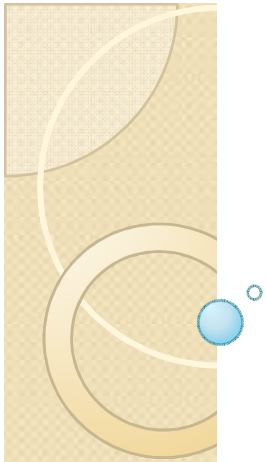
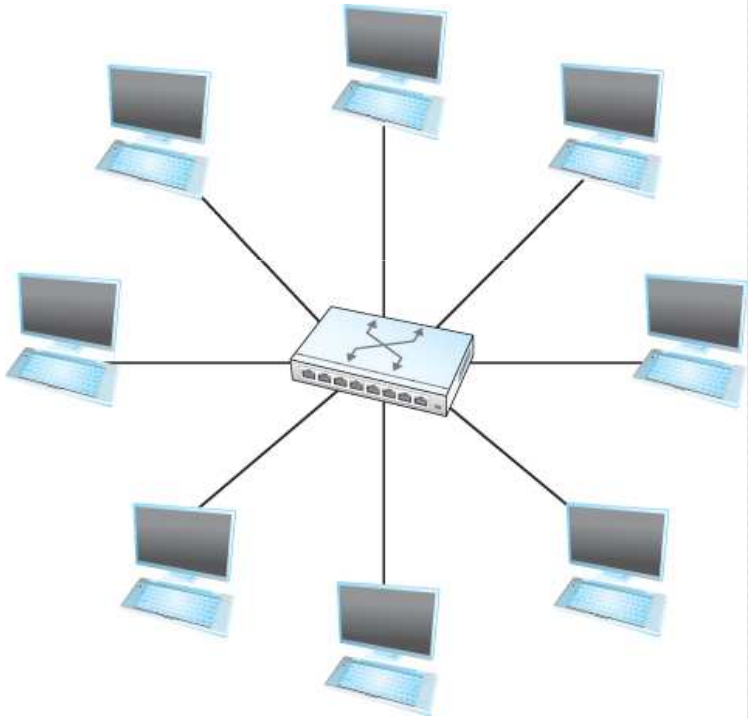


Switching

Introduction

- A switch is a mechanism that allows us to interconnect links to form a larger network
- A switch is a multi-input, multi-output device, which transfers packets from an input to one or more outputs
- A switch adds the star topology to the point-to-point link, bus (Ethernet), and ring



