14-740: Fundamentals of Computer and Telecommunication Networks

Quiz #2 Fall 2020
Duration: 75 minutes

Name: ANSWER KEY Andrew ID: _____

Important:

- Each question is to be answered in the space provided. Material written on the back of the page or in space above or below the question will not be graded.
- This is a closed book exam -- you may not use any reference materials, crib sheets, or formula cards.
- Calculators are not needed, nor allowed.
- **Write legibly**. Unreadable work will be considered incorrect.
- At the end of the final duration, you will be told to "Cease Work." Immediately stop writing and turn in your paper. Any writing after this point will result in a zero grade.
- Answer all questions based on material presented in class. In the real world, there is an exception to just about every statement Prof Nace has made about networks. This exam is too the place to point out those situations.

Page 2	_____ (22 possible)
Page 3	_____ (25 possible)
Page 4	_____ (28 possible)
Page 5	_____ (15 possible)
Page 6	_____ (10 possible)
Total	_____ (100 possible)

I understand that the CMU and course policies on cheating apply to this quiz.

_____

signature date

1. List three responsibilities (or key functions) of the Transport Layer. (6 points)

Multiplex / Demultiplex messages

Segment messages

Connection setup

2. The Go-Back-N (GBN) and Selective Repeat (SR) protocols both use receiver feedback tools, but they use them in different ways. Describe those differences as well as the implications of the difference -- why are protocol details different as a result? (10 points)

The main difference is that GBN uses a cumulative acknowledgement, while SR does not. As a result, GBN cannot directly acknowledge an out-of-order segment and discards them instead.

3. A client application established a TCP connection with a server application and now has 2000 bytes of data to transmit. There are no losses or duplicate ACKs. How many segments will be immediately sent? If more than zero, specify how many bytes will be in each one. Show your work. (12 points).

Client ISN = 5000, Server ISN = 6000, MSS = 1500, Congwin = 4000, SSthresh = 3000, Receive Window=2800, Highest ACK# from server = 9000, SendBase = 10000

RxWindow allows for sending up to byte number 9000+2800-1= 11799.

CongWindow allows for sending up to byte number 9000+4000-1 = 12999

Next byte to send is 10000, so the sender has permission to send 1800 bytes.

MSS of 1500 means:

Segment #1: 1500 bytes. Segment #2: 300 bytes

Don't write down here. This is not considered "space provided." Anything you write down here will not be graded (nor even read).

4. Describe the congestion-avoidance phase of TCP Reno. In particular:

• How does one get into this phase? (2 points):

From slow start, have congwin get bigger than ssthresh.

• How else does one get into this phase? (2 points):

From fast recovery, get an ACK greater than the 3 dup ack value

• What happens when a segment is ACKed normally? (2 points):

Congwin is increased by 1 MSS/RTT

• What happens when a segment is ACKed too late (i.e. premature timer)? (2 points):

Retransmission timer is cancelled. Congestion window is advanced.

• What happens every time the timer goes off? (3 points):

Retransmission of the lost segment, timer is restarted, set thresh to half of congwin,

enter slow start with congwin = 1MSS.

• What happens every time a duplicate ACK is received? (1 points):

Nothing

5. A router wants to forward an 800-byte long IPv4 packet on a link with an MTU of 400 bytes. Calculate as many fragmentation packets as would be required. For each fragment, specify the length of each fragmented packet (in bytes) and the values for all fragmentation-related header fields. The original packet had no options and DF=0. (12 points)

Fragment 1: (400-20)/8 = 47.5. Length = 47*8+20 = 396 bytes. Id = 14740, MF =1,

DF=0, Offset = 0.

Fragment 2: Also 396 bytes, ID = 14740, MF=1, DF=0, Offset = 47

Fragment 3: Original data was 780 bytes. Fragments 1 and 2 have carried 2*376 = 752.

That leaves 28 payload + 20 header = 48 bytes long. ID = 14740, MF=0,

DF=0, Offset = 47*2=94

6. For each of the following BGP attributes, tell me: what it is, what its purpose(s) is(are), if it is required on every prefix announcement. If applicable, also list situations in which it is NOT used on a prefix announcement. (12 points)

A: NEXT_HOP: the IP address of the router interface to which packets for this prefix may be sent. It is a link between the IGP and BGP. It is required.____

B: AS_PATH: The list of Autonomous System Numbers leading to the prefix. It is used to filter, for loop detection and prefix selection. It is required.___

C: MED: Multi-exit discriminator. Used to tell a neighboring AS which, of several, links is preferred for this traffic. Not required. Not used unless multiple links exist between the two ASes._____

D: LOCAL_PREF: Expresses priorities based on internal policies. Used by network administrators for whatever they desire. Not required. Not used for announcements leaving the AS.___

7. DHCP has a separate field for *chaddr*, a unique client hardware identifier. Why is it necessary to communicate this value? Doesn't a networking client already have plenty of ways to identify itself? (8 points)

No, it doesn't. When DHCP is most useful (during network configuration on the client), the client doesn't yet have an IP address, so some other value must be used to identify it.

Don't write down here. This is not considered "space provided." Anything you write down here will not be graded (nor even read).

8. This is a list of some characteristics of routing protocols:

   A. Link State
   B. Distance Vector
   C. Internal Gateway Protocol
   D. Paradoxical Gateway Protocol
   E. Fast Convergence
   F. Mistakes are seen globally
   G. O(n log n) complexity
   H. Count-to-infinity problem
   I. Uses UDP or TCP

For each of these routing protocols write the letter of ALL matching characteristics from the list. (10 points)

RIP: B, C, H, I

BGP: F, I, (will accept H), (B for half-credit)

OSPF: A, C, E, G

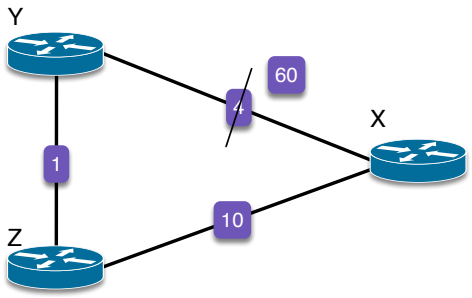
9. What stops a network engineer from building and selling a custom version of TCP which captures extra bandwidth by ignoring ReceiveWindow limitations. Assume the engineer is very clever and can implement a version that really works and averages 20% extra bandwidth for the custom TCP streams. (10 points)

Ethics and a realization that if everyone does this, then the long-term internet will underperform.

Half-point answer: Nothing stops the engineer. There are no TCP police.

Don't write down here. This is not considered "space provided." Anything you write down here will not be graded (nor even read).

10. In lecture, I showed this figure and described something known as the *count-to-infinity* problem. I said, “Actually, you don’t count to infinity, it’ll stop somewhere first.” Was I right (spoiler: no)? Make one or a small number of changes to the figure so that the routers involved will actually count to infinity. Describe the change and why it works. (8 point)



Entirely remove the link between X and Z and the link between X and Y.

We saw the example in class stopped as soon as Z discovered that C(Z,X) was less than the cost Y was advertising + 1 (the C(Y,Z) value). If the lowest cost of the two links is infinity, then the cost Y advertises +1 will never be more than infinity.

BTW: this can happen in real life, anytime there is a network partition.

Don't write down here. This is not considered "space provided." Anything you write down here will not be graded (nor even read).