Problems: Routing

1. A router using distance vector routing has the following routing table:

Net	Hops	Router
Net 2	6	A
Net 3	7	B
Net 4	3	A
Net 6	2	C
Net 7	3	B

   The router receives the following route update from router C. Show the updated routing table for the router.

Net	Hops
Net 2	4
Net 3	4
Net 4	3
Net 6	2
Net 7	3

2. A simple network is used according to Figure 1. Suppose flooding is used to send packets from S to R.

   (a) If we limit the packets by a hop count limit, which is the minimum hop count necessary for a packet from S to reach R?

   (b) What is the total amount of packets generated in the network for this hop count?

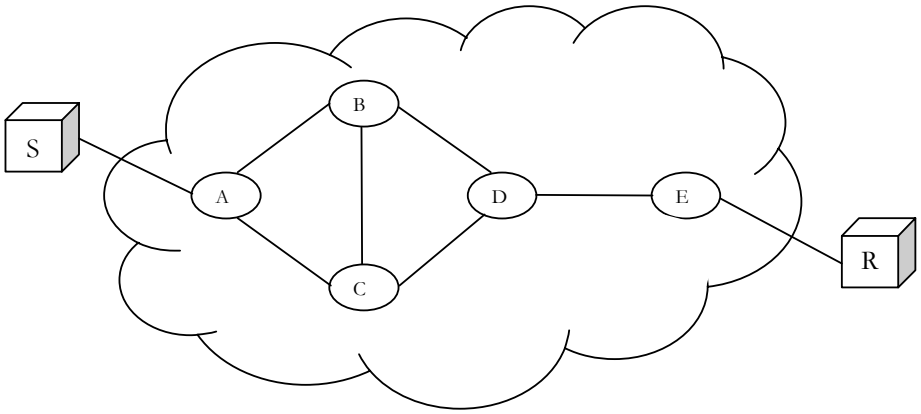


Figure 1: A simple network

3. The network shown in Figure 2 uses a Link State Routing protocol. Construct a Shortest Path Tree for node A, using Dijkstra's algorithm.

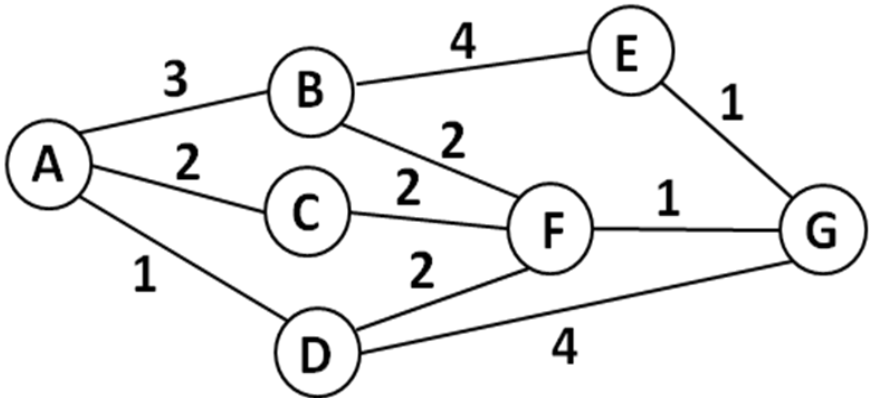


Figure 2: A network

4. Given a network with 6 subnets, numbered from 1 to 6, and 4 routers, denoted A to D. The routers use a Distance Vector routing protocol. Each subnet is connected to max 2 routers

   (a) Below is given the routing tables of routers A and D. Draw a sketch of the complete network and mark out the subnets and the routers. Subnets 1, 2, and 3 are stub nets (i.e. are connected to only one router).Hint: Think of a subnet as one Ethernet; there are no routers inside the subnet.

Router A, routing table		
Subnet	Hops	Next-hop
1	1	–
2	4	D
3	2	D
4	3	D
5	2	D
6	1	–

Router D, routing table		
Subnet	Hops	Next-hop
1	2	A
2	3	C
3	1	–
4	2	C
5	1	–
6	1	–

   (b) The networks layout is changed and router A receives a routing update from a new router E. Show router A?s routing table after the update.

Routing update from router E		
Subnet	Hops	Next-hop
1	1	–
2	1	–
3	2	B
4	4	B
5	3	A
6	2	A
7	2	B

(c) Draw a sketch of the networks new layout.

