Homework 1 solutions

---

1. Suppose an 802.11b station is configured to always reserve the channel with RTS/CTS sequence. Suppose this station suddenly wants to transmit 1,200 bytes of data, the transmission rate is 11Mbps and all other stations are idle at this time. As a function of SIFS and DIFS, and ignoring propagation delay and assuming no bit errors, calculate the time required to transmit the frame and receive the acknowledgement

A frame without data is 34 bytes long. Assuming a transmission rate of 11 Mbps, the time to transmit a control frame (such as an RTS frame, a CTS frame, or an ACK frame) is (272bits)/(11 Mbps) = 24.7 usec. The time required to transmit the data frame is (9872bits)/(11 Mbps) = 897.5

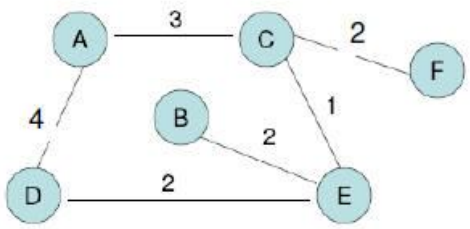
DIFS + RTS + SIFS + CTS + DIFS + FRAME + SIFS + ACK

= 2DIFS + 2SIFS + (3*24.7 + 897.5) usec = 2DIFS + 2SIFS + 971.6usec

---

2.Consider the network shown below. Give global distance-vector tables of each node when the nodes receive update information from their neighbors. Assume that

a) each node initially knows its cost to its neighbors
b) each node has reported the information it had in the preceding step to its immediate neighbors



Optimum 1-hop paths

Table for A			Table for B			Table for C			Table for D			Table for E			Table for F		
Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	HoNp	Dest	Cost	Hop	Dest	Cost	Hop
A	0	A	A	¥	-	A	3	A	A	4	A	A	¥	-	A	¥	-
B	¥	-	B	0	B	B	¥	-	B	¥	-	B	2	B	B	¥	-
C	3	C	C	¥	-	C	0	C	C	¥	-	C	1	C	C	2	C
D	4	D	D	¥	-	D	¥	-	D	0	D	D	2	D	D	¥	-
E	¥	-	E	2	E	E	1	E	E	2	E	E	0	E	E	¥	-
F	¥	-	F	¥	-	F	2	F	F	¥	-	F	¥	-	F	0	F

Optimum 2-hop paths

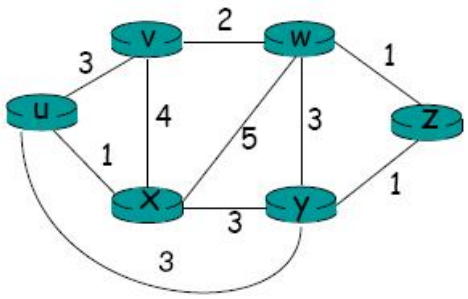
Table for A			Table for B			Table for C			Table for D			Table for E			Table for F		
Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop
A	0	A	A	¥	-	A	3	A	A	4	A	A	4	C	A	5	C
B	¥	-	B	0	B	B	3	E	B	4	E	B	2	B	B	¥	-
C	3	C	C	3	E	C	0	C	C	3	E	C	1	C	C	2	C
D	4	D	D	4	E	D	3	E	D	0	D	D	2	D	D	¥	-
E	4	C	E	2	E	E	1	E	E	2	E	E	0	E	E	3	C
F	5	C	F	¥	-	F	2	F	F	¥	-	F	3	C	F	0	F

Optimum 3-hop paths

Table for A			Table for B			Table for C			Table for D			Table for E			Table for F		
Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop	Dest	Cost	Hop
A	0	A	A	6	E	A	3	A	A	4	A	A	4	C	A	5	C
B	6	C	B	0	B	B	3	E	B	4	E	B	2	B	B	5	C
C	3	C	C	3	E	C	0	C	C	3	E	C	1	C	C	2	C
D	4	D	D	4	E	D	3	E	D	0	D	D	2	D	D	5	C
E	4	C	E	2	E	E	1	E	E	2	E	E	0	E	E	3	C
F	5	F	F	5	E	F	2	F	F	5	E	F	3	C	F	0	F

---

3. (link state routing) For the network given below, show how the link-state algorithm builds the routing table for node x. (note: you need to give the detailed steps)



Step	N'	D(u),p(u)	D(y),p(y)	D(v),p(v)	D(w),p(w)	D(z),p(z)
0	x	1,x	3,x	4,x	5,x	-
1	x,u		3,x	4,x	5,x	
2	x,u,y			4,x	5,x	4,y
3	x,u,y,v				5,x	4,y
4	x,u,y,v,z				5,x	
5	x,u,y,v,z,w					

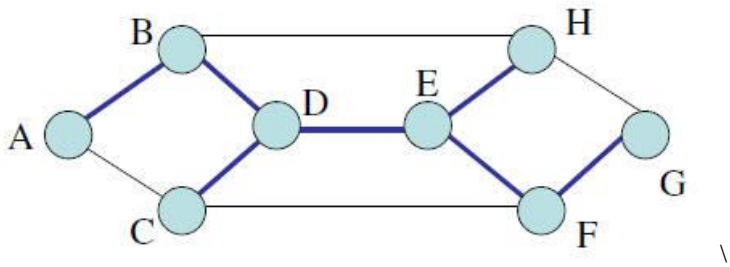
Resulting forwarding table in X:

Destination	Link
u	(x,u)
v	(x,v)
w	(x,w)
y	(x,y)
z	(x,y)

---

4. Consider the network topology given in the following diagram.

a) Suppose the dark blue lines indicate the shortest path from A to all other nodes. If A broadcasts a packet, please describe in detail how the nodes route the packet using RPF? Note: you need provide the information about which packets from which link should be forwarded or not.



