Computer Network Midterm 2019

Question 1: " Basic of Computer Networks and the Internet " (15%)

a) The amount of time required to push all of a packet's bits into a link is called _____

b) The Internet's application layer includes many protocols, such as the _____ protocol (which provides for Web document request and transfer), _____ (which pro-vides for the transfer of e-mail messages), and _____ (which provides for the transfer of files between two end systems).

c) How many IP Protocols are there in the Internet? Please specify their names respectively. _____

d) An application-layer process sends messages into, and receives messages from, the network through a software interface called a _____. This is also referred to as an API which stands for _____.

e) Internet protocols are defined in _____.

f) In order to deal with the issue of scale, the DNS uses a large number of servers, organized in a_____ fashion and distributed around the world. No single DNS server has all of the mappings for all of the hosts in the Internet. Instead, the mappings are distributed across the DNS servers. To a first approximation, there are three classes of DNS servers— _____ DNS servers, _____ DNS servers, and _____ DNS servers

g) In a DNS server, a resource record is a four-tuple that contains the following fields: (Name, Value, Type, TTL) The meaning of Name and Value depend on Type:

- If Type = A, then Name is a _____ and Value is the _____for the host-name. Thus, a Type A record provides the standard hostname-to-IP address mapping. As an example, (relay1.bar.foo. com,145.37.93.126, A) is a Type A record.
- If Type = ____, then Name is a domain and Value is the host-name of an authoritative DNS server that knows how to obtain the IP addresses for hosts in the domain. This record is used to route DNS queries further along in the query chain.

Question 2: " End to end transmission " (10%)

How long does it take a packet of length 3,000 bytes to transmit from one end to the other end over a link of distance 2,500 km, propagation speed 2.5×10^8 m/s, and transmission rate 4 Mbps?

(Please write down your calculation process, or you will get 0 point)

Question 3: " Quickies " (35%)

Answer each of the following questions *briefly, i.e., in at most 3 sentences.*

a) (15%)

①(5%) What does it mean when we say that control messages are "in-band"?

②(5%) What does it mean when we say that control messages are "out-of-band"?

③(5%) Give an example of a protocol that has in-band control messages and one example of a protocol that has out-of-band control messages.

b) (5%) Consider a TCP connection between hosts A and B. Suppose that the TCP segments from A to B have source port number x and destination port number y. What are the source and destination port numbers for the segments traveling from B to A?

c) (5%) What is the purpose of the connection-oriented welcoming socket, which the server uses to perform an *accept()*? Once the *accept()* is done, does the server use the welcoming socket to communicate back to the client? Explain..

d) (10%) Suppose a web server has 300 ongoing TCP connections.

①(5%) How many server-side sockets are used?

②(5%) How many server-side port numbers are used?

(Hint: remember the server implements fork() as introduced in lectures)

Question 4: " A reliable data transfer protocol " (25%)

Consider a scenario in which a Host A wants to simultaneously send messages to Hosts B and C. A is connected to B and C via a broadcast channel – a packet sent by A (e.g., in a single udt_send() operation) is carried by the channel to both B and C. Suppose the broadcast channel connecting A, B, and C

- can independently lose and corrupt messages from A to B and C (and so, for example, a message sent by A might be correctly received at B but not at C)
- has a maximum bounded delay of D (i.e., if a message is sent by A, it will either be lost or arrive at B and/or C within D time units).
- any control messages (e.g., an ACK or NAK) sent by B or C to A will only be received by A but can be lost or corrupted

a) (20%) Design a stop-and-wait-like error-control protocol for reliably transferring a packet from A to B and C, such that A will not get new data from the upper layer until it knows that *both* B and C have correctly received the current packet. Give a FSM description for A and B (assuming the FSM for C is similar, if it is not similar give the FSM for C as well).

b) (5%) Also, give a description of the packet format used.

Question 5: " DNS service " (15%)

Suppose you open a startup company "foo" and want to set up your company network. Your network has the following servers:

- DNS server: "dns1.foo.com" with IP as "140.112.30.40"
- Web server: "foo.com" with two IP as "140.112.30.55" and "140.112.30.56". The web server also has a name as "www.foo.com".
- Email server: "galaxy.foo.com" with IP as "140.112.30.60"
- Your company's email address is "username@foo.com".

a) (5%) What resource records (RRs) do you need to provide to the upper-level ".com" Registrar?

b) (10%) What RRs do you need to put in your company's DNS server?

Question 6: " Caching and delays " (25%)

Consider the networks shown in the figure below. There are two user machines m1.a.com and m2.a.com in the network a.com. Suppose the user at m1.a.com types in the URL www.b.com/bigfile.htm into a browser to retrieve a 1Gbit (1000 Mbit) file from www.b.com.

a) (5%) List the sequence of DNS and HTTP messages sent/received from/by m1.a.com as well as any other messages that leave/enter the a.com network that are not directly sent/received by m1.a.com from the point that the URL is entered into the browser until the file is completely received. Indicate the source and destination of each message. You can assume that every HTTP request by m1.a.com is first directed to the HTTP cache in a.com and that the cache is initially empty, and that all DNS requests are iterated queries.

b) (5%) How much time does it take to accomplish the steps you outlined in your answer to **a)** ? Explain how you arrived at this answer. In answering this question, you can make the following assumptions

- The packets containing any DNS commands and HTTP commands such as GET are very small compared to the size of the file, and thus their transmission times (but not their propagation times) can be neglected.
- Propagation delays within the LAN are small enough to be ignored. The propagation from router R1 to router R2 is 100 ms.
- The propagation delay from anywhere in a.com to any other site in the Internet (except b.com) is 500 ms.

c) (5%) Now assume that machine m2.a.com makes a request to exactly the same URL that m1.a.com made. List the sequence of DNS and HTTP messages sent/received from/by m2.a.com as well as any other messages that leave/enter the a.com network that are not directly sent/received by m2.a.com from the point that the URL is entered into the browser until the file is completely received. Indicate the source and destination of each message.

[Hint: make sure you consider caching here]

d) (5%) How much time does it take to accomplish the steps that you outlined in your answer to c) ?

e) (5%) Now suppose there is no HTTP cache in network a.com. What is the maximum rate at which machines in a.com can make requests for the file www.b.com/bigfile.htm while keeping the time from when a request is made to when it is satisfied non-infinite in the long run?