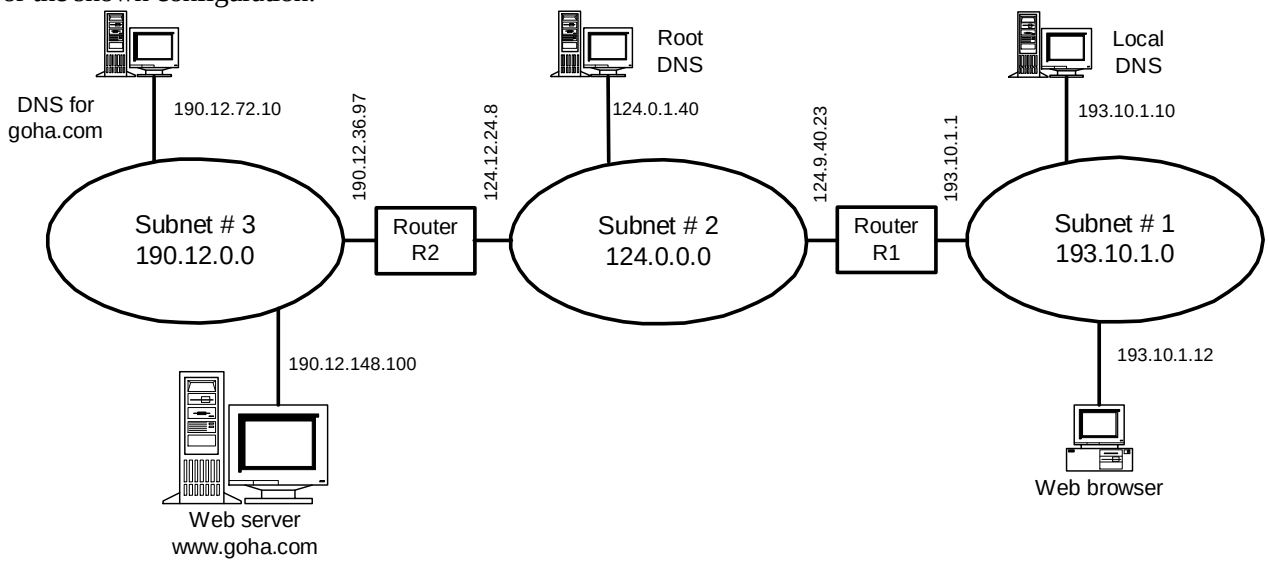
Cairo University
Faculty of Engineering
Electronics and Communications
Department

Fouth Year
ELC403A : Computers 4A
"Computer Networks"
2012-2013

Sheet 4

Problem (1)

For the shown configuration:



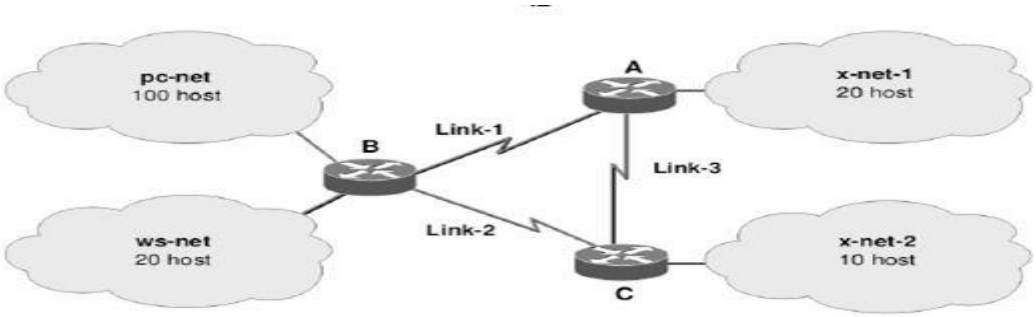
Propose suitable subnetwork masks associated with subnetworks #1, #2, and #3

a) Draw the time sequence diagram of IP packets exchanged in order for the web browser on the right to identify the IP address of the web server (www.goha.com) on the left.
b) Do we need to use ARP in the above sequence? Explain your answer.
c) Sketch the contents of the routing tables for routers R1 and R2.

