

# CS4010: Computer Networks

## Introduction

Indian Institute of Technology Palakkad

# What is the Internet?

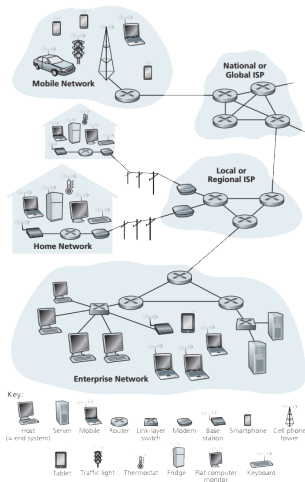


Figure: [Kurose and Ross] Some pieces of the internet.

# What is a protocol?

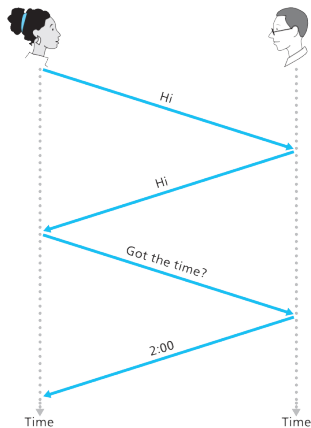


Figure: [Kurose and Ross] A human protocol.

# What is a protocol?

A **protocol** defines the format and the order of messages exchanged between two or more communicating entities, as well as the actions taken on the transmission and/or receipt of a message or other event.

- A network protocol is similar to a human protocol, except that the entities exchanging messages and taking actions are hardware or software components of some device.
- Mastering the field of computer networking is equivalent to understanding the what, why, and how of networking protocols.

# Packet Switching

- End systems exchange messages with each other.
- Long messages into smaller chunks of data known as packets.
- Between source and destination, each packet travels through communication links and packet switches
- Packets are transmitted over each communication link at a rate equal to the full transmission rate of the link. So, if a source end system or a packet switch is sending a packet of  $L$  bits over a link with transmission rate  $R$  bits/sec, then the time to transmit the packet is  $L/R$  seconds.

# Packet Switching

**Store-and-forward** transmission means that the packet switch must receive the entire packet before it can begin to transmit the first bit of the packet onto the outbound link.

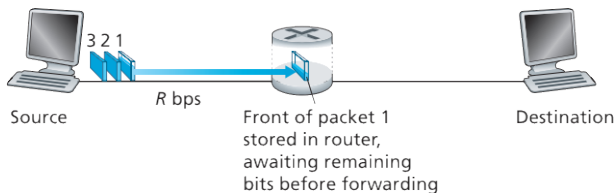


Figure: [Kurose and Ross] Store-and-forward packet switching.

# Circuit Switching

Resources needed along a path (buffers, link transmission rate) to provide for communication between the end systems are reserved for the duration of the communication session between the end systems.

A circuit in a link is implemented with either frequency-division multiplexing (FDM) or time-division multiplexing (TDM).

**Which is better: packet switching or circuit switching?**

# Delay in Packet-Switched Networks

- **Processing Delay** The time required to examine the packet's header and determine where to direct the packet is part of the processing delay. The processing delay can also include other factors, such as the time needed to check for bit-level errors in the packet.
- **Queuing Delay** At the queue, the packet experiences a queuing delay as it waits to be transmitted onto the link.
- **Transmission Delay** This is the amount of time required to push (that is, transmit) all of the packet's bits into the link.
- **Propagation Delay** The required for a the packet to propagation the link.