

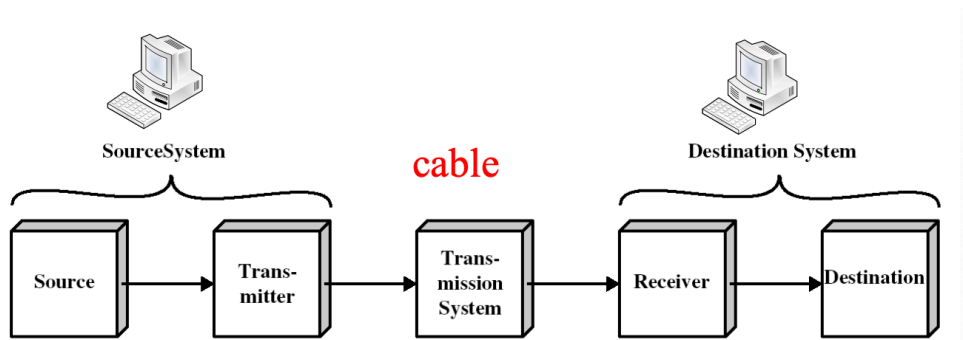
lecture 1 Introduction and Models

Objectives

- data communication model and what is a network
- internet or the Internet is a combination
- protocol layering, TCP/IP protocol suite and OSI 7-layer model

computer communications

- connect either directly or through a network
- source
- **Transmitter**: converts information /message into transmittable signals
- **Transmission System (or Channel)**: Carries signals
- **Receiver**: converts received signal into information / message
- destination



networks

- **A network is the interconnection of a set of devices capable of communication**
- host or connecting device
 - **router** connects networks 网络核心节点, ip寻址
 - **switch** receives a message from any device connected to it and then **transmits the message** only to the device for which message is intended 局域网, Mac转发数据

- **hub** as a multiport repeater, a signal introduced at the input of any port appears at all other available ports
- **modem** that ==changes the form of data ==

switching Techniques

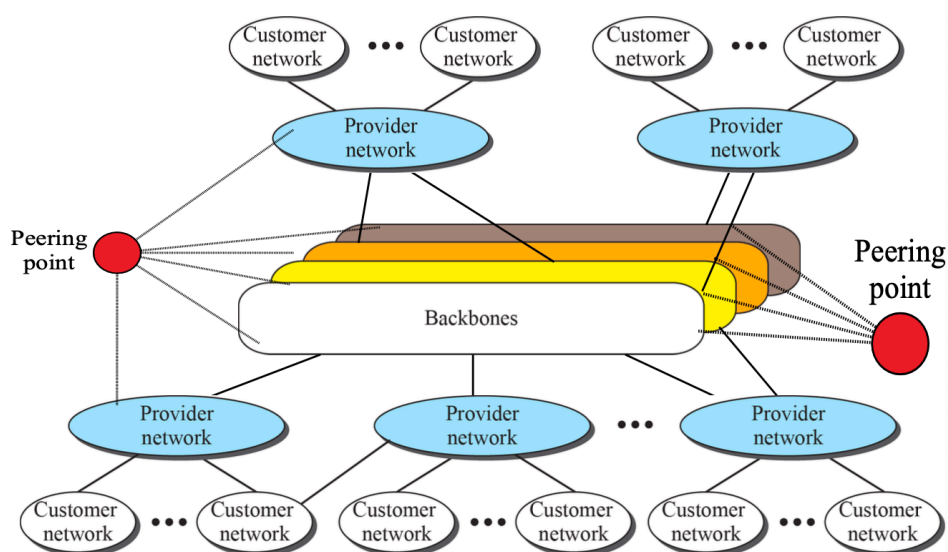
- circuit switching
- packet switching
- devices connect to a network, different networks will be linked up through the network device (router)
- Internet is the particular internet (ARPANET) in usa
- internet or internetwork is a generic term

Internet Structure

- network edge
- core
 - circuit and packet switching
- access network

Internet today

Internet Today



- backbone ISP, international ISPs, provider - national or regional isps

Protocol

- peers: entities at the same level
- syntax: structure or format of data and signal levels. and order
- semantics: interpretation or meaning of each section of bits or fields
- timing
 - when
 - what the speed
- The purpose of each layer is to provide certain services to higher layers, shielding those layers from the details about how the offered services are actually implemented.

network architecture

OSI Seven-Layer Model

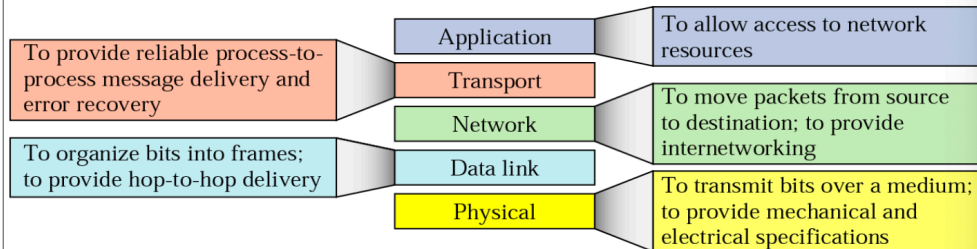
Layer		Protocol data unit (PDU)	Function ^[26]
Host layers	7 Application	Data	High-level protocols such as for resource sharing or remote file access, e.g. HTTP .
	6 Presentation		Translation of data between a networking service and an application; including character encoding , data compression and encryption/decryption
	5 Session		Managing communication sessions , i.e., continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes
	4 Transport	Segment, Datagram	Reliable transmission of data segments between points on a network, including segmentation , acknowledgement and multiplexing
Media layers	3 Network	Packet	Structuring and managing a multi-node network, including addressing , routing and traffic control
	2 Data link	Frame	Transmission of data frames between two nodes connected by a physical layer
	1 Physical	Bit, Symbol	Transmission and reception of raw bit streams over a physical medium

