Ch 8: Questions

[1] Describe the need for switching & Define a switch?

* Switching → provide the practical solution when connecting multiple Devices (Nodes) in a network

* Switch: is a Device that Capable of creating Temporary Connection Between Two Devices Connected to a switch.

[2] List the Three Traditional Switching Methods What are the Most Common today?

[1] Circuit Switching
[2] packet Switching
[3] Message Switching

→ Circuit Switching & packet Switching are Commonly used today.

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[3] What are Two Approaches of packet switching?

1) Datagram networks	2) Virtual circuit network
It is a network in which Message is Divided into packets (Datagrams) That send between Devices	It is a cross Between Circuit Switched Network & Datagram switched Network.

[4] Compare & Contrast a circuit switched Network & packet switched Networ?

Circuit Switched network	packet switched Network
1) Done at physical layer	2) done at network layer.
2) Consist of Three phase - setup phase - Data Transfer phase - Teardown phase.	3) There is No - setup phase. - teardown phase.
3) Resource Reservation Befor sending Data	3) No Resources Reservations.

5] What is The Role The address Field in packet Traveling Through a datagram network?

The address Fied Defines Source To Destination Transmission of Datea.

6] What is The Role of address Field in packeet Traveling through a Virtual Circuit Network?

In VCN (Virtual Circuit Network):

1) Global Address: That is unique For each Node in the network.

2) VCI (Virtual-Circuit Identifier).

- Identifier that actually used For Data Transfer.
- It's Small number that has only Switch Scope. & it's used by a Frame Between Two Switches.

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7) Compare space-Division & Time Division Switches.

Space Division	Time Division
In space Division switch the path from one Device to another is spatially separate from other paths.	- In Time Division Switch. Using (TDM → Time Division Multiplexing) So the inputs Divided in Time. A Central unit Send Input to correct output.

8) What is TSI & its Role in Time-Division Switching?

TSI → Time slot interchange.

TSI → Consist of RAM with several Memory location. The number of locations is the Same Number of Input.
- RAM fill with incoming Data from Time slots in the order Recieved.
- Slots then sent out In order Based on The Decision of Central unit.

5

11) A path in a digital circuit switched network has a data Rate of 1 Mbps.
The Exchange of 1000 Bits is Required For the setup & Teardown phases.
The Distance Between Two pairs is 6000 km.

* Answer The Following Questions.
if propagation speed is 2×10^8 m/s

a) What is the Total delay if 1000 Bits of Data are Exchanged During the Data Transfer phase?

Setup phase (Two-way Communication)

Teardown phase (one-way Communication)

3 [propagation Delay] + 3 [Transmission Delay]

Distance / Speed

Size (number of bits) / Bandwidth.

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Data Rate = 1 Mbps

Speed = 2×10^8 m/s

Distance = 5000 km

$$3\left[\frac{5000 \times 10^3}{2 \times 10^8}\right] + 3\left[\frac{1000}{10^6}\right] =$$

75 ms + 3 ms = 78 ms

Total delay = propagation Delay + Transmission Delay + Delay for setup & Tear down + Data Transfer

$$= 75 + 3 + \left[\frac{75}{3}\right] + 1$$

Number of Bits / Data Rate

$\frac{1000}{100}$ = 1 ms

Total Delay =

= 78 + 1 + 25 = 104 ms

(b) What is the Total Delay if 100,000 Bits of Data Exchanged During the Data Transfer phase?

* Data Transfer = $\frac{100\,000}{100}$ = 100 ms.

Total Delay = 78 + 25 + 100 = 203 ms

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[c] What is The total delay if 1000,000 Bits of Data are Exchanged Durring the Transfer phase?

Data Trasfer. $\frac{1000000}{10^6} = 1s = 1000\ ms$

Total delay = 78 + 25 + 1000 = 1103 ms

[d] Find The Delay per 1000 Bits of Data ~~are Exchenged Durring~~ for each of The above Cases & Compare Them. What Can you infer?

a) 104 ms

b) 203/1000 = 2.03 ms

c) 1103/1000 = 1.103 } → The smallest Delay

So we send more Data.

