Lecture (04)
Packet switching & Frame Relay techniques (I)

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Agenda

- Packet switching technique
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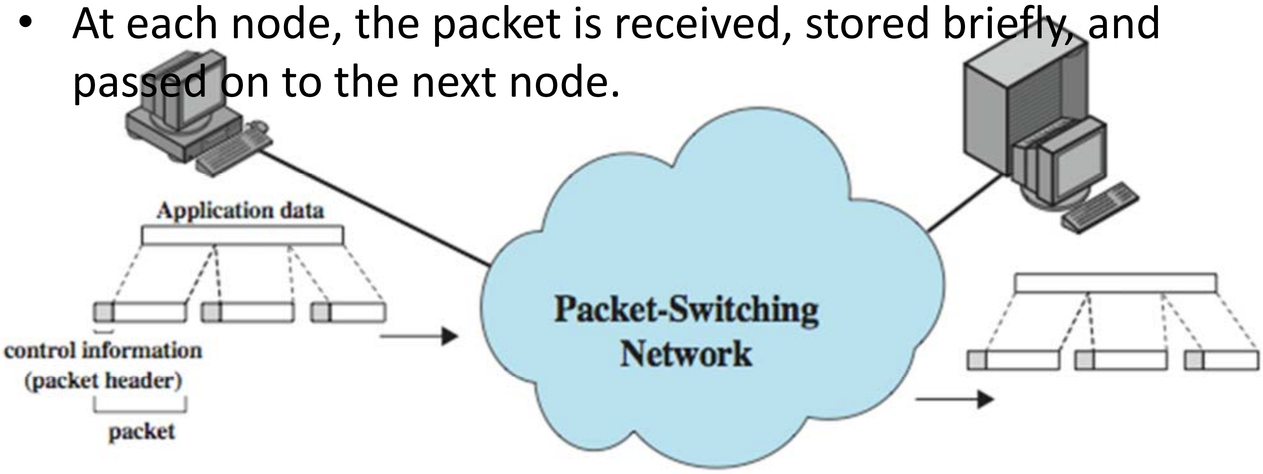
Packet switching technique

Introduction

- In contrast a packet-switching network is designed for data use.
- Data are transmitted in short packets.
- Fixed packet length say 1000 octets (bytes).
- If a source has a longer message to send, the message is broken up into a series of packets.
- Each packet contains a portion (or all for a short message) of the user's data plus some control information.

- The control information, at a minimum, includes the information that the network requires to be able to route the packet through the network and deliver it to the intended destination.
- At each node, the packet is received, stored briefly, and passed on to the next node.



Advantages

1. Line efficiency is greater,

- because a single node-to-node link can be dynamically shared by many packets over time.
- The packets are queued up and transmitted as rapidly as possible over the link.
- By contrast, with circuit switching, time on a node-to-node link is pre-allocated using synchronous time division multiplexing.
- Much of the time, such a link may be idle because a portion of its time is dedicated to a connection that is idle (considered to disadvantage)

2. A packet-switching network can perform data-rate conversion.

- Two stations of different data rates can exchange packets because each connects to its node at its proper data rate.

3. Decrease blocking,

- When traffic becomes heavy on a circuit-switching network, some calls are blocked; that is, the network refuses to accept additional connection requests until the load on the network decreases.
- On a packet-switching network, packets are still accepted, but delivery delay increases.

4. Priorities can be used.

- If a node has a number of packets queued for transmission, it can transmit the higher-priority packets first.
- These packets will therefore experience less delay than lower-priority packets.

Switching technique

- Two approaches are used in packet switching networks: datagram and virtual circuit.

