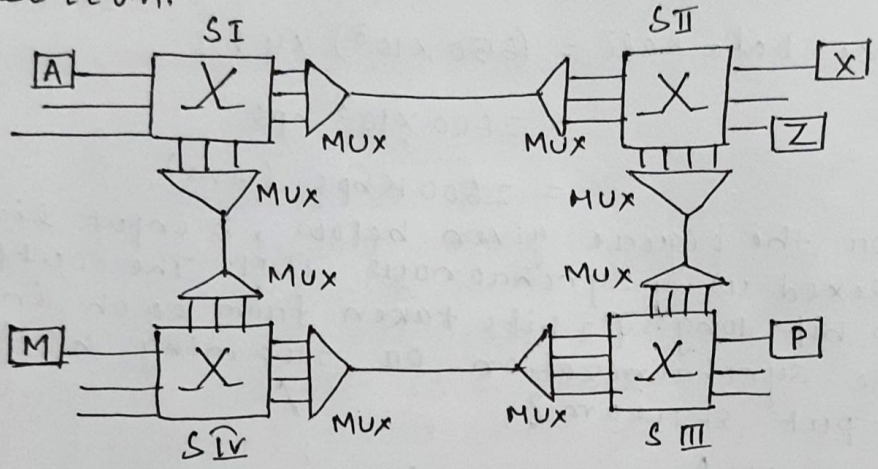
# SWITCHING

Definition – Switching is a technique by means of which a switched network can be formed by interconnecting networking devices known as switch. These switches are not only interlinked with each other but also they are interconnected with the end devices. The switching technique uses multiplexing where a link is divided into channels & each channel dedicated to a connection.




SI, SII, SIII, SIV – SWITCHES.

A, P, M, X, Z – END DEVICES.

## Advantages of Switching technique →

1. A Mesh topology has all the advantages but only one drawback that is cost to implement it & complexity of mesh topology. This can be avoided by using switching technology where by taking the advantage of multiplexing, rather than connecting a link to end devices, a channel is used to interconnect switch with end devices.

2. Switching technology can reduce the cost to implement mesh topology.

3. Switching technology can reduce the ~~complexity~~ complexity to implement mesh topology based network, so that reconfiguration can be easier.

## Types of Switching Technology →

There are 3 types of switching technology. They are-

(a) Circuit switching technique

(b) Packet switching technique
- Datagram switching technique
- Virtual circuit switching technique

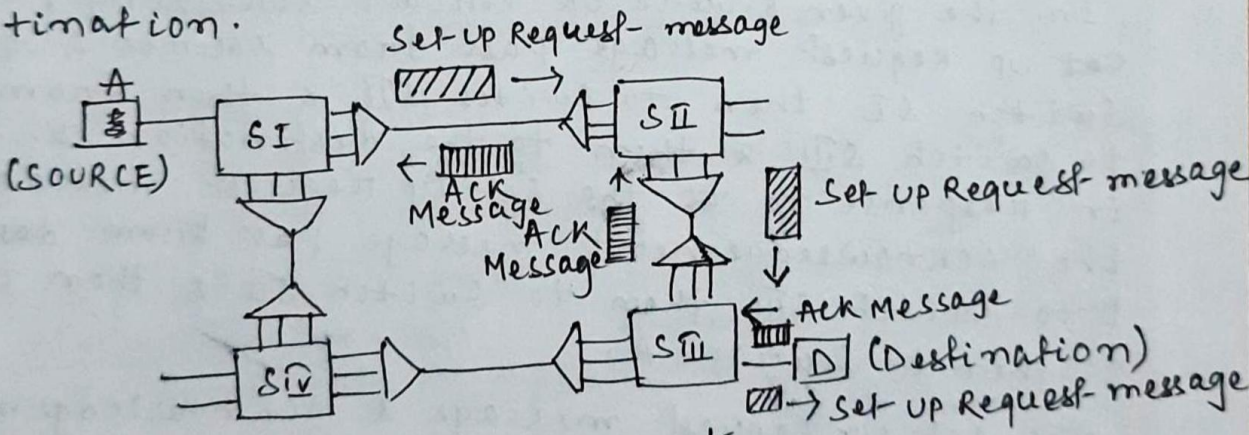
(c) ~~Mes~~ Message switching technique.

## (a) Circuit- Switching Technique -

→ It is implemented in physical layer.

→ A circuit switching network is one where prior to data transmission a physical path or circuit is to be established between source & destination.

