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

Tutorial 3

Topic

In this tutorial we discuss how we can use ARQ protocols to implement a congestion control algorithm (as used in TCP), as well as ARQ protocols under different assumptions on the communication channel.

Question 1: Efficiency and Congestion Control
Two peer processes A (sender) and B (receiver) use stop-and-wait ARQ to send packets over a single link with capacity C. All packets have the same length of 100 bits. The round-trip time (which is the time until A receives an acknowledgment for a sent packet) is equal to 2 seconds. Assume that no packets or ACK's are dropped and that all packets and ACK's arrive error-free. Furthermore, assume that the capacity C is equal to 100,000 bits per second.

(a) Find the average (transmission) rate (in bits per seconds) with which process A sends data to process B?

(b) What is the link utilization?

(c) Assume that A and B implement Go-Back n ARQ. For this case, express the average (transmission) rate (in bits per seconds) with which process A sends data to process B a function of n.

(d) Find the link utilization as a function n?

(e) Assume that we 200 processes (each generating packets of length 100 bits) share the single link. How should we choose n to avoid link congestion? (Note: this question shows how we can use go-back n ARQ to implement a congestion avoidance algorithm. However, one additional difficulties we have to deal with is that in practice, we do not know the number of sessions sharing a link and we have to design an (adaptive) algorithm to tune n. TCP uses go-back n to implement congestion control, as we will discuss in more details later in the course).

Question 2: A variant of the stop-and-wait protocol

Consider a channel that can lose packets but has a maximum delay that is known. Design a stop-and-wait protocol that can communicate reliably over this channel.