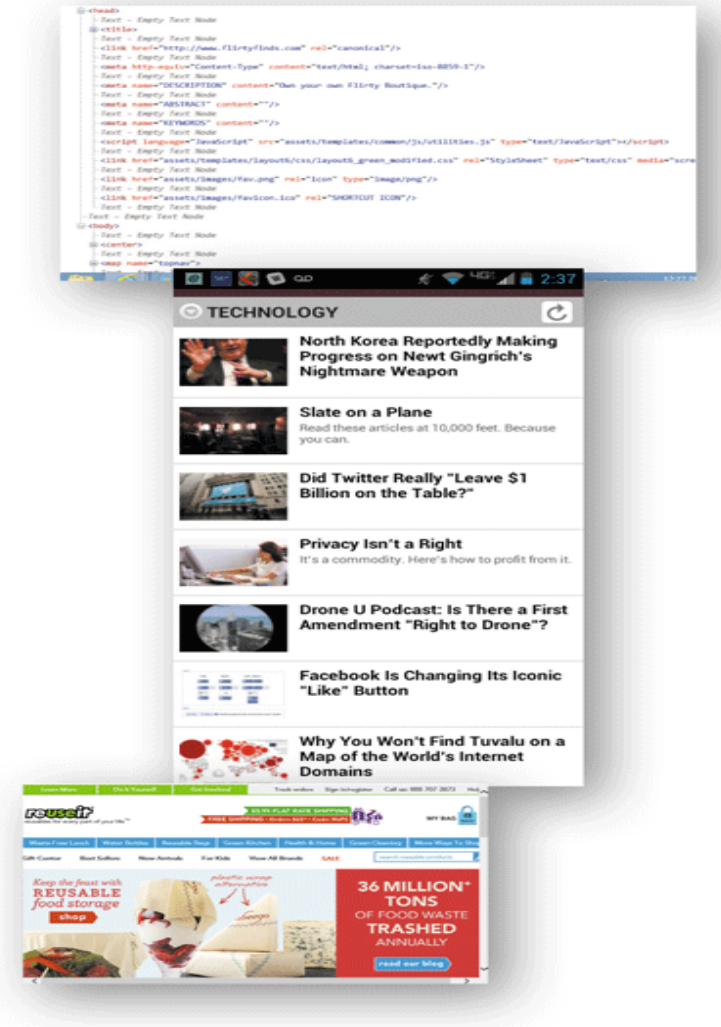
1 Into the Internet (Lecture 02)



Discovering the Internet, 5th Edition

Objectives

- Explain how individuals and businesses connect to the Internet
- Describe OSI model and the Internet

Connecting to the Internet

- **Internet Service Providers (ISPs)**
  - Provide Internet access to individuals and companies
  - **Mobile service provider,** sometimes called a wireless data provider, offers wireless Internet access to computers and mobile devices

Connecting to the Internet

- Internet Service Providers (ISPs) (continued)
  - Considerations for choosing an ISP
    - The speed or **bandwidth** of the connection
    - The availability of wireless or mobile data service
    - The type of connection and cost of service
    - Availability of customer service and technical support

Bandwidth - the amount of data that can be transmitted in a fixed amount of time.

Connecting to the Internet

- Internet Service Providers (ISPs) (continued)
  - **Transfer rate** measures numbers of bits can be transmitted in one second **(bits per second** or **bps)**
    - **Kilobits per second (Kbps)** – thousands of bits per second
    - **Megabits per second (Mbps)** – millions of bits per second
    - **Gigabits per second (Gbps)** – billions of bits per second