→ A path or circuit- is a collection of channels from different links that connect source & destination.




(Block diagram of circuit switching technique)

A - Source, D - Destination, ▨ - Set-up Request message

▥ - Acknowledgement message.

## Characteristics of circuit switching technique -

→ Before data transmission, the resources that are required to establish a path need to be reserved. The resources are - bandwidth of the channel, buffer of switch, port of switch.

→ Because there is a dedicated path established between source & destination, so the message is

devided in stream manner or ~~instant~~ in terms of stream of bits, rather than ~~de~~ dividing message into packets.

→ Delay for transmitting data is minimum.

→ Data transmission is performed by using 3 different phases -

(a) Set-up phase.
(b) Data transfer phase.
(c) Teardown phase.

→ In <u>Set-up phase</u>, one pair of handshaking messages are to be transmitted in between source & destination to reserve the resources. The one pair of handshaking signals for set up phase are,

- Set-up Request message
- ACKnowledgement ~~me~~ message.

In the given figure of circuit switching, ~~Set~~ set up Request message pass from source A to switch SI then to switch SII & then from SII to switch SIII & then to the destination D. And in response ~~to~~ to the set-up request message, the ACKnowledgement message pass from destination D to switch SIII then to switch SII & then to SI & then to source A.

The set-up Request message & ACKnowledgement message move in reverse direction of each other. These two messages use same channel or bandwidth for their communication. i:e: the ACKnowledgement message move through the same channel ~~as~~ as that of set up request message.

→ In <u>data transfer phase</u>, the source A send the ~~st~~ stream of bits of the message to the destination D through the reserved or established path. i:e: A to SI to SII to SIII.

A → ~~S~~ SI → SII → SIII → D

→ In teardown phase, after completion of data transfer the resources that are reserved during connection establish phase gets released. Or in the teardown phase, the resources that are allocated for path creation are terminated.

Any one between source or destination can send teardown message to release the resources.

Efficiency →

Circuit switching technique is efficient one except the case when there is no data to send over the circuit or path then there is some period of silence or the bandwidth of the path or circuit remains unused or wasted. So it is not efficient one because we can not give the guarantee that always there will data flow over the path & when there is no data to flow then the bandwidth is inefficiently utilized.

Delay → (Total Delay)

→ Delay is the total time required to send data from source to destination.

→ In circuit switching technique the delay is minimum. Because all the bits of the data follow the same path to reach the destination side.

