Final — Networking

Select 4 of the following 5 problems. They are all worth 20 points. Also, there is a 20 pts quiz that is part of the final.

Problem 1:

A 802.11 (Wireless LAN) packet has the following content in hexadecimal. Remember that bytes (not hex digits) need to be reversed. (The frame header has been removed, so this is the

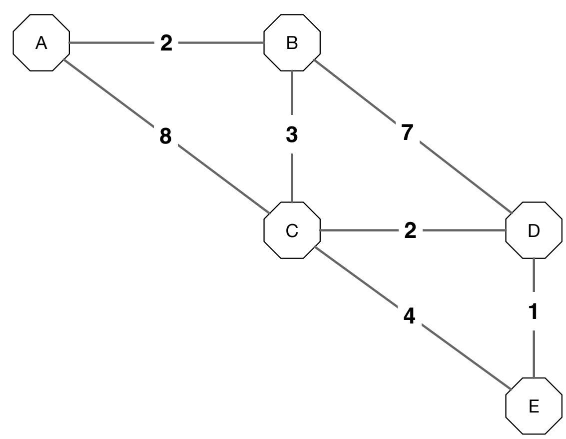
```
88 41 30 00 64 a5 c3 69   52 4d 38 f9 d3 90 56 5a
64 a5 c3 5e ac 95 80 41   01 00 e7 27 00 20 3f 01
00 00 23 66 09 34 1d af    …
```

Determine the destination and the source addresses.

Problem 2:

(Distance Vector Routing)

The network on the right has been recently configured and is running a / the Distance Vector Routing protocol. The current distance vector are in the table below. Each column gives a distance vector. An entry X: n, Y means that the distance to node X is n and a package to X is forwarded to Y. For instance, in the second column (Node B), there is an entry E: 14, A. This means that B can route a packet to E with a total cost of E. B forwards such a packet to A. When this packet arrives in A, the entry E: 12, C in Node A's distance vector applies, meaning that the package is forwarded to Node C, which then forwards it to Node E. Clearly, the route B-A-C-E is not optimal.



A	B	C	D	E
A: 0, -	A: 2, A	A: 8, A	A: ∞, -	A: ∞, -
B: 2, B	B: 0, -	B: 3, B	B: 7, B	B: 8, D
C: 5, B	C: 3, C	C: 0, -	C: 2, C	C: 4, C
D: ∞, -	D: 7, D	D: 2, D	D: 0, -	D: 1, D
E: 12, C	E: 14, A	E: 4, E	E: 1, E	E: 0, -

A distance vector routing protocol has nodes send their distance vector to an adjacent node. The recipient of such an update message then uses this information in order to update its own distance vector.

(a) Node D sends its distance vector to Node B. Show the new distance vector in Node B.
(b) How would Node B now treat a packet for Node E?
(c) After its update, Node B sends its distance vector to Node A. What is the new distance vector for Node A?
(d) After its update, Node B sends its distance vector to Node D. What is the new distance vector for Node D?

Problem 3:

The following is a fictitious forwarding table for IPv4 addresses at a router. For each entry, find the network mask in binary, the CIDR range of addresses, and the number of addresses. The addresses are non-routable, i.e. the fictitious router is inside a private network.

When receiving a packet with destination 10.14.101.12, what is the interface chosen for forwarding. Explain your decision.

CIDR Address (IPv4)	Interface
10.14.96.0/20	m1
10.14.100.0/23	m2
10.14.98.128/25	m3
10.14.0.0/16	m4
10.128.0.0/10	m1
10.0.0.1	m5
Default	m5

Problem 4:

The transport layer is responsible for providing reliable communication. We look at a long-haul network with a large bandwidth. The maximum transmittable unit (MTU) is assumed to be 1460 bytes of payload. Assume we are transmitting continuously at 10 MB/sec = 10^7 B/sec from Los Angeles to Miami over a distance of 4000 km. Assume further a processing delay of 100 μsec per router and three routers for a total of 300 μsec. The bandwidth of the connection is 100 Mb = per second. The medium is optical fiber with a speed of light of 204 m/μsec.

(e) What is the size of an IPv4 packet with 1480 B payload when using TCP?
(f) Assuming no queueing delay, what is the total network delay (propagation delay + transmission delay + processing delay) of a message of 1460B payload. (Neglect the frame overhead at the data link layer.)
(g) What is the total network delay of a frame if the payload is a single byte?

(h) How many frames per second of MTU size are needed to send 10^7 B/sec.
(i) Assuming that every frame is acknowledged and that transmission follows TCP Tahoe rules (after three acknowledgments of the same segment number, a frame is assumed to have failed), how many frames will have to be resent whenever one frame is lost.

Problem 5:

(a) How many bits are necessary to display a frame of "Full High Definition" TV using an image size of 1920×1080 pixels and 24bit per pixel. Assume that this is the "progressive" version where there is no interleaving.
(b) How many bits are needed per second at 30 frames per second.
(c) How many minutes of uncompressed FHDTV can a DVD (4.7 GiB = 4.7×10^9 Bytes) hold.
(d) The H.264/MPEG-4 standard provides a compression ratio of about 2000:1. How many minutes of compressed FHDTV can a DVD hold.