1,000

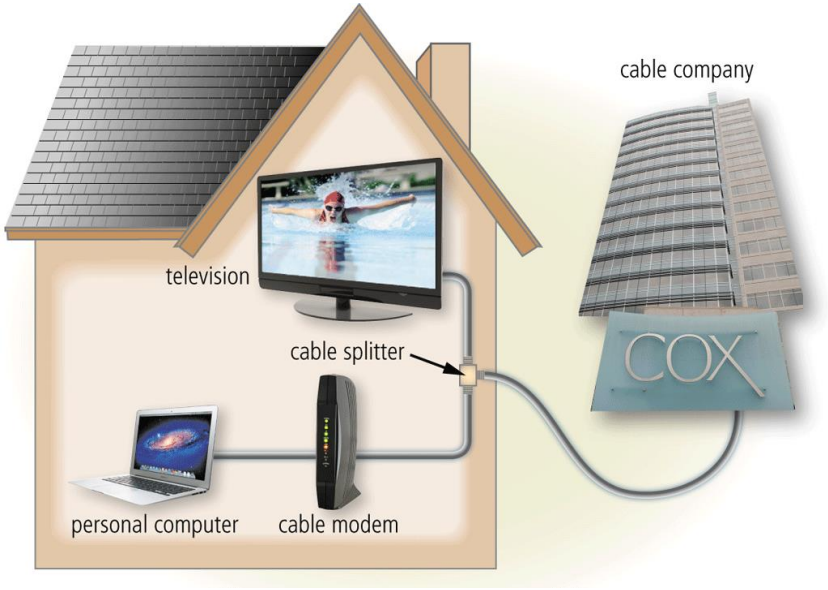
1,000,000

1,000,000,000

1 US billion = 1,000,000,000
1 UK billion = 1,000,000,000,000

Connecting to the Internet

- Connection Methods
  - **Cable**
    - **Cable television (CATV) lines** use same coaxial cable that delivers TV transmissions
    - **Cable modem** and **line splitter** required



Connecting to the Internet

- Connection Methods (continued)
  - **Digital Dedicated Lines**
    - A constant connection between two communications devices that uses a local phone network
      - **Integrated Services Digital Network (ISDN)**
      - **Digital subscriber line (DSL)**
      - **Asymmetrical digital subscriber line (ADSL)**
      - **T-carrier line**
      - **Fractional T-1 line**
      - **T-3 line**

A set of standards for digital transmission of data over standard copper phone lines, up to 1.54Mbps

Transmits at fast speeds on existing standard copper phone wiring, up to 8.45Mbps

Type of DSL that supports faster transmissions when receiving data (8.45Mbps) than when sending data (640Kbps)

Types of long-distance digital phone lines that carry multiple signals over a single communications line, whereas a standard phone line carries only one signal

T-1 (1.544Mbps)
Fractional T-1 (up to 768Kbps)
T-3 (44.736Mbps)

Connecting to the Internet

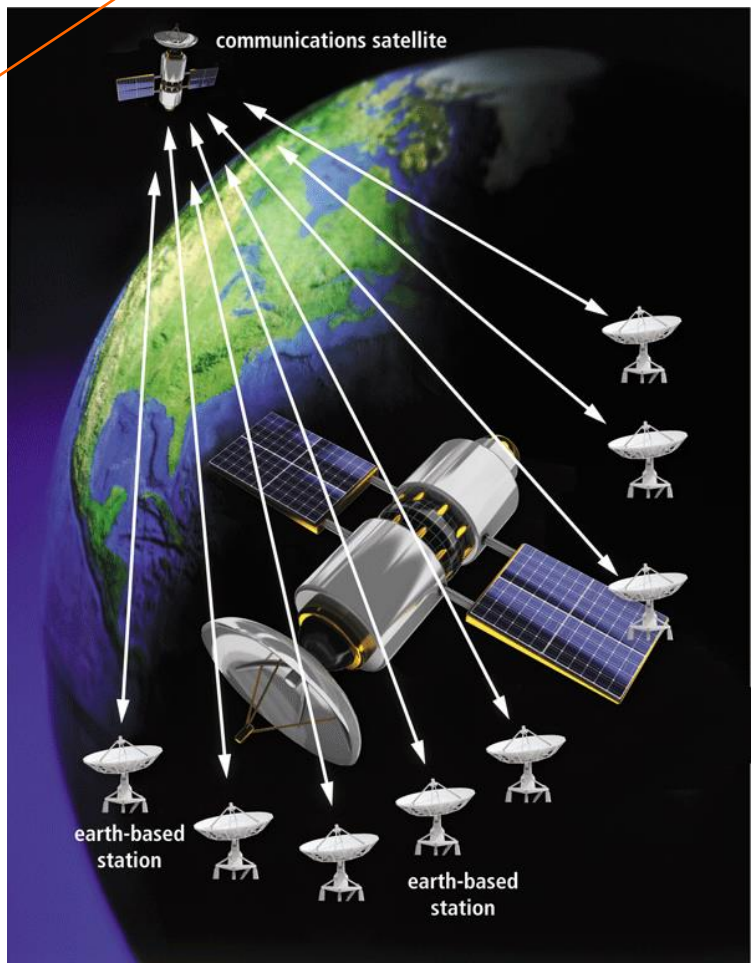
- Connection Methods (continued)
  - **Wireless Fidelity**
    - **Wireless fidelity** (**Wi-Fi**) technologies to connect to networks
    - **Hotspot** – specific geographic location in which a wireless access point provides public Internet access
    - **Wireless access point** – hardware that connects wireless devices to a network

