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Networking and Communications

Lecture 10 Assignment

1)

a)

Given,

Window Size (N) = 4

Assuming that the receiver has received up to packet K-1, because it is now expecting k, and has Acknowledged all off these previous packets. Assuming now that the sender has received all of these acked messages, then the sender’s window can be represented as [k, k+N-1]. If none of the Acks have been received by the sender, then the window can be represented as [k-N, k-1]. Based on these arguments and the sender’s window being of size 4 begins somewhere in the range of [k-4, k].

b)

If the receiver is waiting for packet with sequence number , then it has received the packet before that (k-1) and all packets leading up to that point as well (N-1). Because the sender has already sent packet [k-N, k-1] then the sender must have already received the ack for (k-N-1). Once the receiver has sent the ack for (k-N-1), it will not resend this ack, assuming no that the ack message is not lost resulting in retransmission, therefore it will not send an Ack lower than (k-N-1), meaning the current value of ack messages propagating across the network is [k-5, k-1].

2)

To avoid the occurrence of the problems described in figure on p.13, there should not be any overlap condition regarding the sequence number space. The sequence number space must be sufficient to fit the complete receiver and sender windows, Therefore, it is necessary to determine the range of sequence numbers that can be covered at any given point of time by the receiver and sender windows.

Let x be the lowest sequence number of the packet for which the receiver is waiting.

Then, the receiver window is [x, x+w-1]. The receiver has received the packet x-1 and all w-1 packets before the packet x-1 and sends acknowledgments for all the packets. If the sender does not receive any of the w acknowledgements sent by the receiver, then the ACK messages with values of [x-w, x-1] may still be propagating back.

As the sender receives no acknowledgements, the sender window would be [x-w, x-1]

Hence, the lower edge of the sender’s window is (x-w). Next edge of receiver’s window is (x+w-1)

For the next edge of receiver’s window not to overlapping with the previous edge of sender’s window, the sequence number space is to accommodate 2w sequence numbers, where k is the expecting sequence number.

Therefore, the sequence number space must be as twice as large the window size, (k >=2w)

3)

a)

There are 232 = 4, 294, 967, 296 possible sequence numbers. The sequence number does not increment by one with each segment rather it increments by the number of bytes of data sent. Consequently, the size of the MSS is irrelevant and the maximum file size that can be sent from A to B is the number of bytes representable by

L = 232 [bytes] ≈ 4.29 [GBytes].

b)

The number of segments is S = (232 [bytes] / 512 [bytes] ) = 8, 388, 608. To each segment, a header of 64 bytes is added and the total number of bytes to transfer becomes L͒ = S \* (512 [bytes] + 64 [bytes]) = 4,831,838,208 [bytes]. On the 156 Mbps link, the time needed to transfer L͒ bytes is L͒ \* 8 [bit] /(156 \* 106 ) [bit/s] ≈ 248 [s].