Headers and Trailers

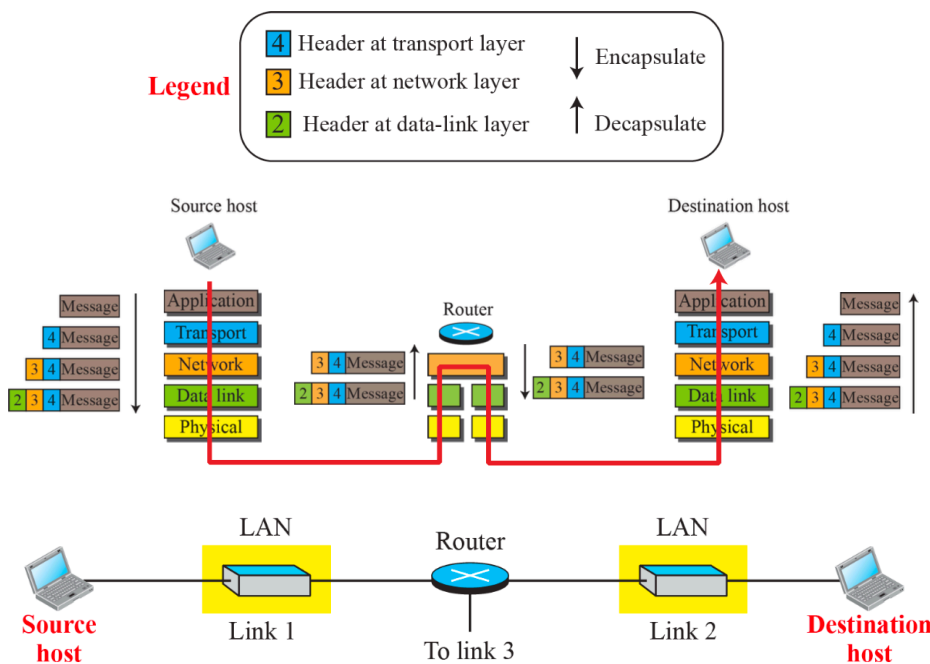
- On sending data, before giving the data to the lower layer, each layer adds information to the data by appending a header and/or attaching a trailer.
- variable length
- Header normally contains
 - destination address
 - source address
 - packet length

- protocol information
- sequence number for re-ordering
- error-detection bits

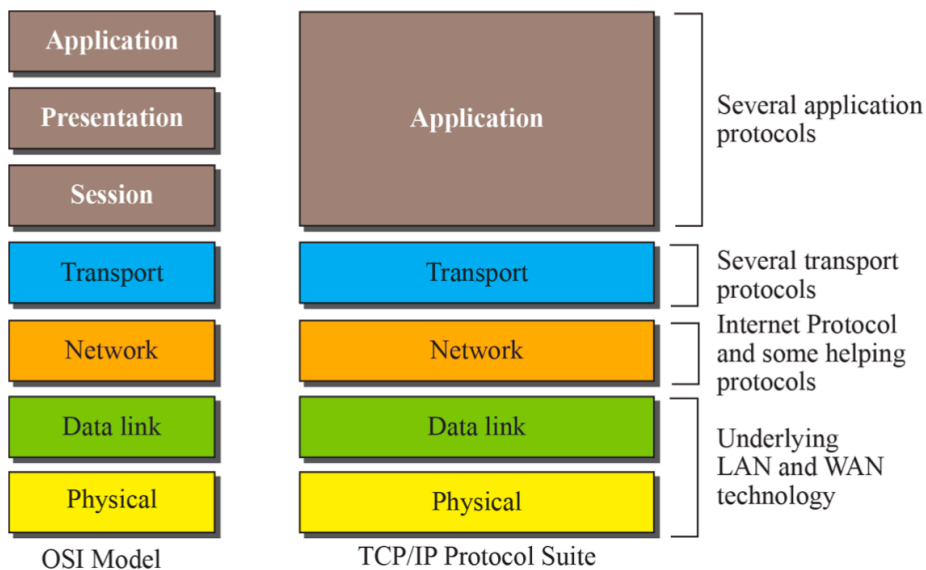
TCP/IP Reference Model



Data Encapsulation



OSI vs TCP/IP



Performance Measures

- Throughput- the actual output rate of sys

$$\text{Throughput} = \text{Transfer Size (bits)} / \text{Transfer time (s)}$$

- Utilization - a measure of how many portion of time the output line (or the server) is useful (or busy).
- End-to-End Delay (Latency)

- Transmission Time: the time to send out data bits into medium

$$\text{Transmission time} = \text{Data size (bits)} / \text{Data rate (bps)}$$

- Propagation delay: the time for the data bits to travel

$$\text{Propagation time} = \text{Distance (m)} / \text{Speed of light (3} \times 10^8 \text{ m/s)}$$

- Processing delay
 - Queuing delay

- Loss Rate (Blocking Probability): the percentage that the data bits (packets) are lost
- Bandwidth Delay Product: the maximum number of bits that could be in transit through the physical medium at any given instant

$$\text{Bandwidth delay product} = \text{Data rate} \times \text{Propagation Delay}$$

Queuing Models

Two common ways in evaluating the performance of a computer network:

- Analytical Methods – Queuing models
 - Queuing theory is the study of queuing systems, where some **customers** get some services from some **servers**, a model is as follows:

