King Fahd University of Petroleum & Minerals
College of Computer Science and Engineering

ICS 343: Fundamentals of Computer Networks [Term 162]

Major Exam I

Date & Time: Wednesday March 8, 2017 [7:30PM-9:00PM]

Duration: 90 Minutes

Ref. Book Chapters 1, 2, 23, 25, 26 & Lecture slides

Student ID#	
Student Name	

Question	Max. Points	Points	CLO
1	~~35~~ **20**		1 and 2
2	20		1 and 2
3	20		1 and 2
4	25		1 and 2
Total	~~100~~ **85**		

Notes. 1. Make sure you have **Nine** different pages including cover page
2. This is not an Open Book/Notes Exam
3. Provide brief, clear and precise answers
4. Cheating will result in DN grade

Question 1 [35 Points].

1. **[6 Points]** What is the difference between **multiplexing** and **de-multiplexing**? Why are they needed?

Answer:
Since the TCP/IP protocol suite uses several protocols at some layers, we can say that we have multiplexing at the source and demultiplexing at the destination.

Multiplexing in this case means that a protocol at a layer can encapsulate a packet from several next-higher layer protocols (one at a time); demultiplexing means that a protocol can decapsulate and deliver a packet to several next-higher layer protocols (one at a time).

Refer to Section 2.2.6

2. **[8 Points]** Match the following functions to the proper layers of the TCP/IP model
    a) Enabling the user, whether human or machine to access the network
        Application Layer
    b) Carrying individual bits across the link **Physical Layer**
    c) Setting process-to-process connections (via socket interfaces) **Application Layer**
    d) Routing across the network(s) **Network Layer**

3. **[6 Points]** Define the following terms:

    a) Error Control:
        - Detecting and discarding **corrupted**, **lost**, **duplicate** and **out-of-order** packets until the missing packets arrive
    b) Congestion Control:
        - Control **transmission rate** by setting transmission "**window size**".

    c) Flow Control:
        - The **sender's communication with the receiver** on the rate of sending packets in order to avoid overwhelming the receiver's. Buffering is utilized here

Refer to Book & Lecture 07 Slides

4. **[15 Points]** Given the figure below, explain why the five communication devices between 'A' and 'B': *(source, destination, router and switches)* do not implement all TCP/IP layers. Explain the case for each device.

THIS QUESTION IS NOT INCLUDED IN THE EXAM'S SCORE
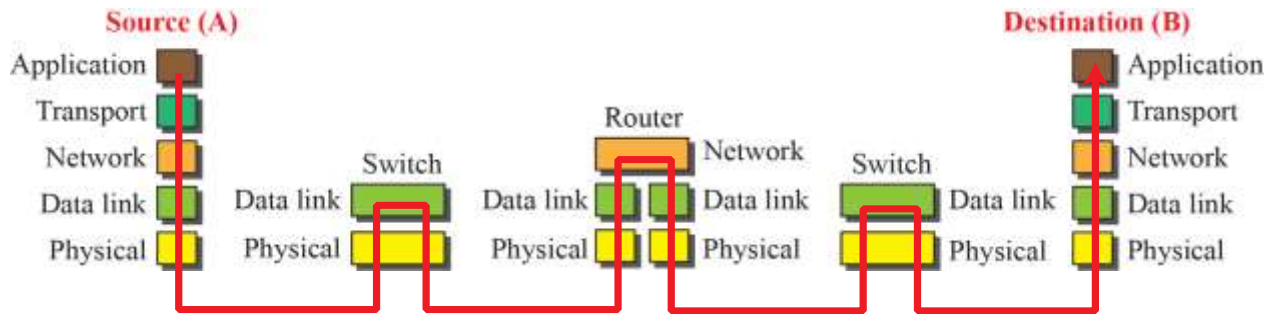
Answer:

We have five communication devices:
- **Source host (computer A)**
- **First Link-layer switch.**
- **A router**
- **Second Link-layer switch**
- **Destination host (computer B)**

Each device is involved with a set of layers depending on the role of the device in the inter-network. The two hosts are involved in all five layers.

The source host needs to create a message in the application layer and send it down the layers so that it is physically sent to the destination host.