Connecting to the Internet

One-way satellite access uses the satellite for downloading data, and uses a slow, regular phone line and modem for uploading data

- Connection Methods (continued)
  - **Satellite Internet access:** One-way or two-way satellite transmissions

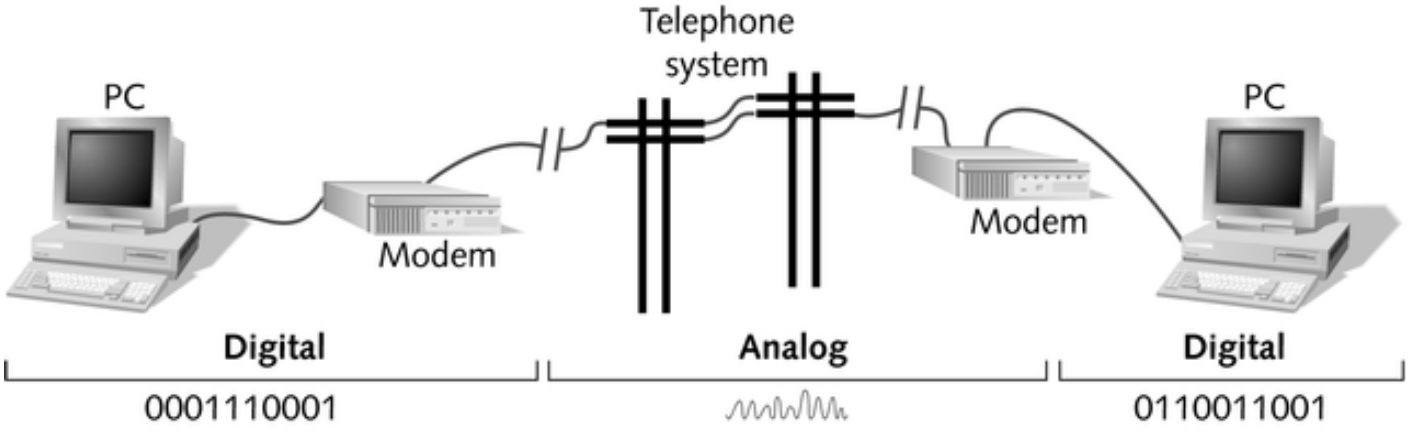
Two-way satellite access uses the faster satellite connection for both uploading and downloading data