\

1) A broadcasts the packet to B, C. C Discards it.

2) B broadcasts the packet from A to D and H. H discords it.

3) D broadcasts the packet from B to C and E.

4) C broadcasts the packet from D to A and F. Both discard it

5) E broadcasts the packet from D to H and F.

6) F broadcasts it to C and G. C discards it. G broadcasts it to H. H discards it

7) H broadcasts it to B and G. Both discard it.

b) Suppose E is selected as the center node, please describe in detail how to construct a spanning tree using center based approach.

Note: you need to make assumptions as needed.

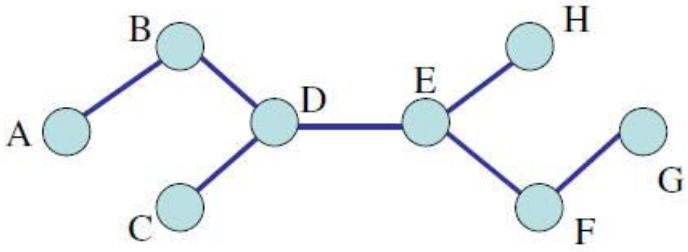
1. D sends a join message to E. DE becomes a branch of the tree

2. A sends a message to E. Assume the shortest path from A to E is through B. ABD becomes a branch of the tree

3. C sends a join message to E. CD becomes a branch of the tree

4. G sends a message to E. Assume the shortest path from G to E is through F. GFE becomes a branch of the tree

5. H sends a join message to E. HE becomes a branch of the tree



c) Based on the spanning tree constructed in b), if E broadcasts a packet, how do the nodes route the packet?

1). E sends it to D, H and F

2). D sends it to B and C, B sends it A.

3). F sends it to G

---

5. Consider the network in the above diagram. Suppose routers C and G don't have group numbers and A is the sender. Describe in detail how RPF with pruning works?

1) A sends a packet to B~~, C~~

2) B sends the packet to D

3) D sends the packet to E and C

4) E sends the packet from F and H

5) F sends the packet to G

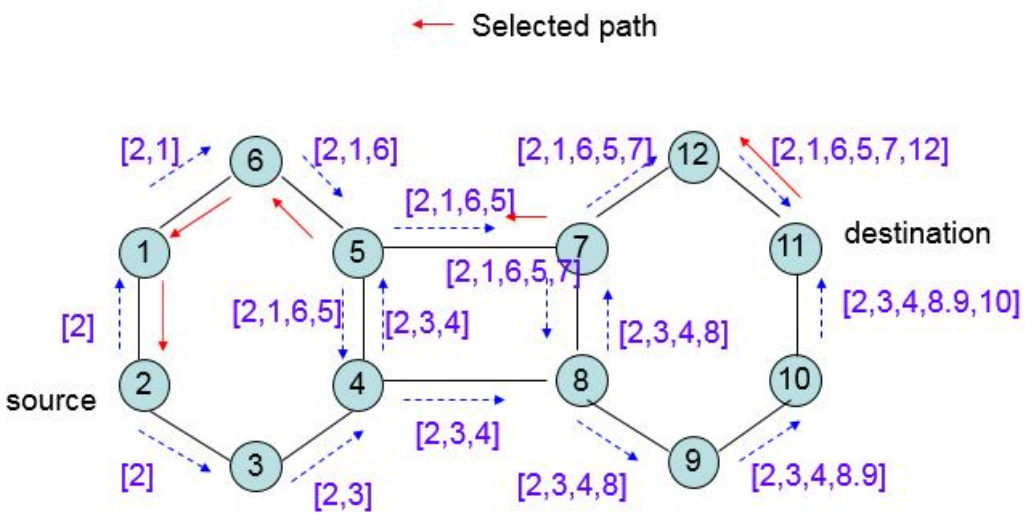
7) G sends a prune message to F

8) ~~F sends a prune message to E. E won't send data to F.~~

9) C sends a prune message to D. D won't send data to C.

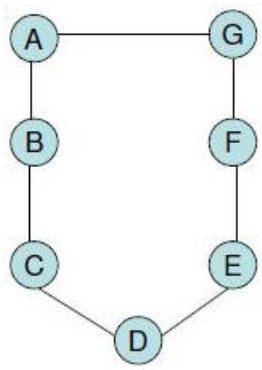
---

6. Consider the topology given in the following diagram. Simulate DSR protocol for path establishment from node 2 to node 11.



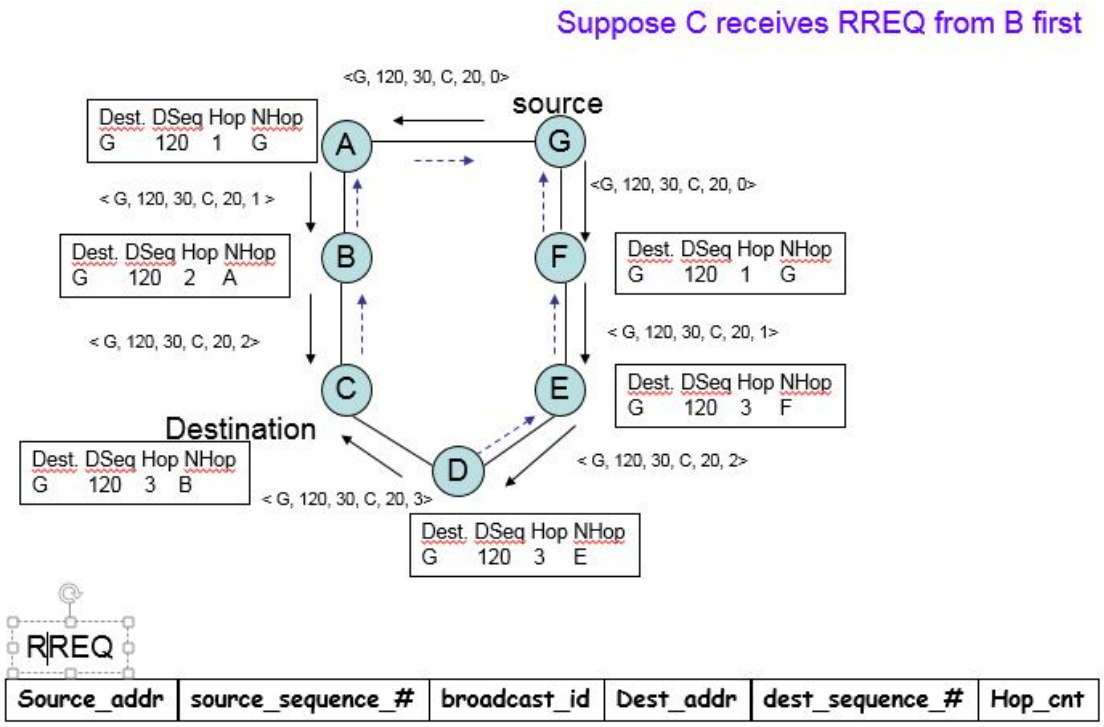
---

7. AODV protocol is used in the following MANET. Node G needs to send a packet to node C. Since G doesn't have a route to C, so G sends a RREQ
<source address, source seq#, broadcast id, destination address, destination seq#, hop count>
= <G, 120, 30, C, 20, 0>



a) Suppose tables in nodes A, G, and B are empty, describe how each node sets up the reverse path along the path

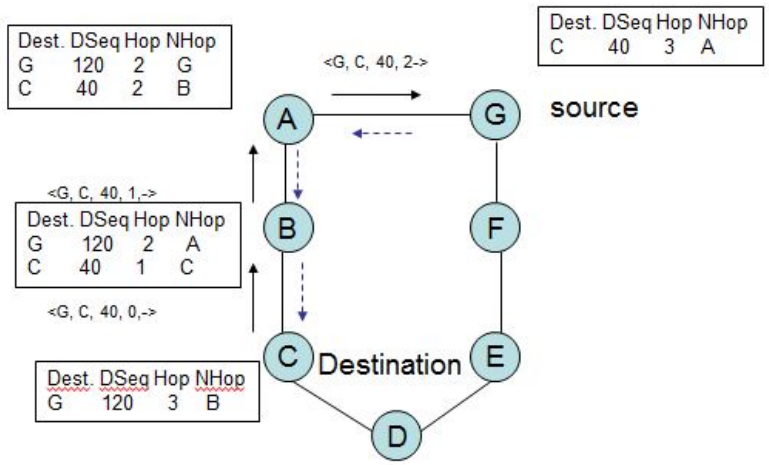
G-A-B-C. Give content of the table in each node.



RREQ

Source_addr	source_sequence_#	broadcast_id	Dest_addr	dest_sequence_#	Hop_cnt

b) Now, C receive the RREQ and replies with a RREP with a new desi_sequence number 40, describe how each node sets up a forward path. Give the content of the table in each node along the path.



RREP: <Source_Addr, Dest_Addr, Dest_Seq#, Hop_Count, Lifetime>

c) Suppose the table in F is empty and the table in E has one entry <C, D, 2, 50, --,-->, how the RREQ is processed along the path G-F-E-D-C. Note: you don't need to give the table information at each node.

When E receives the RREQ, it sends back a RREP to G.

d) Suppose the table in F is empty and the table in E has one entry <C, D, 2, 10, --,-->, how the RREQ is processed along the path G-F-E-D-C . Note: you don't need to give the table information at each node.

E broadcasts the RREQ to D and D broadcasts it to C.