جامعة القاهرة

Dept. of Electronics and Electrical Communication Engineering
Faculty of Engineering – Cairo University

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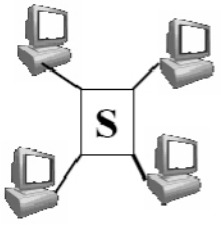
Computer Networks
Sheet 2

Problem 1 *(Hub, Switch and Router)*
Compare between repeaters, switches and routers from the point of view of: Cost, Processing Capabilities, Routing Rules, Range of Coverage and the OSI layers they support.

Problem 2 *(Throughput Calculations)*
For the switch shown below:



Let the total number of stations be 16 and assume each link operate at rate of 10 Mbps.
Calculate

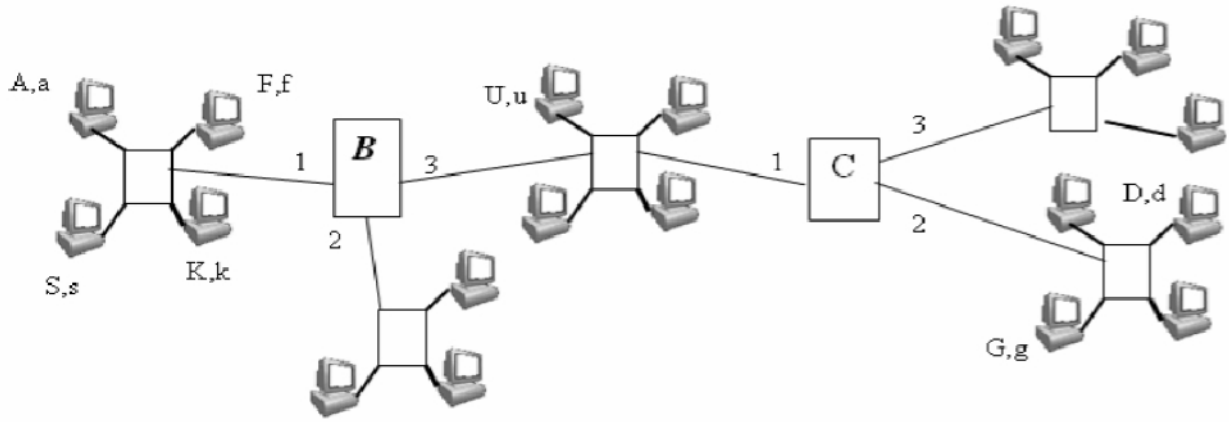
a) The maximum total transmission rate over this network. Under which conditions is this rate attained ?

b) The minimum total transmission rate over this network when all stations are active. Under which conditions is this rate attained ?

c) If one of the stations is connected using a link whose rate is 100 Mbps. Repeat part a); b)

Problem 3 *(Packets format and routing tables)*
For the figure shown below:
a. if B & C are two switches, and packets are transmitted among stations in the following order:

S ⟶ D
G ⟶ K
U ⟶ G
D ⟶ K



Provide the following details of each packet type

- Packet format
- Port of switch B that forward information, entries of switch B after packet forwarding
- port of switch C that forward information, entries of switch C after packet forwarding

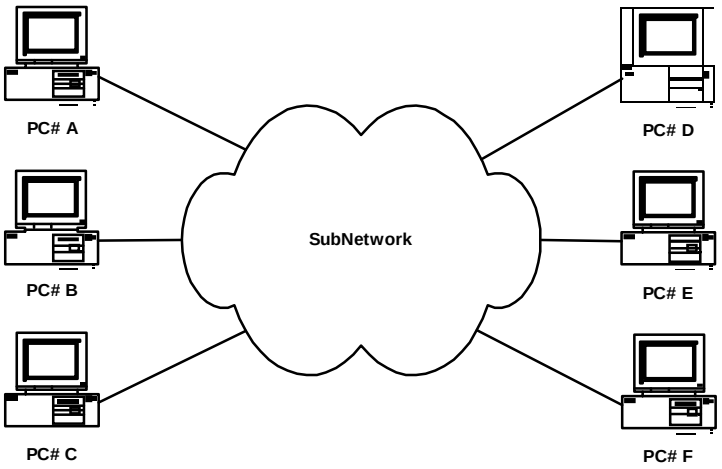
b. If B & C are two routers, and packets are transmitted in the same order as in a) above.
Provide the following details of each packet type

- Packet format at input of router B; Packet format at output of router B
- Packet format at input of router C; Packet format at output of router C

Hence; suggest the required entries for the routing table of B & C

Problem 4: *(Comparing Different Switching Techniques)*

For the shown topology, assume that distances are less than 100 meters long.