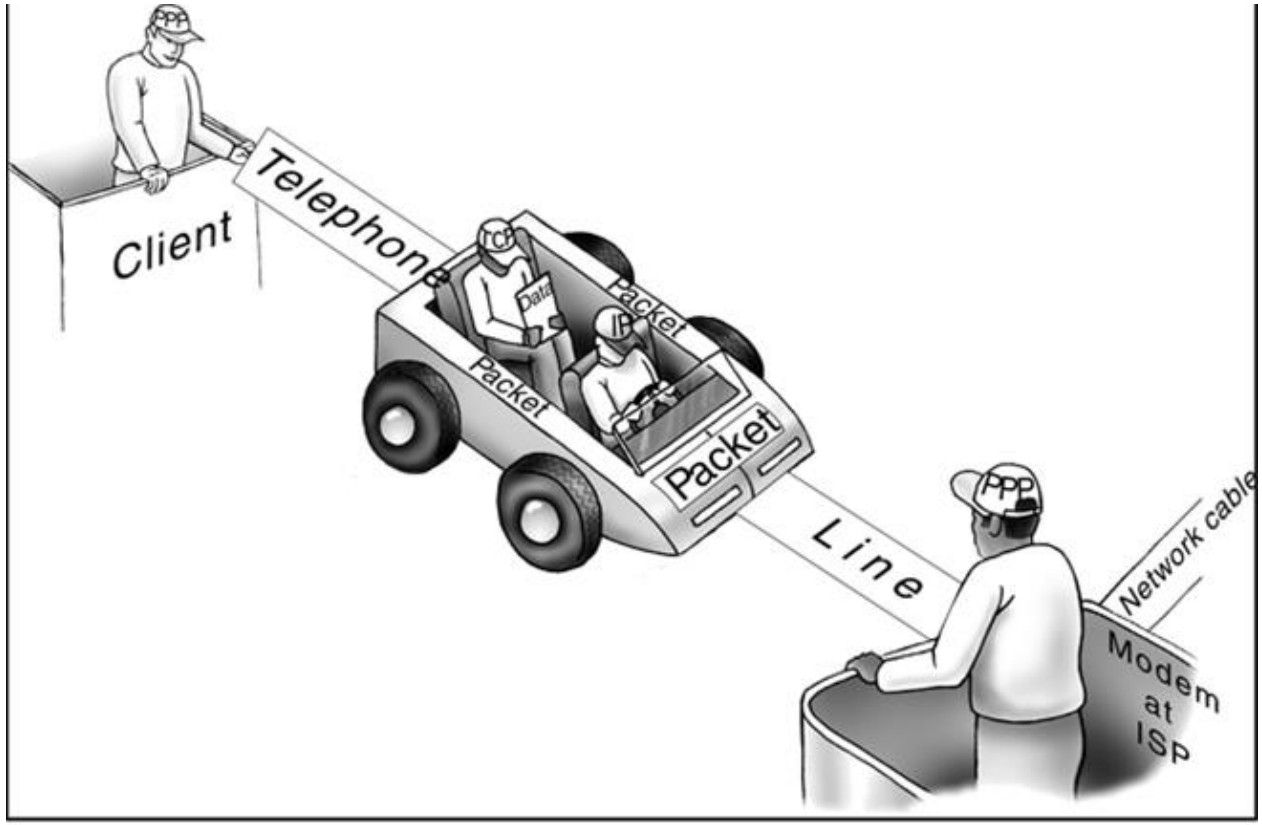
Regular Telephone Lines

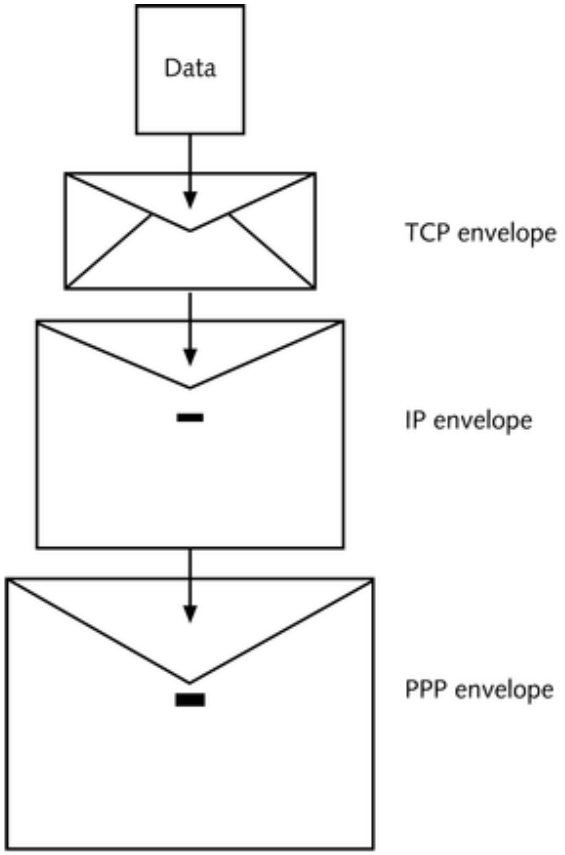
Transmission Control Protocol/Internet Protocol

