Network Topology and Switching

Course Code: **COE 3201** Course Title: **Data Communication**

Dept. of Computer Engineering
Faculty of Engineering

Lecture No:	**12**	**Week No:**	**13**	**Semester:**	
Lecturer:					

Lecture Outline

1. Network topologies
2. Switching Mechanism for Data Transfer
3. Circuit Switching
4. Message Switching
5. Packet Switching
6. Virtual Circuit Switching
7. Datagram Switching

Network topologies

Figure 1.6 *A bus topology connecting three stations*

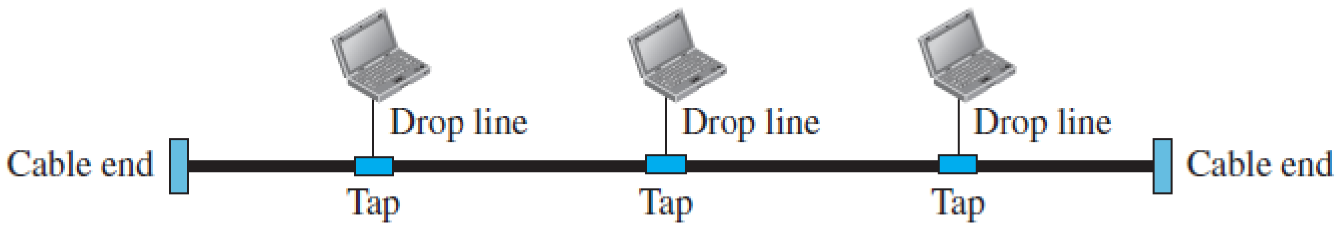
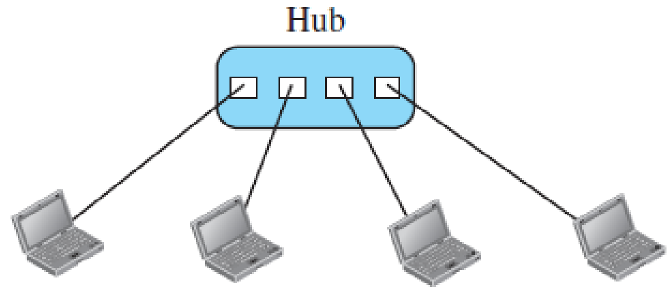


Figure 1.5 *A star topology connecting four stations*



Network topologies

Figure 1.4 *A fully connected mesh topology (five devices)*

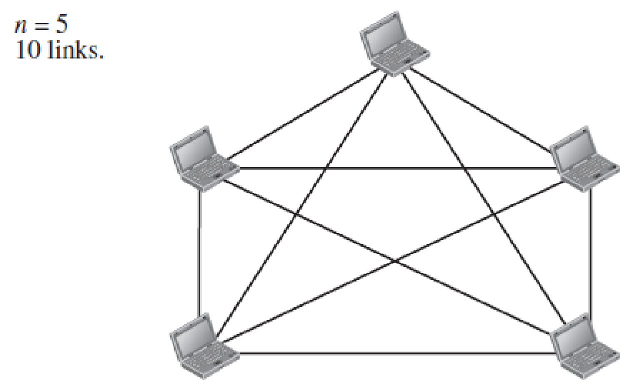
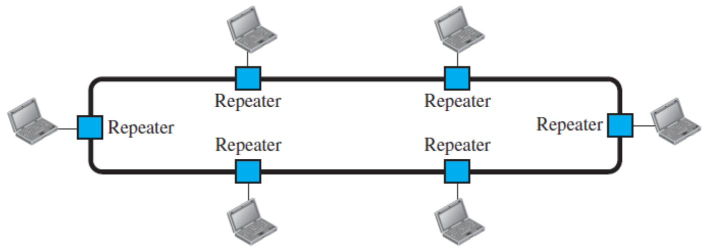


