

# EE 6340: Introduction to Telecommunications Networks

## PROJECT 4

### A. Performance of slotted system with Poisson and geometric arrivals.

In a slotted system, two different types of packets are arriving, i.e., type  $P$  and  $G$ . The arrival rate of type  $P$  packets follows a continuous-time Poisson process with rate  $\lambda_P$ . The arrival rate of type  $G$  packets follows a geometric process, i.e., one packet can arrive in a slot with probability  $\alpha$  or no packets arrive with probability  $1 - \alpha$ . The arrival rate of type  $G$  packets is  $\lambda_G$ , i.e.,  $\lambda_G T_s = \alpha$  being  $T_s$  the slot duration. In each slot of duration  $T_s$ , one packet can be transmitted. Different policies can be used to select the packet to transmit. Priority can be given either to type  $P$  packets or to type  $G$  packets, or First-Come First-Served (FCFS) policy can be used.

1. Under the FCFS policy, evaluate the average number of type  $P$  packets ( $N_{Q,P}$ ) and type  $G$  packets ( $N_{Q,G}$ ) in the buffer.
2. Under the FCFS policy, evaluate the average waiting time of type  $P$  packets ( $W_P$ ) and type  $G$  packets ( $W_G$ ).
3. Under the FCFS policy, evaluate the average time spent in the system by of type  $P$  packets ( $T_P$ ) and type  $G$  packets ( $T_G$ ).
4. Assume that the arrival rate of type  $G$  packets is proportional to the arrival rate of type  $P$  packets as  $\lambda_G = K\lambda_P$ . **Plot #1:** plot the average waiting time for type  $P$  and  $G$  packets ( $W_P$  and  $W_G$ ) versus the utilization factor  $\rho = \rho_P + \rho_G$ , when  $T_s = 1$ , for  $K = 0.5, 1, 2$  and  $5$ .
5. From Plot #1, which type of packet shows the highest waiting time? Explain the reason.
6. **Plot #2:** plot  $W_P$  and  $W_G$  for each one of three policies to select the next packet to transmit versus the utilization factor  $\rho$ , when  $\mu = 1$  and  $\rho_G = \rho_P$ .
7. Which policy has the smallest  $W_P$ ? Which policy has the smallest  $W_G$ ?