P28. Host A and B are directly connected with a 100 Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send its application data into its TCP socket at a rate as high as 120 Mbps but Host B can read out of its TCP receive buffer at a maximum rate of 50 Mbps. Describe the effect of TCP flow control.

**ANS - Effect of TCP flow control:**

• As given that the link capacity is only 100 Mbps, so the sending rate of Host A can be almost 100 Mbps.

• Host A sends data into the TCP receive buffer at a rate as high as 120 Mbps.

• The receive buffer fills up at a rate of about 50Mbps.

• Host B removes data from the TCP receive buffer at a rate of 50 Mbps.

• When the TCP receive buffer is full, Host B sets the RcvWindow to 0. It is a signal to Host A to stop sending data.

• Host A stops sending the data into TCP receive buffer and waits till it receives a TCP segment with RcvWindow > 0.

• Host A will stop and start sending data depending on the value of the RcvWindow that Host A receives from Host B.

• Thus it can be determined that the on an average, the long-term rate at which Host A sends data to Host B can be no more than 50Mbps.

P30. Suppose that the five measured SampleRTT values (see Section 3.5.3) are 106 ms, 120 ms, 140 ms, 90 ms, and 115 ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of α = 0.125 and assuming that the value of EstimatedRTT was 100 ms just before the first of these five samples were obtained. Compute also the DevRTT after each sample is obtained, assuming a value of β = 0.25 and assuming the value of DevRTT was 5 ms just before the first of these five samples was obtained. Last, compute the TCP TimeoutInterval after each of these samples is obtained.

**Calculate the EstimatedRTT after obtaining the first sample RTT=106***ms***,**

*EstimatedRTT = α \* SampleRTT+(1- α) \* EstimatedRTT*

*EstimatedRTT*=0.125 \* 106 + (1-0.125) \* 100

                     =0.125\* 106 + 0.875 \* 100

                     =13.25 + 87.5

                     =100.75*ms*

**Calculate the DevRTT** **after obtaining the first sample RTT:**

*DevRTT***=***β \* | SampleRTT- EstimatedRTT|+(1- β)\* DevRTT*

            =0.25 \* |106-100.75| + (1-0.25) \*5

            =0.25 \*5.25 + 0.75 \* 5

            =1.3125 + 3.75

            =5.0625*ms*

**Calculate the Timeout Interval after obtaining the first sample RTT:**

*TimeoutInterval* = *EstimatedRTT +4\* DevRTT*

                        = 100.75 + 4 \*5.0625

                        =121*ms*

**Calculate the EstimatedRTT after obtaining the second sample RTT=120***ms***,**

*EstimatedRTT = α \* SampleRTT+(1- α) \* EstimatedRTT*

*EstimatedRTT*=0.125 \* 120 + (1-0.125) \* 100.75

                     =0.125\* 120 + 0.875 \* 100.75

                     =15 + 88.15625

                     =103.15625*ms*

**Calculate the DevRTT** **after obtaining the second sample RTT:**

*DevRTT***=***β \* | SampleRTT- EstimatedRTT|+(1- β)\* DevRTT*

            =0.25 \* |120-103.15625| + (1-0.25) \*5.0625

            =0.25 \*16.84 + 0.75 \* 5.0625

            =4.21 + 3.79

            =8*ms*

**Calculate the Timeout Interval after obtaining the second sample RTT:**

*TimeoutInterval* = *EstimatedRTT +4\* DevRTT*

                        = 103.15 + 4 \*8

                        =135.15*ms*

**Calculate the EstimatedRTT after obtaining the third sample RTT=140***ms***:**

*EstimatedRTT = α \* SampleRTT+(1- α) \* EstimatedRTT*

*EstimatedRTT*=0.125 \* 140 + (1-0.125) \* 103.15

                     =0.125\* 140 + 0.875 \* 103.15

                     =17.5 +90.26

                     =107.75*ms*

**Calculate the DevRTT** **after obtaining the third sample RTT:**

*DevRTT***=***β \* | SampleRTT- EstimatedRTT|+(1- β)\* DevRTT*

            =0.25 \* |140-107.75| + (1-0.25) \*8

            =0.25 \*32.25 + 0.75 \* 8

            =8.06 + 6

            =14.06*ms*

**Calculate the Timeout Interval after obtaining the third sample RTT:**

*TimeoutInterval* = *EstimatedRTT +4\* DevRTT*

                        = 107.75 + 4 \*14.06

                        =164*ms*

**Calculate the EstimatedRTT after obtaining the fourth sample RTT=90***ms***:**

*EstimatedRTT = α \* SampleRTT+(1- α) \* EstimatedRTT*

*EstimatedRTT*=0.125 \* 90 + (1-0.125) \* 107.75

                     =0.125\* 90 + 0.875 \* 107.75

                     =11.25 +94.28

                     =105.53*ms*

**Calculate the DevRTT** **after obtaining the fourth sample RTT:**

*DevRTT***=***β \* | SampleRTT- EstimatedRTT|+(1- β)\* DevRTT*

            =0.25 \* |90-105.53| + (1-0.25) \*14.06

            =0.25 \*15.53 + 0.75 \* 14.06

            =3.88 + 10.545

            =14.42*ms*

**Calculate the Timeout Interval after obtaining the fourth sample RTT:**

*TimeoutInterval* = *EstimatedRTT +4\* DevRTT*

                        = 105.53 + 4 \*14.42

                        =163.21*ms*

**Calculate the EstimatedRTT after obtaining the fifth sample RTT=115***ms***:**

*EstimatedRTT = α \* SampleRTT+(1- α) \* EstimatedRTT*

*EstimatedRTT*=0.125 \* 115 + (1-0.125) \* 105.53

                     =0.125\* 115 + 0.875 \* 105.53

                     =14.375 +92.34

                     =106.715*ms*

**Calculate the DevRTT** **after obtaining the fifth sample RTT:**

*DevRTT***=***β \* | SampleRTT- EstimatedRTT|+(1- β)\* DevRTT*

            =0.25 \* |115-106.715| + (1-0.25) \*14.42

            =0.25 \*8.285 + 0.75 \* 14.42

            =2.07 + 10.815

            =12.885*ms*

**Calculate the Timeout Interval after obtaining the fifth sample RTT:**

*TimeoutInterval* = *EstimatedRTT +4\* DevRTT*

                        = 106.715 + 4 \*12.885

                        =158.255*ms*