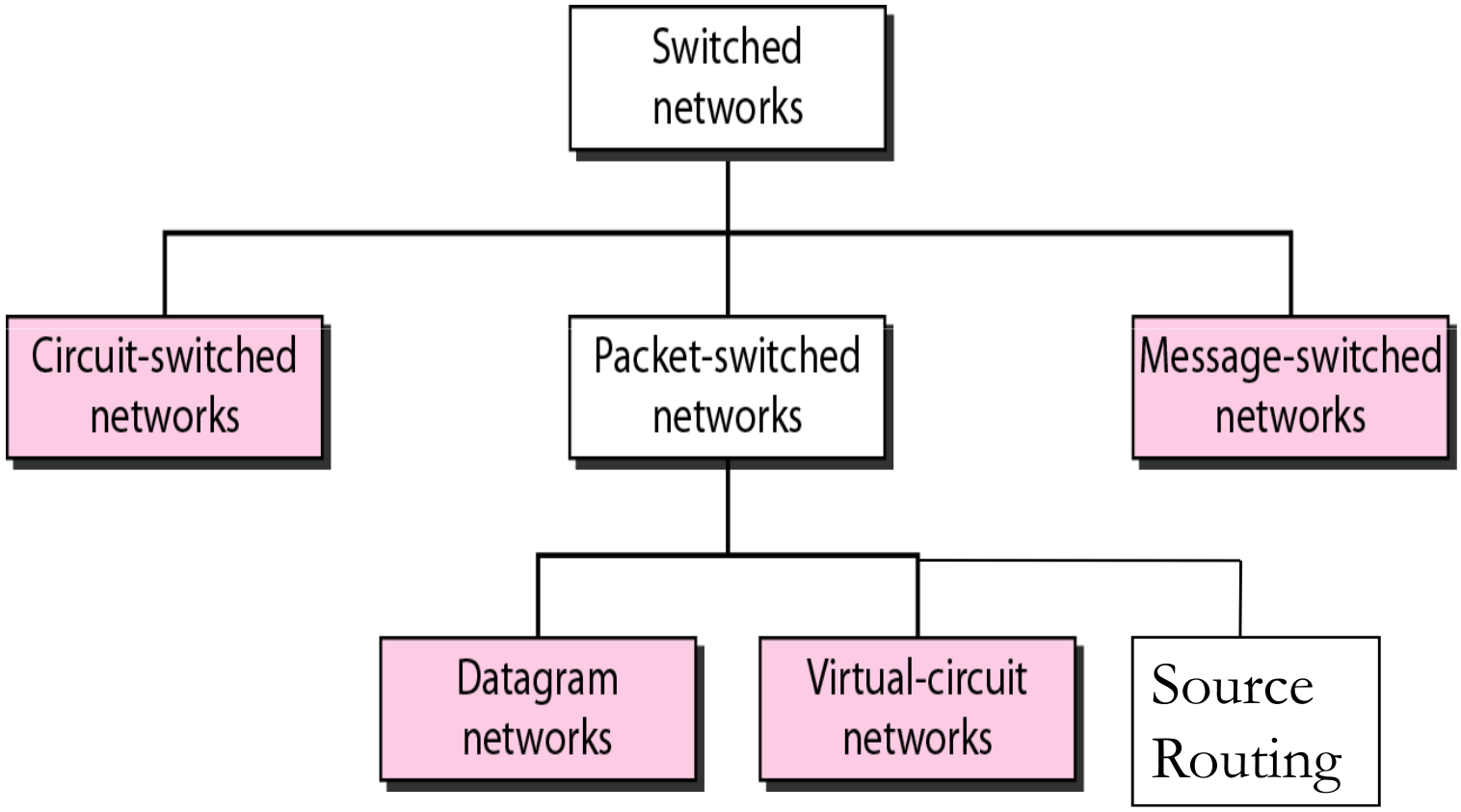
Properties of Star Topology

- Even though a switch has a fixed number of inputs and outputs, which limits the number of hosts that can be connected to a single switch, large networks can be built by interconnecting a number of switches
- By connecting switches to each other and to hosts using point-to-point links, which typically means that networks of large geographic scope is built.
- Adding a new host to the network by connecting it to a switch does not necessarily mean that the hosts already connected will get worse performance from the network

Switching or Forwarding

- A switch's primary job is to receive incoming packets on one of its links and to transmit them on some other link.
- This function is sometimes referred to as either switching or forwarding

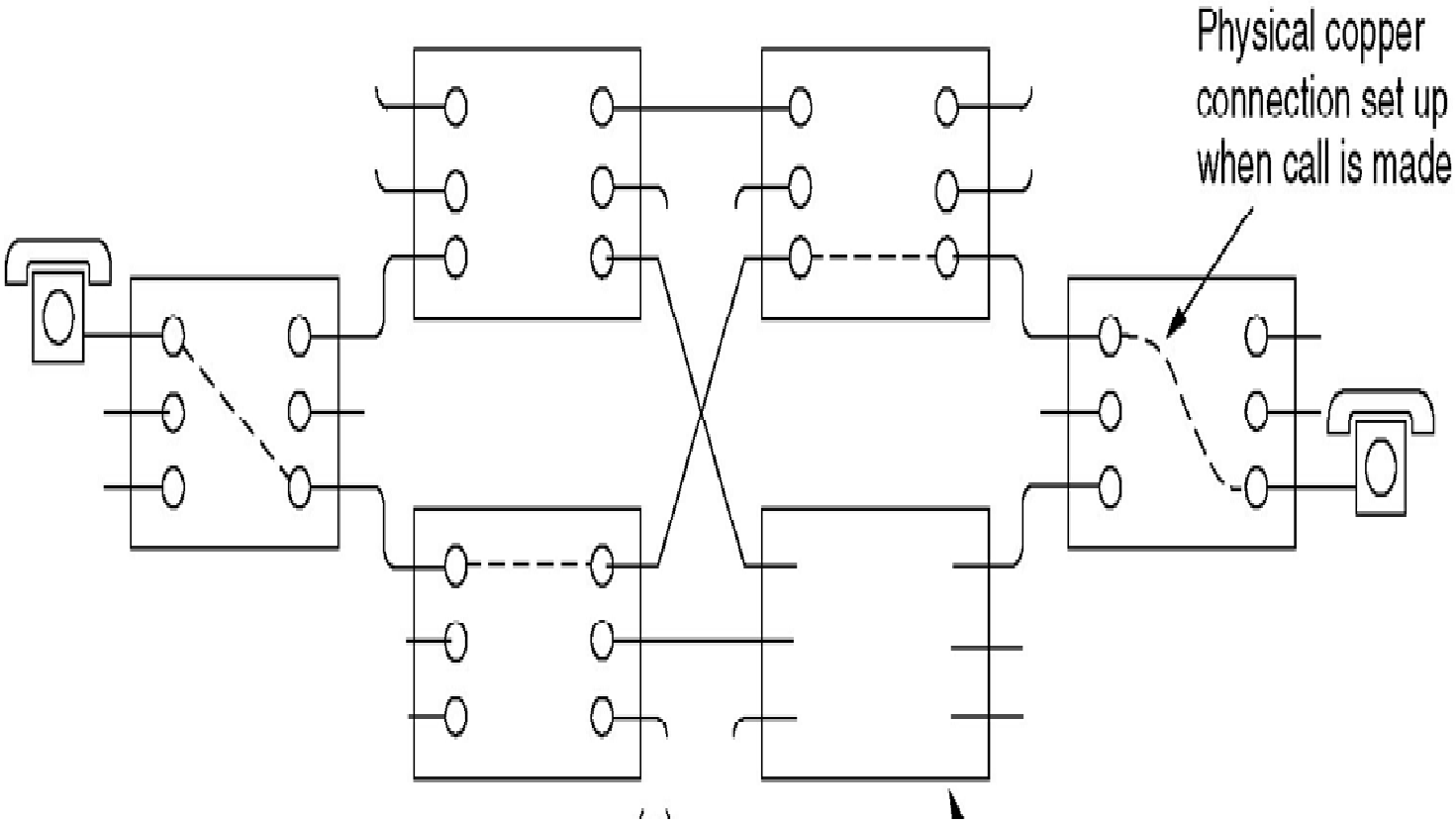
Types of switched networks



Circuit Switched Networks

- A circuit-switched network consists of a set of switches connected by physical links.
- A connection between two stations is a dedicated path made of one or more links in connection establishment phase
- Each connection uses only one dedicated channel on each link.

