Technical Report
Assignment-2
CS3205,Introduction to Computer Networking

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Aim:

The aim of the assignment is to understand the working of a simplified tcp model using simulations.

Introduction:

The application layer of the TCP/IP model relies on the transport layer to deliver its packets. There are many implementations of transport protocols such as UDP, TCP, etc.

TCP protocol is a widely used internet protocol which offers services like reliability,congestion control,integrity etc.Unlike UDP, TCP is a connection oriented protocol.The end-systems must perform a 3-way handshake before actually start transmitting anything via the connection.TCP maintains buffers in the end-systems to ensure reliability and inorder transmission of segments. Any TCP socket can be identified with a 4-tuple (source-ip, source-port, destination-ip, destination-port).

There are widely different implementations of TCP using algorithms like GBN(Go back N) and SR(Selective Repeat) for dealing with missing/duplicate packets and various algorithms for fast-recovery phase can be used for congestion control.

GBN is a protocol used to deal with missing/duplicate packets while using pipelined transmission of segments.The protocol imposes an upper bound on the number of segments that are sent but are not acknowledged.Whenever a negative acknowledgement or timeout occurs,the sender sends all the sent but not acknowledged segments again.The receiver rejects all the out of order segments as they are anyway sent by the sender again.

TCP implements congestion control in a complicated manner.A simplified approach will be discussed here just for the purposes of the assignment.There are two phases namely slow-start and congestion-avoidance.The sender will be in a slow-start phase in the beginning of the transmission.The sender exponentially increases his cwnd size until he reaches a timeout.He will note the value at which it has timed out and starts again in slow-start phase.Once he reaches half the previous timeout cwnd size,the sender changes to congestion-avoidance phase which increments the cwnd size linearly.Nevertheless,at some point,it again times out.It again notes the value at which it times out and starts new again.The value it remembers each time is called threshold value.

Experiment Details:

Setup
Some assumptions valid for entirety of the simulation are

- Sender does not run out of data.
- Receiver window (rwnd) is set to 1000KB.
- Sender's maximum segment size(MSS) is set to 1KB.
- Each segment has the size of 1 MSS
- Congestion window(cwnd) is rounded off to a higher integer.
- Threshold size is always set to 50% of cwnd size.

The protocol used for dealing with timeouts/missing packets is GBN.

We are going to implement slow-start and congestion-avoidance phases for congestion control.

To simulate the receiver,we are going to use a random function which tells us whether a segment did not reach before the round trip time(RTT).

Important Legends

Km denotes the multiplier of Congestion Window during slow-start.
Kn denotes the multiplier of Congestion Window during congestion-avoidance.
Kf denotes the multiplier of Congestion Window when timeout occurs.
Ps denotes the probability with which a segment may get lost.
T denotes the number of updates for which the simulation has to be run for.
cwnd denotes the current window size of sender.

Functions used in the simulation.

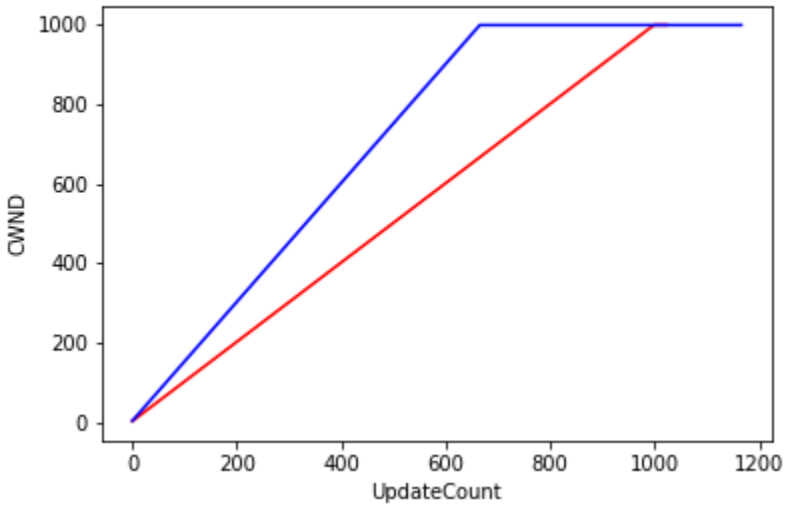
bool isReceived(double ps)
Tells whether a segment has been received or not by the receiver given the probability of not receiving.

double acked(int phase, double cwnd, double rwnd, double km, double kn, double mss)
Increases the cwnd size appropriately according to the current phase,km or kn.

double timeout(double cwnd, double kf)
Decreases the cwnd size appropriately according to kf.

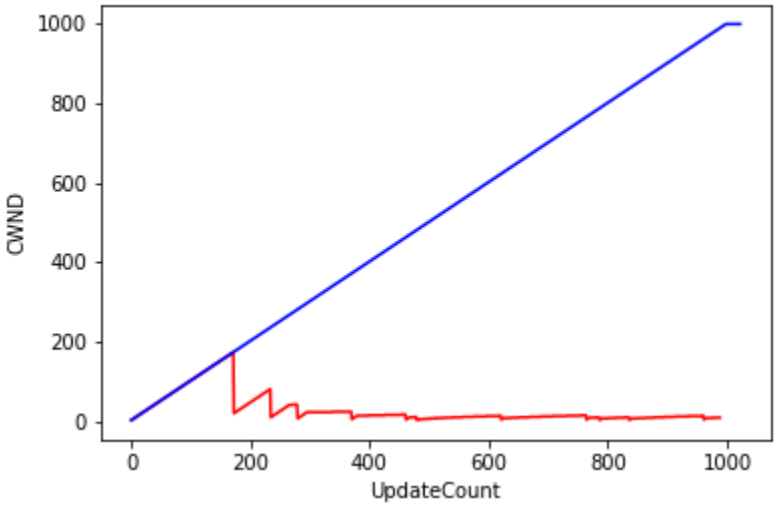
Results and Observations:

- When the Km value is higher,we are more fast and more probable to reach higher values

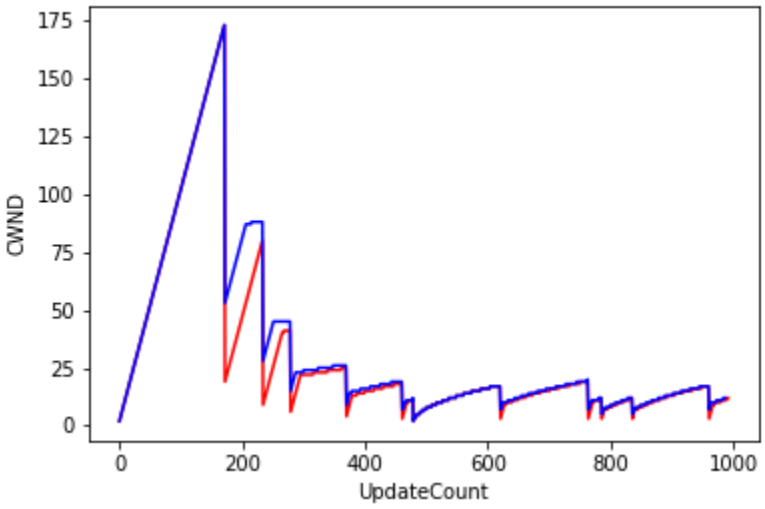


of cwnd.

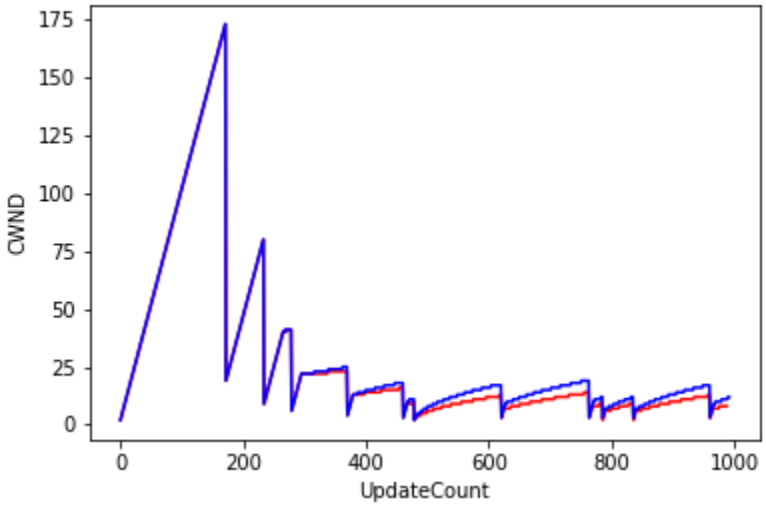
- When the probability of missing/timeouts (Ps) is less,we observe that higher peaks are formed.



- When the value of Kf is high, the resetted value is high after timeout.



- When the value of Kn is high,we recover fast in the congestion avoidance phase.



- Although we know that higher value of Ki leads to fast increase of congestion window initially, all plots are drawn with respect to the number of steps.So in any time step,the increase is identical.So,the plots are almost the same.

Learnings:

With the help of simulations,we learned how TCP works in general.We gained further insight into the GBN algorithm and the way TCP implements congestion control.We understood how different parameters characterize the congestion control system.

Feedback:

The assignment has been very insightful and time-worthy.It would be even more insightful to implement receiver separately and use sockets to communicate with our own version of TCP.

Conclusion:

With the help of simulations,we understood how different parameters can change the way TCP works.We conclude by saying that,

Higher Km value ensures fast and high probability to reach higher values.
Higher Kn value ensures faster recovery in the congestion avoidance phase.
Small Ps value ensures taller peaks.
Higher Kf value ensures faster overall recovery.

References:

Drive folder containing all files and images.

Read more about TCP in wikipedia.