8

Five equal-size datagrams belonging to the same message leave for the destination one after another. They travel through different paths.

Datagram	Path length	Visited switches
1	3200 Km	1, 3, 5
2	11700 Km	1, 2, 5
3	12200 Km	1, 2, 3, 5
4	10200 Km	1, 4, 5
5	10700 Km	1, 4, 3, 5

We assume that delay for each switch (including waiting & processing) is 3, 10, 20, 7, 20 ms respectively.

Assume the propagation speed is 2×10^8 m/s. Find the order the datagrams arrive at the destination & the delay for each, ignore any other delay in transmission.

Switch(1)	Switch(2)	Switch(3)	Switch(4)	Switch(5)
Delay	Delay	Delay	Delay	Delay
3ms	10ms	20ms	7ms	20ms

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propagation Delay = المسافة / السرعة

* Delay For 1 Datagrame (1, 3, 5)

$= \frac{3200\,km}{2*10^8} + 3 + 20 + 20 = 59\ ms$

* Delay For 2 Datagram (1, 3, 5)

$= \frac{11700 \times 10^3}{2 \times 10^8} + 3 + 10 + 20 = 91.5\ ms$

* Delay For 3 Datagram (1, 2, 3, 5)

$= \frac{12200 \times 10^3}{2 \times 10^8} + 3 + 10 + 20 + 20 = 114\ ms$

* Delay For 4 Datagram (1, 4, 5)

$= \frac{10200 \times 10^3}{2 * 10^8} + 3 + 7 + 20 = 81\ ms$

* Delay For 5 Datagram (1, 4, 3, 5)

$= \frac{10700 \times 10^3}{2 * 10^8} + 3 + 7 + 20 + 20 = 103.5\ ms$

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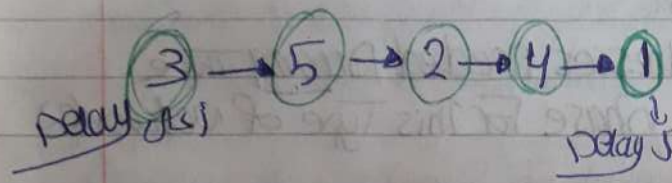
The order of Arrival:

الاكثر وصول الأول بكون الاسرع
يعني أقل Delay



13 Transmission of information in any Network involves End-to-End Addressing & Sometimes local Adderessing (VCI)

Table shows the Types of Network & the addressing Mechanism used in each of them.

Network	setup	Data Transfer	Teardown
Circuit Switched	End-To-End		End-To-End
Datagram		End-To-End	
Virtual Circuit	End-To-End	local	End-To-End

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Answer The Following Questions.

a) Why does a circuit-switched network need End-To-End Addressing During setup & Teardown phases?
Why are no addresses needed During The Data Transfer phase For This Type of Network?

→ End-To-End Addressing is needed During the setup & teardown phase to Create a Connection For The whole Data Transfer phase

After The Connection Made Data send Through The Reserved Resources.

So There is No Need For Addresses in Data Transfer phase.

b) Why does a datagram network need only ~~end-to-~~ end-to-end Addressing during the Data transfer phase, but No addressing During The setup & teardown phases?

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In Datagram Network, each packet is independent Even if packet is part of a multi-part packet So the Routing of a packet is Done For each part of the packet.

So each part of packet needs to Carry End-to-End Address.

There is no setup & Teardown phases in Datagram network So there is No End-to-End Addressing

(c) Why does a Virtual-circuit network need addresses During all Three phases?

In Virtual-circuit Network, There is No Need For End-to-End Addressing During The setup & teardown phases to Make Corresponding Entry in the Switching table.

The Entry is made For each Request for Connection. During the Data Transfer phase, each packet needs to Carry a VCI (Virtual Circuit Identifier).

[14] We mentioned that Two Types of Networks, Datagrams & VCN, need a Routing or switching table to find the output port from which the information belonging to a Destination should be sent out, But a Circuit Switched Network has no need For such a Table.

Give The Reasen For This Differences.

Datagram or Virtual Circuit Network handle packets of Data. So For each packet The switch needs to search in the Switching table to Find The output port.

In Datagram Network → Find output port.

In Virtual Circuit Network →
Find combination of output port & VCI (port, VCI)

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While in Circuit Switched Network:
Data not send as packets, Data send Analog (continuous).
So switch not need to search in the switching table.

15) An entry in the switching table of VC N/W is normally created during the setup phase & Deleted during the teardown phase.

In other words, the entries in this type of networks Reflect the current connections, the Activity in the network.

In Contrast, The entries in a Routing table of a datagram network don't depend on The Current Connections, They Show the Configuration of The network & How many packet Should be routed to a Final destination. The entries may Remain the Same even if There is No Activity in the network. The Routing tables, However, are updated if there are Chenges in the network.

Can You Explain The Reason For These Two Different Characteristics?

Can You Say that a Virtual Circuit is a Connection oriented Network & Datagram Network is Connectionless Because of the Above Characteristics.

In Circuit-switched & Virtual Circuit network we deal with Connections.

A Connection needs to be made befor the Data Transfer Can take place.

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In Circuit switched Network

↳ Connection needs to be made (Resource Reservation) Before the Data Transfer take place.

Resource Reservation in setup phase.
& Torn down in teardown phase.

In Virtual Circuit Network.

↳ Virtual Connection is made in setup phase.
& Torn down in Teardown phase.

So Circuit switched & VCN is Connection oriented.

In Datagram switched Network

↳ No Connection Made / No setup & Teardown phases.

So, it's Connectionless.

16 The minimum number of Columns in Datagram network is Two; The minimum number of Columns in VCN is Four.

Can you Explain The Reason? Is The Difference Related to The Type of Addresses Carried in the packets of each Network?

In Datagram Network: Switch has switching table Based on The Destination Address So switching table consist of (Destination Address / port) → Two Columns.

In VCN: Switch has Routing table Consist of: (port & VCI) For the incoming Data & The Corresponding (port & VCI) for output.

	Incoming		outgoing	
	port	VCI	port	VCI

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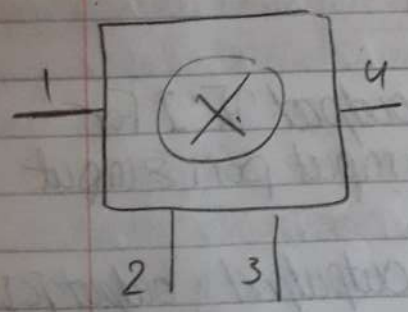
17 In Figure 8.27 show switch in Datagram network: Find the output port for packets with the following addresses:

packet 1 : 7176
packet 2 : 1233
packet 3 : 8766
packet 4 : 9144



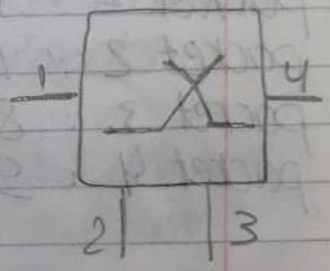
Destination Address	port
1233	3
1456	2
3255	1
4470	4
7176	2
8766	3
9144	2

output port

packet 1 : 7176 : 2
packet 2 : 1233 : 3
packet 3 : 8766 : 3
packet 4 : 9144 : 2

18. Figure 8.28 shows a switch in virtual circuit network.

Incoming		outgoing	
port	VCI	port	VCI
1	14	3	22
2	71	4	41
2	92	1	45
3	58	2	43
3	78	2	70
4	56	3	11



Find the output port & the output VCI for packets with the following input port & input VCI addresses:

	input port	input VCI	output port	output VCI
Packet 1:	3,	78	2	70
Packet 2:	2,	92	1	45
Packet 3:	4,	56	3	11
Packet 4:	2,	71	4	41

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19] Answer the following questions:

a) Can a Routing table in Datagram Network have two entries with the same Destination Address? Explain.