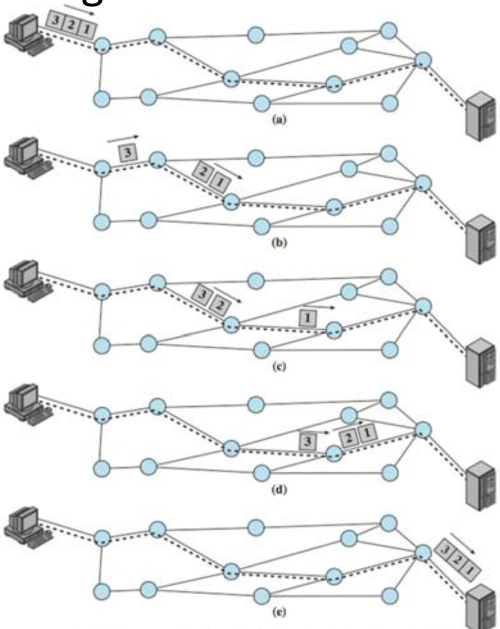


Figure 10.10 Packet Switching: Virtual-Circuit Approach

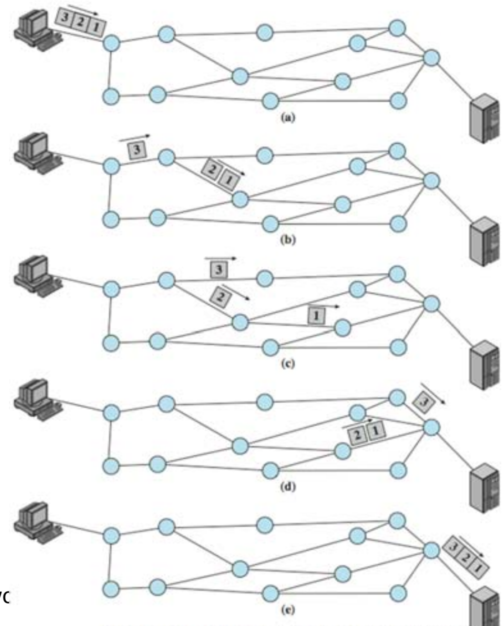


Figure 10.9 Packet Switching: Datagram Approach

datagram approach,

- each packet is treated independently, with no reference to packets that have gone before.
- Each node chooses the next node on a packet's path, taking into account information received from neighboring nodes on traffic, line failures, and so on.
- So the packets, each with the same destination address, do not all follow the same route, and they may arrive out of sequence at the exit point.
- Exit node, or destination rearrange the data grams to restore the original squence.

Virtual circuit

- a preplanned route is established before any packets are sent.
- Once the route is established, all the packets between a pair of communicating parties follow this same route through the network.
- Because the route is fixed for the duration of the logical connection, it is somewhat similar to a circuit in a circuits switching network and is referred to as a virtual circuit.
- Each packet contains a virtual circuit identifier as well as data.
- Each node on the pre-established route knows where to direct such packets; no routing decisions are required.

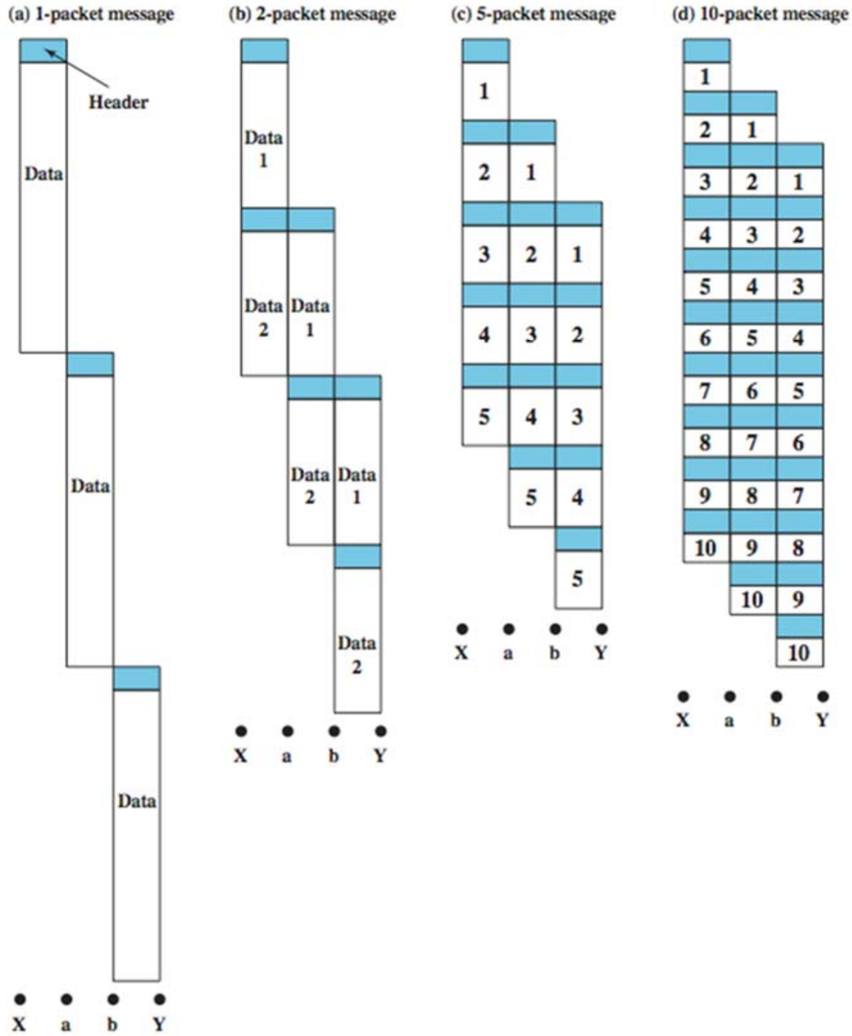
- At any time, each station can have more than one virtual circuit to any other station.
- The virtual circuit is established before data being transferred, even, it’s not a dedicated path.
- A transmitted packet is buffered at each node, and queued for output over a line, while other packets on other virtual circuits may share the use of the line.
- Nods do no routing decisions, as virtual path is already established.

