

Name Solution

Class: 348

1) (5 pts) You are designing a reliable byte stream transport layer protocol (not TCP) to operate over a 1×10^7 bps network and it is using a sliding window for flow control. The time for keeping the transmission pipe full is taken to be the RTT of the network which is 50ms. Each number in the advertised window or sequence number represents 2 Bytes of data.

a) (3 pts) What is the minimum number of bits necessary for the Advertised Window field of your protocol header? Provide this minimum number as a whole number (round your answer up to the next whole value. i.e. if you calculate 20.67 bits necessary, then the answer is 21)

$$\begin{aligned} & \text{delay} \times \text{BW} \\ &= 50 \times 10^{-3} \times 1 \times 10^7 \\ &= 5 \times 10^5 \text{ bits} \end{aligned}$$

$$2^n \times 2 \times 8 \geq 5 \times 10^5$$

$n = 15$

b) (2 pts) How would you choose the Sequence number size in accordance with the Advertised Window size determined in a)?

$$\begin{aligned} \text{SeqNum} &\geq 2 \times \text{AW} \\ &= 16 \text{ bits} \end{aligned}$$

2) (13 pts) Answer the following short answer questions.

a) (2 pts) What is the difference between flow control and congestion control in the TCP protocol?

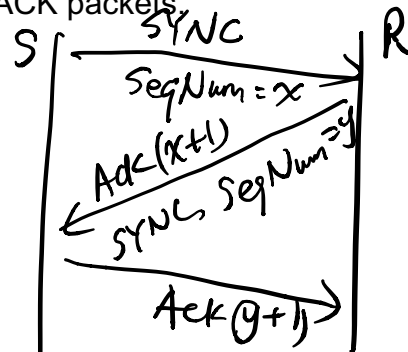
avoid receiver's
buffer overflow

avoid network devices'
buffer overflow

b) (2 pts) Why does the border gateway protocol (BGP) only find a possible, but not optimal, path to the destination (or an autonomous system)?

different ASs have different cost metrics

c) (3 pts) Draw the three-way handshake used to establish a TCP connection. Show all SYN and ACK packets. Also show all sequence and acknowledgement numbers (as a variable) associated with the SYN and ACK packets.



d) (2 pts) What makes the estimation of RTT in TCP difficult?

There are many intermediate devices
for an end-end connection.

e) (4 pts) If you want to connect 1,200 devices to the Internet and you are only allowed to get **one** IP class block, which IP class will you get for the highest IP usage efficiency? What is the IP usage efficiency in this situation? Class A-C IP address formats are given below.

$2^{16} > 1200$, so
class B.

$$\text{eff} = \frac{1200}{2^{16}} = 1.83\%$$



3) (8 pts) A TCP packet has been encapsulated in an IP packet (IP header, TCP header, Data). Answer the questions about the following IP packet: (values shown are hexadecimal values, so each individual character represents 4 bits, and each grouping of 4 characters is 16 bits. All of the TCP data is not completely shown)

4500 0047 0ff4 4000 7406 8682 c6aa cd22
92a5 643f fbd9 0050 bd51 a0f4 0000 0f21
7002 2238 1c80 0000 0204 05b4 0101 0402 ...

- A) What is the total length of this IP packet? Give your answer in the total number of bytes as a decimal number (not hex). **Hint: This information is contained in the "Length" field of the IP header.**

71 bytes

- B) Given the above finding, what is the percentage of effective (or meaningful) data in the IP packet? **Hint: it is the ratio between data payload size and the overall IP packet size. IP and TCP headers are not meaningful data.**

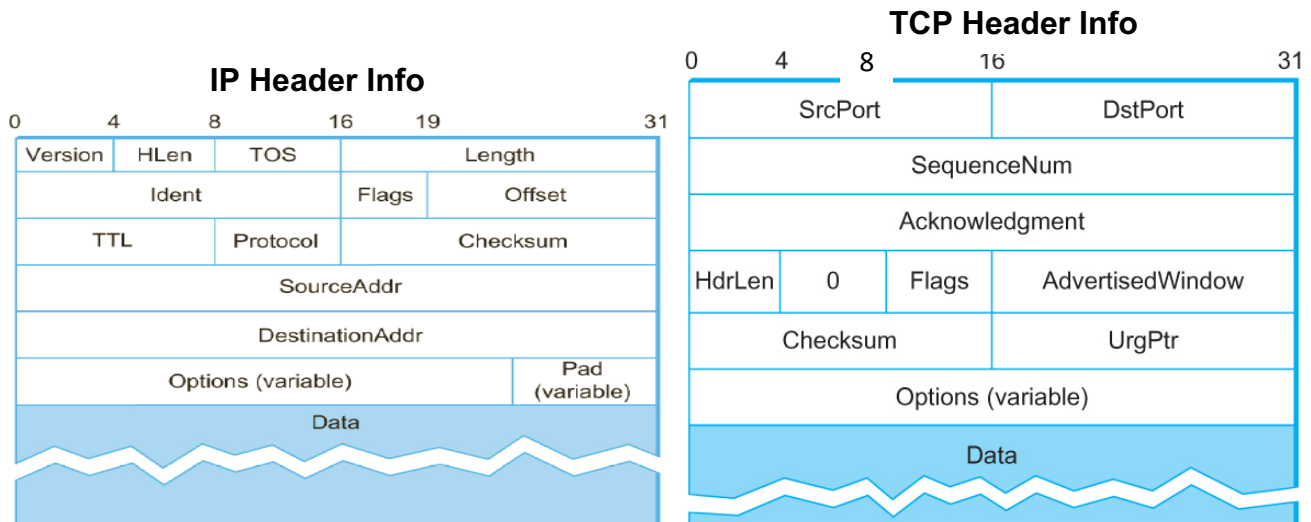
$$\text{off: } \frac{71 - 12 \times 4}{71} = 32.4\%$$