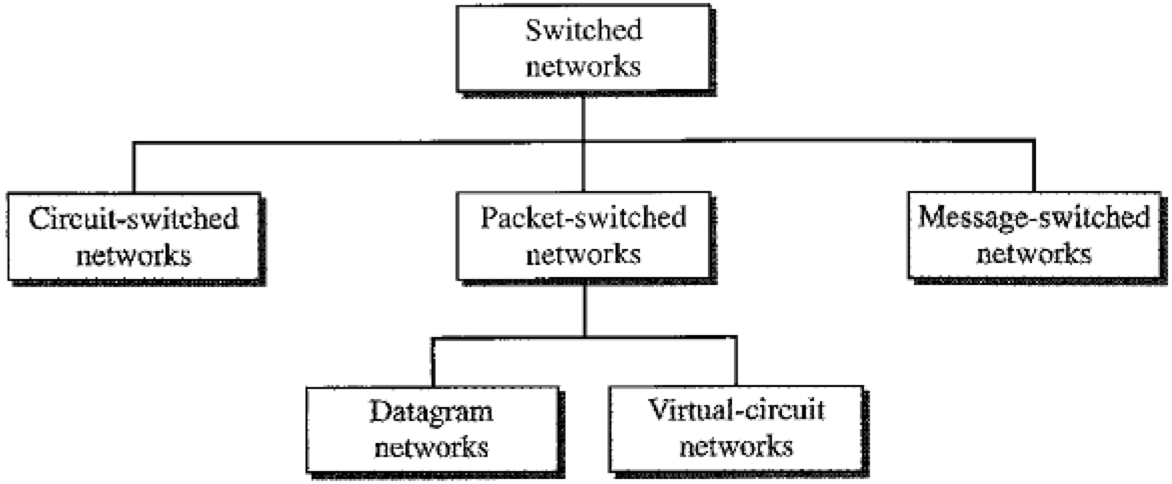
Figure 1.7 *A ring topology connecting six stations*



Switching Mechanism for Data Transfer

Taxonomy of Switched Network

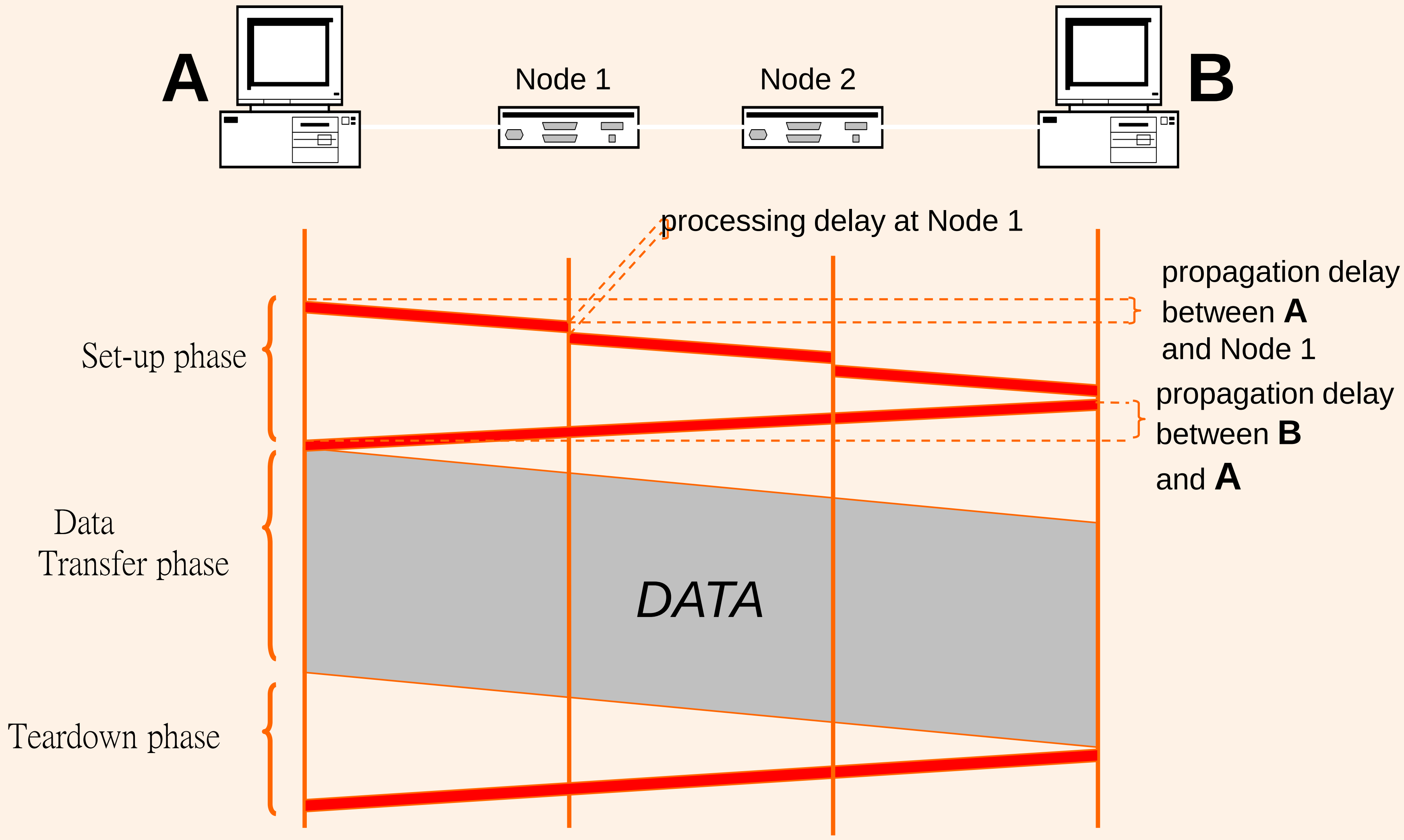
Traditionally, three methods of switching have been important: circuit switching, packet switching, and message switching. The first two are commonly used today. The third has been phased out in general communications but still has networking applications. We can then divide today's networks into three broad categories: circuit-switched networks, packet-switched networks, and message-switched. Packet-switched networks can funher be divided into two subcategories-virtual-circuit networks and datagram networks- as shown in Figure 8.2.



