

CSE 123: Computer Networks

Homework 3

Out: 11/11, Due: 11/18

Instructions:

1. Turn in a physical copy at the beginning of the class on 11/18.
2. Ensure the HW cover page has the following information clearly written:
 - a. Name
 - b. UCSD email
 - c. PID
3. Please contact the TAs or post on Piazza to seek any clarification.
4. The homework is to be done individually.

1. Link State Routing

Build the routing table for node A in the network shown in the figure 1 using the Link State Routing. Show all the steps as shown in Table 3.14 in P&D 5th edition. The respective distances are mentioned on the edges.

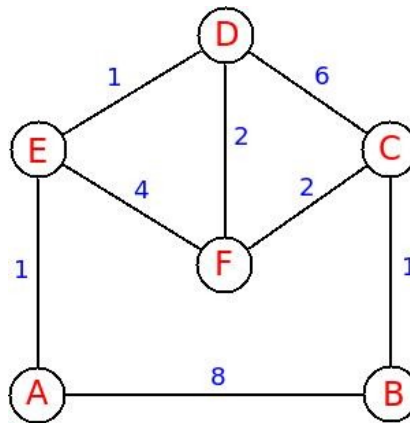


Figure 1: Network for questions 1 & 2

No.	Confirmed	Tentative
1	(A, 0, -)	
2	(A, 0, -)	(E, 1, E), (B, 8, B)
3	(A, 0, -), (E, 1, E)	(B, 8, B), (D, 2, E), (F, 5, E)
4	(A, 0, -), (E, 1, E), (D, 2, E)	(B, 8, B), (F, 4, E), (C, 8, E)
5	(A, 0, -), (E, 1, E), (D, 2, E), (F, 4, E)	(B, 8, B), (C, 6, E)
6	(A, 0, -), (E, 1, E), (D, 2, E), (F, 4, E), (C, 6, E)	(B, 7, E)
7	(A, 0, -), (E, 1, E), (D, 2, E), (F, 4, E), (C, 6, E), (B, 7, E)	

2. Distance Vector Routing

For the network given in figure 1, give the global view tables using Distance Vector Routing for the following instances:

- a) Each node knows only the distances to its immediate neighbors.

	A	B	C	D	E	F
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A	0	8	∞	∞	1	∞
B	8	0	1	∞	∞	∞
C	∞	1	0	6	∞	2
D	∞	∞	6	0	1	2
E	1	∞	∞	1	0	4
F	∞	∞	2	2	4	0

b) Each node has reported the information it had in the preceding step to its immediate neighbors.

	A	B	C	D	E	F
A	0	8	9	2	1	5
B	8	0	1	7	9	3
C	9	1	0	4	6	2
D	2	7	4	0	1	2
E	1	9	6	1	0	3
F	5	3	2	2	3	0

c) Final convergence occurs.

	A	B	C	D	E	F
A	0	7	6	2	1	4
B	7	0	1	5	6	3
C	6	1	0	4	5	2
D	2	5	4	0	1	2
E	1	6	5	1	0	3
F	4	3	2	2	3	0

Note: Refer to Table 3.10 in P&D 5th edition for how the global view tables should look like.

3. Link State Routing issues

Suppose that the nodes in the network shown in figure 2 participate in link-state routing, and C receives contradictory LSPs: One from A arrives claiming the link A-B is down, but one from B arrives claiming the A-B link is up. The links A-C and B-C are considerably longer than the link A-B.

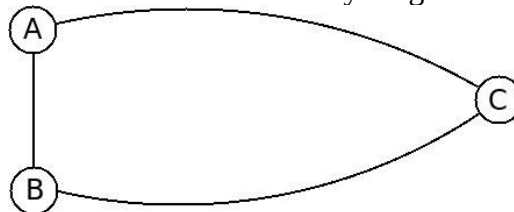


Figure 2: Network for question 3

a) How could this happen? Explain the scenario which can lead to the described situation.

