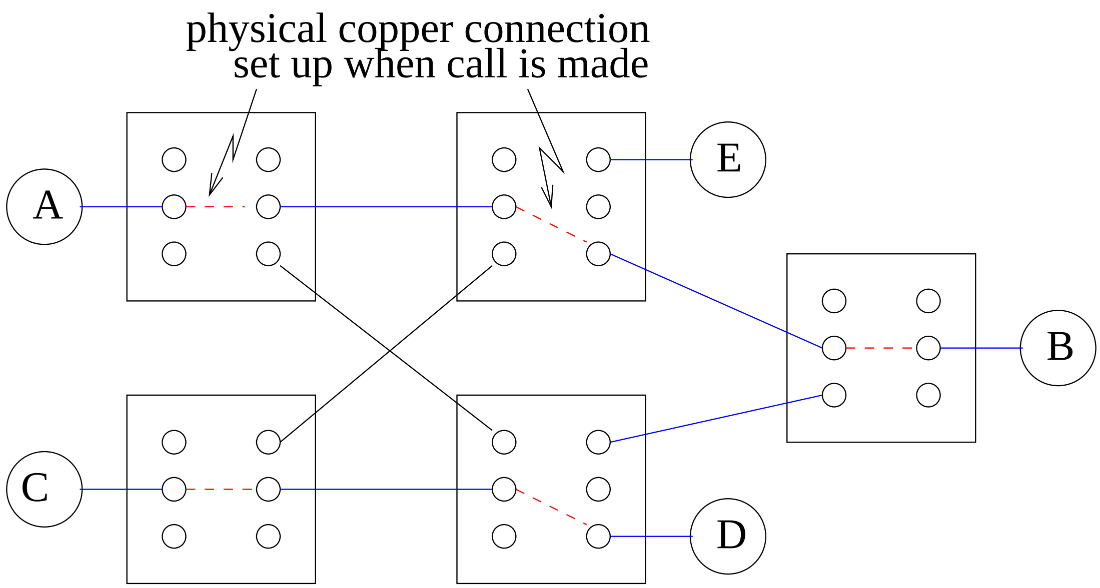
Wide-Area Networks

I) Switching Techniques

1. Circuit Switching

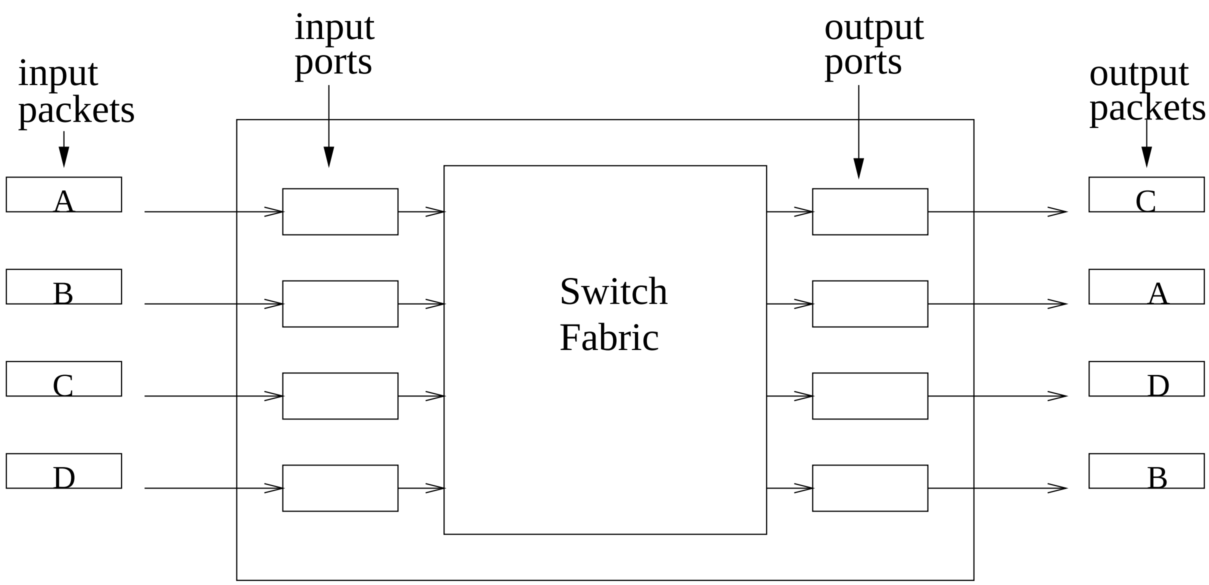
   - A dedicated transmission circuit must be established before data transmission.