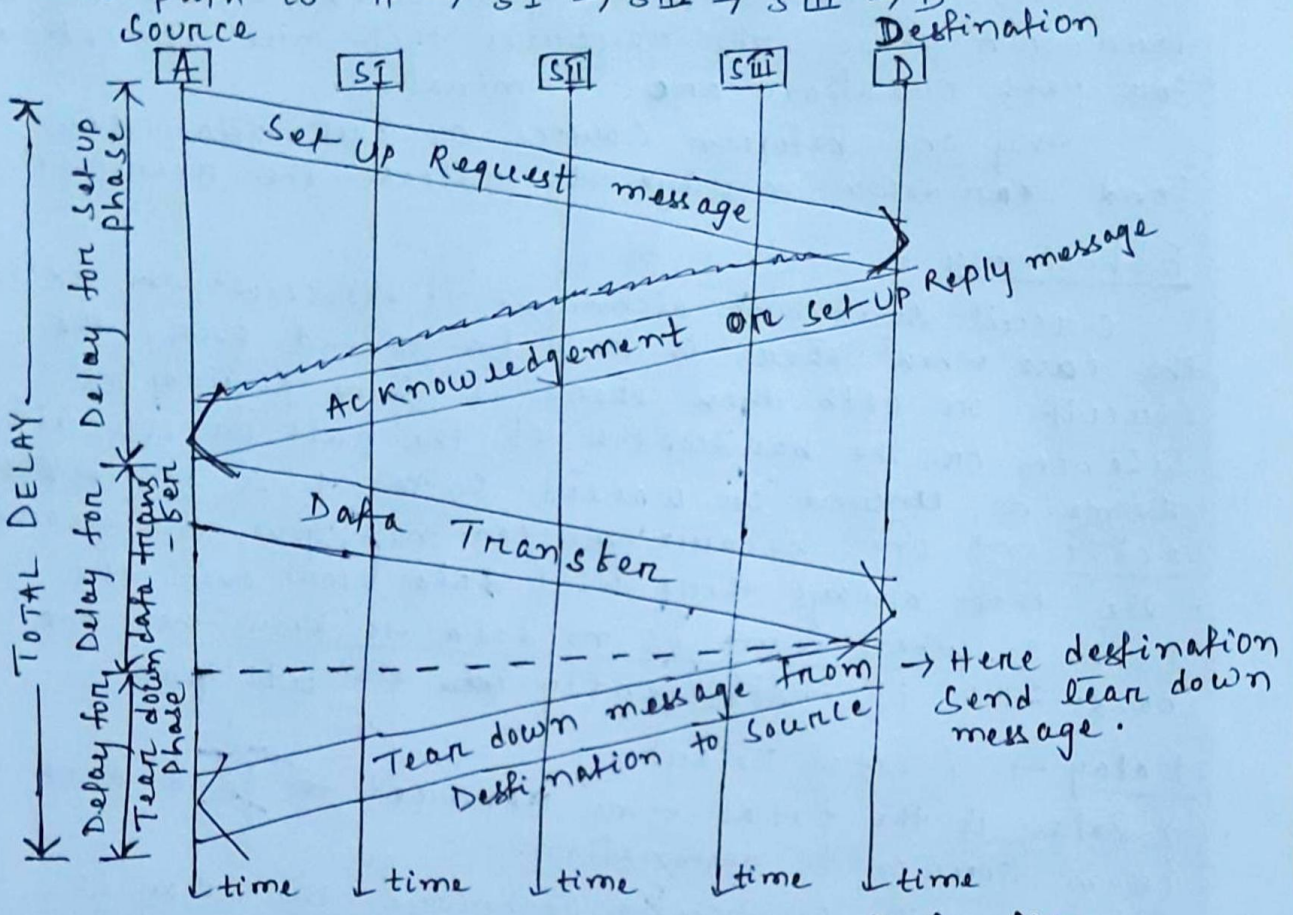
→ Therefore, in circuit switching technique the delay is minimum because path between source & destination is dedicated only for these two devices. (source & destination).

TOTAL DELAY ($T_D$) = Delay for set up phase
+
Delay for data transfer phase
+
Delay for tear down phase

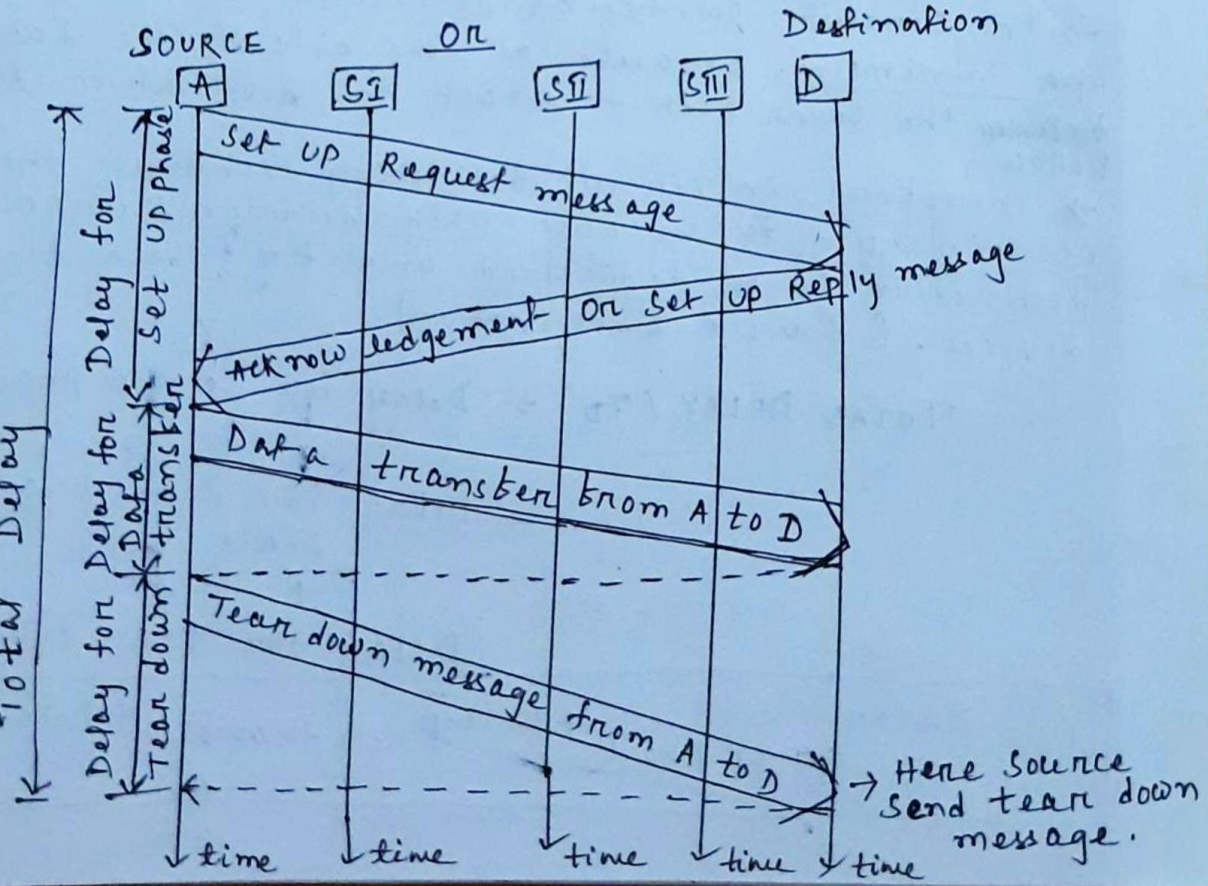
$T_D$ = Delay set up phase + Delay Data transfer + Delay Tear down