Circuit Switched Networks



Circuit Switched Networks

- In circuit switching, the resources need to be reserved during the setup phase.
- Two parties can transfer the data in data transfer phase
- The resources remain dedicated for the entire duration of data transfer until the connection termination phase
- Example: Telephone Networks

Packet Switched Networks

- In a packet-switched network, there is no resource reservation.
- Resources are allocated on demand
- Data needs to be divided into packets of fixed or variable size.
- The size of the packet is determined by the network and the governing protocol

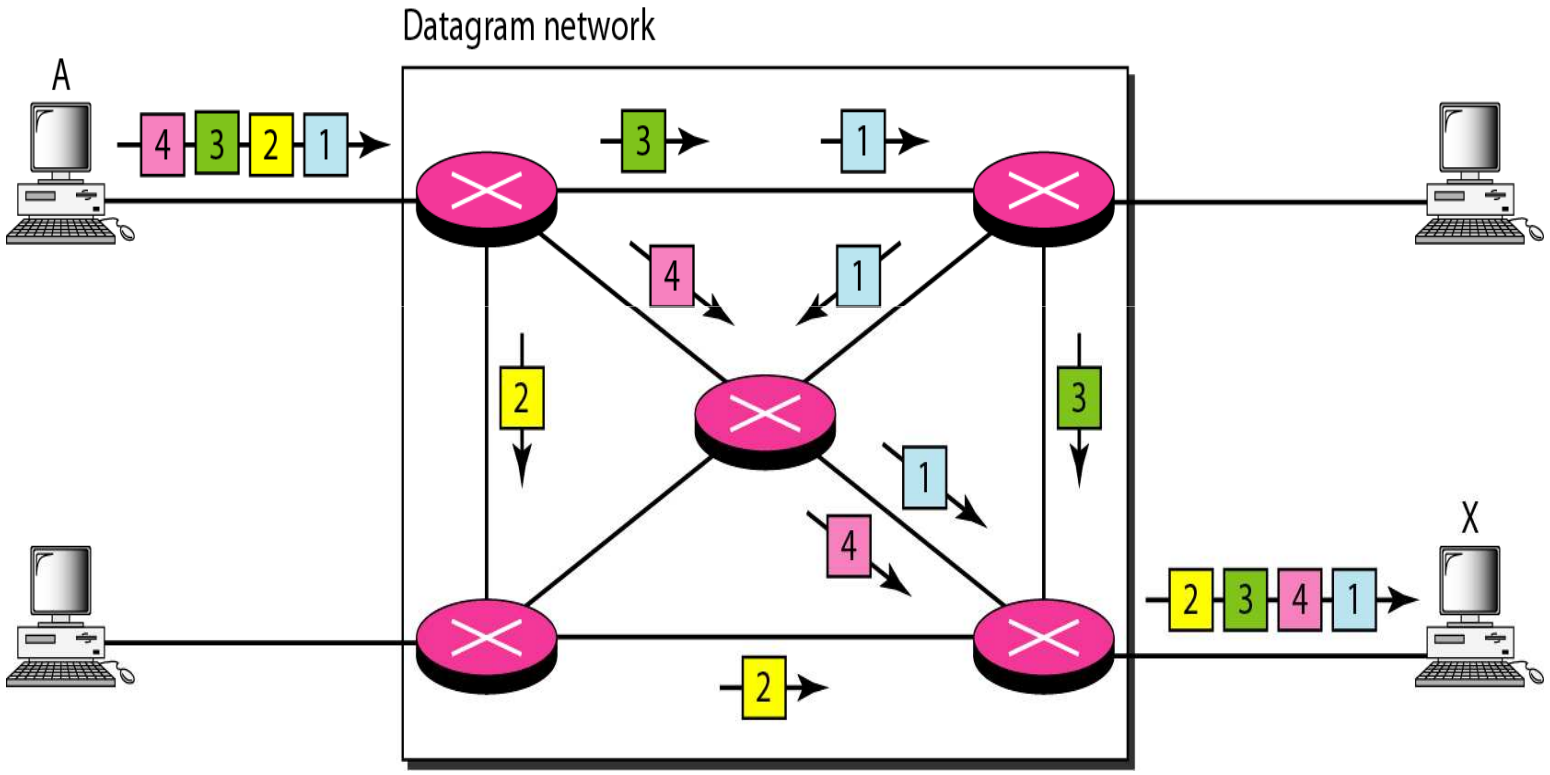
Packet Switched Networks

- Two common approaches
  - *Datagram or Connectionless approach*
  - *Virtual circuit or Connection-oriented approach*
- A third approach *source routing* is less common

Datagram Networks

- Each packet is treated independently of all others.
- Even if a packet is part of a multipart transmission, the network treats it as though it existed alone.
- Packets in this approach are referred to as datagrams.
- Every packet contains enough information to enable any switch to decide how to get it to destination
  - Every packet contains the complete destination address

A datagram network with four switches (routers)



Example

- All four datagrams belong to the same message, but may travel different paths to reach their destination.
- This cause the datagrams to arrive at their destination out of order with different delays between them.
- The upper layer reorders the datagrams.
- Datagram networks are referred to connection less networks
- Switching in the Internet is done by using the datagram approach at the network layer.