   - Traffic delay is minimum once the connection is established.
   - It is not very efficient if the traffic is bursty.

2. Packet Switching

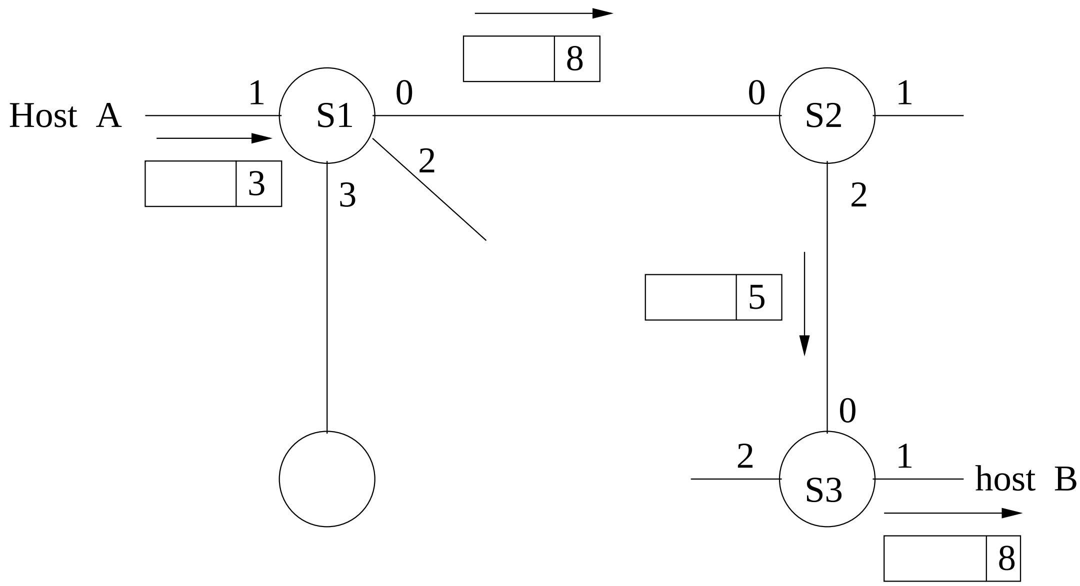
- No dedicated circuit.
- Message is broken down into a number of smaller data units called packets.
- Packets are transferred from the source to the destination through a series of switches.
- At each switch, a packet must be completely received and processed before retransmitting to the next switch or destination (store-and-forward).



- Two types of packet switching: virtual circuit and datagram.

3. Virtual Circuit (VC)

- A transmission path is established before data transmission.
- Packets from the same source/destination pair are delivered in the same path.
- Each packet carries a VC number for switching.

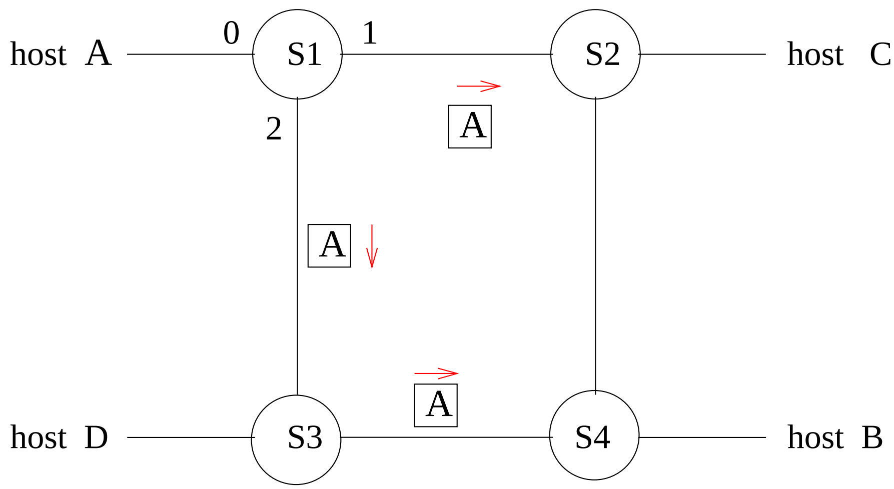


- Segment of forwarding table for switch 1.

Input Port	Incoming Identifier	Output Port	Outgoing Identifier
1	4	3	9
1	3	0	8
3	3	0	3
3	6	2	1

4. Datagram

- No fixed transmission path. Each packet is routed independently.
- Each packet must carry the full address of the destination.
- No guarantee of delivery.