The destination host needs to receive the communication at the physical layer and then deliver it through the other layers to its application layers.
Since all TCP/IP layers are utilized in the processes of end-to-end transmission, hosts A and B are involved with all five layers as shown above.

The router is involved in only three layers. There is no transport or application layers in a router as long as the router is used only for routing. A router is always involved in one network layer, it is involved in n combinations of link and physical layers, where n is the number of links the router is connected to.

A link layer switch is involved in only in two layers, data-link and physical. The connections at a switch are always in the same link (network). This means that unlike the router, a swich doesn't need to be involved with a network layer and it only needs the lower two layers of the TCP/IP suite.

Refer to Figure 2.5, Page 36

Question 2 [20 Points].

a) What are Socket addresses? How are they related to the Application Layer? How are they related to the Transport Layer? (*5 Points*)

An application creates a socket when it needs a connection to a network. It then establishes a connection to a remote application via the socket. Communication is achieved by reading data from the socket and writing data to it

**[3 Points] A local/remote socket address defines:**
- **The client/server computer (IP address)**
- **The application (process) program (Port number)**

32 bits	16 bits
IP address	**Port number**

Socket Address

**Each of the server and client need a pair of local and remote socket address for communication.**

b) Conceder the e-mail scenario depicted in the figure below, explain the meaning of using SMTP and HTTP by the client host and the server host, respectively. (*5 Points*)
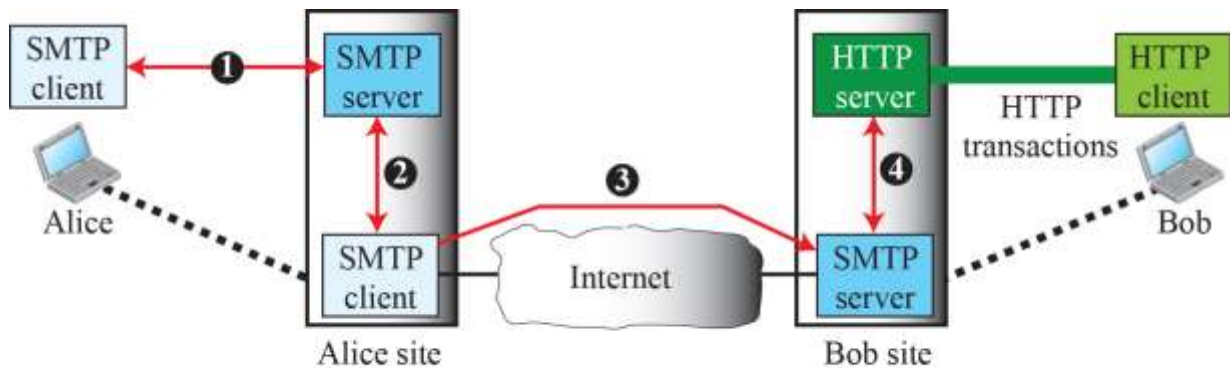
Since SMTP is applied, the user (Alice) is using a PUSH e-mail client and protocol. This However, since HTTP is used at the other host, it means that (Bob) is using a web-based e-mail service. There is no need for a PULL protocol tp retrieve the messages from the MAA.

Consider the e-mail communication scenario depicted in the figure below *(10 Points)*