flow diagram for delay calculation -

In the example that is given for circuit-switch, the path is A → SI → SII → SIII → D



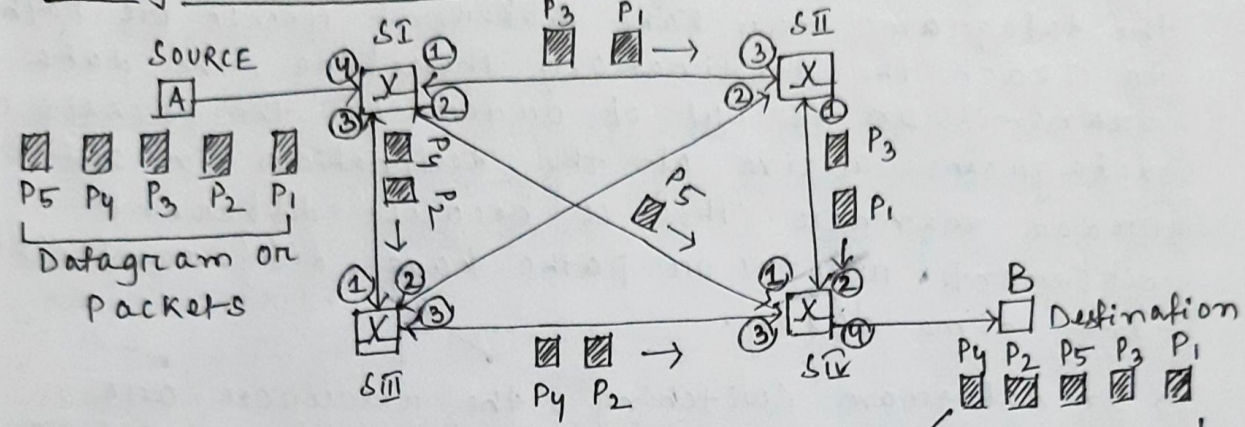

OR



Application of circuit switching technique →

Circuit switching technique is used in ~~telephone~~ telephone network or in LAN creation also but the LAN must contain less no. of nodes. Otherwise more no. of nodes in LAN wont't utilize the BW of the path or link.

(b) Datagram Switching Network technique →




| Destination | PORT |
|---|---|
| A | 4 |
| SII | 1 |
| SIII | 3 |
| SIV | 2 |

Routing table of SI

| Destination | PORT |
|---|---|
| SI | 3 |
| SIII | 2 |
| SIV | 1 |

Routing Table of SII Switch

| Destination | PORT |
|---|---|
| SI | 1 |
| SII | 2 |
| SIV | 3 |

Routing table of switch SIII

| Destination | PORT |
|---|---|
| ≠ SI | 1 |
| SII | 2 |
| SIII | 3 |
| B | 4 |

Routing Table of switch SIV

## Characteristics of Datagram switching technique –

→ The datagram switching technique create ~~connect~~ connectionless network where before data transfer there is no set up phase or before data transfer there is no dedicated path established between source & destination.

→ ~~The~~ The bit stream that is produced at source side are divided in terms of packets or datagram of same or variable size.