Problem (2) (VLSM)

For the shown network topology, it is required to assign IP addresses for all PCs in pc-net, ws-net, x-net 1 and x-net 2. Propose an addressing scheme for them considering the following two cases:

a) Without using VLSM.
b) Using VLSM.



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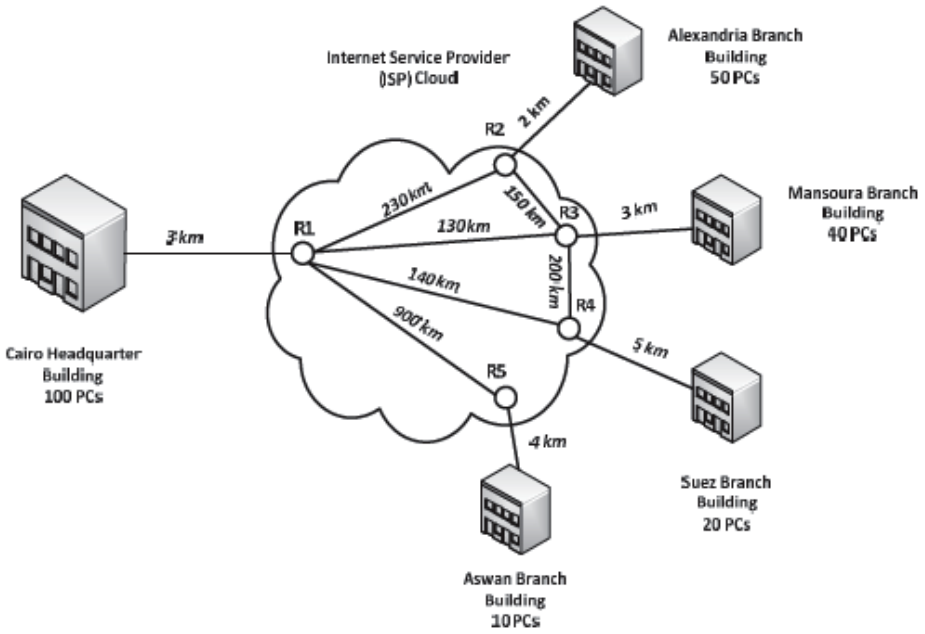
Problem (3)

A company has its Headquarters in Cairo, with 4 branches located in:

Alexandria - Mansoura - Suez – Aswan

The above 5 locations are interconnected through the Internet Service Provider (ISP) cloud as shown below:



a) For the # of PCs specified above for each building, propose a suitable network diagram within each building that allows interconnection of PCs inside the building, as well as its connection to the other 4 buildings. Make sure to specify the type of networking device used, their quantity, the # of ports, and the type/speed of the transmission medium used.

b) Propose a suitable addressing scheme for the proposed network topology in the FIVE buildings suggested in part a). Make sure to specify the values for the addresses.

c) Assume that each building connects to a router in the ISP cloud, as shown in the figure. Moreover, let the distances and the bidirectional links between these routers be as depicted in the figure.
Propose the entries of the routing tables for each of the FIVE routers (R1, R2, R3, R4, and R5).

d) Let a source PC (s, S) in Mansoura Branch would like to send a packet to a destination PC (d,D) in Aswan. Draw the Time Sequence Diagram that clarifies how such a packet is delivered from (s,S) to (d,D). In your answer, indicate how MAC addresses are obtained, and show how entries of routing table for switches are created.
Assume ALL switches to be empty at the start of operation.

Problem (4)

The figure below shows a proposed setup for the information network that connects a “School” to the “Ministry” of Education and the Internet. In this configuration, the “School” hosts its own Website as well as an E-Learning Server (ELS), that contains data related to the courses and teachers. Meanwhile, the “Ministry” hosts its own Website and a School Management System (SMS) that contains data related to the school and its statistics. A “Student” of the “School” may access the ELS or the SMS via the Internet from his/her home. At the same time the school should exchange its data with the “Ministry” via a direct link.