Comparisons between datagrame, and Virtual circuits

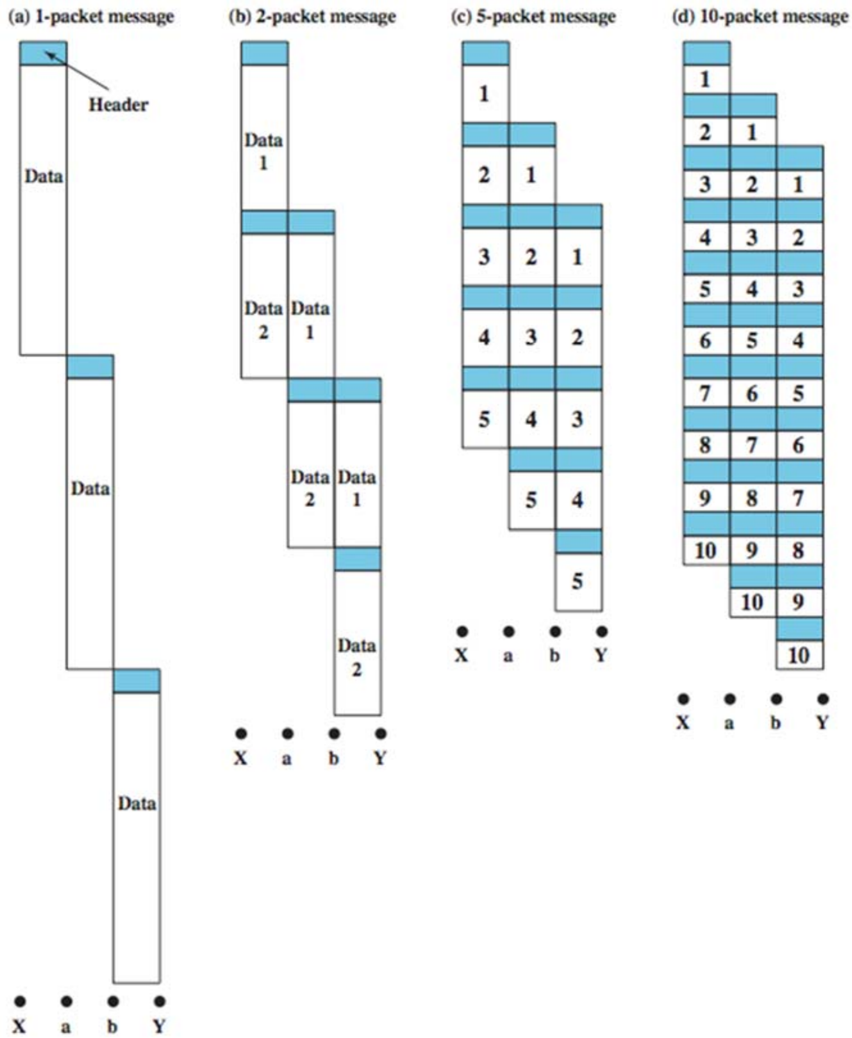
Datagram	Virtual circuit
No sequencing or error control, destination or exit node should solve these problems	network can provide sequencing and error control, as all packets follow the same route
Packets are slow, need routing decision at each node.	packets are forwarded more quickly, no routing decisions
no call setup phase, immediate transmission	Call setup, wait before start
More reliable, any available path, if node fail, forward to any nearby node	less reliable, only predefined path, if node fails, path down
more flexible	Less fixable