It is required to exchange messages between the six PC's A, B, C, D, E and F. For that purpose, the following FOUR scenarios were proposed:

Scenario 1
Each PC is connected via al link to a box that performs circuit-switching.
Scenario 2
Each PC is connected via al link to a box that performs packet-switching at layer 1 (Physical Layer).
Scenario 3
Each PC is connected via al link to a box that performs packet-switching at layer 2 (Data Link Layer).
Scenario 4
Each PC is connected via al link to a box that performs packet-switching at layer 3 (Network Layer).

For each of the FOUR scenarios:

a) Draw a detailed network diagram showing ALL components (hardware and software) needed to allow meaningful communication between (A and D), (B and E) and (C and F).

b) Draw the format of the message (or its components) as it travels between one source and the corresponding destination.

c) Explain the mechanism by which a message in a source PC is delivered to the appropriate destination PC.

d) State the factors that determine the delay between the time a message is ready to send at the source, and the time it is completely delivered to the destination. Hence, write a mathematical expression for the delay.

e) Determine the link speeds of the PC's and the switching speed of the switching box, if the message is produced in the form of bursts, with the following characteristics: average burst duration = 40 ms - average burst size = 2560 bits - average interval between bursts = 60 ms

f) Compute the maximum throughput through the switch for the values given in e) above. Under what conditions is the maximum throughput realized?

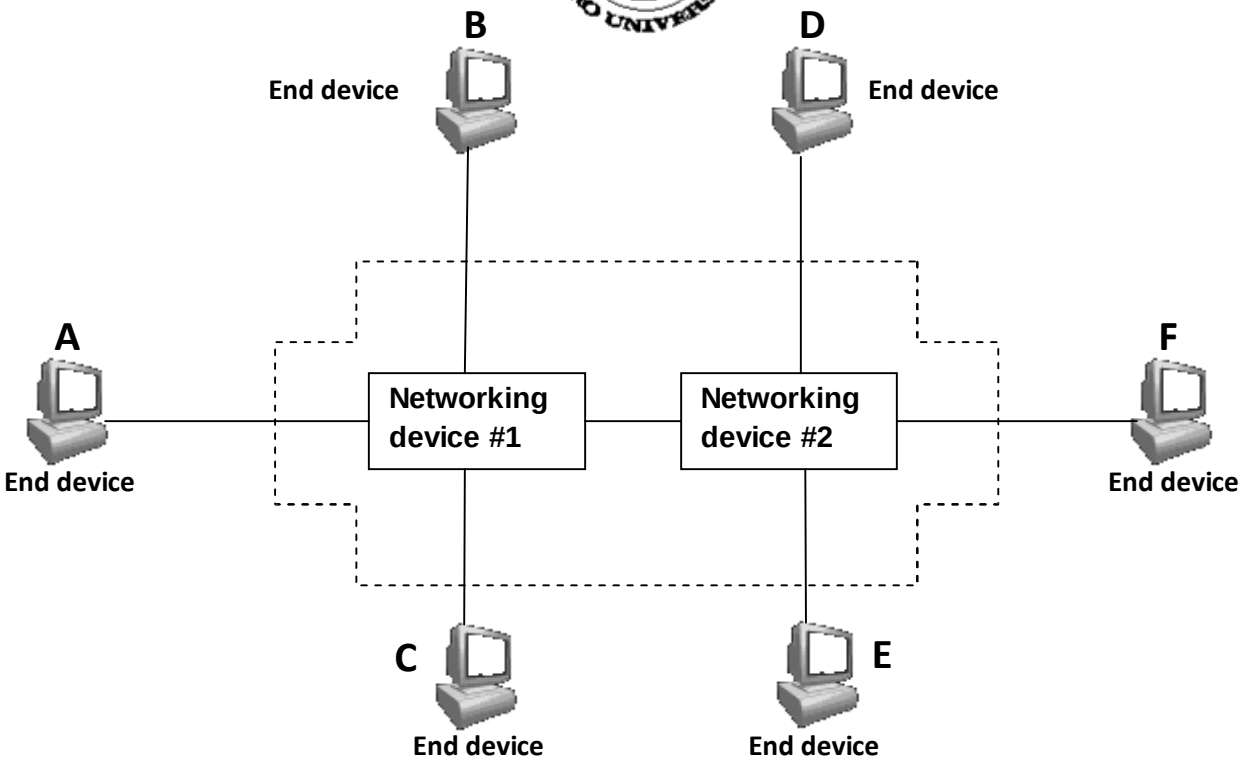
Problem 5: *(Comparing Different Network Devices)*