- Require an internal or external modem (i.e. for dial-up Internet access) to convert PC's digital data to analog data
- Use PPP (Point-to-Point Protocol) to transmit TCP/IP packets



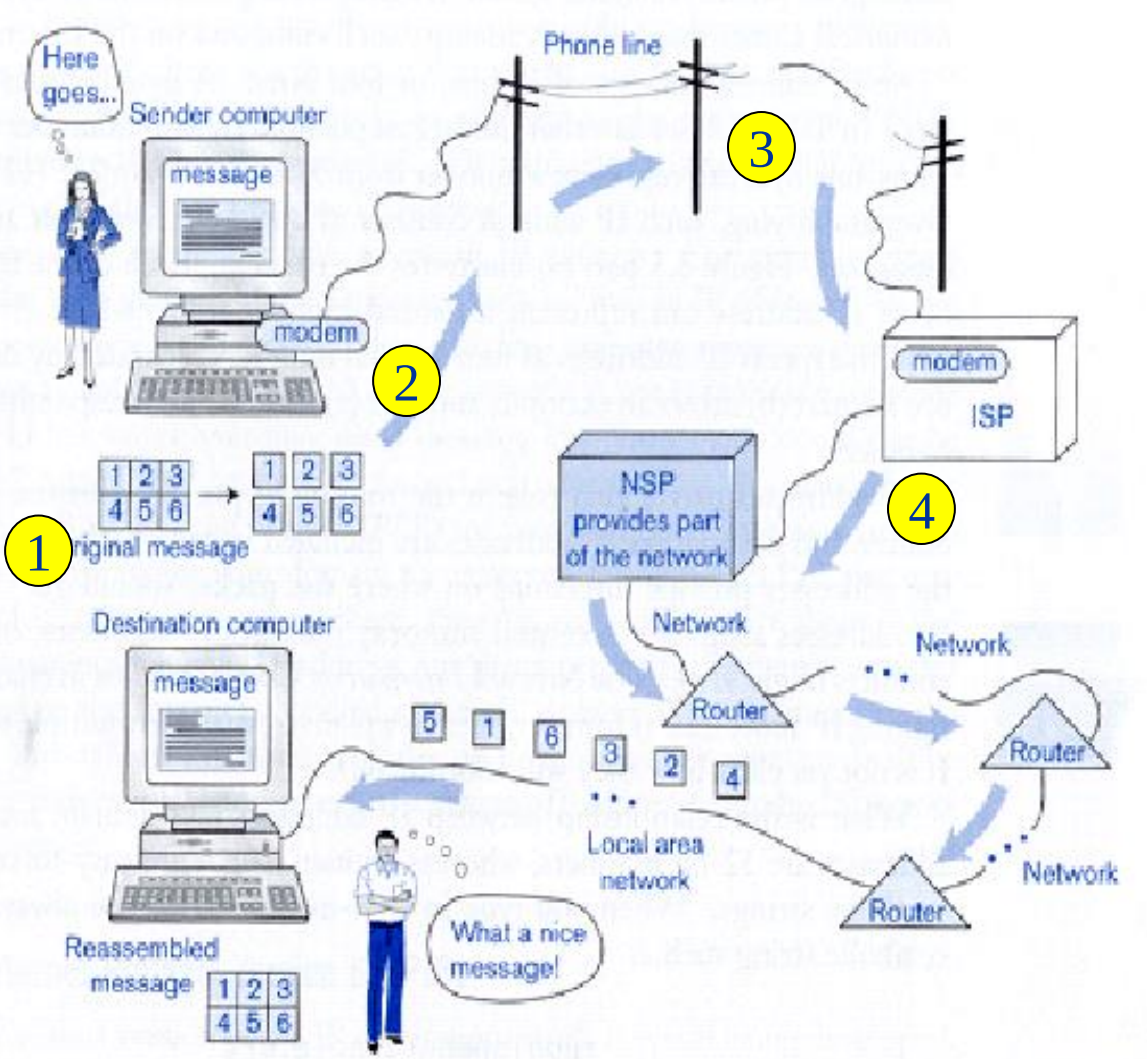
Point-to-Point Protocol





The PPP line protocol supports TCP/IP packets as they travel over a telephone line from the client to the ISP