Packet size and transmission time

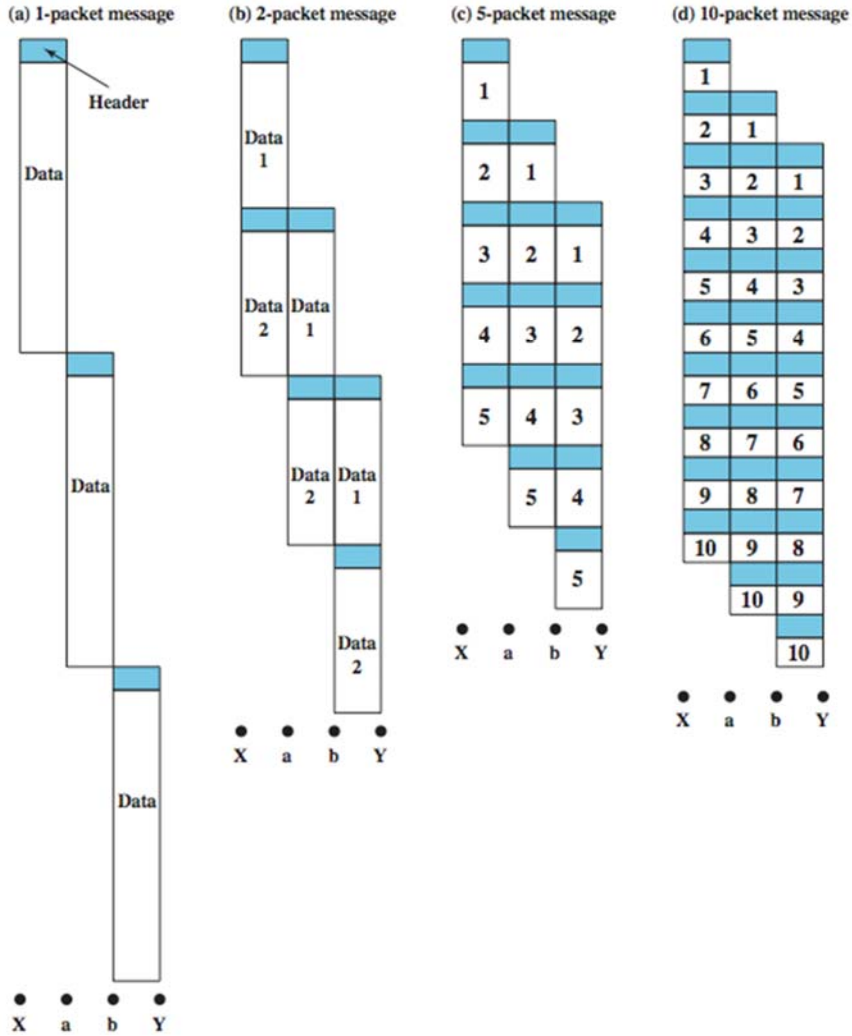
- Assume that a virtual circuit exists from station “X” through nodes “a” and “b” to station “Y”.
- The message to be sent comprises 40 octets, with 3 octets of control information at the beginning of each packet in the header.



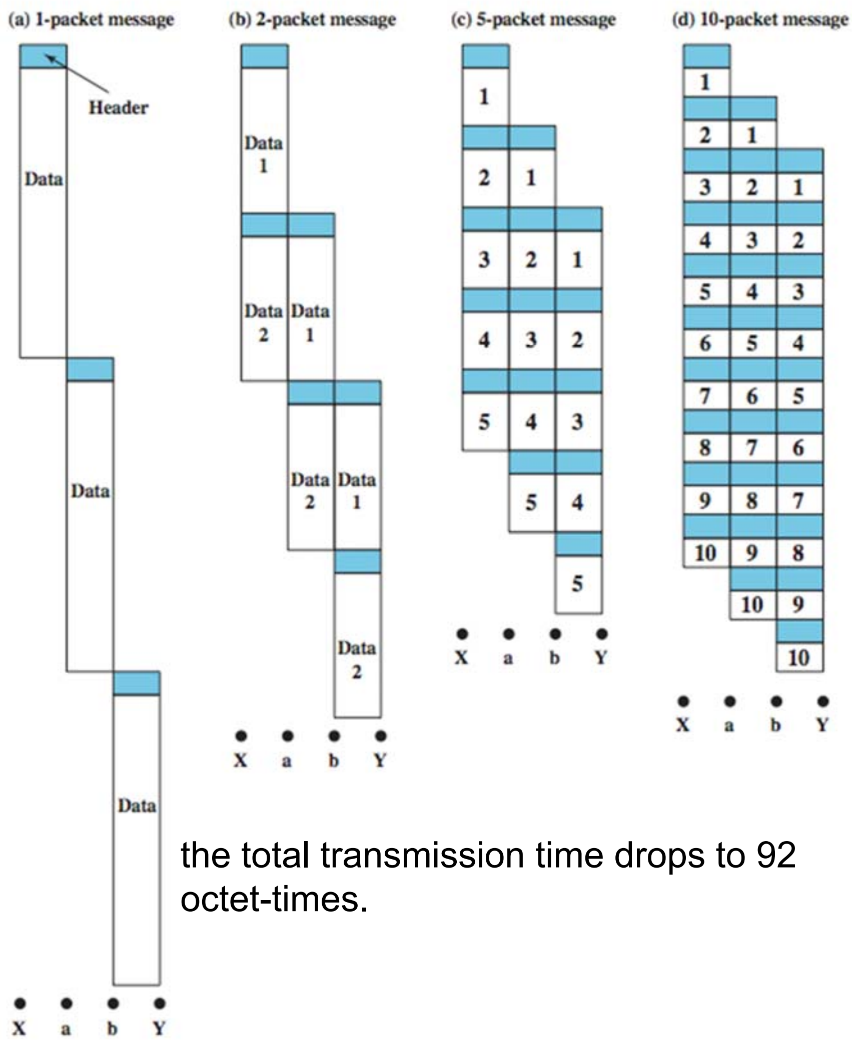
- If the entire message is sent as a single packet of 43 octets
- (3 octets of header plus 40 octets of data), then the packet is first transmitted from station “X” to node “a”
- When the entire packet is received, it can then be transmitted from “a” to “b”.



