Electrical and Information Technology

Communication and Networks

Problems Network Layer (IP)

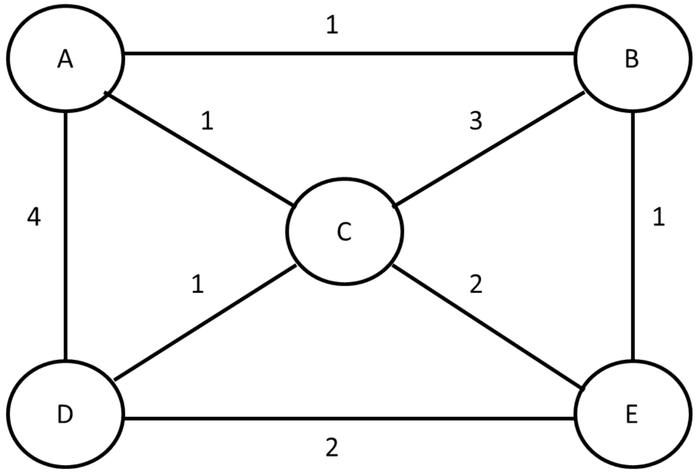
2016

Problems

1. The table below describes the next hop for each destination in the network for all nodes in the network. From this information draw the net graph. *Least hop path* is assumed. *dn* = destination node, *nn* = next node.

A		B		C		D		E		F	
dn	nn	dn	nn	dn	nn	dn	nn	dn	nn	dn	nn
B	B	A	A	A	B	A	A	A	A	A	E
C	B	C	C	B	B	B	A	B	A	B	B
D	D	D	A	D	F	C	E	C	F	C	C
E	E	E	A	E	F	E	E	D	D	D	E
F	B	F	F	F	F	F	E	F	F	E	E

2. Consider the network:



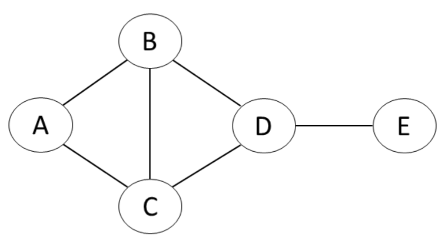
(a) Calculate the cumulative cost A-C-E.

(b) Assume cost is equal for all links/edges. Use *least hop path* and construct a routing table for node B.

(c) Assume costs as in the figure. Use *least cost path* and construct a routing table for node B including the cumulative cost to use a path.

(d) Now assume that the link A-C is broken. Construct the new routing table for node B.

3. Given the network in the figure. Assume flooding is used when a packet is sent from A to E An upper limit for the hop count (TTL) is set to reduce the number of packet copies.



(a) What is the smallest hop count that guarantees that at least one copy shall reach E?

(b) How many packet copies in total will be transmitted?

4. Determine the 8 bit checksum for the following bit sequences.

   (a) 10010011 10010011
   (b) 00011001 01010011
   (c) 11000111 00001101

5. Suppose a receiver receives the following bit sequences. 8 bit checksum is used. Have the streams been received correctly?

   (a) 10010011 10011011 11011001
   (b) 00110011 10110111 00010101
   (c) 01110000 00111000 01010111

6. Below is a printout of an Ethernet frame taken from a sniffing tool. The preamble, SFD and CRC is not included in the trace.

```
0000 ff ff ff ff ff ff 08 60 6e 7a a6 a4 08 00 45 00
0010 00 44 0d 79 00 00 80 11 91 11 82 eb c9 48 82 eb
0020 cb ff c5 aa 07 9b 00 30 8e 01 50 5a 38 70 61 6d
0030 48 38 7a 65 5a 74 74 4f 6f 7a 58 65 36 4e 42 52
0040 6b 44 4c 49 73 65 49 52 75 77 4c 64 6b 36 73 75
0050 38 41
```

   (a) We have learned from a previous problem that this frame contains an IPv4 datagram. How can we see this from looking into the payload of the Ethernet frame?
   (b) How can we determine where the payload field of the IP datagram is found?
   (c) What is the content of the IP datagram's payload?
   (d) What is the IP address of the sender and of the receiver of this IP datagram?

(e) Knowing that the net mask for network 130.235.200.0 is 255.255.252.0, what type of address is the destination address?

(f) Write the destinations network id as a *prefix*!

(g) Has the header been correctly received?

7. Calculate efficiency on the IP and Ethernet level for some IPv4 datagram scenarios. No options are added the IPv4 header. Include all control fields as well as preamble and SFD in your calculations.

   (a) The smallest IP datagram encapsulated in an Ethernet II frame.

   (b) The biggest IP datagram encapsulated in an Ethernet II frame.