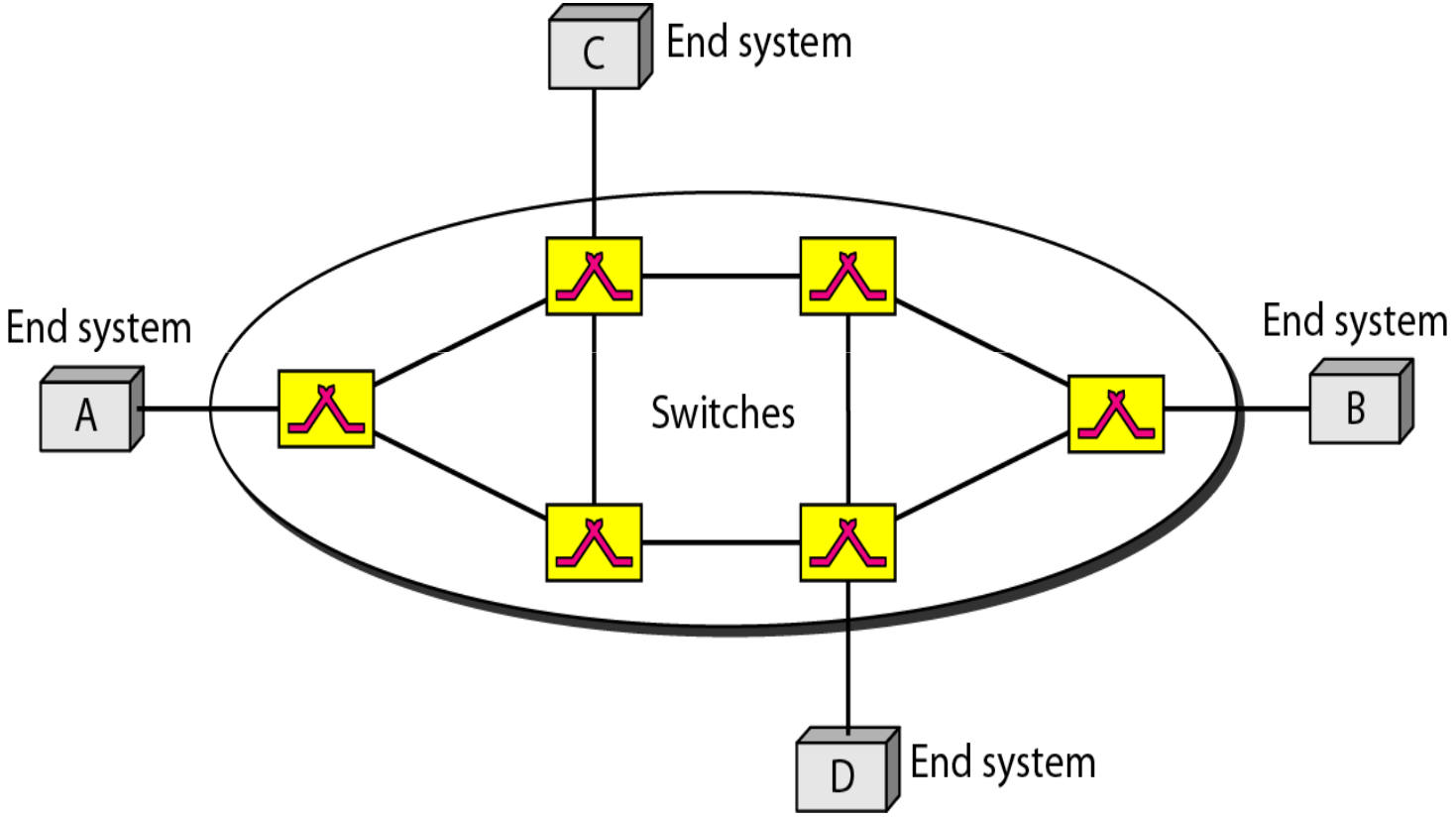
2 Types of Services

- Connection Oriented Service
- Connection less Service.
- Both are decided in Transport layer.
- Based on this the network layer works.
- Connection Oriented Service→ Packets
- Connection Less Service → Datagrams