It can occur when the event between A and B is realized by the two at different times. Say, the link goes down. The timer for the route needs to expire in A and B for them to realize that (or by using some Link state protocol) or for C to send them this info after getting it from one of the two nodes. The later is not a possibility since C is too far. Now A and B can experience timeouts at different times (or their Link-state protocols detect at different times) leading to them

sending different messages.

b) What should C do? What can C expect to happen eventually?

C has no way but to trust the higher sequence LSP packet from respective nodes. If the sequence number is lower than the one used to install the route, it will be discarded and if higher, the route will be updated.

Eventually C will expect to get higher sequence number packets containing the same information from both A and B leading to convergence.

Do not assume that the LSPs contain synchronized timestamp.

4. Split horizon and Poison reverse

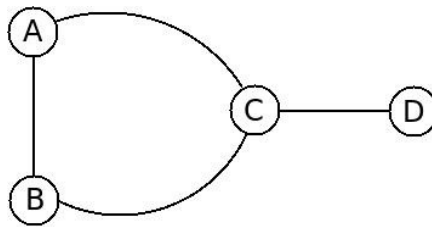


Figure 3: Network for question 4

Suppose routers A and B in figure 3 somehow end up with following forwarding-table entries:

1. At A: $\langle D, B, n \rangle$ and
2. At B: $\langle D, A, m \rangle$

(where $\langle x, y, z \rangle$ refers to path to node x via node y of length z),

This creates a routing loop. Write down the messages exchanged for the following cases to remove the loop:

- i. if A and B both use poison reverse with split horizon

In this case, A and B send $\langle D, A, \infty \rangle$ and $\langle D, B, \infty \rangle$ respectively to each other leading to immediate removal of the loopy route from both of them. Now the two nodes can likely receive $\langle D, C, x \rangle$ from C thereby, updating their routes since $x < \infty$ and stopping the poisoning. It may be possible that A eventually updates to some $\langle D, B, y \rangle$ if $y < x$ i.e., A has a shorter route via B rather than via C. If this happens, A will continue to poison B about route to D via A.

- ii. if A and B use split horizon only.

In this case, A and B will stop sending each other messages about D. Eventually either timeout for the routes occurs or a better message from C arrives $\langle D, C, x \rangle$. If $x < m$ (or n), the B (or A) updates the route to $\langle D, C, x \rangle$. If timeout occurs, then eventually an update from C will update both the nodes. Like above, there is a possibility that A has a shorter route via B rather than C. If this happens, A will update to $\langle D, B, y \rangle$ and continue to not send this update to B.

Which one converges faster?

Poison with split horizon converges faster since, the negative weights immediately remove the loopy routes and the next update from C will lead to convergence. On the other hand, split horizon needs to wait for the timeout.

5. Routing

Consider the network shown in figure 4 where R1 and R2 are routers while C (client) and S (server) are hosts. The forwarding table and ARP cache for the both the routers is given below:

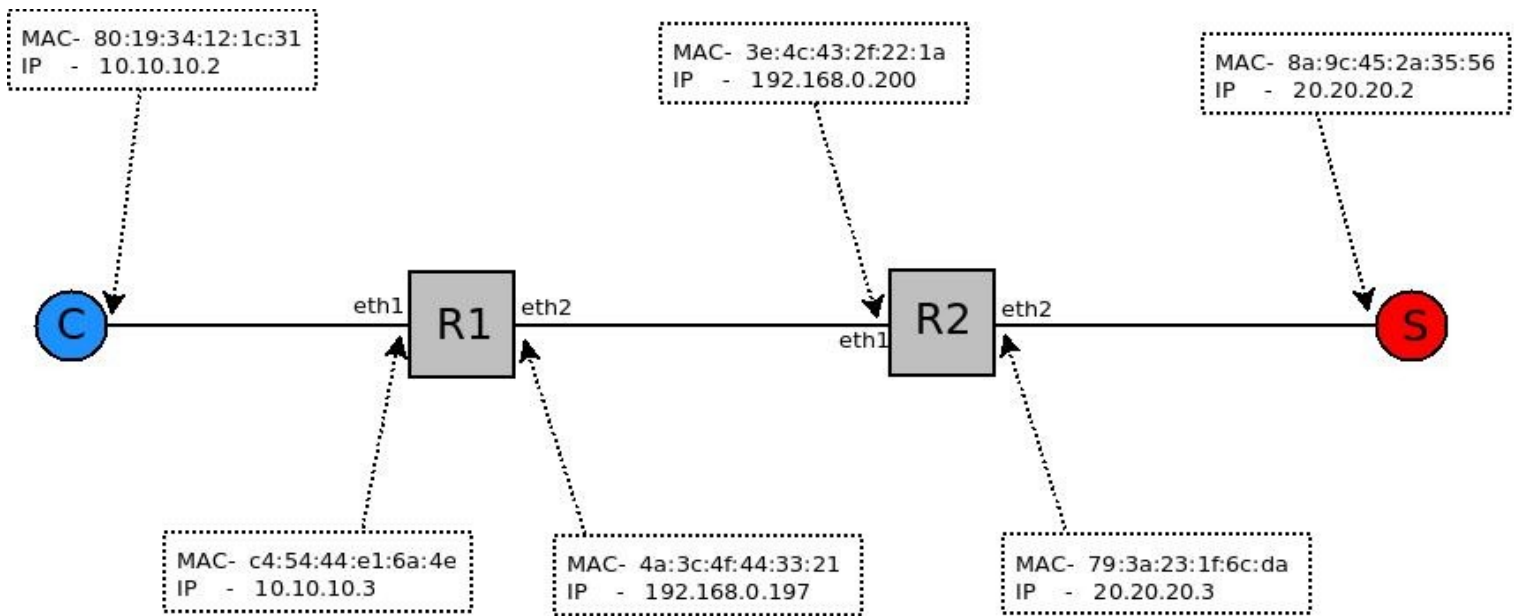


Figure 4: Network for question 5

Router R1

Routing table (R1)		
Destination	Next hop	Interface
127.0.0.1/32		lo0
default	192.168.0.200	eth2
20.20.0.0/16	192.168.0.200	eth2
10.10.10.0/24		eth1
192.168.0.0/16		eth2

ARP cache (R1)	
IP address	MAC address
10.10.10.2	80:19:34:12:1c:31
192.168.0.197	4a:3c:4f:44:33:21
10.10.10.3	c4:54:44:e1:6a:4e

Router R2

Routing table (R2)		
Destination	Next hop	Interface
127.0.0.1/32		lo0
default	192.168.0.197	eth1
20.20.0.0/16		eth2
10.10.10.0/24	192.168.0.197	eth1
192.168.0.0/16		eth1

ARP cache (R2)	
IP address	MAC address
192.168.0.200	3e:4c:43:2f:22:1a
192.168.0.197	4a:3c:4f:44:33:21
20.20.20.2	8a:9c:45:2a:35:56
20.20.20.3	79:3a:23:1f:6c:da

Client C (10.10.10.2) sends an IP packet destined to the server S (20.20.20.2). Write down the packets (IP and ARP) sent and received by the router R2 at both of its interfaces. The packets must be mentioned in the sequence they are received/sent. Label each packet with:

- i. the source and destination Ethernet addresses,
- ii. source and destination (or target) IP addresses and
- iii. the interface at which they are sent/received at R2.

1. ARP request (at eth1)

Src MAC: 4a:3c:4f:44:33:21
Dst MAC: ff:ff:ff:ff:ff:ff
Src IP: 192.168.0.197
Target IP: 192.168.0.200

2. ARP response (at eth1)

Src MAC: 3e:4c:43:2f:22:1a
Dst MAC: 4a:3c:4f:44:33:21
Src IP: 192.168.0.200
Target IP: 192.168.0.197

3. IP packet (at eth1)

Src MAC: 4a:3c:4f:44:33:21
Dst MAC: 3e:4c:43:2f:22:1a
Src IP: 10.10.10.2
Dst IP: 20.20.20.2

4. IP packet (at eth2)

Src MAC: 79:3a:23:1f:6c:da
Dst MAC: 8a:9c:45:2a:35:56
Src IP: 10.10.10.2
Dst IP: 20.20.20.2