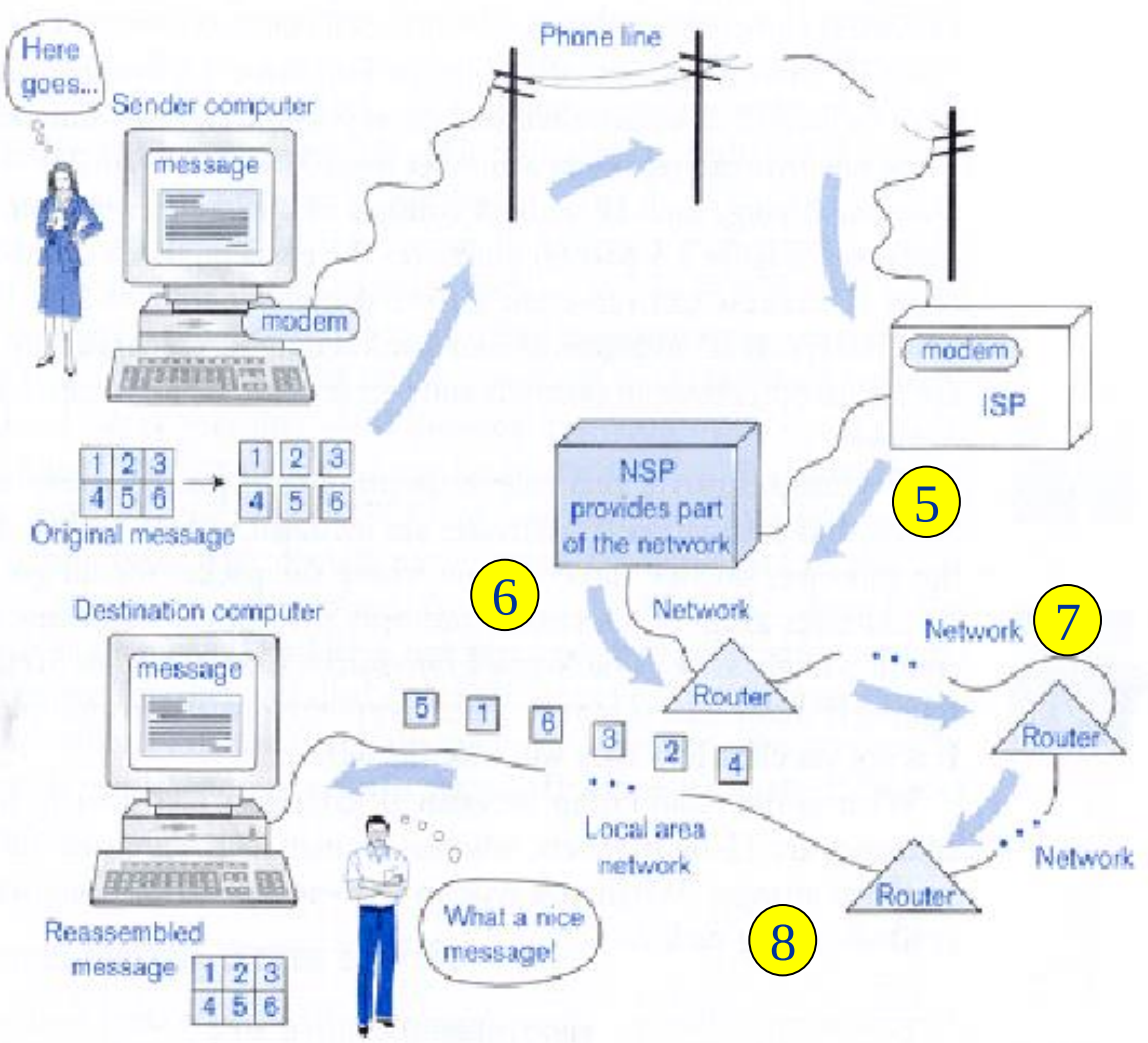
Illustration of a Message Split into Packets, Routed to Destination through an ISP and an NSP, and Reassembled