- When the entire packet is received at node "b", it is then transferred to station "Y".
- Ignoring switching time, total transmission time is 129 octet-times (43 octets × 3 packet transmissions).

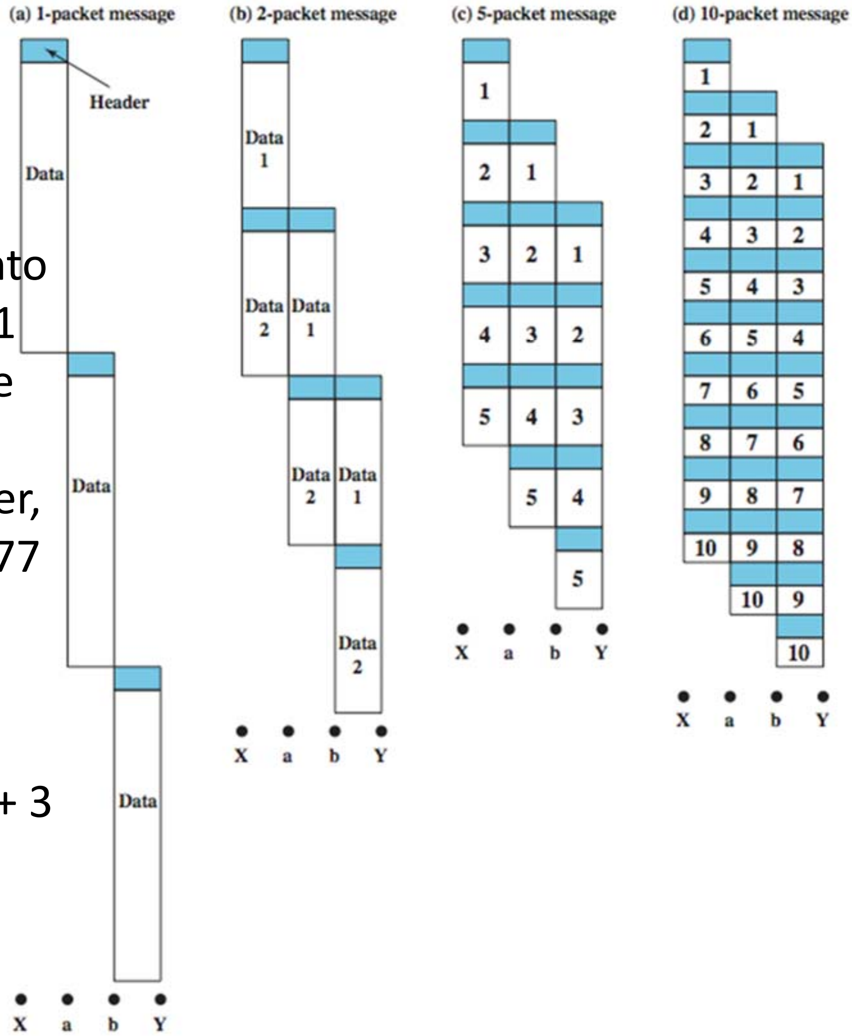


- If we break the message into two packets with 20 octets of message and 3 octets of header each.
- node "a" can begin transmitting the first packet as soon as it has arrived from "X". Because of this overlap in transmission,
- Tx time=92 octet time