→ ~~The datagrams that are produced behave independent of each other. That is even if the datagrams belongs to the same message but behave independent of each other.~~

→ The datagrams that are produced by the source behave independent of each other even if they (all the datagrams) belong to the same message. And the datagrams may take different route or path to reach the destination. Therefore, the data transmission is out of order or the packets or datagrams arrive at the destination in out of order manner. This is because different different routes or paths have different different time delay.

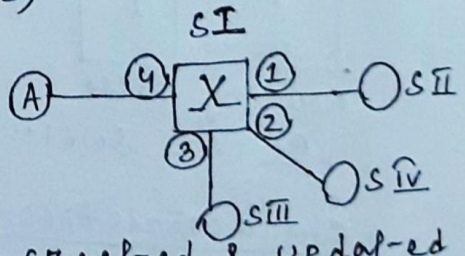
→ In datagram switching, the resources are allocated or reserved for data transmission on demand basis. i:e: resources are allocated to those device which has some data to send or transmits. Hence the resource gets efficiently utilized. Specially bandwidth of path or route gets efficiently utilized. So it removes the drawback of circuit switching.

→ In datagram switching there is a routing table at each switch that consist of two different column – Destination address & Port address.

(SI Routing Table)

| Destination ADDRESS | PORT ADDRESS |
|---|---|
| A | 4 |
| SII | 1 |
| SIII | 3 |
| SIV | 2 |

SWITCH SI Routing table. This routing table says from switch SI to possible destion through which port.




→ The routing tables of switch is created & updated automatically by learning the movement of datagram.

→ Delay associated with datagram switching is ~~maximum~~ maximum than others because waiting at the queue or buffer of switch to look up the routing ~~table~~ table to find out the next node to forward data & also to avoid congestion.

→ Efficiency - Datagram switching is efficient if we consider resource utilization. But the datagram switching is inefficient one if the waiting delay at switch is maximum or if the total delay is maximum.

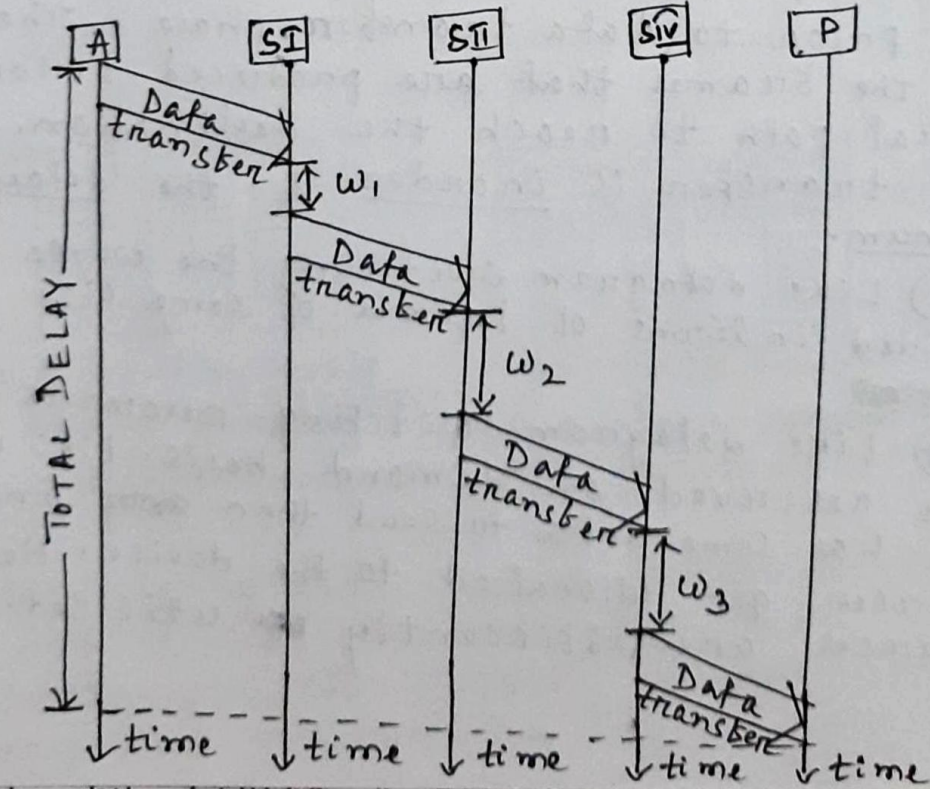
→ Delay or Total Delay

Total Delay for datagram switching can be calculated by combining or adding the delay due to data transfer & waiting delay at switches.

