Faculty of Arts and Science
University of Toronto
**CSC 358 - Introduction to Computer Networks**

# Tutorial 6

## Topic

Unslotted Aloha

**Question 1:**
In unslotted Aloha (the precursor of slotted Aloha), each node (host), upon receiving a new packet, transmits the packet immediately rather than waiting for a slot boundary (slots play no role in unlotted Aloha). If the transmission times of two packets overlap at all, both packets will be lost (collison). If a packet is involved in a collision, it is retransmitted after a random delay. Assume that all packets have the same length $L$ and the tranmission rate of the shared link is $R$. We rescale time and use $T = L/R$ as the new time unit.
Assume that there is an infinite number of nodes (i.e. each node has at most one packet to transmit) and let $n$ be the number of backlogged packets at a given time. The waiting time $\tau$ until a backlogged packet is retransmitted is exponentially distributed with probability density $xe^{-\tau x}$, where the parameter $x$ is the retranmission attempt rate. The aggregated arrival rate (over all nodes) of new packets to the system form a Poisson process with rate $\lambda$ packet per unit time.

(a) Given that there $n$ backlogged packets at time $t_0$ and the system is idle at time $t_0$, what is the probabilith that there is no transmission attempt (by a new packets or a backlogged packet) in the interval $[t_0, t_0 + t)$, $t > 0$?

(b) Let $t_k$ be the time of the $k$th transmission attempt (by a new packet or a backlogged packet). For simplicity, assume that both at time $t_k$ and $t_{k+1}$, there are $n$ backlogged packets. What is the probability that the $k + 1$th tranmission attempt is successful?

(c) Assume that there are $n$ backlogged packets, what is the throughput, i.e. the rate (of packets per unit time) of successful tranmistted packets?

(d) What is the maximal throughput that we can achieve?

(e) What is the optimal choice for the retransmission attempt rate $x$?

(f) In (e), you saw that the choice for the retransmission attempt rate $x$ depends on $n$ and $\lambda$. B ut a node in unslotted Aloha will not know $n$ and $\lambda$. Can you come up with

a simple heuristic for how to dynamically change $x$ to emulate the optimal choice for the retransmission attempt rate?