For the shown network configuration:

a) If the two networking devices are Ethernet hubs:
   i. What is the maximum allowable distance between any two end devices?
   ii. What is the maximum throughput through the entire network (consisting of the two hubs), if each end device is connected via a 10 Mbps link?

b) If the two networking devices are Ethernet switches:
   i. What is the maximum allowable distance between any two end devices?
   ii. What is the maximum throughput through the entire network (consisting of the two switches), if each end device is connected via a 10 Mbps link (half-duplex)?
   iii. Repeat part b) ii if each end device is connected via a 10 Mbps link (full-duplex).
   iv. Repeat part b) ii if end devices B and D are connected via a 100 Mbps links (full-duplex), but all other end devices are connected via 10 Mbps links (full-duplex).

c) Suppose that a router is placed between the two hubs (in part a), and between the two switches (in part b). How would this effect the computed throughput in each case of parts a) and b)? Justify your answer.

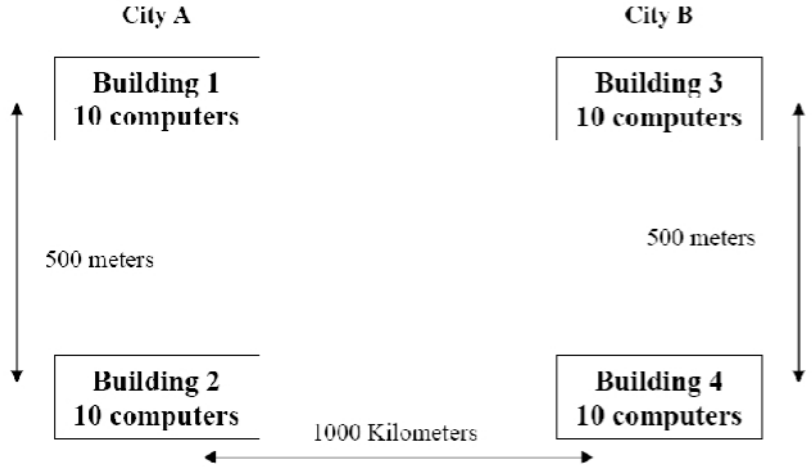


Problem 6: *(Typical LAN Design - 1)*

Consider the shown configuration:

It is required to interconnect the computers shown above so that any computer can communicate with all other computers.

a. Suggest suitable networking devices (hubs, switches or routers) that would achieve the required interconnectivity
b. Show the content of routing tables in the networking devices you selected that correspond to the following transmission of packets:
   - Computer (C11) in Bldg 1 to computer (C14) in bldg 4
   - Computer (C13) in Bldg 3 to computer (C21) in bldg 1
   - Computer (C12) in Bldg 2 to computer (C21) in bldg 1
   - Computer (C22) in Bldg 2 to computer (C13) in bldg 3

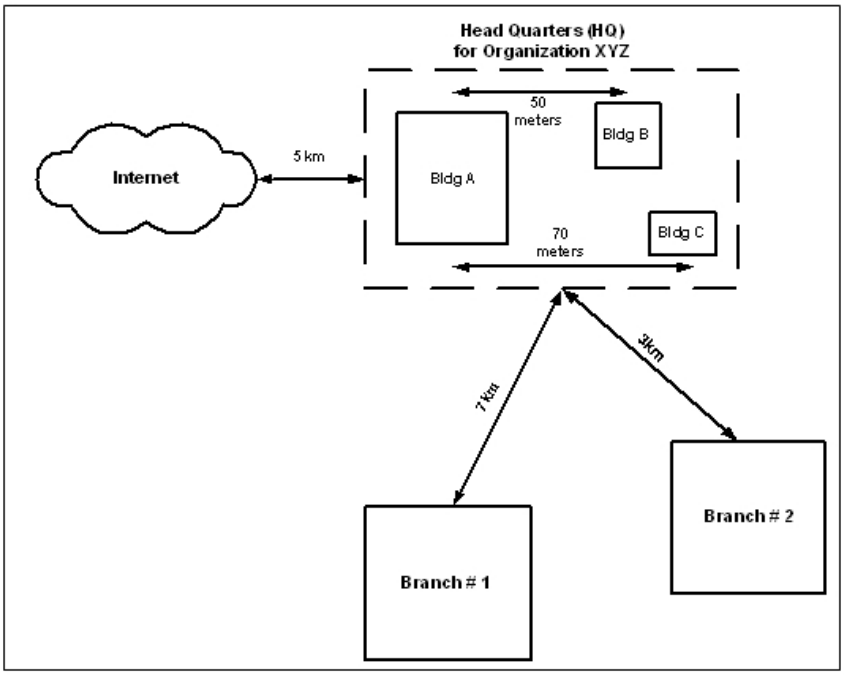


Problem 7: *(Typical LAN Design - 2)*

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.



Propose a suitable design to achieve the above requirements by specifying the following information:

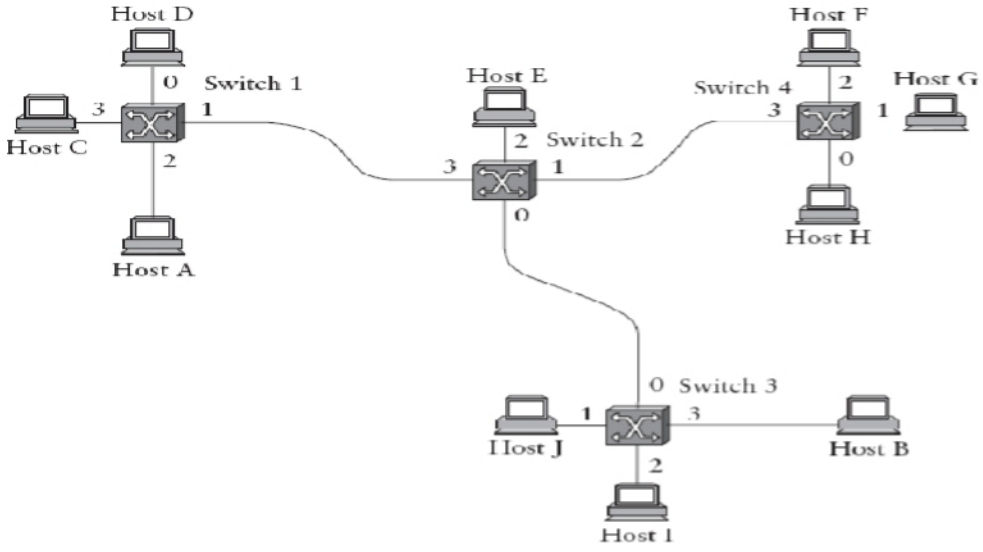
i) Type and number of networking devices (hubs, switches, routers) to be used in each building (A, B, and C) and in each branch (Branch # 1 and Branch # 2).
ii) The connection diagram between the various devices proposed in i) above. (Distinguish between LAN links and WAN links).

Remark: Assume that a hub or a switch can have up to 24 ports in one device, while a router can have multiple ports.

Problem 8: *(ATM Networks Operation)*

Using the example network given in Figure , give the virtual circuit tables for all the switches after each of the following connections is established. Assume that the sequence of connections is cumulative; that is, the first connection is still up when the second connection is established, and so on. Also assume that the VCI assignment always picks the lowest unused VCI on each link, starting with 0.

(a) Host A connects to host B.
(b) Host C connects to host G.
(c) Host E connects to host I.
(d) Host D connects to host B.
(e) Host F connects to host J.
(f) Host H connects to host A.



Problem 9: *(Leaky bucket)*

Consider an ATM switch, which is serving a number of sources whose traffic, is constrained by a leaky bucket. Assume that:

- Buffer size of leaky bucket = 0.2 Mb
- Token rate of leaky bucket = 2Mbps
- ATM switch buffer size = 16 Mb
- ATM output link speed = 155 Mbps

Determine:

- Maximum number of sources that can be served by the output link of the ATM switch without losing bits due to buffer overflow.
- Maximum delay encountered by a bit at the output link.