Virtual Circuit Networks

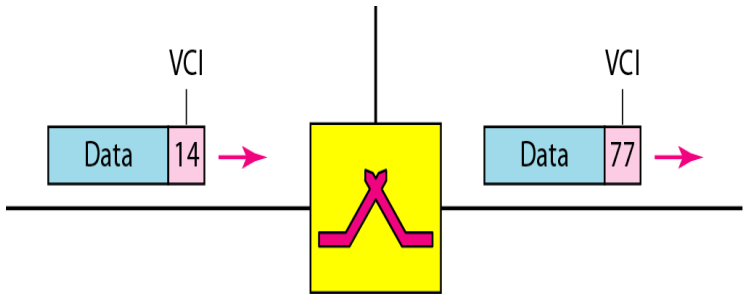
- A virtual circuit network is a cross between a circuit switched network and a datagram network.
- Characteristics of VCN
  - 3 phases as in CSN (connection setup, data transfer, connection teardown)
  - Resources allocated during connection setup (CSN) or on demand (DN)
  - Data in form of packets
  - All packets follow the same path (CSN)

Virtual Circuit Networks



Addressing

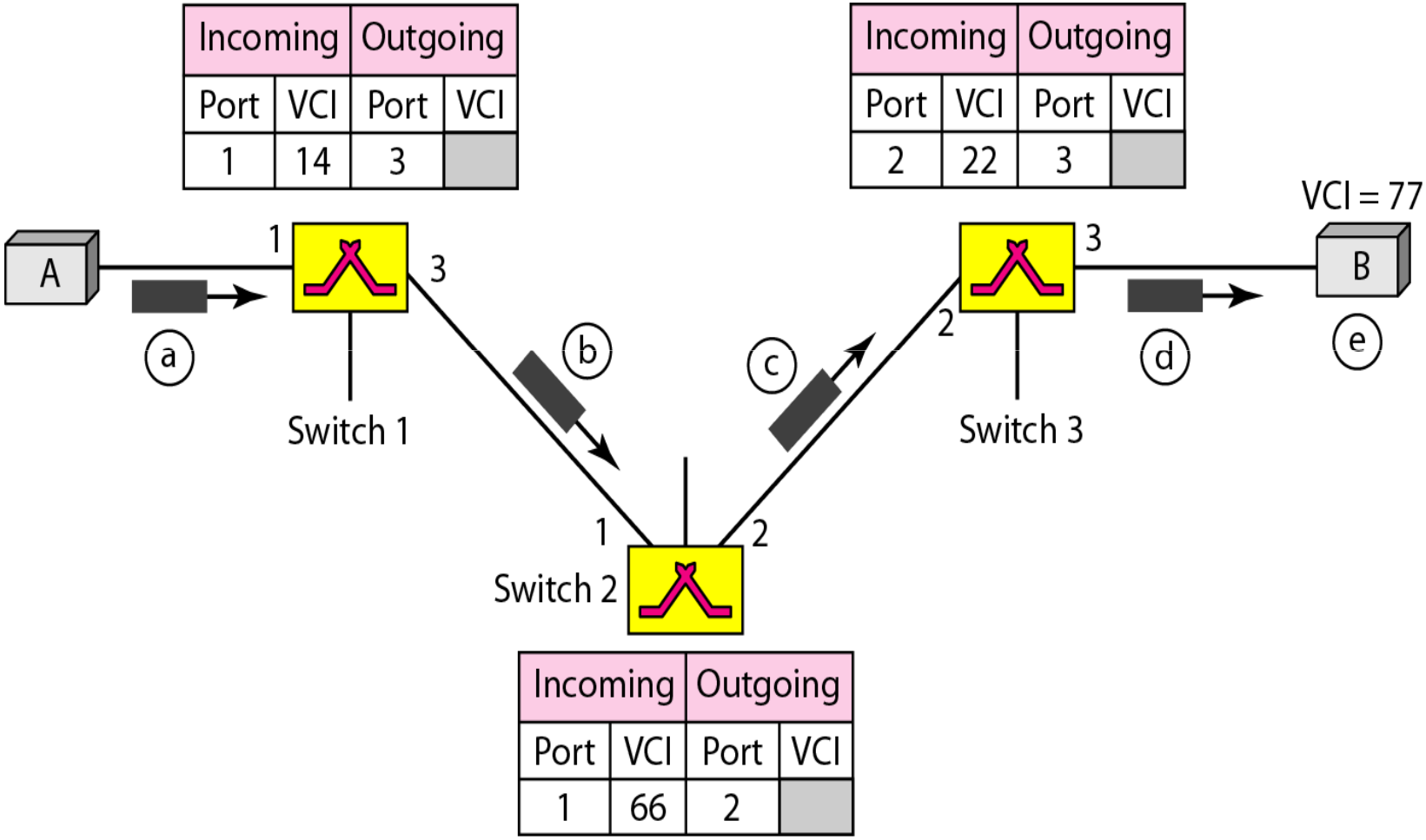
- Global
  - Network address
- Local
  - Virtual Circuit Identifier(VCI)
  - Small number assigned by a switch
  - Used by a pkt between 2 switches



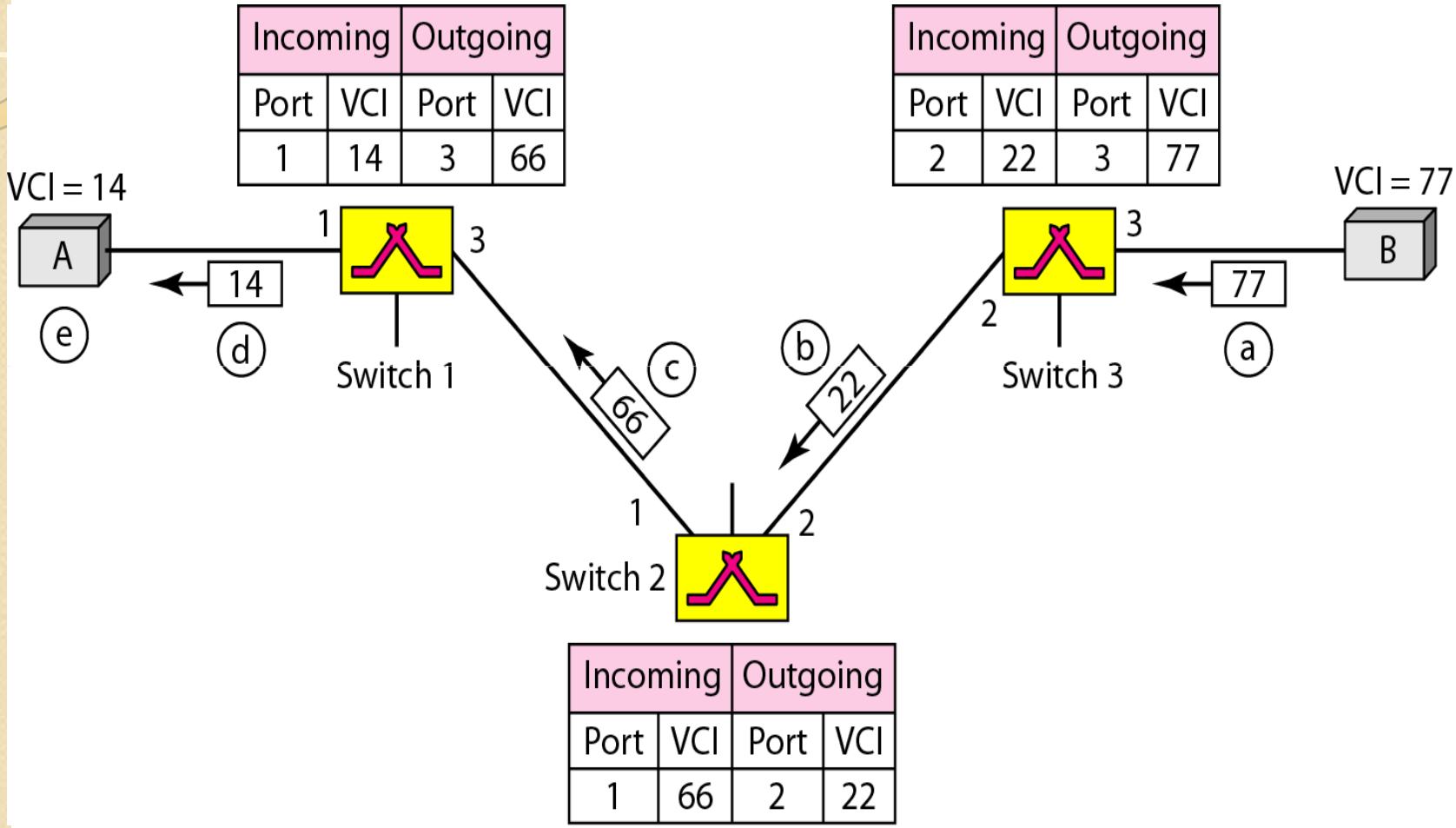
Connection setup phase

- Connection setup request
- Connection setup ack

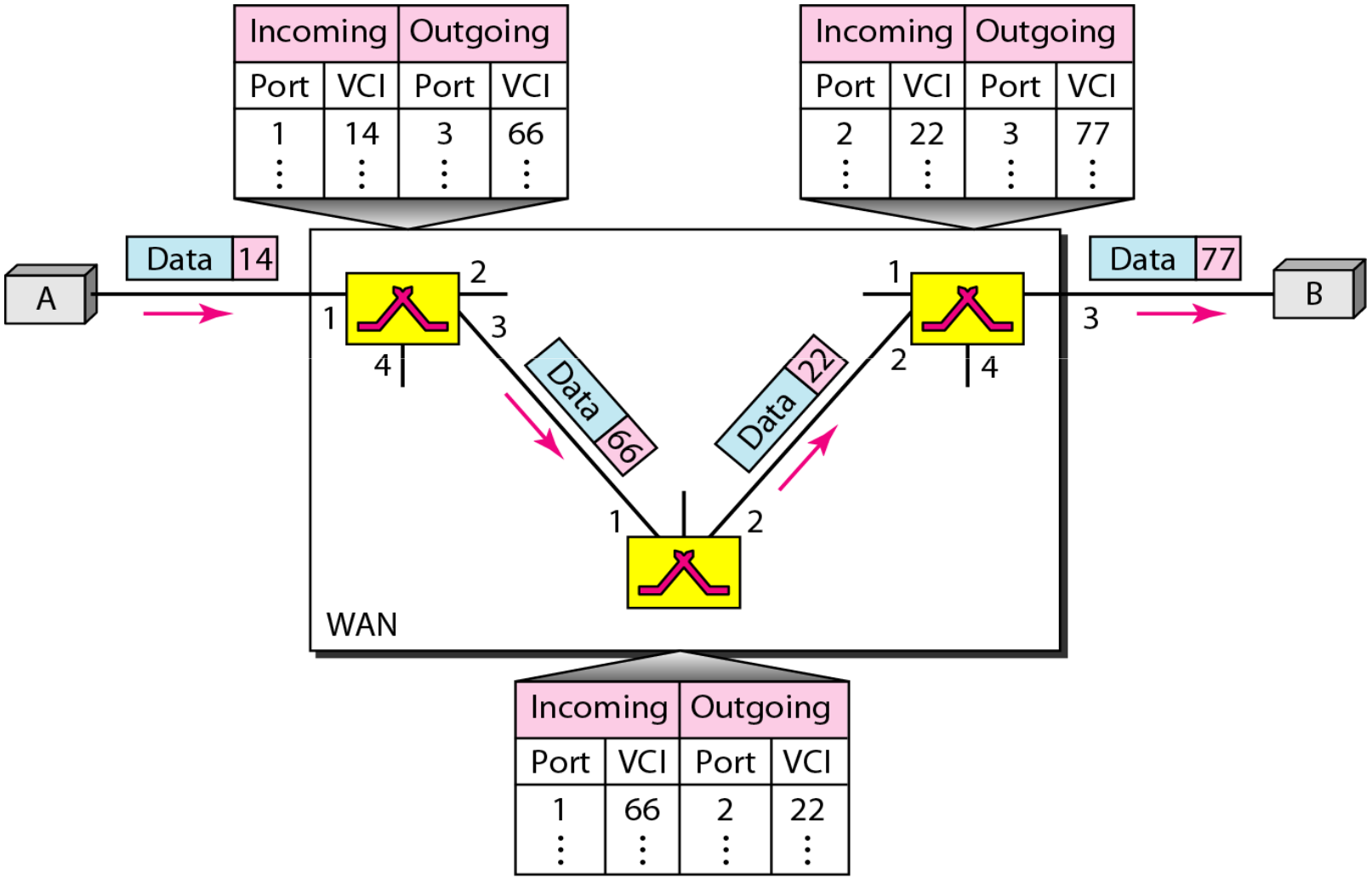
Setup request in a VCN



Setup acknowledgment in a VCN



Data Transfer in a VCN



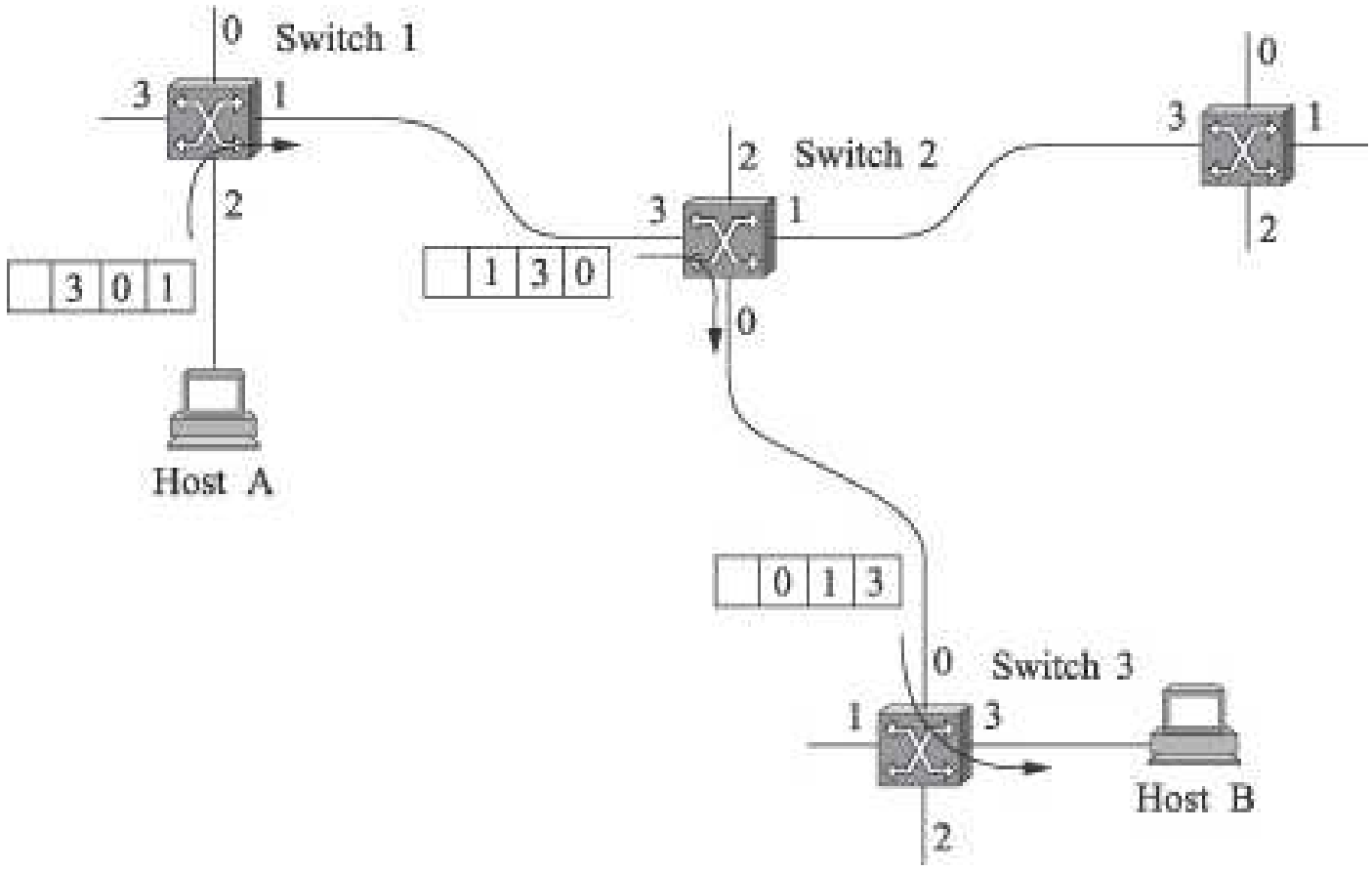
Data Transfer in a VCN

- In virtual-circuit switching, all packets belonging to the same source and destination travel the same path.
- But the packets may arrive at the destination with different delays if resource allocation is on demand

Source Routing

- Another approach to switching that uses neither virtual circuits nor conventional datagrams is known as source routing
