Q2: Stop-and-Wait Protocol

Let's consider a 10 KB/s link with 100ms latency and frame size of 1 KB.

1. What is the minimum wait time in a stop-and-wait protocol? How do you determine the right wait time? Why the difference between minimum and "right" wait time?

2. The link utilization is 100% if the sender transmits 10 KB of information every second. If we are using a frame size of 1 KB, what is the maximum link utilization with the basic stop-and-wait protocol?

3. We can use a sliding window to improve efficiency of stop-and-wait protocol. If the sender window size is 5, what is the maximum link utilization?

1. Minimum wait time = the minimum time for transmitting a packet from transmitter to receiver and receiving its "ack" back from the receiver. Therefore, minimum wait time = 100+100 = 200ms=0.2 s

   Right Wait time=RTT+ (frame size/Line Capacity) + (ACK size/Line Capacity)

2.

   With frame size of 1 KB, whenever sender sends a frame, it should wait until receiving the ack from receiver, so, in ideal case the time needed for each frame is 100+100 = 200ms.

   Therefore, we can send maximum of 5 frames in a second. So, we can send 5KB of data in a second. Therefore, our maximum link utilization in this case is: 5 KB / 10 KB * 100 = 50%

3.

W = windows size of sliding window protocol = 5

Latency = 100ms

Transmission time of frame = 100ms

x= Latency / Transmission time of frame = 100/100 = 1

Link utilization in sliding window Protocol = (Window Size (W) / (2x+1)) If W<(2x+1)

= 1 if W>(2x+1)

So, 2x+1=2(1)+1=3

Since W>(2x+1) i.e 5>3

So Link utilization is 100% in sliding window protocol when window size is 5.

Q3: Ethernet

1. What is the maximum length of cable you are allowed to use in 100BASET?

2. Assume the speed of signaling in the wire is 0.7c and a 64 byte minimum frame size. How much of the wire is occupied by a single bit?

3. Calculate the maximum cable length with the assumptions above. If your calculated length is different from the suggested length, explain the reason for the difference.

1) Maximum length of cable you are allowed to use in 100BASET = 100m

2)

Data Rate of 100BASET = 100Mbit/s = 10^8 bit/s
Signaling speed = 0.7c = 0.7 *3*10^8 m/s = 2.1*10^8m/s
So the length of the wire occupied by a single bit = signaling speed / Data Rate
= (2.1*10^8) / (10^8)
= 2.1m
So, a single bit occupies 2.1m of the wire.

3. 64 byte=64*8=512 bit
Single bit occupies 2.1m of the wire.
So maximum cable length= (2.1*512)/2=538 m

Reason: the sender has to detect collation successfully when it is in sending mode.

Q4: Distance Vector Routing
One of the students in COSC6377 had a brilliant idea about extending Distance Vector routing by not only keeping track of the minimum cost path to each destination but also the second best path.
1. Why would you want this extension?
2. What changes are necessary in the basic distance vector routing to support backup (second best) routes in addition to the shortest path? The resulting protocol should provide the primary and a backup path from each node to every destination in the network.
3. Design an algorithm that helps a node decide when it should use the second best route. Justify each choice you make in your algorithm design.

1. When we have the second best path, whenever the first path encounters a problem, like line broken, low bandwidth, or network high traffic, we can use the second path.
2. We can add an extra column in the table which will keep the record of second best path.
3. We will not broadcast the second best path only the best path will be broadcasted and second best path will be calculated in the node and keep the record in the table.
   The algorithm which you have describe should have
   - In which cases the second best path will be used.
   - How the router will decide that it need to use the second best path
   - If you think after few try it will use second best path then you have to mention how much time the router have to wait / how many try it should do to use the best path and then decided to use second best path.

