中山大学软件学院 2009 级软件工程专业(2011 学年秋季学期)

# 《SE-301 计算机网络》期末试题参考答案(A)

1. (12 points.) In this problem we consider sending real-time voice from Host A to Host B over packet-switched network (VoIP). Host A converts analog voice to a digital 64 kbps bit stream (encode) on the fly. Host A then groups the bits into 56-byte packets. There is one link between Host A and B; its transmission rate is 500 kbps and its propagation delay is 2 msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet's bits to an analog signal (decode). How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

**Solution:**

Consider the first bit in a packet. Before this bit can be transmitted, all of the bits in the packet must be generated. This requires

$$\frac{56 \cdot 8}{64 \times 10^3} \text{ sec} = 7 \text{ msec.(3 points)}$$

The time required to transmit the packet is

$$\frac{56 \cdot 8}{1 \times 10^6} \text{ sec} = 448\mu \text{ sec.(3 points)}$$

Propagation delay = 2 msec.

The delay until decoding is

$$7 \text{ msec} + 448\mu \text{ sec} + 2\text{msec} = 9.448 \text{ msec.(4 points)}$$

A similar analysis shows that all bits experience a delay of 9.448 msec.

2. (12 points) Suppose Alice, with a Web-based e-mail account (such as gmail), sends a message to Bob, who accesses his mail from his mail server using POP3. Discuss how the message gets from Alice's host to Bob's host. Be sure to list the series of application-layer protocols that are used to move the message between the two hosts.

   Solution:

   Message is sent from Alice's host to her mail server over HTTP. Alice's mail server then sends the message to Bob's mail server over SMTP. Bob then transfers the message from his mail server to his host over POP3.

3. (10 points) Consider transferring an enormous file of L bytes from Host A to Host B. Assume an MSS of 1,460 bytes.
   a) What is the maximum value of L such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.(4 points)
   b) For the L you obtain in (a), find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 100 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.(6 points)

   Hint: $2^{32} = 4,294,967,296 \approx 4.19$ Gbyte

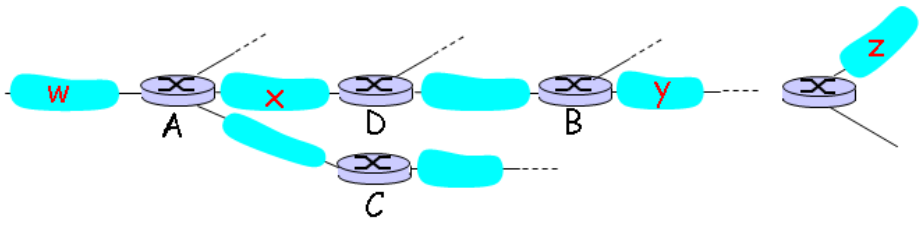
Solution:

a) The sequence number does not increment by one with each segment. Rather, it increments by the number of bytes of data sent. So the size of the MSS is irrelevant -- the maximum size file that can be sent from A to B is simply the number of bytes representable by $2^{32} = 4,294,967,296 \approx 4.19$ Gbytes.

b) The number of segments is $\left\lceil \frac{2^{32}}{1460} \right\rceil = 2{,}941{,}758$. 66 bytes of header get added to each segment giving a total of 194,156,028 bytes of header. The total number of bytes transmitted is $2^{32} + 194{,}156{,}028 = 3{,}591 \times 10^7$ bits.

Thus it would take 3,591 seconds = 59 minutes to transmit the file over a 10~Mbps link.

4. (12 points) Suppose there is an autonomous system using RIP protocol. Consider the following figure.




routing table in router D

| destination subnet | next router | # hops to dest |
|---|---|---|
| w | A | 2 |
| y | B | 2 |
| z | B | 7 |
| x | -- | 1 |
| .... | .... | .... |

Starting with the original table in D, suppose that D receives from A the following advertisement:

| Destination Subnet | Next Router | # Hops to Destination |
|---|---|---|
| z | C | 5 |
| w | - | 1 |
| x | - | 1 |
| … | … | … |

a) Brief explain the RIP protocol.(6 points)

b) Will the table in D changes? If so how?(6 points)

Solution: a) Ref to text book. DV. b) Yes. Change from 7 to 6.

5. (12 points)Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 222.200.176/20. Also suppose that Subnet 1 is required to support up to 2000 interfaces, and Subnet 2 and 3 are each required to support up to 1000 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints.
(Hints: $2^{10}$=1024, $2^{11}$=2048, $2^{12}$=4096, $176_{10}=10110000_2$)
Solution: Total interfaces = $2^{12}$=4096, from 222.200.176.0 to 222.200.191.255, i.e.
11011110.11001000.10110000.00000000
throught
11011110.11001000.10111111.11111111
Subnet 1: 222.200.176/21, with $2^{11}$ interfaces: 222.200.176.0~222.200.183.255, i.e.
11011110.11001000.10110000.00000000
throught
11011110.11001000.10110111.11111111

Subnet 2: 222.200.184/22, with $2^{10}$ interfaces: 222.200.184.0~222.200.187.255
i.e.
11011110.11001000.10111000.00000000
throught
11011110.11001000.10111011.11111111