- C) What is the destination IP address? Give this as decimal numbers in the form #.#.#.#

146.165.100.63

- D) What is the destination port number? give this as a decimal number (not hex).

41204



4) (8 pts) A router has the following (CIDR) entries in its routing table

Address/mask	Next Hop
156.87.64.0/22	Interface 0
156.87.72.0/22	Interface 1
156.87.56.0/21	Router 1
156.87.48.0/20	Router 2
Default	Router 3

What is the next hop that the router selects when it receives IP packets with the addresses shown below? **Show your work for full credits.**

a) 156.87.52.10

a) Next Hop R2

b) 156.87.85.14

b) Next Hop R3

c) 156.87.57.2

c) Next Hop R1

d) 156.87.69.7

d) Next Hop R3

5) (8 pts) Link State: Perform the Link State Routing Algorithm for node A by completing the confirmed and tentative list columns. Note that costs are additive (e.g., latency, number of hops). The link state packets sent by the nodes in the network are shown below. **Link state packets are in the form of (destination, cost, next hop).** When finished, provide the routing table for node A.

For a cost tie in the tentative column, chose the lower letter node first [i.e. if tentative list contains (A,4,E) and (C,4,D) select (A,4,E) over (C,4,D)]

Node A	Node B	Node C	Node D	Node E	Node F
B,3,B	A,3,A	A,4,A	A,2,A	B,2,B	B,5,B
C,4,C	C,2,C	B,2,B	E,4,E	C,3,C	E,1,E
D,2,D	E,2,E	E,3,E		D,4,D	
	F,5,F			F,1,F	

ConfirmedTentative

(A, 0, -)

(B, 3, B) (C, 4, C) (D, 2, D)

(A, 0, -), (D, 2, D)

(B, 3, B) (C, 4, C) (E, 6, D)

(A, 0, -), (D, 2, D), (B, 3, B)

(C, 4, C) (E, 5, B) (F, 8, B)

(A, 0, -), (D, 2, D), (B, 3, B)

(E, 5, B) (F, 8, B)

(C, 4, C)

(A, 0, -), (D, 2, D), (B, 3, B)

(F, 6, B)

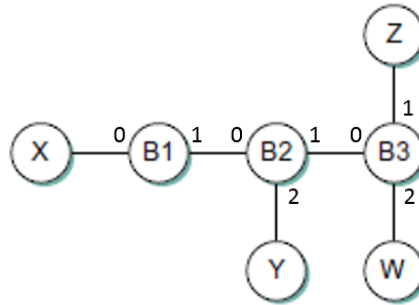
(C, 4, C), (E, 5, B)

(A, 0, -), (D, 2, D), (B, 3, B)

(C, 4, C), (E, 5, B), (F, 6, B)

Node A Routing Table		
Destination	Cost	NextHop
B	3	B
C	4	C
D	2	D
E	5	B
F	6	B

6) (8 pts) Consider the following network where W, X, Y and Z are nodes and B1, B2 and B3 are learning bridges. (Designed from HW3 Q2)



Assume that the forwarding tables for the three bridges are all empty when the three **transmissions below are made in the order shown**. After the transmissions have been made, what are the contents of the forwarding tables for the three bridges? In the above network, B1 has interfaces 0 and 1, B2 has interfaces 0, 1 and 2, and B3 has interfaces 0, 1 and 2.

Transmissions:

1) X transmits to W 2) Z transmits to X 3) Y transmits to X

Fill in the table below for the three Bridges. If a destination node is unknown for a bridge, **write unknown** for the interface (in that case the bridge would forward a packet for that destination out on all outgoing interfaces). **The tables below are to be filled in with the interface number that the bridge would use to forward a packet to the destination specified.** The bridges learn this information as nodes make transmissions on the network.

Bridge B1		Bridge B2		Bridge B3	
Destination	Interface	Destination	Interface	Destination	Interface
W	unknown	W	unknown	W	unknown
X	0	X	0	X	0
Y	1	Y	2	Y	unknown
Z	1	Z	1	Z	1

7) Bonus (3 pts) What do you expect the course to change or to keep in the remaining semester?