# CS 4251/6250 Computer Networks, Fall 2021

## HW2

## DUE : October 8 at 11:59pm

## Submit on CANVAS

## *HW to be done INDIVIDUALLY*

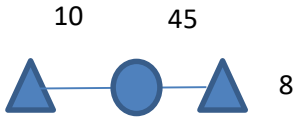
**Problem 1**

a) A sender is capable of sending at a rate of 10 Mbps. A transport connection is used between sender and receiver to send data that the receiver will write to its local storage.

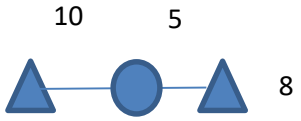
For each of the following scenarios state whether Flow Control and/or Congestion Control are needed. Explain your answers.

i) The sender and receiver are connected by a single wire (no network in between), the receiver can write the data to storage at 100Mbps.

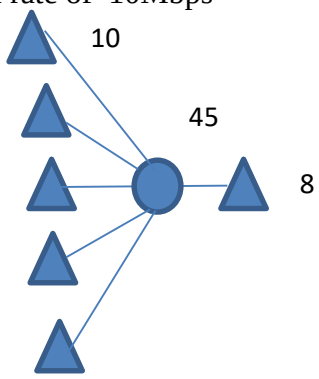

ii) The sender and receiver have one router between them and there are no other end systems in the network. The receiver is connected to the router by a 45Mbps link and the receiver can write the data to storage at 8Mbps.




iii) The same scenario in ii) above except that the receiver is connected to the router by a 5Mbps link.



iv) The same scenario in ii) except there are 5 senders connected to the router and sending to the receiver. Each sender can send at a maximum rate of 10Mbps




## Problem 2

Consider two TCP flows using a router link with capacity 100Mbps. The flows start with flow 1 sending at 120 Mbps and flow 2 sending at 40 Mbps. The flows use one of two Congestion control algorithms:

i) AIMD: with multiplicative decrease factor of 0.5 and additive increment of 1 MSS which (= 5 Mbps).
ii) AIAD (Additive Increase Additive Decrease): with additive increase increment of 1 MSS (= 5Mbps) and additive decrease increment of 2 MSS (= 10 Mbps).
iii) MIMD (Multiplicative increase Multiplicative decrease) with multiplicative decrease factor of 0.5 and multiplicative increase factor of 1.25.
iv) MIAD (Multiplicative Increase Additive decrease) with multiplicative increase factor of 2 and additive decrease (negative) increment of 4 MSS (= 20 Mbps)

For each case, and assuming the two flows increase and decrease their bandwidths in lock step, sketch the progression of the rates for flow 1 and flow 2. Look for whether the rates converge and if they do whether they converge to some sort of "fair" behavior.

**Problem 3** *(You may need to wait until Tuesday 10/5 lecture to be able to answer this question)*

a) A TCP Reno flow has the following properties: RTT=100ms, Segment Size= 10000 bits. When operating at its maximum throughput, the flow experiences a single packet loss that is detected by a triple-duplicate ACK and the throughput drops. Assuming no further losses, how long does it take for the throughput to recover to its maximum value again when

   i) The Maximum Bandwidth is 10 Mbps

   ii) The Maximum Bandwidth is 10 Gbps

b) client needs to choose between two servers. Prior experience when using the servers has shown the following behavior
   Server 1: RTT = 50 ms, loss rate: 0.5 %
   Server 2: RTT = 25 ms, loss rate: 1 %

   Which server should the client choose? Explain your reasoning.