Circuit Switching

- Dedicated communication path between two stations
- Must have switching capacity and channel capacity to establish connection
- Must have intelligence to work out routing
- Inefficient
  - Channel capacity dedicated for duration of connection
  - If no data, capacity wasted
- Set up (connection) takes time
- Developed for voice traffic (phone)
- Examples
  - Telephone networks
  - ISDN (Integrated Services Digital Networks)

Circuit Switching



Message Switching

- No dedicated path needs to be established between end-nodes.
- Source and destination node do not interact in real time. There is no need to determine the status of the destination node before sending the message.
- Each message is an independent entity and carries address information of the destination. There is no upper limit on the size of the message.

- The messages are stored at each node before being forwarded to the next node in the route.
- Message switching accept all traffic but offers longer delivery time than circuit switching. Circuit switching blocks/rejects access traffic.

Packet Switching

- Messages are broken into small segments of bit-sequences and they are called packets. As packets are restricted to a specific size, they can be routed more rapidly.
- Packets have the following structure:

  - Header carries control information (e.g., destination id, source id, message id, packet id, control info)

- Each packet is passed through the network from node to node along some path (**Routing**)

- At each node the entire packet is received, stored briefly, and then forwarded to the next node (**Store-and-Forward Networks**)

- Typically no storage is required at nodes/switches for packets.