In datagram switching because of the datagrams choosing different paths so the flow diagram is different for different paths & consequently the delay is different for different paths.

$T_D$ (Delay) = Delay for Data transfer + Waiting Delay at the switch

→ flow diagram for path A → SI → SII → SIV - P



If T = delay for data transfer

$w_1$, $w_2$ & $w_3$ = waiting delay at switch SI, SII & SIV respectively.

$w_1$, $w_2$ & $w_3$ may be of same or different value. Or the value of $w_1$, $w_2$ & $w_3$ depends on congestion at switch SI, SII & SIV respectively.

Hence, $\boxed{T_D = 4T + w_1 + w_2 + w_3}$

→ Application - Datagram switching is used in creating Internet.

Virtual circuit switching -

The virtual circuit switching combines the good & advantageous characteristics of circuit switching as well as datagram switching.

(1) Like circuit switching, it has 3 different phases - Set-up phase, Data transfer phase, tear down phase.

(2) Like circuit switching a logical or virtual path need to be established during set-up phase prior to data transfer phase. Therefore, all the frames that are produced follow the same virtual path to reach the destination. Hence data transfer is inorder & the delay is minimum.

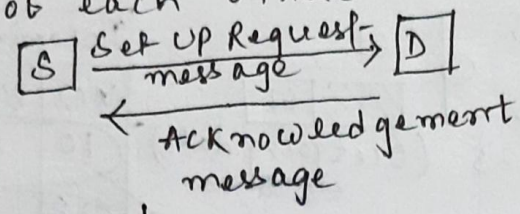
(3) Like datagram switching the whole bit-stream is divided in terms of frames of same size or variable size.

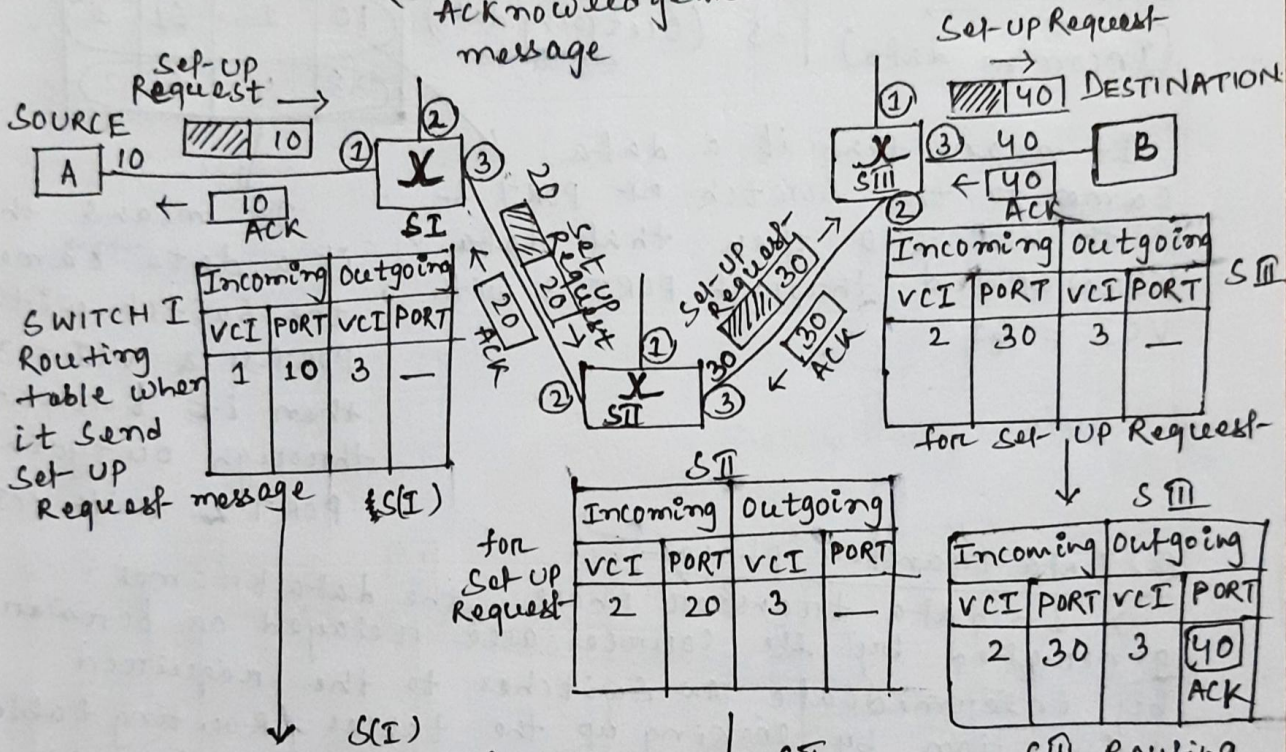
(4) Like datagram switching resources are allocated or reserved on demand basis. i.e: if the device has some data to send then only the resources get allocated to the device. Hence the resources are efficiently utilized.

## Description of different phases of virtual circuit-switching →

### (1) Set-up phase

The set up phase is accomplished by sending a pair of handshaking message in reverse direction of each other.



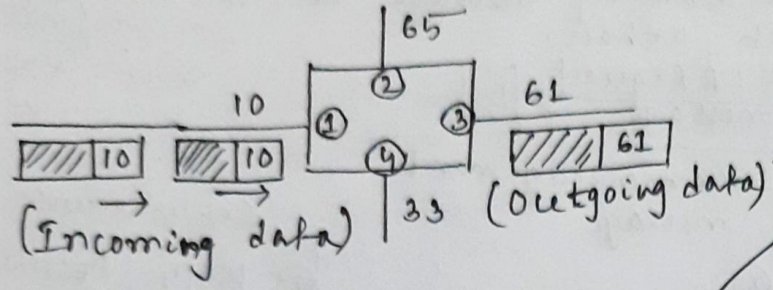

SWITCH I Routing table after receiving ACK message from SII.

SWITCH II Routing table after receiving ACK message from SIII.

SIII Routing table after receiving ACK message from B.

→ During set up phase, a set-up request is forwarded from source side to destination side via different interconnected switches & the switches create an entry for virtual or logical path at each switch by filling 3 different column & one last column remain blank. This last column get filled up when the switch receive ACK message &

on behalf of set-up request message. The ACK message contain the outgoing VCI number, where the set-up request contain incoming VCI number. VCI is the virtual channel identifier or the identification value of a virtual channel.




| Incoming | | Outgoing | |
|---|---|---|---|
| VCI | PORT | VCI | PORT |
| 10 | 1 | 61 | 3 |
| 33 | 4 | 65 | 2 |

It means that it a data came to the switch at PORT 1 with VCI = 10 then that data forwarded through PORT 3 with VCI = 61

It means that it a data came to the switch with PORT=4 & VCI = 33 then it forwarded through outgoing PORT 2 with VCI=65

(2) Data transfer phase -

→ In data transfer phase, the data frames generated by the source are relayed or forwarded by intermediate switches to the required destination by looking up the tables (Routing tables) to bind incoming port, incoming VCI with outgoing port & outgoing VCI.

Incoming port, incoming VCI $\xleftrightarrow{\text{Bind}}$ Outgoing port, outgoing VCI.

→ Due the dedicated virtual path, the data transfer is inorder & of minimum delay.

(3) Tear Down Phase -

→ After completion of data transfer, the virtual path is released, that is the entry of virtual path from routing table of intermediate switches are deleted or removed.