Subnet 3: 222.200.188/22, with $2^{10}$ interfaces: 222.200.184.0~222.200.187.255
i.e.
11011110.11001000.10111100.00000000
throught
11011110.11001000.10111111.11111111

6. (8 points) Consider the 4-bit generator, G=1011, and suppose that D has the value 11111010. What's the CRC value of R? Give the detailed calculation.
Solution: R=111, n=11010101

7. (16 points) I have a notebook computer. I bring it to the teaching building, and power it on. Now I want to check the homepage of our school, ss.sysu.edu.cn, with Internet Explorer. Please explain from the **wireless router**'s (router that my

machine will directly connect to, it is the WIFI AP device) **perspective** (视角), what kind of operation (**from application layer, if exist, down to data link layer**), the router must do to get the webpage to display. (Hint: You can focus on the router function of the AP device only)

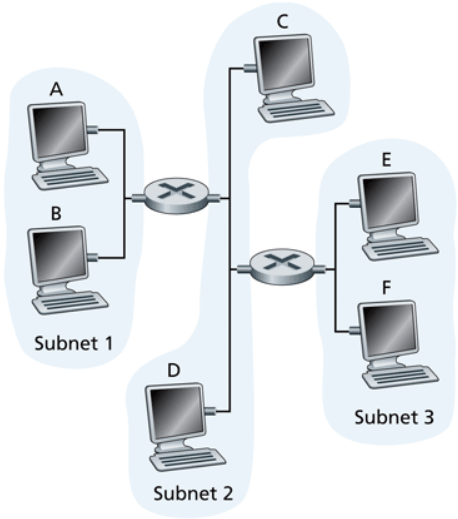
Solution: (1) Router need not handle any application and transport layer information.

(2) Router might need to handler DNS (name to IP packet lookup) packet if DNS server is not on the same subnet.

(3) Router might also receive ARP query on it is IP to MAC mapping. This happens when first packet needs to be sent out via the router.

(4) To relay packet to the DNS server or the destination host, it need to look up the next hops for packets. To send packets to next hops, proper layer-2 mechanisms such as ARP to generate cache, generate layer-2 frames must be done.

8. (10 points)Consider the following figure.

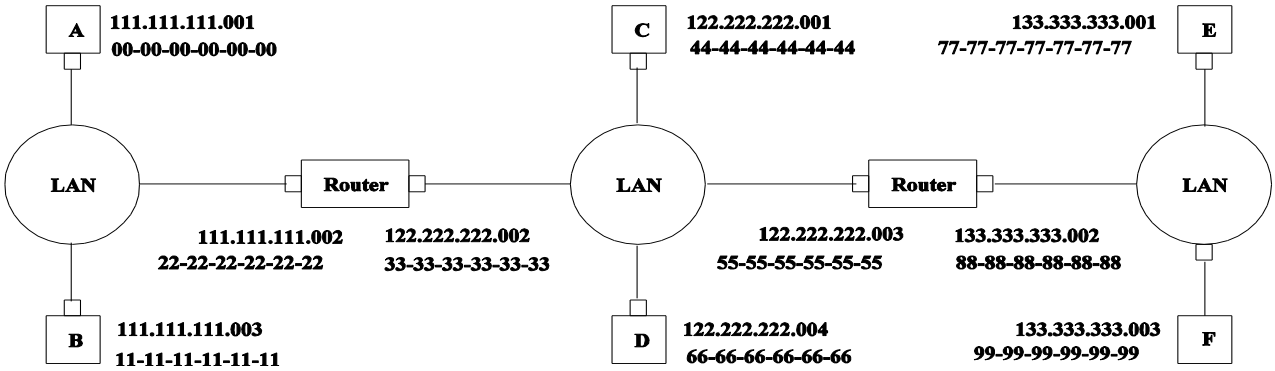



Provide MAC addresses and IP addresses for the interfaces at Host A, both routers, and Host E. Suppose Host A sends a datagram to Host E. Give the source and destination MAC addresses in the frame encapsulating this IP datagram as the frame is transmitted

a) from A to the left router,
b) from the left router to the right router,
c) from the right router to E.

Also give the source and destination IP addresses in the IP datagram encapsulated within the frame at each of these points in time.

**Solution:**




i) from A to left router: Source MAC address: 00-00-00-00-00-00
Destination MAC address: 22-22-22-22-22-22
Source IP: 111.111.111.001
Destination IP: 133.333.333.003

ii) from the left router to the right router: Source MAC address: 33-33-33-33-33-33
Destination MAC address: 55-55-55-55-55-55
Source IP: 111.111.111.001
Destination IP: 133.333.333.003

iii) from the right router to F: Source MAC address: 88-88-88-88-88-88
Destination MAC address: 99-99-99-99-99-99
Source IP: 111.111.111.001
Destination IP: 133.333.333.003

9. (8 points) What are the differences between wireless link to wired link? What additional problems do the multiple wireless senders and receivers create (beyond multiple access)?
Solution: 1)**decreased signal strength:** radio signal attenuates as it propagates through matter (path loss), 2)**interference from other sources:** standardized wireless network frequencies (e.g., 2.4 GHz) shared by other devices (e.g., phone); devices (motors) interfere as well; 3)**multipath propagation:** radio signal reflects off objects ground, arriving ad destination at slightly different times
**Hidden terminal problem and Signal attenuation problems.**