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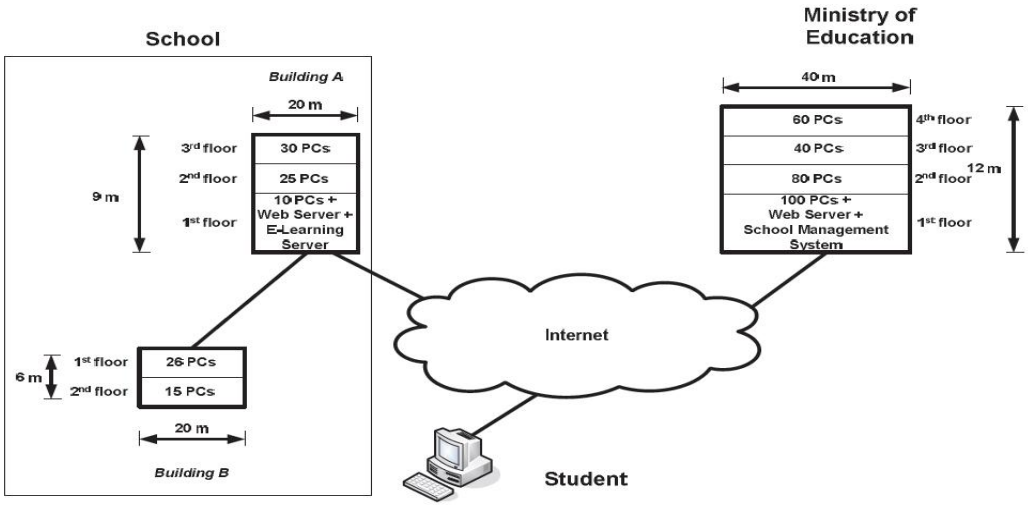


a) Redraw the diagram after adding the following components:
- Switches and routers needed to enable physical connection for the PCs and servers, as well as physical connectivity to the outside world.
- DNS (s) needed to resolve URLs of various servers.

b) For the given devices (PCs, Servers, Switches, Routers, and DNSs), propose a suitable IP scheme. In your design, clarify the type of addressing used (class-based, subnetting, or CIDR), and the utilization of the proposed IP range.

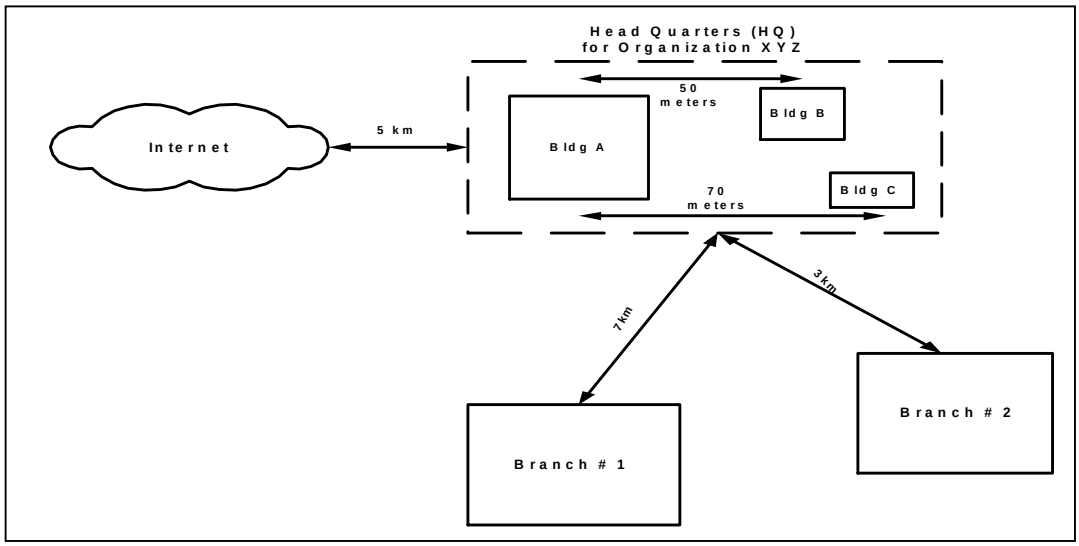
c) Based on the chosen IP scheme, give the entries of the routing tables needed at the "School" and at the "Ministry".

d) If "Student" – S - would like to access ELS whose URL is: www.els.edu.eg:
- Draw the time sequence diagram showing how S gets the IP address of ELS
- Explain – with the help of suitable diagrams showing exchanged packets & their headers – how the student browser sends a request to the ELS. In your explanation, indicate how various addresses are obtained, and how routing tables entries are deduced.