Sending a Message

1. Message is split into IP packets.
2. Modem converts the digital IP packets into analog telephone signal.
3. Analog signal is transmitted over the telephone line.
4. A second modem at the ISP's end completes the connection and converts analog signal back to digital IP packets

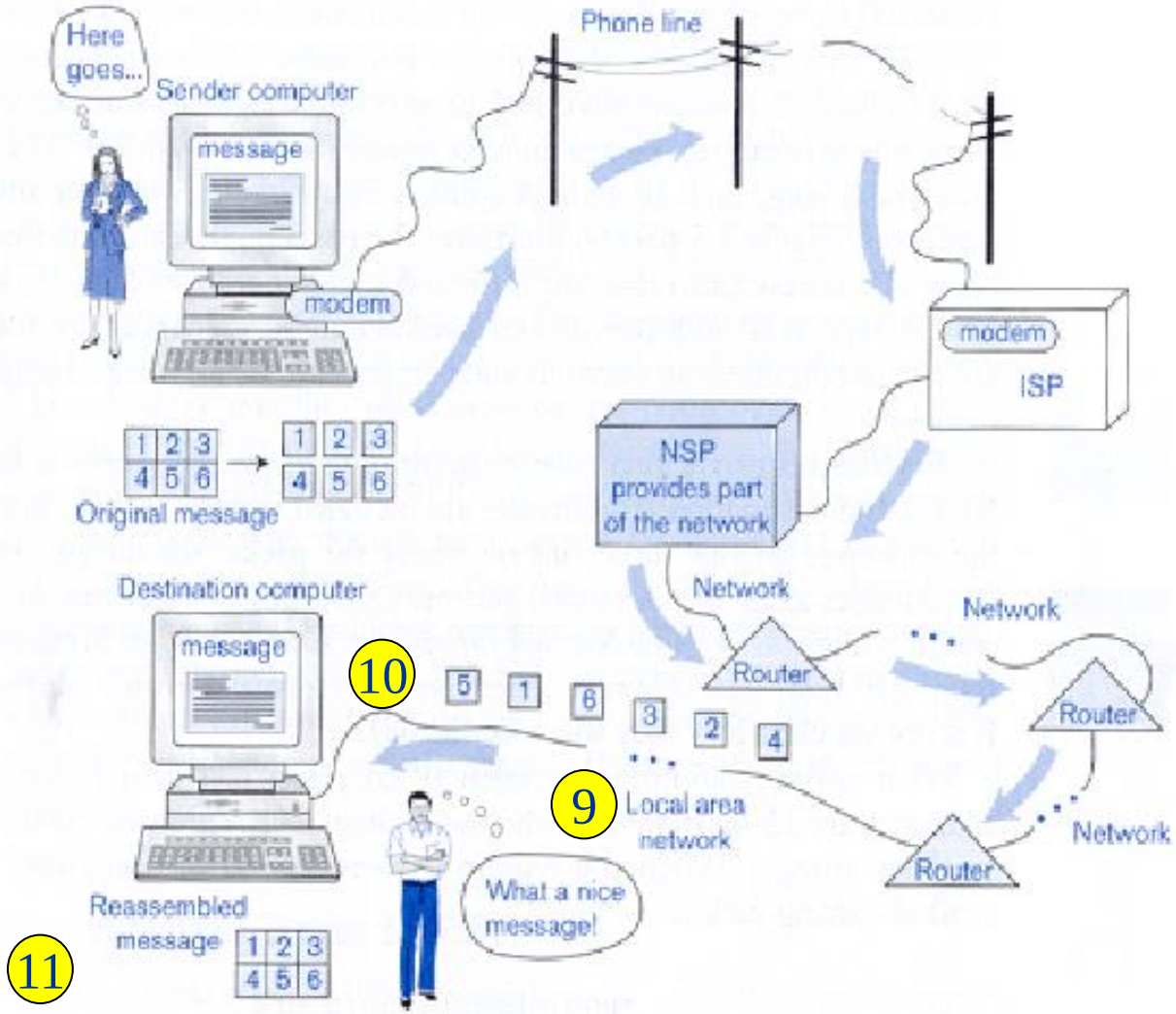
Illustration of a Message Split into Packets, Routed to Destination through an ISP and an NSP, and Reassembled