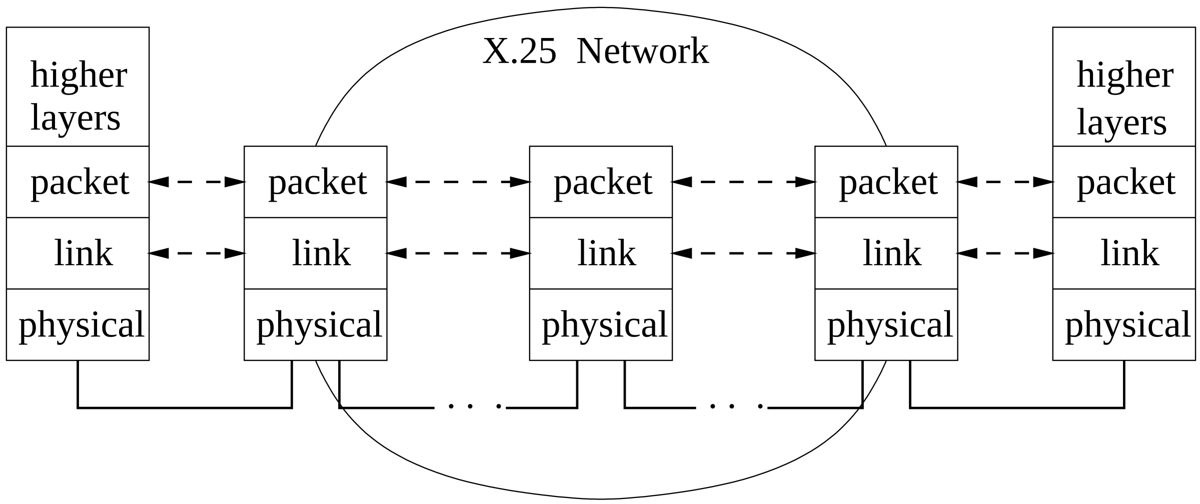


- Forwarding table for switch 1.

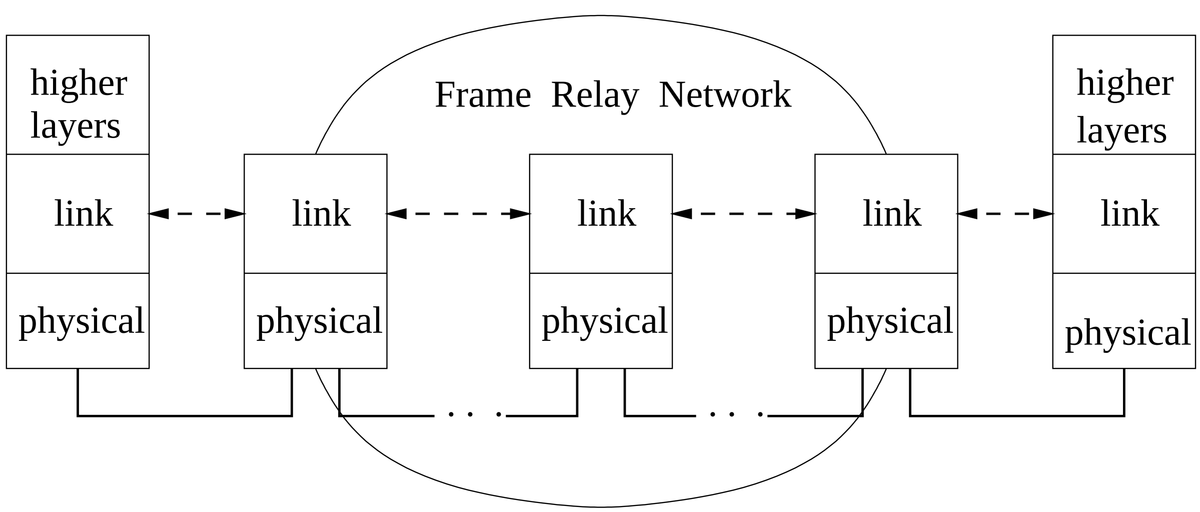
Destination	Switch Port
host A	0
host B	1
host C	1
host D	2

5. X.25 and Frame Relay

- X.25 – public packet-switched Network.