- Describe the role of MTA client/server
- Describe the role of MAA client/server
- What are the consequences of replacing MAA client/server with MTA client/server?
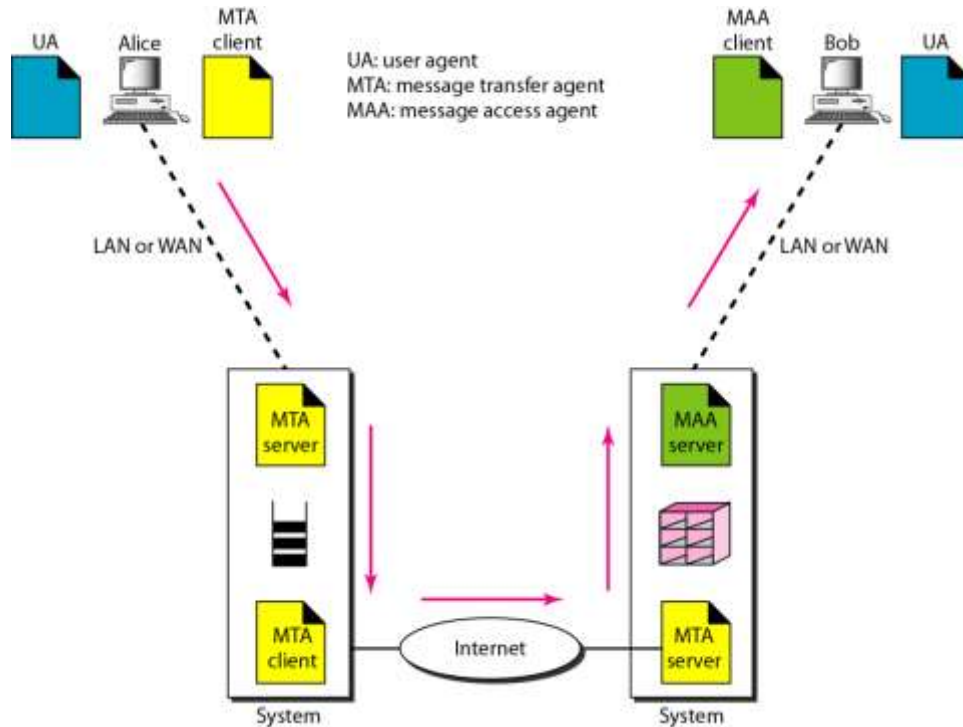
Answer:

- **An MTA is software that is responsible for e-mail transmission (sending) using a client-server application model under the Application layer's SMTP Protocol.**
- **An MAA is software that is responsible for e-mail retrieval using a client-server application model under the Application layer's message access protocols such as IMAP or POP.**
- **MTA client/servers use push mechanisms. Whereas MAA clients/servers use pull mechanisms.**

- **Replacing MAA client/server with MTA client/server may result in the sender not being able to retrieve any email messages for the e-mail server, unless if the recipient's MTA.**

Question 3 [20 Points].

a) A File Transfer Protocol (FTP) session between a client and an FTP server has two types of connections. What are they? Explain the differences between them. *(5 Points)*

Answer:
FTP uses the services of TCP. It needs two TCP connections: one for data transfer and the other for control information.
The two connections in FTP have different lifetimes

- **The control connection remains connected during the entire interactive FTP session.**
- **The data connection is opened and then closed for each file transfer activity. It opens each time commands that involve transferring files are used, and it closes when the file is transferred**

b) What is the Difference between a Uniform Resource Locator (URL) and a Fully-Qualified Domain Name (FQDN)? (*5 Points*)
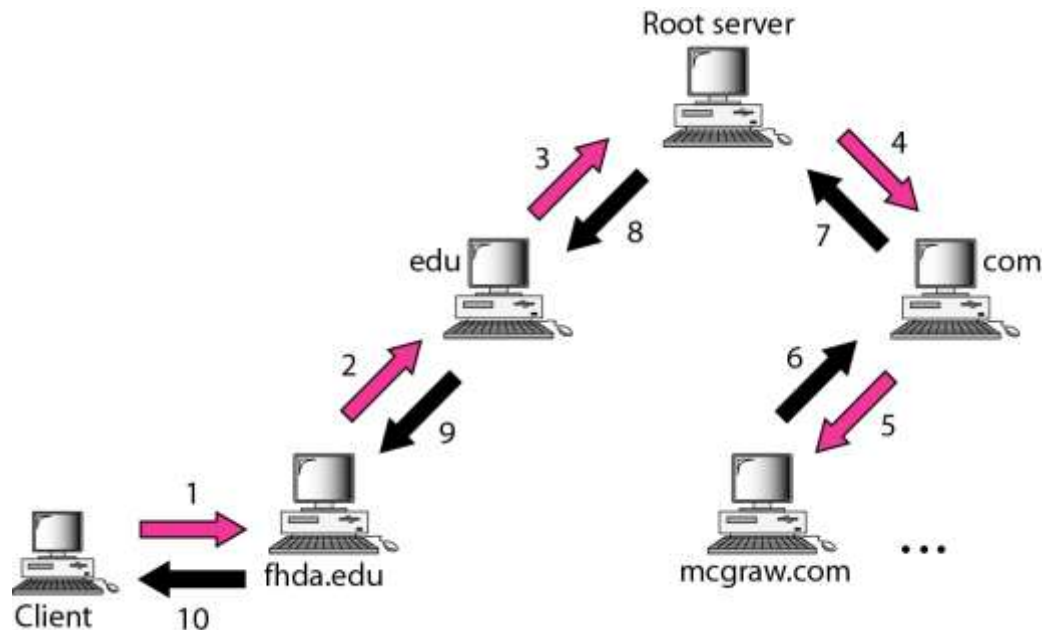
Answer:
The FQDN is part of the full URL.
A URL is a Web address. It is a unique identifier of a *web page* that states its protocol, host, port and path.
A FQDN specifies the exact location of a *domain name* in the tree hierarchy of the Domain Name System (DNS).
A FQDN is that portion of an Internet Uniform Resource Locator (URL) that fully identifies the server program that an Internet request is addressed to. The prefix "http://" added to the fully-qualified domain name completes the URL.

