CSE 473 – Introduction to Computer Networks *Roch Guérin*

Quiz 1 – (10 points)

Your Name: *9/06/2017*

1. **(7 points)** A packet arrives at a router and needs to be transmitted over one of the router's links that has a capacity of 100Mbps (10^8 bits/sec) and that is connected to the packet's destination over a 100km fiber optic link.

   What is the maximum possible load ρ_{max} on the link to ensure that *on average* the time between the arrival of the packet at the router, and the arrival of its *first bit* at the destination is less than or equal to *1msec* (10^{-3}secs)? Assume a propagation speed of 200,000 km/sec in the optical fiber, an average packet size of 5,000 bits, and an average queueing delay at the router link that is well approximated by assuming random packet arrivals and lengths and enough router memory to ignore the impact of finite memory space.

   ***Solution**: The total average time for the first bit of the packet to arrive at the destination includes: queueing delay + propagation delay. Note that since we are only interested in the arrival time of the first bit, we don't need to worry about the transmission time of the packet itself.*

   The propagation delay alone is equal to $\delta = 10^2/2\times10^5 = 0.5$msecs. This means that the packet can afford an average queueing delay of at most 0.5 msec. The transmission time τ of an average size 5,000 bits packet is equal to $\tau = 5\times10^3/10^8 = 0.05$msec. This means that the average queue size at the router link can be no more than 10 packets. This means that the load ρ must satisfy

   $$\rho/(1-\rho) \leq 10 \Rightarrow \rho \leq 10/11 \approx 0.91$$

2. **(3 points)** Which of the following are valid IPv4 addresses (cross-out invalid addresses), where addresses are represented in either decimal or hex format:

0.1.2.3	192.168.15.67	~~261.23.16.8~~	~~55.23.1.33.6~~
0.0.0.0	128.0.0.0	0xAF1B2D79	0xFFFFFFFF

***Solution**: 261 > 255 and the 4th address has 5 rather than 4 8-bit digits. All other addresses are fine.*