

# Network Layer

Design Issues

# Network

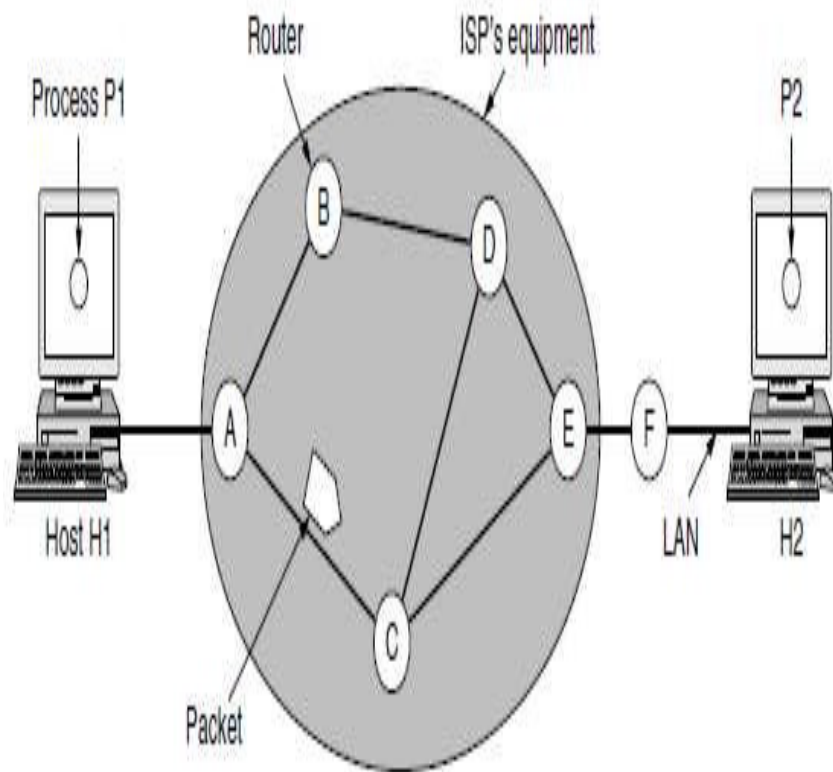
## Layer

- The network layer is concerned with getting packets from the source all the way to the destination with minimal cost.
- Unlike the DLL which has the more modest goal of just moving frames from one end of a wire to the other.
- Network Layer is the lowest layer that deals with end-to-end transmission.

# **NETWORK LAYER DESIGN ISSUES**

- **Store-and-Forward Packet Switching**
- **Services Provided to the Transport Layer**
- **Implementation of Connectionless Service**
- **Implementation of  
Connection-Oriented Service**
- **Comparison of Virtual-Circuit and  
Datagram Networks**

# Store-and-Forward Packet Switching



- A host with a packet to send transmits it to the nearest router.
- The packet is stored there until it has fully arrived.
- the link has finished its processing by verifying the checksum.
- Then it is forwarded to the next router along the path until it reaches the destination host.
- This mechanism is store-and-forward packet switching.

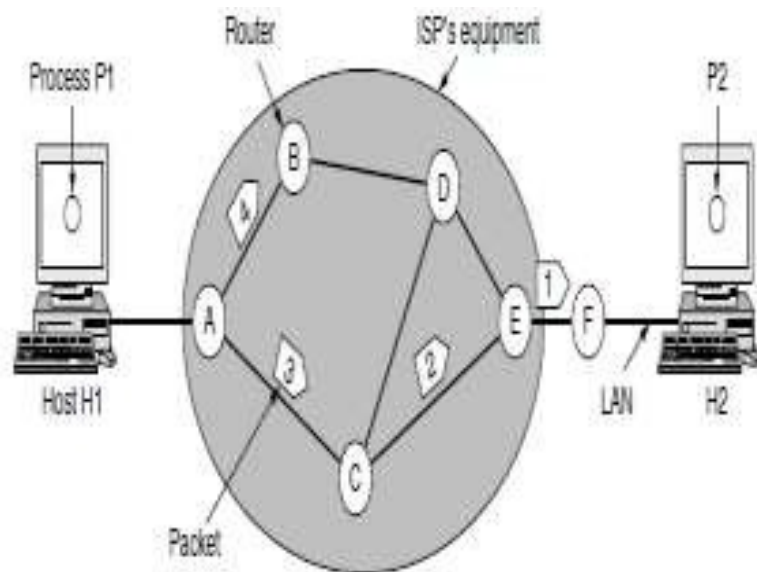
# Services Provided to the Transport Layer -