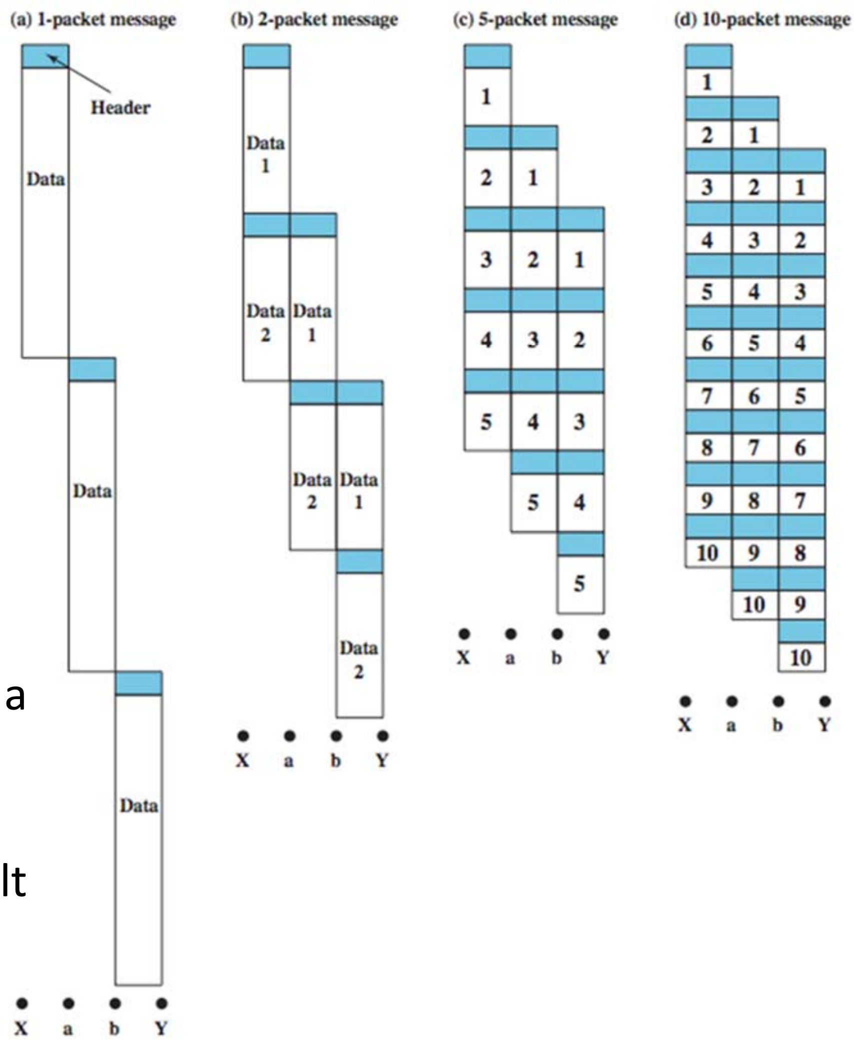
the total transmission time drops to 92 octet-times.

- breaking the message into five packets (40/5)+3=11 octet, each intermediate node can begin transmission even sooner, with a total of = 11x7 = 77 octet-times for transmission.
- Dividing message to 10 packets each of 4 octet + 3 control=7 octet/ packet
- Total Tx time = 12x7=84 octet time



Conclusions:

- each packet contains a fixed amount of header, and more packets Also, processing and queuing delays at each node are greater when more packets are handled for a single message.
- extremely small packet size (53 octets) can result in an efficient network design.