Packet Switching Advantages

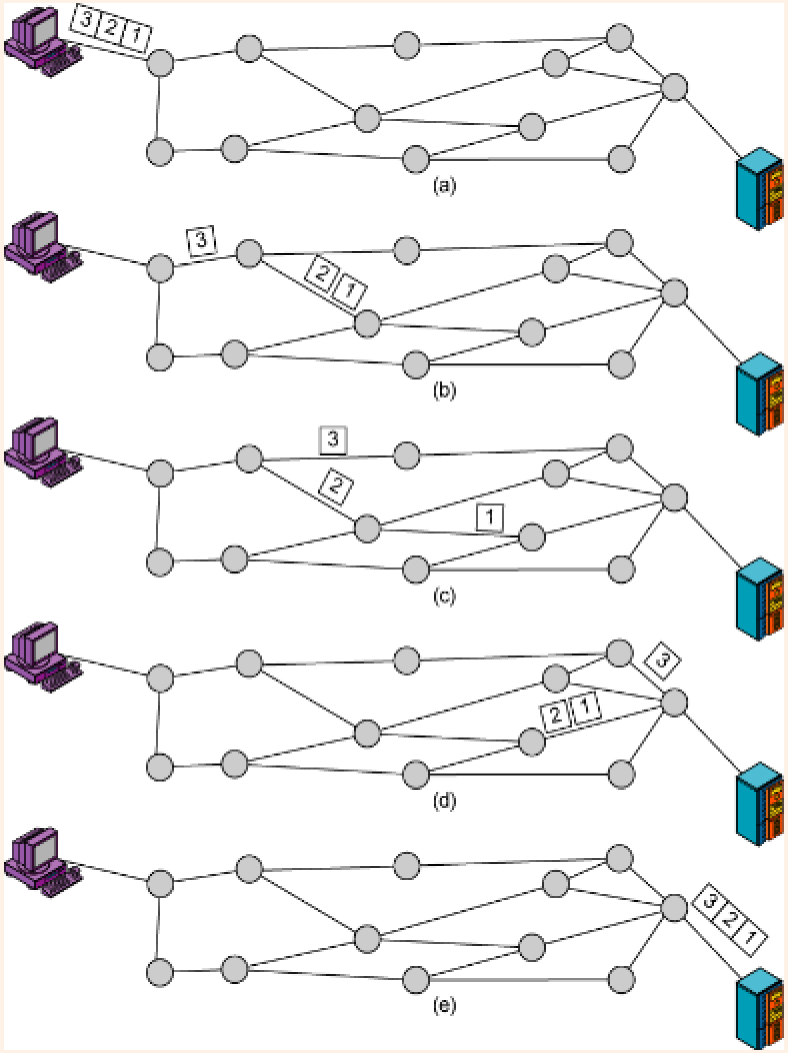
- ✓ Packetization allows short messages to get through a transmission link without waiting behind long messages.

- ✓ Line efficiency
  - Single node to node link can be shared by many packets over time
  - Packets queued and transmitted as fast as possible

- ✓ Nodes can accept packet and keep it in the packet queue as long as they have enough space in buffer memory of queue.
  - ✓ But it may increase queueing delay

