prove your answer without deriving the max-min fair allocation yourself. Parameters:
   2 links, A, B: C(A)=C(B)=1.
   4 flows, allocation: r(0)=1/3, r(1)=1/3, r(2)=1/3, r(3)=2/3



2. Fairness is controlled by protocols and functions implemented in the network nodes or at the network edge. Name at least two and explain briefly how do they control fairness. Give also a real example.

3. Consider a media independent FEC(3,2) using a parity check, such that for all *b* bits in packets $i=1,2,3$:

$$\sum_{i=1}^{3} b_i = 0.$$

   Packet 2 is lost. Packet 1 is [00001111], packet 3 is [10101010].

   1. Derive the lost packet 2 from packets 1 and 3.
   2. What would be the advantage and this disadvantage of using FEC(6,4) instead of FEC(3,2)?