- Connection-oriented service : is a network communication mode, where a communication session or a semi-permanent connection is established before any useful data can be transferred, and where a stream of data is delivered in the same order as it was sent.
- Connectionless service: is a data transmission method used in packet switching networks by which each data unit is individually addressed and routed based on information carried in each unit, rather than in the setup information of a pre-arranged fixed data channel as in connection-oriented communication.
- Packet Switching: is a digital networking communications method that groups all transmitted data into suitably sized blocks, called packets.
- A Datagram: is a basic transfer unit associated with a packet-switched network. The Delivery, Arrival time, and order of arrival need not be guaranteed by the network.
- A Virtual circuit: is a means of transporting data over a packet switched computer network in such a way that it appears as though there is a dedicated physical layer link between the source and destination end systems of this data

# Implementation of Service

- If connectionless service is offered, packets are injected into the network individually and routed independently of each other.
- No advance setup is needed.
- In this context, the packets are frequently called Datagram.
- If connection-oriented service is used, a path from the source router all the way to the destination router must be established before any data packets can be sent.
- This connection is called a VC (Virtual Circuit).

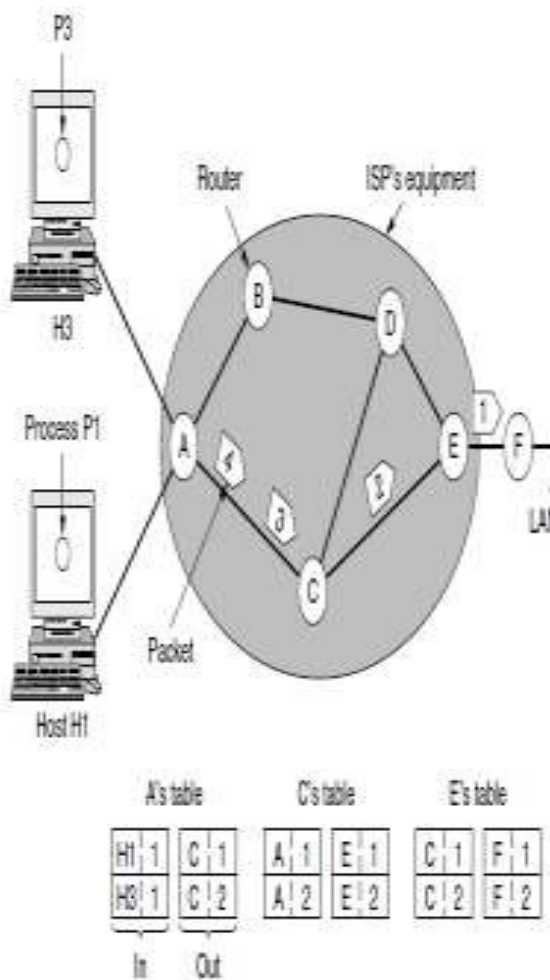
# Implementation of Connectionless Service



- Suppose that the process *P1* in Fig. has a long message for *P2*
- It hands the message to the transport layer,
- with instructions to deliver it to process *P2* on host *H2*.
- *The transport layer code runs on H1, typically within the operating system.*
- *It prepends a transport header to the front of the message and hands the result to the network layer, probably just another procedure within the operating system*

A's table (initially)	A's table (later)	C's table	E's table
A -	A -	A A	A C
B B	B B	B A	B D
C C	C C	C -	C C
D B	D B	D E	D D
E C	E B	E E	E -
F C	F B	F E	F F
Dest. Line			

# Implementation of Connection-Oriented Service



- For connection-oriented service, we need a virtual-circuit network. The idea behind virtual circuits is to avoid having to choose a new route for every packet sent.
- With connection-oriented service, each packet carries an identifier telling which virtual circuit it belongs to.
- Assigns a different connection identifier to the outgoing traffic for the second connection. Avoiding conflicts of this kind is why routers need the ability to replace connection identifiers in outgoing packets. In some contexts, this process is called **label switching**



# Comparison of Virtual-Circuit and Datagram Networks

Issue	Datagram network	Virtual-circuit network
Circuit setup	Not needed	Required
Addressing	Each packet contains the full source and destination address	Each packet contains a short VC number
State information	Routers do not hold state information about connections	Each VC requires router table space per connection
Routing	Each packet is routed independently	Route chosen when VC is set up; all packets follow it
Effect of router failures	None, except for packets lost during the crash	All VCs that passed through the failed router are terminated
Quality of service	Difficult	Easy if enough resources can be allocated in advance for each VC
Congestion control	Difficult	Easy if enough resources can be allocated in advance for each VC