8. Show the following IPv4 addresses in binary notation.

   (a) 114.34.2.8

   (b) 129.14.6.8

   (c) 208.34.54.12

   (d) 238.34.2.1

9. Show the following IPv4 addresses in dot decimal notation.

   (a) 01111111 11110000 01100111 01111101

   (b) 10101111 11000000 11110000 00011101

   (c) 11011111 10110000 00011111 01011101

   (d) 11101111 11110111 11000111 00011101

10. What class do these IPv4 addresses belong to?

   (a) 208.34.54.12

(b) 238.34.2.1
(c) 114.34.2.8
(d) 129.14.6.8
(e) 241.34.2.8

11. State net id and host id for the following classfull IPv4 addresses.

    (a) 114.34.2.8
    (b) 171.34.14.8
    (c) 192.8.56.2

12. State net id and host id for the following classless IPv4 addresses.

    (a) IP address 130.235.185.49, mask 255.255.0.0.
    (b) IP address 130.235.188.247, mask 255.255.192.0.
    (c) IP address 120.14.22.16, mask 255.255.128.0
    (d) IP address 141.181.14.16, mask 255.255.224.0

13. Show these IPv6 addresses in their shortest form.

    (a) 2340:1ABC:119A:A000:0000:0000:0000:0001
    (b) 0000:00AA:0000:0000:0000:0000:119A:A231
    (c) 2340:0000:0000:0000:0000:119A:A001:0000
    (d) 0000:0000:8000:2340:0000:0000:0000:0000

14. Show these IPv6 addresses in their original, complete form.

    (a) 0::0

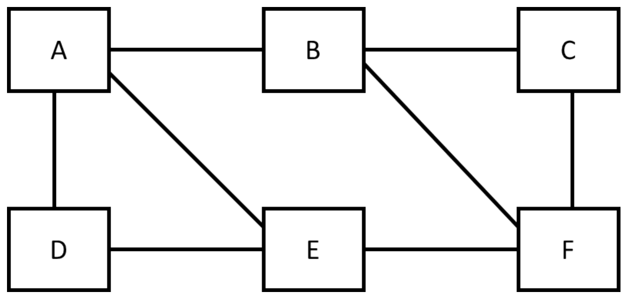
(b) 0:AA::0

(c) 0:1234::3

(d) 123::1:2

Solutions

1. See the figure:



2. (a) 3

(b)

dn	nn
A	(B,A)
C	(B,C)
D	(B,A) or (B,C) or (B,E)
E	(B,E)

(c)

dn	nn, cost
A	(B,A), 1
C	(B,A,C), 2
D	(B,A,C,D), 3 or (B,E,D), 3
E	(B,E), 1

(d)

dn	nn, cost
A	(B,A), 1
C	(B,C), 3 or (B,E,C), 3
D	(B,E,D), 3
E	(B,E), 1

3. (a) 3

(b) 14

4. (a) 11011000
   (b) 10010011
   (c) 00101011

5. (a) No
   (b) Yes
   (c) Yes

6. (a) The first byte following the Ethernet header contains `45`. The first *nibble* (=half a byte) contains 4_{16} which indicates IP version 4.
   (b) The header size in number of 32 bit words is found in the second nibble of the first byte of the IP datagram. This field is 5_{16}, thus the header is 20 bytes long.
   (c) The type field contains 11_{16} = 17_{10} which indicates UDP.
   (d) The source field contains `82 eb c9 48` thus 130.235.201.72. The destination field contains `82 eb cb ff` thus 130.235.203.255.
   (e) Applying the net mask on the destination address gives a hos id of *all ones* which is the networks broadcast address.
   (f) 130.235.200/22 or 130.235.200.0/22
   (g) No. Doing header checksum calculation gives a non zero result.

7. (a) The smallest IP datagram payload consists of one byte. The IPv4 header is 20 bytes; thus $1/20 = 5\%$. The minimum Ethernet II frame size is 72 bytes; thus $1/72 = 1.38\%$.
   (b) The largest IP datagram payload is 65515 bytes; thus $65515/(20 + 65515) = 99.9\%$. The largest Ethernet II frame payload is 1500 bytes. An IPv4 datagram payload must not be greater that 1480 bytes. This gives the IPv4 efficiency $1480/1500 = 98.7\%$ and the Ethernet II efficiency $1480/1526 = 97.0\%$.

8. (a) 01111010 00100010 00000010 00001000
   (b) 10000001 00001110 00000110 00001000
   (c) 11001000 00100010 00110110 00001100
   (d) 11101110 00100010 00000010 00000001

9. (a) 127.240.103.125
   (b) 175.192.240.29
   (c) 223.176.31.93
   (d) 239.247.199.29

10. (a) Class C
    (b) Class D
    (c) Class A
    (d) Class B
    (e) Class E

11. (a) Net id: 114.0.0.0; host id: 0.34.2.8
    (b) Net id: 171.34.0.0; host id: 0.0.14.8
    (c) Net id: 192.8.56.0; host id: 0.0.0.2

12. (a) Net id: 130.235.0.0; host id: 0.0.185.49
    (b) Net id: 130.235.128.0; host id: 0.0.60.247
    (c) Net id: 120.14.0.0; host id: 0.0.22.16
    (d) Net id: 141.181.0.0; host id: 0.0.14.16

13. (a) 2340:1ABC:119A:A000::1
    (b) 0:AA::119A:A231

(c) 2340::119A:A001:0

(d) 0:0:8:2340::0

14. (a) 0000:0000:0000:0000:0000:0000:0000:0000

(b) 0000:00AA:0000:0000:0000:0000:0000:0000

(c) 0000:1234:0000:0000:0000:0000:0000:0003

(d) 0123:0000:0000:0000:0000:0000:0001:0002