Efficiency -

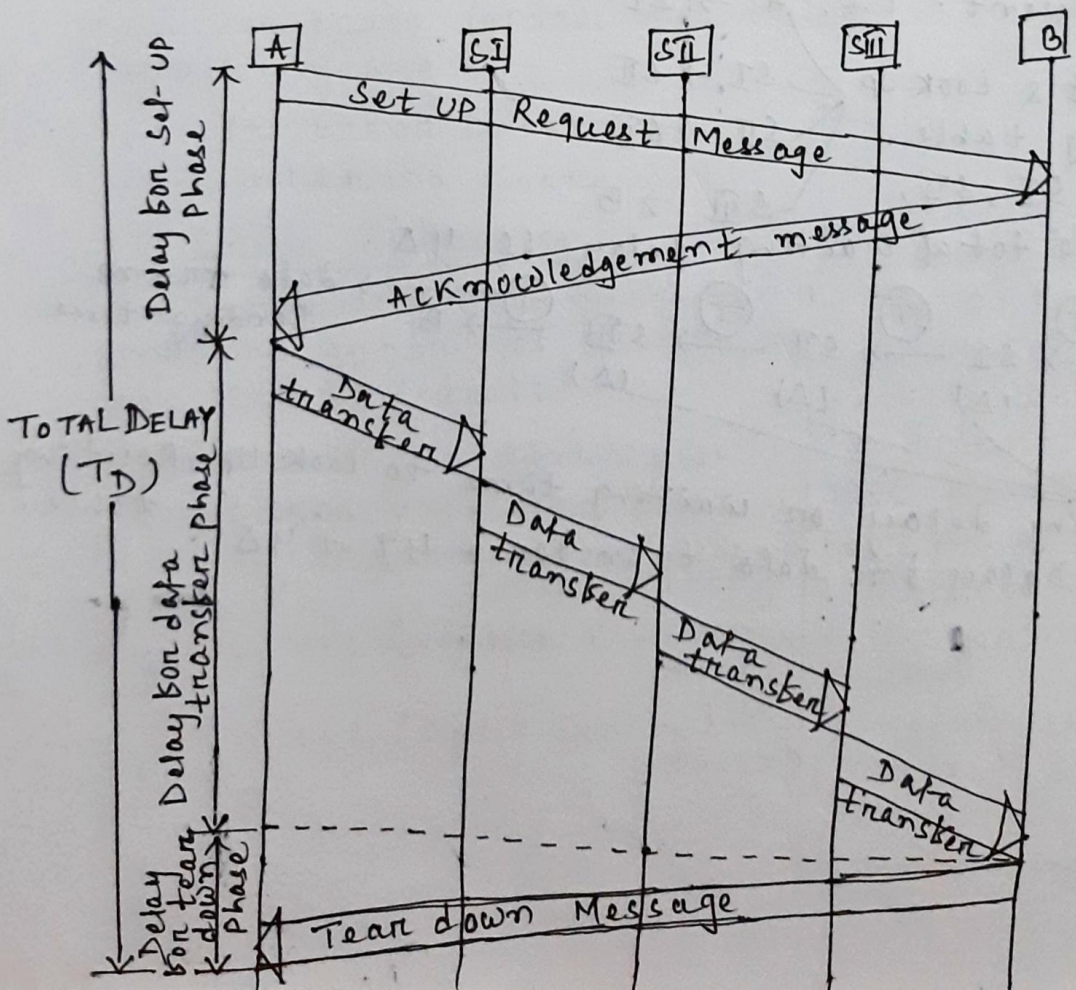
Virtual switching technique is a efficient switching technique because,

→ Resources are reserved in set up phase but on demand basis. Hence efficient utilization of resources.

→ All the generated or produced frames follows the same virtual or logical path to reach the destination.

Delay - ($T_D$)

Total Delay or Delay ($T_D$) = Delay for set up phase
+
Delay for Data transfer phase
+
Delay for Tear down phase.



~~$T_D$ = Delay for set up phase + 4T + 4Δ + Delay for~~

$T_D$ = Delay for Set up phase

+

$4T + 4\Delta$ → Delay for data transfer phase

+

Delay for tear down phase

where T = time or delay to transmit a data frame from one node to another node.

Δ = time or delay to look up the Routing Table.

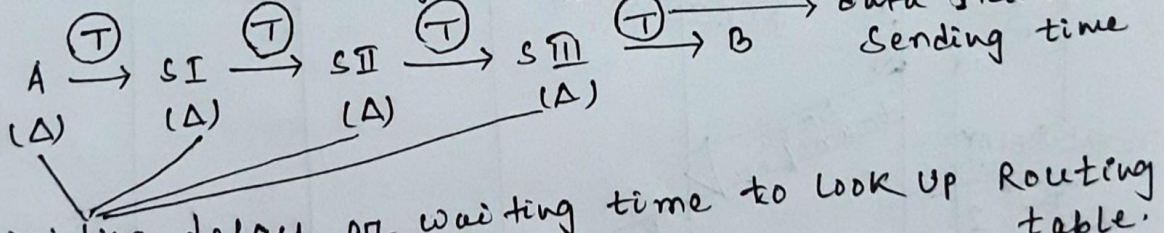
Because, there are 4 hops to send a data frame from A to B. Therefore total data transfer time is 4T. Similarly before forwarding data frame to the next node, routing table look up time is also present. i.e: A → SI

wait & Look up Routing table at A, SI, SII, SIII. So total waiting delay is 4Δ.

SI → SII

SII → SIII

SIII → B




waiting delay or waiting time to look up Routing table.

Hence Delay for data transfer = 4T + 4Δ