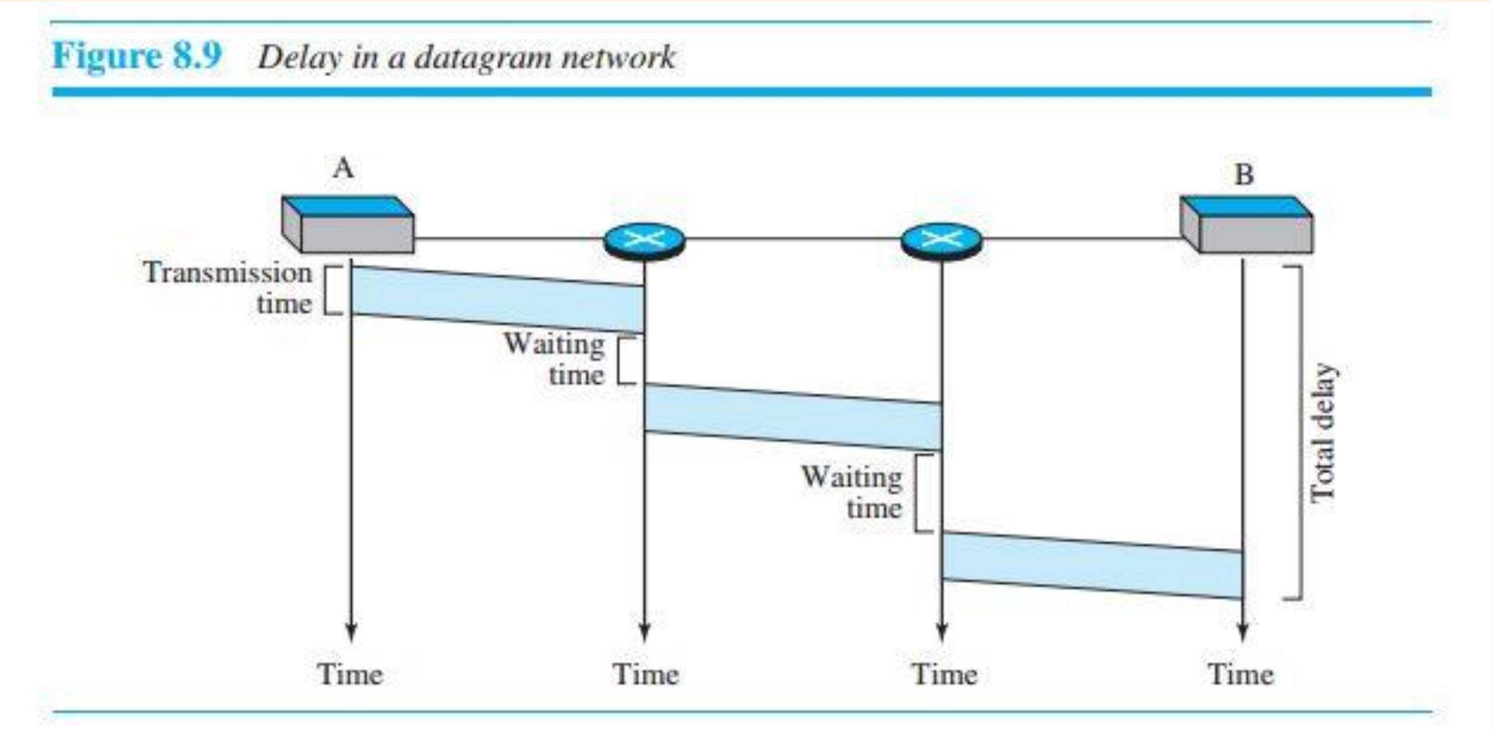
- ✓ Packet priority can be used in the packet queue to introduce network QoS

Datagram packet switching



- Each packet is independently switched
  - Each packet header contains destination address
- No resources are pre-allocated (reserved) in advance
- Routes may change during session