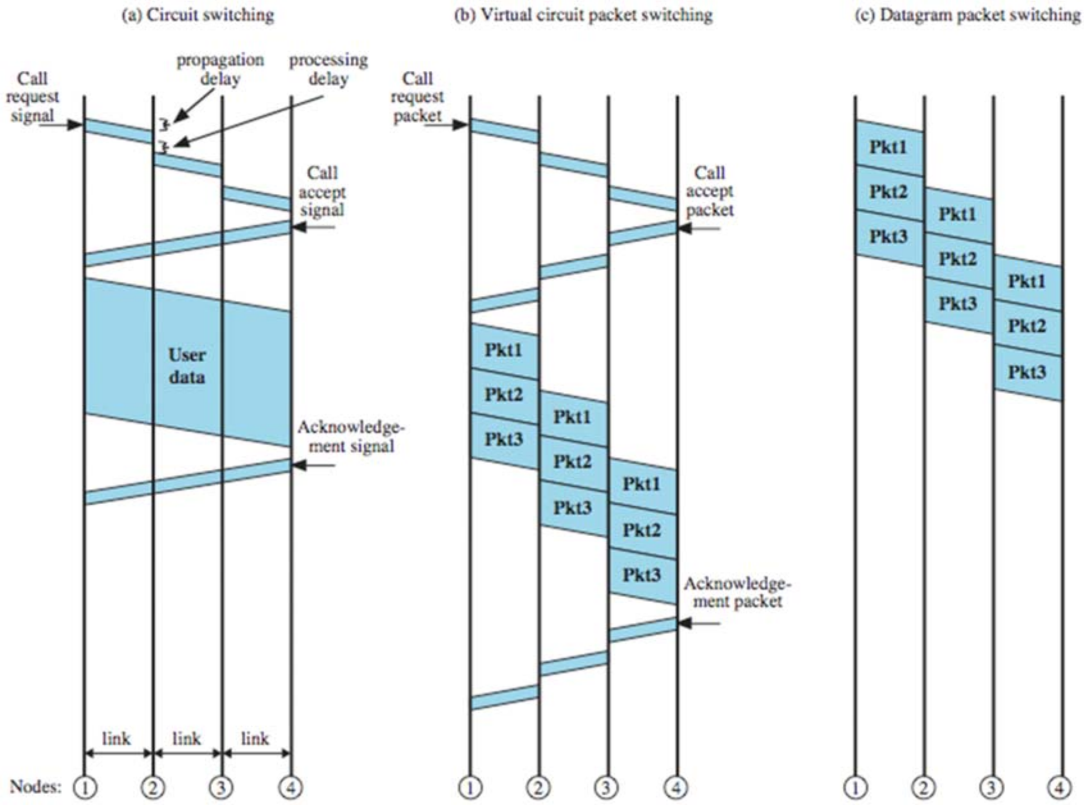
Packet switching delays

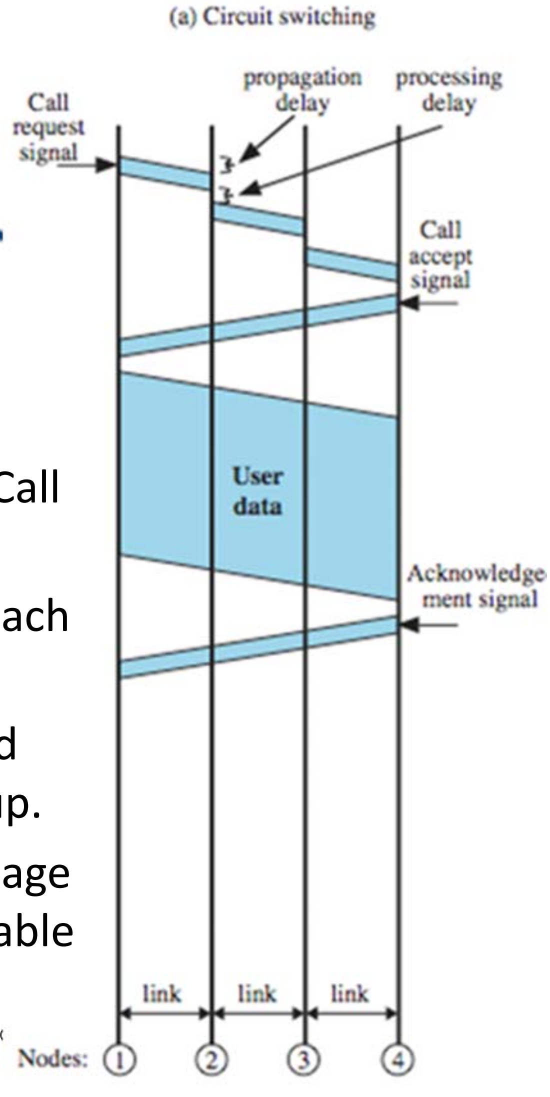
- **Propagation delay:** The time it takes a signal to propagate from one node to the next. The speed of electromagnetic signals through a wire medium, for example, is typically 3×10^8 m/s, delay is neglectable.
- **Transmission time:** The time it takes for a transmitter to send out a block of data. For example, it takes 1 s to transmit a 10,000-bit block of data onto a 10-kbps line.
- **Node delay:** The time it takes for a node to perform the necessary processing as it switches data.

Circuit switching and packet switching comparison

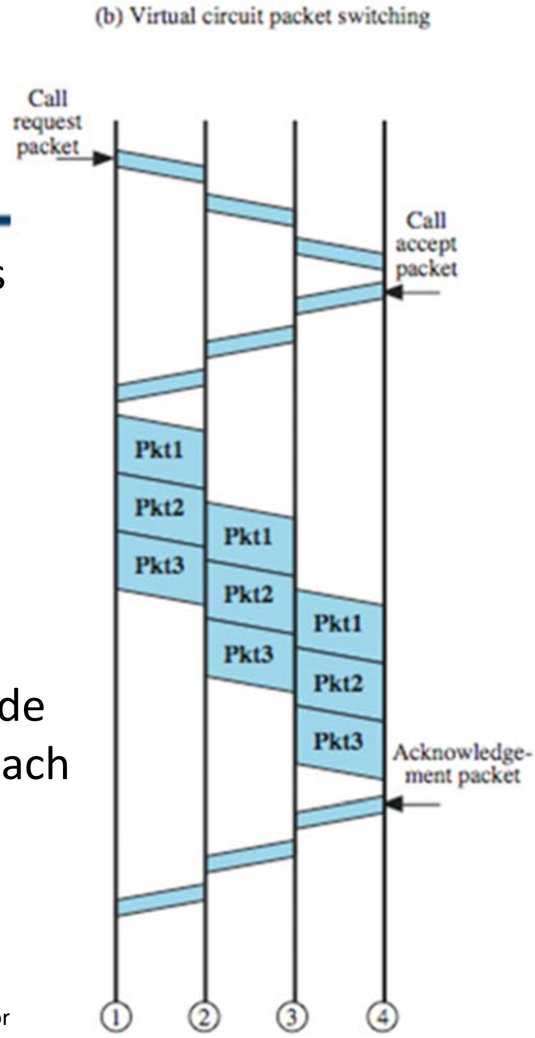
Circuit switching	Packet switching
Transparent service, once connection is established fixed data rate in provided	Variable delay is introduced to packets, which need some sequencing and error recovery
No overhead required for routing packets	Add header to each packet contains routing information
Not achieving 100% line utilization	Almost achieves 100% line utilization
Blocking till free up resources	No Blocking till solving congestion
no traffic priority	Traffic Priority
expansive	Cheap
Fixed data rate	Equalizing data rates
Analog and digital	Digital only
Wait till establishment	Immediate start(datagram) or wait for establishment (Virtual circuit)