- Various ways to implement source routing
- Assign a number to each output of each switch and to place that number in the header of the packet

Source Routing

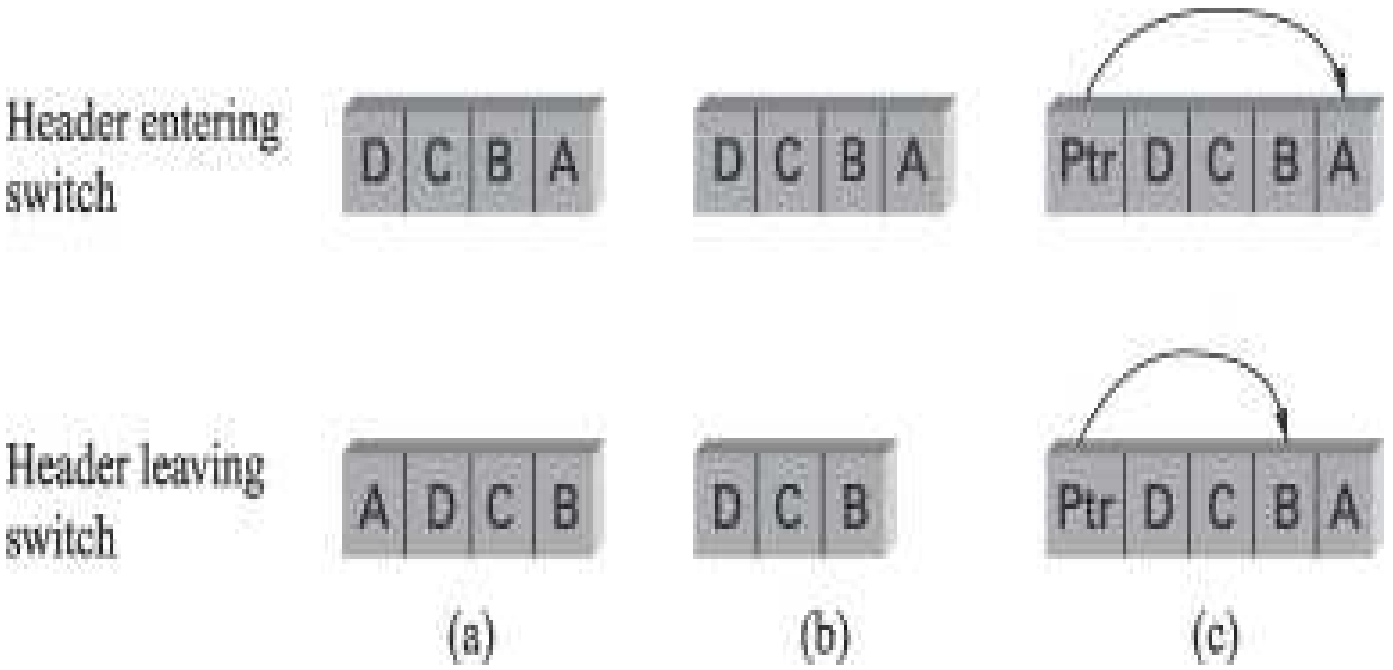


Things to note Down

- The host should have enough knowledge about the topology of the network to form a header that has all the right directions in it for every switch in the path
- One cannot predict how big the header needs to be, since it must be able to hold one word of information for every switch on the path.
- There are some variations in this approach

Variations

- Three ways to handle headers for source routing:



Message Switching

- Entire Messages are routed, one hop at a time
- Message switching systems are nowadays mostly implemented over packet-switched or circuit-switched networks
- Each message contains addressing information, and at each switch this information is read and the transfer path to the next switch is decided

Message Switching

- Each message is stored (usually on hard drive due to RAM limitations) before being transmitted to the next switch.
- Because of this it is also known as a 'store-and-forward' network.
- Email is a common application for Message Switching.
- A delay in delivering email is allowed unlike real time data transfer between two computers.