Q6: BGP
In this question we will explore real-world Internet routes between different ASes. Download the BGP table either directly from the routeviews project site: http://archive.routeviews.org/ oix-route-views/2011.08/oix-full-snapshot-2011-08-28-2000.bz2 or download a local copy of the BGP table snapshot. The file is 30MB and will expand to nearly 1GB. Make sure you have enough disk space before you attempt this problem. You can find more information about how the data was collected on this link: http://www.routeviews.org/
1. Draw two trees representing all the paths from route-views.routeviews.org (which is where all the above data was collected) to UH. In one tree, use AS numbers and in the second tree use AS names. Does the topology make sense geographically?
2. What is the best path between this router and UH? Why?
3. Run traceroute or tracepath to route-views.routeviews.org from UH. What path do you see? Is this path the same as one of the paths you drew above? If they are different, why are they different? If they are the same, is that surprising?
4. Compare the UH->route-views.routeviews.org and route-views.routeviews.org->UH paths that you got in this question to the path you got in Q4. You can search for the AS corresponding to the IP address in the path on ARIN website: https://www.arin.net/

PATH AS DETERMINED BY THE DATA GIVEN IN THE ROUTING TABLE:
11537 14085 4557 7276
22388 11537 14085 4557 7276
7660 22388 11537 14085 4557 7276
293 11537 14085 4557 7276
3356 4323 7276
812 4323 7276
3549 6461 7276
8492 9002 6461 7276
31500 3549 6461 7276
1239 4323 7276
7018 6461 7276
701 6461 7276
3257 6461 7276
13030 6461 7276
1221 4637 6461 7276
3130 2914 6461 7276
286 6461 7276
2914 4323 7276
1668 6461 7276
6939 6461 7276
8001 6461 7276
6762 6461 7276
852 4323 7276
11686 11164 6461 7276
5056 209 4323 7276

3130 1239 4323 7276
5413 6461 7276
3561 6461 7276
852 6461 7276
2152 2153 19401 26468 4557 7276
3303 4323 7276
6539 6461 7276
2497 6461 7276
39756 3356 4323 7276
8492 3356 4323 7276
31500 3267 3356 4323 7276
293 6461 7276
2152 6461 7276
7660 2516 6461 7276

So you have to draw a tree using this as numbers and another tree using the name of this as.

Any of the minimum length paths from the above information. So you have to mention at least one here.

Tracepath:

1: stuff.cs.uh.edu 0.368ms pmtu 1500

1: Charybdis-VLAN21.cs.uh.edu 15.977ms

1: Charybdis-VLAN21.cs.uh.edu 17.241ms

2: no reply

3: vespasian-vlan11.gw.uh.edu 2.600ms

4: 129.7.254.65 0.923ms

5: LINK2UH-IT.GIGAPOP.GEN.TX.US 1.186ms

6: GATEWAY-MAN.GIGAPOP.GEN.TX.US 1.018ms asymm 7

7: hstn-setg-newnet-ge-1-0-3-3001-layer3.tx-learn.net 1.209ms asymm 8

8: hstn-hstn-newnet-layer3.tx-learn.net 11.686ms asymm 9

9: ge-6-1-0.0.rtr.losa.net.internet2.edu 532.319ms asymm 10

10: vl-101.xe-0-0-0.core0-gw.pdx.oregon-gigapop.net 79.938ms asymm 11

11: no reply

12: vl-3.uonet2-gw.uoregon.edu 62.663ms asymm 15

13: route-views.routeviews.org 212.454ms reached

Resume: pmtu 1500 hops 13 back 240

You have to find the ip address of the above nodes and find in which AS they belong to and finally draw a tree using these as and compare it with the tree you found from the router table information.
The two paths are different because different router may follow different strategy for routing and there is a concern of cost for sending data over the network.

http://bgphints.ruud.org/articles/cymru-whois.html site is helpful for finding the as numbers.

Q7: TCP

1. Label X and Y axes
2. Label all the points in the graph where the slope of the curve changes. For example, if a line changes the direction, curves, changes value, etc.
3. What are the green and red lines?
4. What is the main difference in mechanisms employed on the two graphs? Label the two graphs.

1.

X: Time
Y: Congestion window size

3.

Green Lines:
Condition Thresholds
Red Lines:
Incremental Addition to the number of packets

4. First graph: slow start
Second graph: fast recovery