Packet Transmission

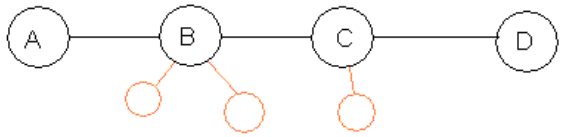
COMP476 Networked Computer Systems

Switching methods

- **Circuit switching** — a switch electronically connects the wires of the two computers together.
- **Message switching** — An intermediate sends the message after it is completely received.
- **Packet switching** —information transferred in small packets.

Example Problem

- Consider an arbitrary network that has at least K nodes
- Assume we want to send X bits from node A to node D

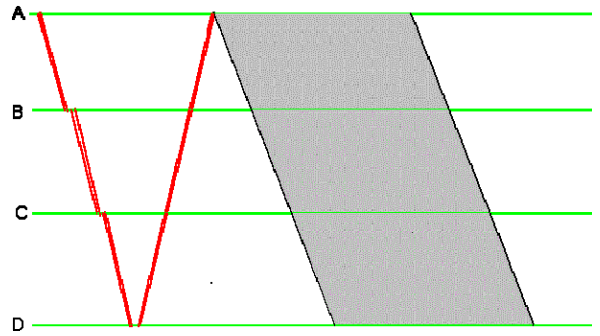


Circuit Switching

- An electrical connection is made between the source and the destination.
- The telephone system uses circuit switching when connecting local calls.
- Circuit switching generally requires some initial setup time. This is analogous to dialing the phone.
- After the connection is made, the data can be sent with no delay.

Early Telephones Used Circuit Switching

Circuit Switching



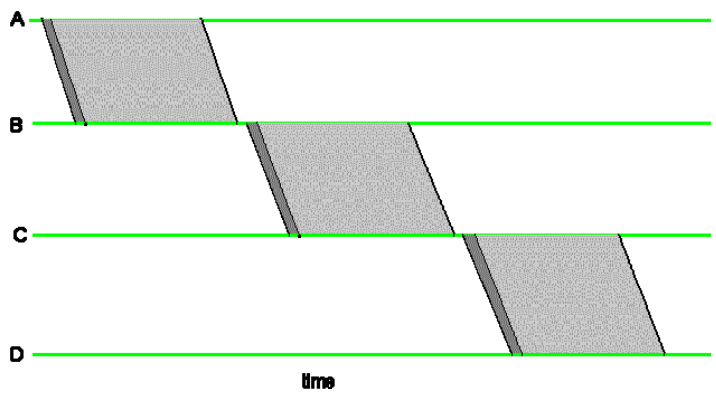
Message Switching

- Message switching - All of the digital data is sent from the source to the destination as a unit.
- When there are intermediate nodes between the source and destination, each intermediate node must receive the entire message before sending it on to the next intermediate or final destination

Message Switching

- Called "store and forward" transmission.
- The intermediate nodes may have to make a decision as to which route the message will be sent.
- A header is attached to the beginning of the message to identify the destination.

Message Switching



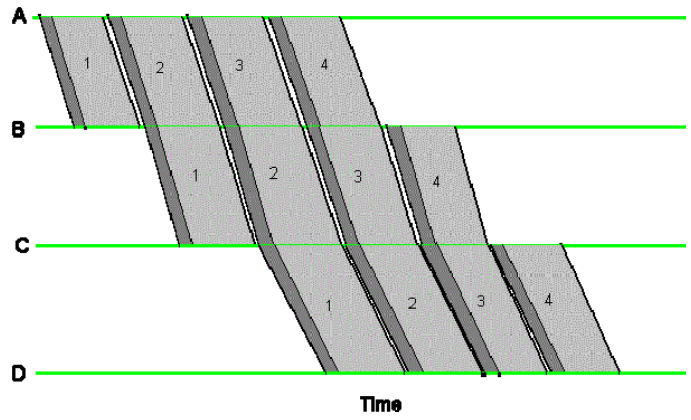
Packet Switching

- Similar to message switching except the data is divided into packets.
- Intermediate nodes must receive an entire packet before sending on towards the destination, but they do not have to receive the entire message.
- Each packet needs a header to identify its destination.

Packet Switching

- The packets can be variable sized or (more often) fixed sized.
- The size of a packet is usually much smaller than the total data size.
- Packet sizes range from 48 bytes for ATM to 1500 bytes for Ethernet to 8K bytes for frame relay.

Packet Switching



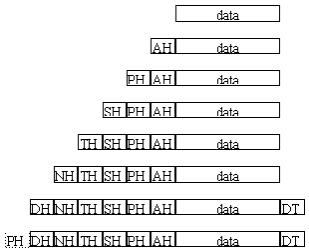
Comparison of Methods

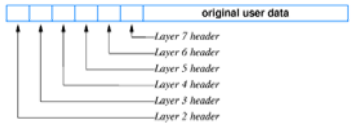
- Circuit switching works well if the time to transfer the data is long compared to the circuit setup time.
- Packet switching easily allows multiple independent data streams to be combined one a channel.
- The Internet uses packet switching.

Standard Packet

- Header contains destination address, maybe source address and other parameters.
- Data bytes are sent without start, stop or parity bits. Only the data is sent.
- Trailer contains error checking values.

Nested Protocol Headers





•The data link layer often adds a trailer to the packet that contains a cyclic redundancy check (CRC) to detect errors.

•The physical layer might, or might not, append a header or trailer to the packet.

•It is the bottom frame, with all of the headers, that is actually sent across the network. When it is received at the other end, the headers are stripped off as the packet is passed up the stack to the user application.

Ethernet frame format

Preamble	Destination	Source	type	data	CRC
8	6	6	2	46 - 1500	4

- Note that Ethernet has a minimum data size of 46 bytes for a minimum frame size of 72 bytes
- If less than 46 bytes are to be sent, the rest of the frame is padded with null data

Transmission Time

- When calculating the transmission time of data sent over a packet switched system, you have to account for the header and trailer overhead.
- Each packet has a header and can only hold some maximum amount of data.

$$time = \left\lceil \frac{dataBits}{PktSize} \right\rceil * \frac{PktSize + headerSize}{transmissionRate}$$

How long does it take to send one data byte over a 10 Mbps Ethernet?

1. 800 nsec
2. 36.8 µsec
3. 57.0 µsec
4. 1.22 msec