Event timing

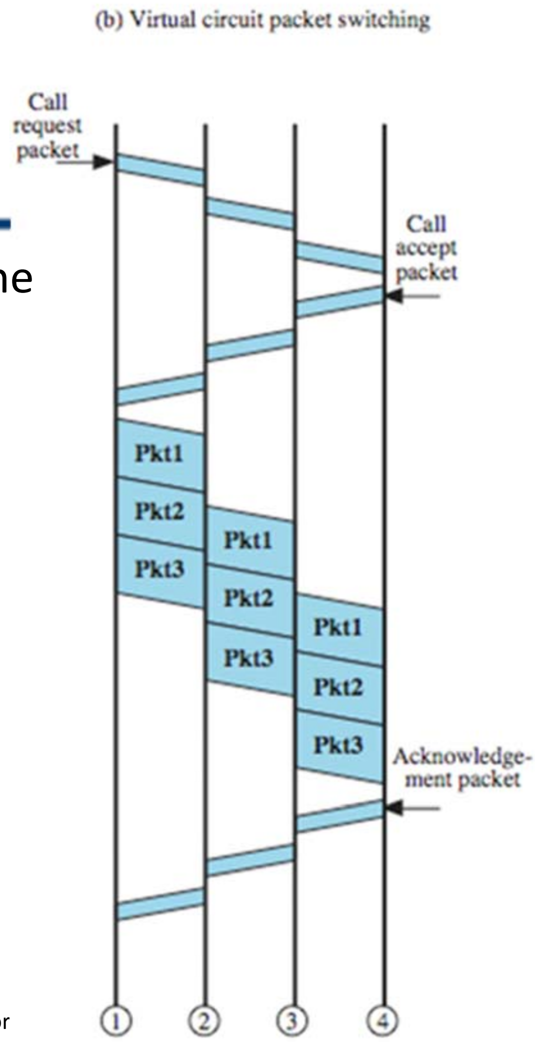




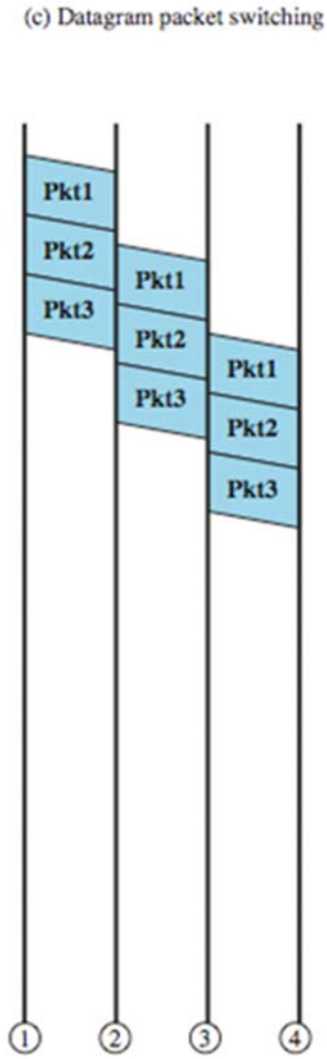
- For **circuit switching**, there is a delay before the message is sent.
- First, a Call Request signal is sent.
- If the destination station is not busy, a Call Accepted signal returns.
- Note a processing delay is incurred at each node during the call request.
- On return, this processing is not needed because the connection is already set up.
- After the connection s set up, the message is sent as a single block, with no noticeable delay at the switching nodes.



- **Virtual circuit packet switching** appears similar to circuit switching.
- A virtual circuit is requested using a Call Request packet, which incurs a delay at each node, and is accepted with a Call Accept packet.
- In contrast to the circuit-switching case, the call acceptance also experiences node delays, since each packet is queued at each node and must wait its turn for transmission.



- Once the virtual circuit is established, the message is transmitted in packets.
- Packet switching involves some delay at each node in the path.
- Worse, this delay is variable and will increase with increased load.



- Datagram packet switching does not require a call setup.
- Thus, for short messages, it will be faster than virtual circuit and perhaps circuit switching.
- However, because each individual datagram is routed independently, the processing at each node may be longer than for virtual circuit packets.
- For long messages virtual circuits may be superior.

Thanks,…