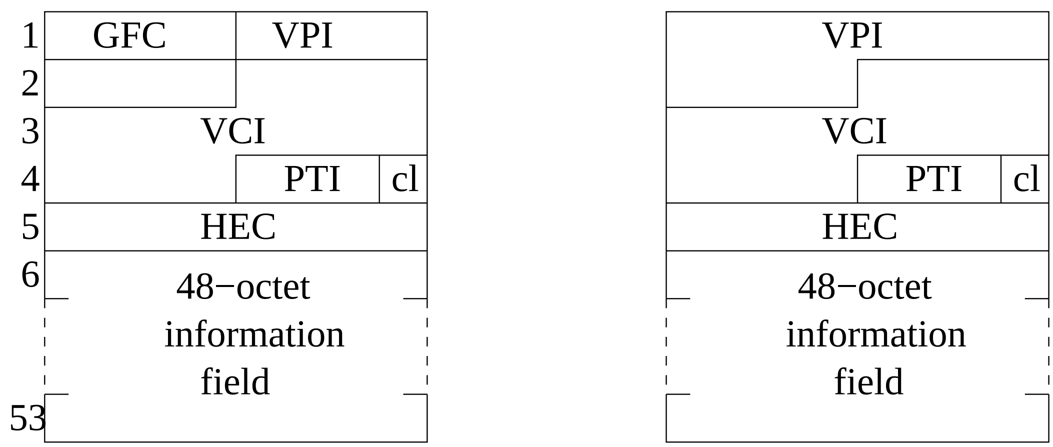
- Frame Relay Network



II) Asychronous Transfer Mode (ATM)

1. Basic Properties

- Switching technique for broadband ISDN.
- Connection-oriented. Information is transmitted in 53-byte data units - cells.
- Bandwidth on demands: support various traffic requirements.
- No error protection or flow control on a link-by-link basis. Error detection and correction in the header.
- ATM cell format:



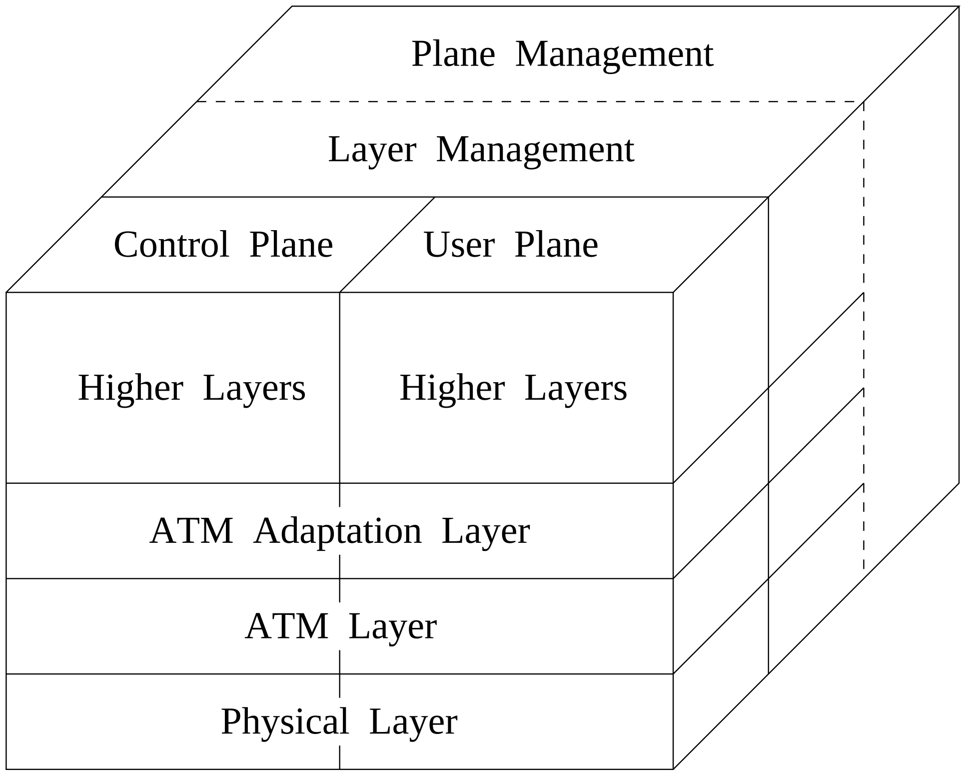
(a) User−Network

(b) Network−Network

GFC = Generic flow control
VPI = Virtual path identifier
VCI = Virtual circuit identifier

PTI = Payload type identifier
cl = Cell loss priority
HEC = Header error check

2. ATM Layered Model



- User Plane: manages the transfer data to and from applications.
- Control Plane: manages call establishment and release.
- Management Plane: maintains the network and performs operational functions.

3. <u>Virtual Channel and Virtual Path</u>

- Virtual circuit: logical connection between end users.
- Virtual path: collection of virtual circuits traversing the same path in the network.
- Virtual path emulates the functions of the trunk concept in circuit switching.