(Make any reasonable assumptions).

Problem (5)

For the shown topology, suppose that organization XYZ has the following layout



Further, assume that: Bldg A has 100 PCs, Bldg B has 50 PCs, Bldg C has 30 PCs, Branch # 1 has 60 PCs, and Branch # 2 has 40 PCs.

You are asked to design a computer network for organization XYZ that achieves the following connectivity requirements:
1 – All PCs in each Bldg, and all PCs in each Branch are interconnected together.
2 – Bldgs A, B, and C are interconnected together.
3 – The THREE sites: HQ, Branch # 1, and Branch # 2 are interconnected together.
4 – The company is connected to the Internet via a link from the HQ.

a) Propose a suitable design to achieve the above requirements by specifying the following information:
   i) Type and number of networking devices (hubs, switches, routers) to be used in each building (A, B, and C) and in each branch (Branch # 1 and Branch # 2).
   ii) The connection diagram between the various devices proposed in i) above. (Distinguish between LAN links and WAN links).

   Remark: Assume that a hub or a switch can have up to 48 ports in one device, while a router can have multiple ports.

b) If each PC is given a separate IP address, propose the required range of IP's needed to allow communication between them using the IP protocol. In your answer, consider the following THREE cases:
   Class-based addressing - Subnetting addressing - CIDR addressing
   For each case, calculate the efficiency of the proposed IP range.

c) Suppose a PC in Bldg B has a message of size 10 KB which is to be sent to a remote site connected to the Internet:
   i) Draw the path taken by the packets of such a message (starting from the PC in Bldg B, passing by the various networking devices, until it enters the Internet)
   ii) If a LAN uses Ethernet protocol with MTU of 1500 bytes, how many Ethernet frames are produced by the PC for the above message?
   iii) If the WAN connection uses the SLIP protocol with MTU of 512 bytes, how many SLIP frames are transmitted over the WAN link for the above message?
   iv) Draw a typical IP packet produced by the PC. (Show all header fields and give typical values for each field).
   v) For the same IP packet of iv) above, draw the corresponding IP packet(s) sent over the link to the Internet. (Show all headers fields and give typical values for each field).

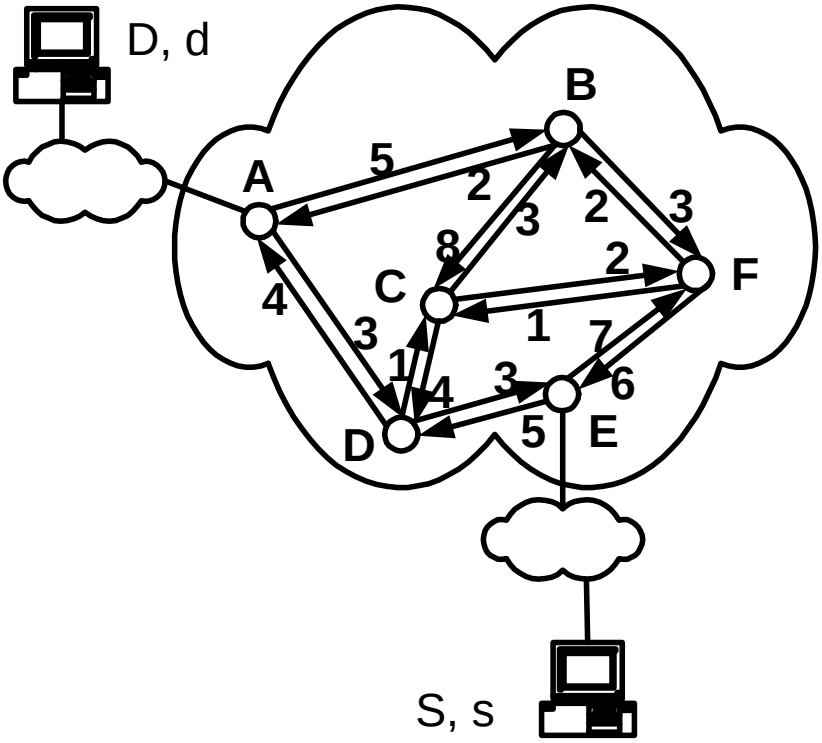
d) If the remote site is located in the USA and has a URL given by: www.ieee.org.
   i) Propose the network topology that allows establishing a connection between the HQ of organization XYZ and the server: www.ieee.org.
   ii) Propose the location of DNS(s) needed to allow determining the IP address corresponding to www.ieee.org.
   iii) Draw the time-sequence diagram for the steps that take place in order for the PC in Bldg B gets the IP address of the server www.ieee.org.