5. Consider the Ethernet based network in Figure 3. A, B, C, and D are hosts. R1 and R2 are routers. In the figure DNS is a DNS server and SWITCH is an up to date layer 3 switch. All hosts are configured with their own IP address and IP address of the DNS server. Host A, B, and C all have R1 as default gateway. Host D has R2 as default gateway. All caches and/or dynamic tables are empty in all devices. R1 and R2 are configured with static routing information and therefor exchange no routing information. The position of your sniffer is marked by the arrow. What frames do you see in the following two cases? Give the purpose of the frames as well as all layer 2 and 3 adresses.

   (a) Host A sends one ping to host D. D is only known to A by its alfa-numerical name.

   (b) Host B sends one ping to host D. D is only known to B by its alfa-numerical name.

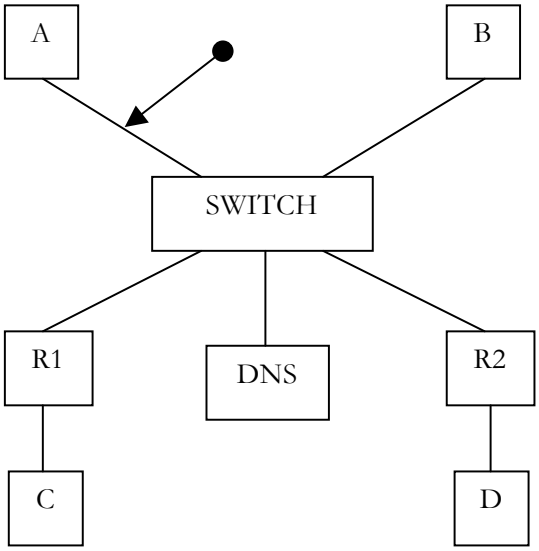


Figure 3: An Ethernet based network.

Solutions: Routing

1. The updated routing table is:

Net 2	6	A
Net 3	5	C
Net 4	3	A
Net 6	3	C
Net 7	3	B

2. Minimum hop count from A to E is 3

   1: A sends 2 packets (B & C).

   2: B sends 2 packets (C & D), C sends 2 packets (B & D).

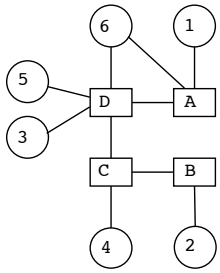
   3: C sends 2 packets (A & D), B sends 2 packets (A & D), D sends 2 packets (C & E), D sends 2 packets (B & E).

   Total amount of packets $= 2 \cdot 7 = 14$.

3. Since we are using a Link State protocol, we need to apply Dijkstra's algorithm to solve the shortest path problem:

Iter	M	B	C	D	E	F
1	A	2 AB	1 AC	∞ -	∞ -	∞ -
2	AC	2 AB	1 AC	4 ACD	3 ACE	6 ACF
3	ACB	2 AB	1 AC	4 ACD	3 ACE	6 ACF
4	ACBE	2 AB	1 AC	4 ACD	3 ACE	6 ACF
5	ACBED	2 AB	1 AC	4 ACD	3 ACE	5 ACDF
6	ACBEDF	2 AB	1 AC	4 ACD	3 ACE	5 ACDF

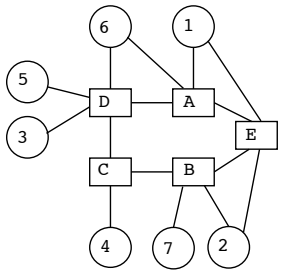
4. a)



   b)

Subnet	Cost	Next-hop
1	1	-
2	2	E
3	2	D
4	3	D
5	2	D
6	1	-
7	3	E

   c)



5. ARP request from MAC(A) to MAC(broadcast): Who has IP(DNS)?
   ARP reply from MAC(DNS) to MAC(A): I am IP(DNS)
   DNS request from MAC(A) to MAC(DNS): from IP(A) to IP(DNS): What IP is hostname(D)?
   DNS reply from MAC(DNS) to MAC(A): from IP(DNS) to IP(A): hostname(D) = IP(D)
   ARP request from MAC(A) to MAC(broadcast): Who has IP(R1)?
   ARP reply from MAC(R1) to MAC(A): I am IP(R1)
   ICMP echo from MAC(A) to MAC(R1): from IP(A) to IP(D)
   ICMP redirect from MAC(R1) to MAC(A): from IP(R1) to IP(A): redirect to IP(R2)
   ARP request from MAC(R1) to MAC(broadcast): Who has IP(R2)?
   ICMP reply from MAC(R2) to MAC(A): from IP(D) to IP(A): ICMP echo reply

   In the second case the messages are identical (substituting A for B). However, because of the switch there are only three messages seen by the sniffer – the broadcast messages.