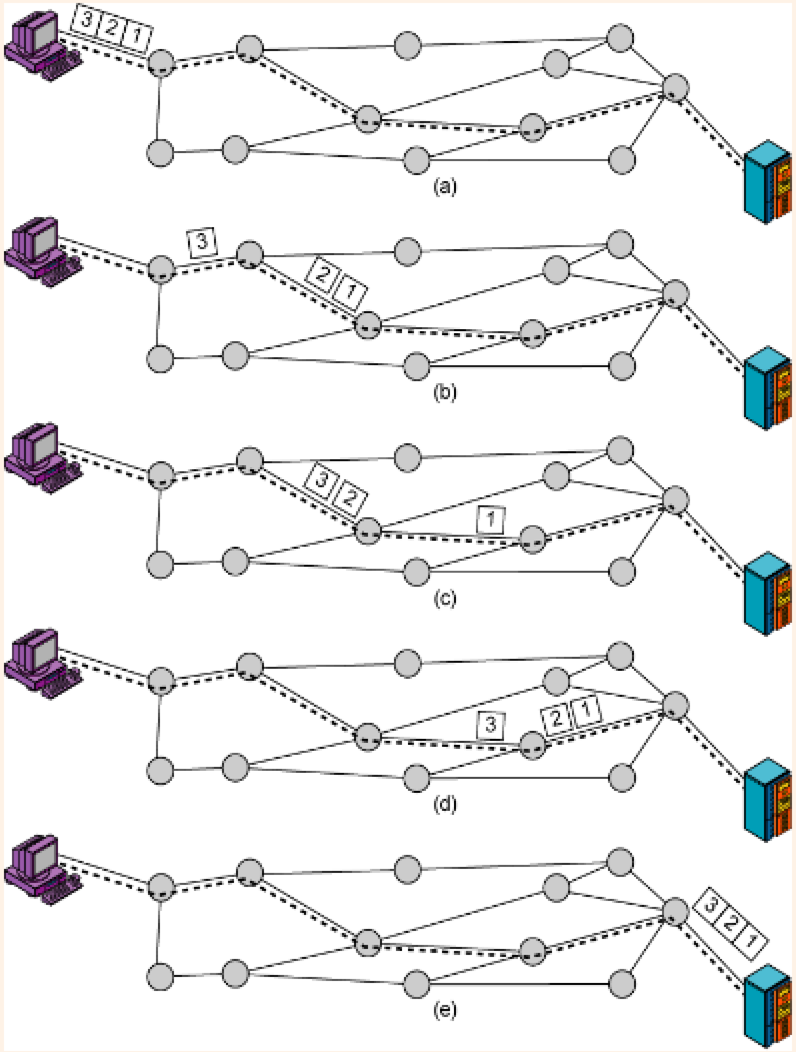
Delay in datagram network



- ✓ There are three transmission times (3*T*), three propagation delays (slopes 3τ of the lines), and two waiting times (*w*1 + *w*2). We ignore the processing time in each switch.
- ✓ The total delay = $3T + 3\tau + w_1 + w_2$

Virtual-Circuit Packet Switching

- A virtual-circuit network is a cross between a circuit-switched network and a datagram network.
- Preplanned route established before any packets sent
- Resources can be allocated: predefined/on-demand
- Call request and call accept packets establish connection (handshake)
- Communication with virtual circuits takes place in three phases
  - VC establishment
  - data transfer
  - VC disconnect



Delay in a virtual-circuit network

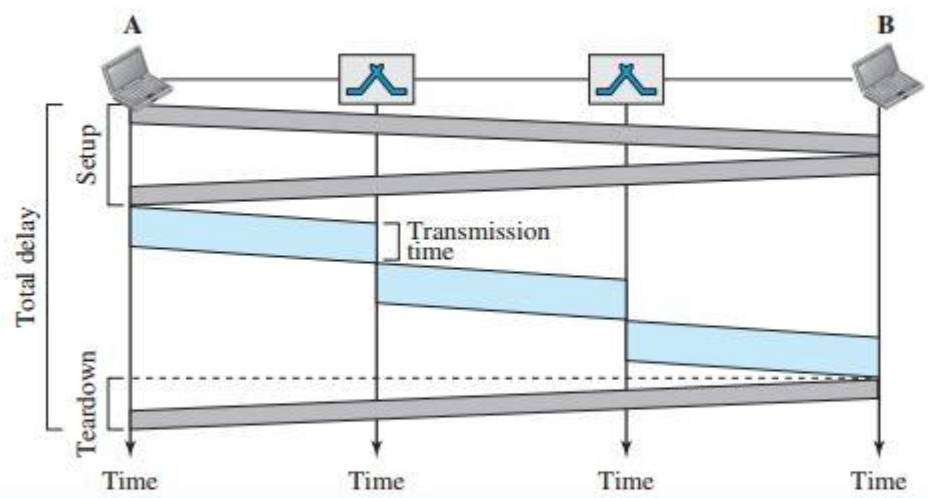


Figure 8.16 *Delay in a virtual-circuit network*

- ✓ There are three transmission times (3T), three propagation times (3τ),
- ✓ A setup delay, and a teardown delay. We ignore the processing time in each switch.
- ✓ The total delay time is

$$\textbf{Total delay} = \mathbf{3}T + \mathbf{3}\tau + \textbf{setup delay} + \textbf{teardown delay}$$

Datagram vs. Virtual-Circuits

Packet Switching

Datagram	Virtual circuits
No call setup phase - Better if few packets More flexible - Routing can be used to avoid congested parts of the network	Network can provide sequencing and error control Packets are forwarded more quickly - No routing decisions to make Less reliable - Loss of a node loose all circuits through that node

Books

1. Forouzan, B. A. "Data Communication and Networking. Tata McGraw." (2005).

References

1. Prakash C. Gupta, “Data communications”, Prentice Hall India Pvt.
2. William Stallings, "Data and Computer Communications”, Pearson
3. Forouzan, B. A. "Data Communication and Networking. Tata McGraw." (2005).