Problem (6)

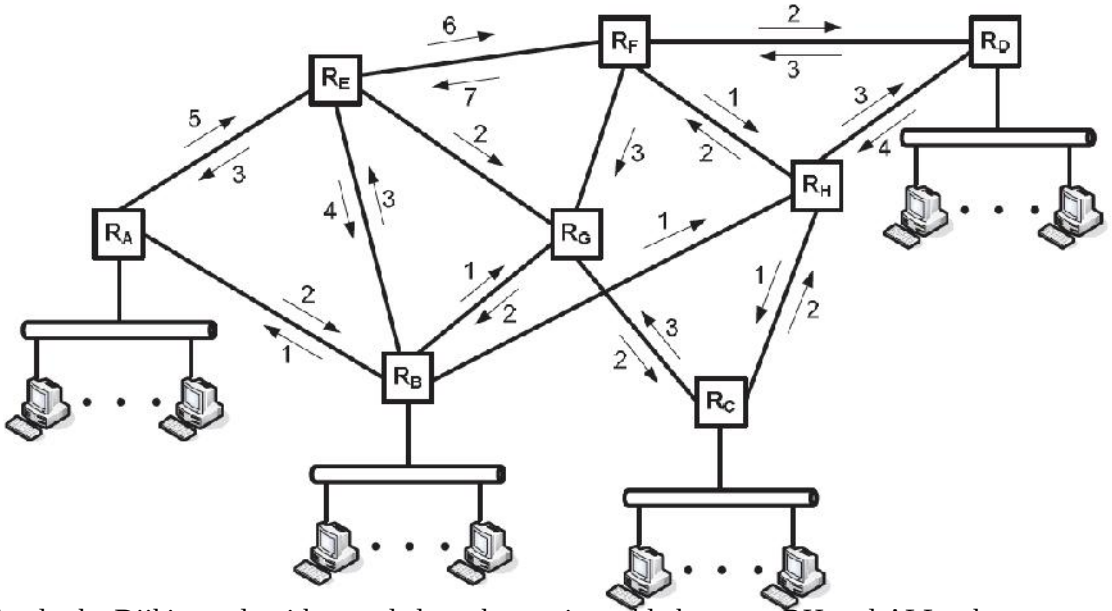
a) For the given link costs, apply the Dijkstra algorithm to deduce the shortest path from node E to all other nodes. In your answer: Draw the table depicting Up Nodes, Neighboring Nodes, and other Floor Nodes (for each step of the solution). Specify link costs, and paths (for each step of the solution).

b) If Station S has a file of size 4000 bytes, which it wants to send to Station D:

- How many packets are needed to carry the file from S to D, if MTU = 1500 bytes for hubs of S and D, and MTU = 512 bytes for all links between routers.
- Sketch the fields of header for ALL packets sent from S to D, and show the values of Packet Length, Packet ID, M Flag, and Fragment Offset.



Problem (7) *(Dijkstra Algorithm)*



Apply the Dijkistra algorithm to deduce the routing table between RH and ALL other routers. In your answer show all steps, and for each step identify the set of up-balls, the set of floor-balls, and the neighbors, as well as the distance for each ball to the root ball.