In Datagram Network Destination Address is unique, they can't be Find Two entries with the same Destination Address.

b) Can a switching table in a VCN have
Two entries with the same input port number?
with the same output port number?
with the same incoming VCIs?
with the same outgoing VCIs?
with the same incoming values (port, VCI)?
with the same outgoing values (port, VCI)?

In a Virtual Circuit Network (VCN)
↳ VCIs are local
A VCI is unique only in Relationship to a port.
(port, VCI) → combination of them is unique.

This means that we can have two entries with the same input or output ports.

We can have two entries with the same VCIs.

However: We can't have two entries with the same (port, VCI) pair.

20] It's obvious that a Router or a switch needs to do searching to find information in the corresponding table. The searching in a Routing Table for a Datagram Network is based on the destination Address.
The searching in a switch table in a VCN is based on the combination of incoming port & incoming VCI.

Explain the Reason & Define How These tables must be ordered (stored) based on these values

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* Switch in Datagram Network when Receive the packet Examin the Destination Address of these packets to find the Corresponding ~~packet~~ port which the packet should be forward to Go to the Destination.

So the Switching table Based on the Destination Address & switch Find the Corresponding port

Destination Address	port

* In VCN there is two Address Global Address & VCI (Virtual Circuit Identifier) that used for Data Transfer.

When Frame arrives at a switch it has VCI & when leaves has Different VCI

So

The Switching Table based on the combination of (port, VCI)

Incoming		outgoing	
port	VCI	port	VCI.

(21) Consider n×K Crossbar switch with n & K outputs.

a) Can you say that switch acts as a Multiplixer if n > K?

if n > k: n*K Crossbar is like a Multiplixer that Combines n inputs into k outputs.

b) Can you say that switch acts as Demultiplixer if n < K?

if n < k: n*K Crossbars is like a demultiplixer that Divides n inputs into k outputs.

(22) We need a Three-stage Space-Division switch with N = 100 we use 10 Crossbars at the first & third stages & 4 Crossbars at the Middle stage.

N = 100

K = 10 → First, third stage stage

K = 4 → Middle stage.

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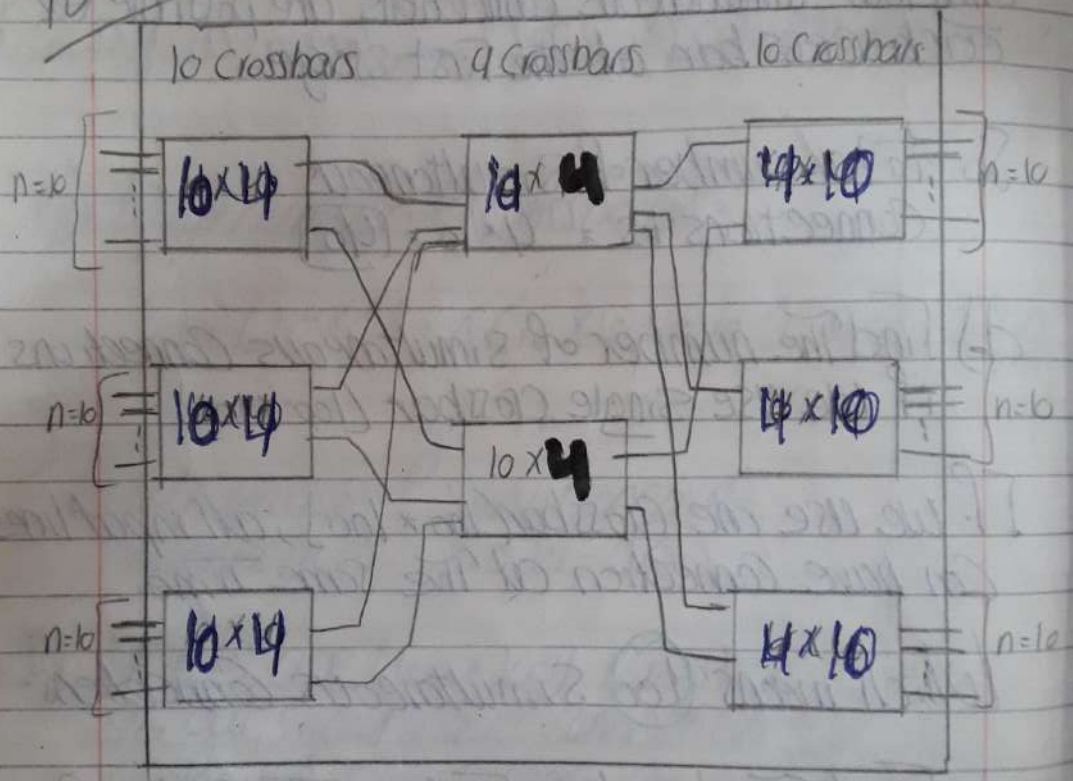
a) Draw The Configuration Diagram.

N = 100



b) Calculate The Total number of cross points.

total number = 10.(10x4) + 4(10x10) + 10(4x10)

1200 Crosspoints.

c) Find the number of simultaneous connections?

only four simultaneous connections are possible for each cross bar at the first stage.

So total number of simultaneous connections is = $4 * 10 = 40$

d) Find the number of simultaneous connections if we use single crossbar (100 * 100).

If we use one crossbar (100 * 100), all input lines can have connection at the same time.

which means 100 simultaneous connections.

e) Find the blocking factor, the ratio of the number of connections in part c & in part d

number of simultaneous connection $= \frac{40}{100} = 40\%$.

Total number of connection

26

[23] Repeat [22] if we use 6 Crossbars at the Middle Stage

نفس إجابة رقم [22] بس لتغيير كل 4 لـ 6

b) total number of crosspoints =

$10(10\times6)+6(10\times10)+10(6\times10)=1800$

c) total number of simultaneous connections: $6*10=60$

d) If we use (100*100) Crossbars. So all input have connection So number of simultaneous connection = 100

e) Blocking factor: $\frac{60}{100}=60\%$

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25 We need to have a space-Division switch with 1000 inputs & outputs.

What is the Total number of crosspoints in each of the following cases?

a) Using one single crossbar?

total number of crosspoints: $N^2 = 1000^2 = 1000000$

b) using a multi-stage switch Based on Clos Criteria.

Total Crosspoints $\geq 4N\left[(2N)^{\frac{1}{2}} - 1\right]$

$4 * 1000\left\{(2*1000)^{\frac{1}{2}} - 1\right\} = 174885$

We can Design Three-stage switch.

using $n = (N/2)^{\frac{1}{2}} = (1000/2)^{\frac{1}{2}} \simeq 23$

$k = 45 \longrightarrow k > (2n-1)$

$(2 \times 23) - 1 = 45$

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20) We need a Three-stage Time-space switch with N=100. We use 10 TSI at the First & Third stages & 4 Crossbars at the Middle stage.

a) Draw Configuration Diagram.

b) Calculate The Total number of Crosspoints.

Total number of Crosspoints:

4 (10 x 10) = 400 Crosspoints

(4 crossbars)

c) Calculate the Total number of Memory locations we need for the TSIs.

- Each Time slot must be stored by the RAM.

Total number of slot ~~number~~ in First stage.

= 10 + 10 = 100 Time slots.

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Total number of slot in Third stage =
10 * 10 = 100 time slot.

Total Number of Memory locations
(= Number of Time slots) =

100 + 100 = 200 Memory locations.