c) Conceder the name-address resolution in the figure below. Is this Recursive Resolution or Iterative Resolution? What is the difference between the two approaches? (*10 Points*)

Answer:

The figure depicts *Recursive* Resolution.
In recursive resolution, if the answer to the query (the resolution) is no found at the first server, then that server will re-send the query on behalf of the client. A recursive query is one which the DNS server, who received your query, will do all the work of fetching the answer, and giving it back to you. During this process, the DNS server might also query other DNS server's in the internet on your behalf, for the answer.

However, in an iterative query, the name server, will not go and fetch the complete answer for the client's query, but will give back a referral to other DNS server's, which might have the answer. You (as a client) must then try again until you get the answer.

Refer to Section 26.6.3

Question 4 [25 Points].

a) Compare between *Stop-and-Wait*, *Go-Back-N* and *Selective Repeat* protocols in terms of: *(15 Points)*

	Stop-and-wait	Go-back-n	Selective-repeat
Max send window size	1	$2^m - 1$	2^{m-1}
Max receive window size	1	1	2^{m-1}
Acknowledgement (cumulative or non-cumulative)	Non-cumulative	Cumulative	Non-cumulative
Out-of-order packets (keeps them or discards them)	discards	discards	keeps

b) Circle the correct answer *(10 Points)*:

1- In Go-Back-N, if the window size is 63, what is the range of sequence numbers?

    A) 0 to 63

    B) 0 to 64

    C) 1 to 63

    D) 1 to 64

2- In Go-Back-N, if frames 4, 5, and 6 are received successfully, the receiver may send an ACK _____ to the sender.

    A)   5

    B)   6

    C)   7

    D)   Any of the above

3- For Stop-and-Wait, for 10 data packets sent, _____ acknowledgments are needed.

    A)   Exactly 10

    B)   Less than 10

    C)   More than 10

    D)   None of the above

4- The _____Protocol has flow control, but not error control.

A)   Stop-and-Wait

B)   Simplest

C)   Go-Back-N

D)   Selective-Repeat

5- The _____Protocol has both flow control and error control.

A)   Stop-and-Wait

B)   Go-Back-N

C)   Selective-Repeat

D)   Both (b) and (c)

6- In the _____ protocol we avoid unnecessary transmission by sending only frames that are corrupted.

A) Stop-and-Wait

B) Go-Back-N

C) Selective-Repeat

D) none of the above

7- In Go-Back-N, if 5 is the number of bits for the sequence number, then the maximum size of the send window must be _____

A)   15

B)   16

C)   31

D)   1

8- In Selective Repeat, if 5 is the number of bits for the sequence number, then the maximum size of the send window must be _____

A)   15

B)   16

C)   31

D)   1

9- In Selective Repeat, if 5 is the number of bits for the sequence number, then the maximum size of the receive window must be _____

A) 15

B) 16

C) 31

D) 1

10- Stop-and-Wait is a special case of Go-Back-N in which the size of the send window is ___.

A) 2

B) 1

C) 8

D) None of the above