Sending a Message

5. Packet redirected to Network service provider via high speed leased lines
6. NSP connects to the global Internet high-speed backbone.
7. The packets are transmitted over the international links and routers.
8. Packets arrive at the network that the destination computer attached to.

Illustration of a Message Split into Packets, Routed to Destination through an ISP and an NSP, and Reassembled

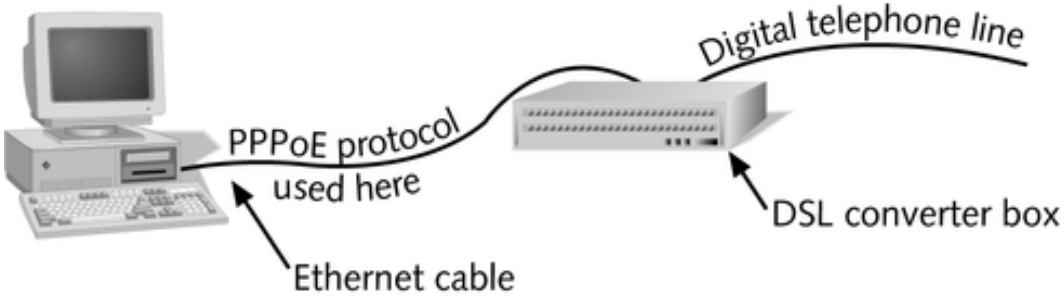


Sending a Message

9. Packets are transmitted
10. Packets arrives the destination computer without proper order.
11. The destination computer reassemble the message

PPPoE (Point-to-Point Protocol over Ethernet) – e.g. for DSL connection

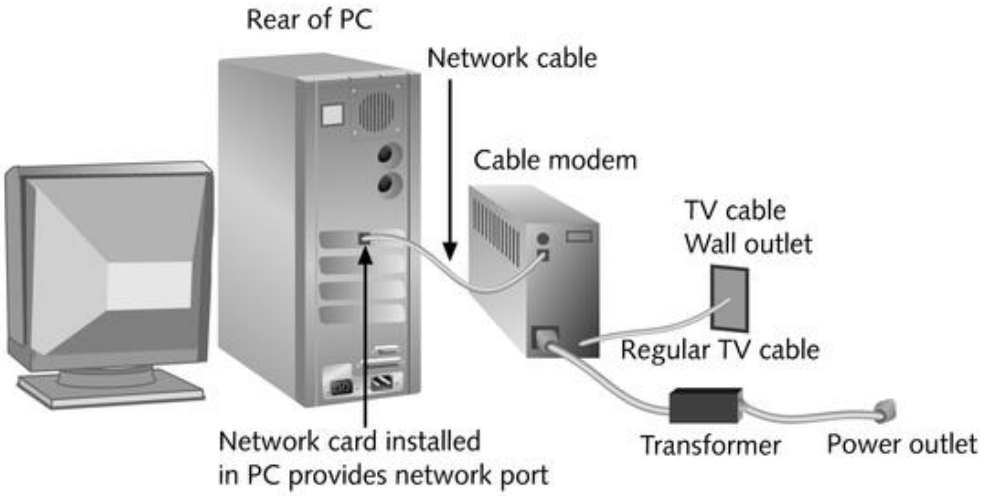
- Adapts PPP to work with the Internet
- Describes how a PC is to interact with a broadband converter box (e.g. DSL modem)
- Gives the user security and authentication
- Sets standards for networks to connect to the Internet via DSL modems and other high-speed access services



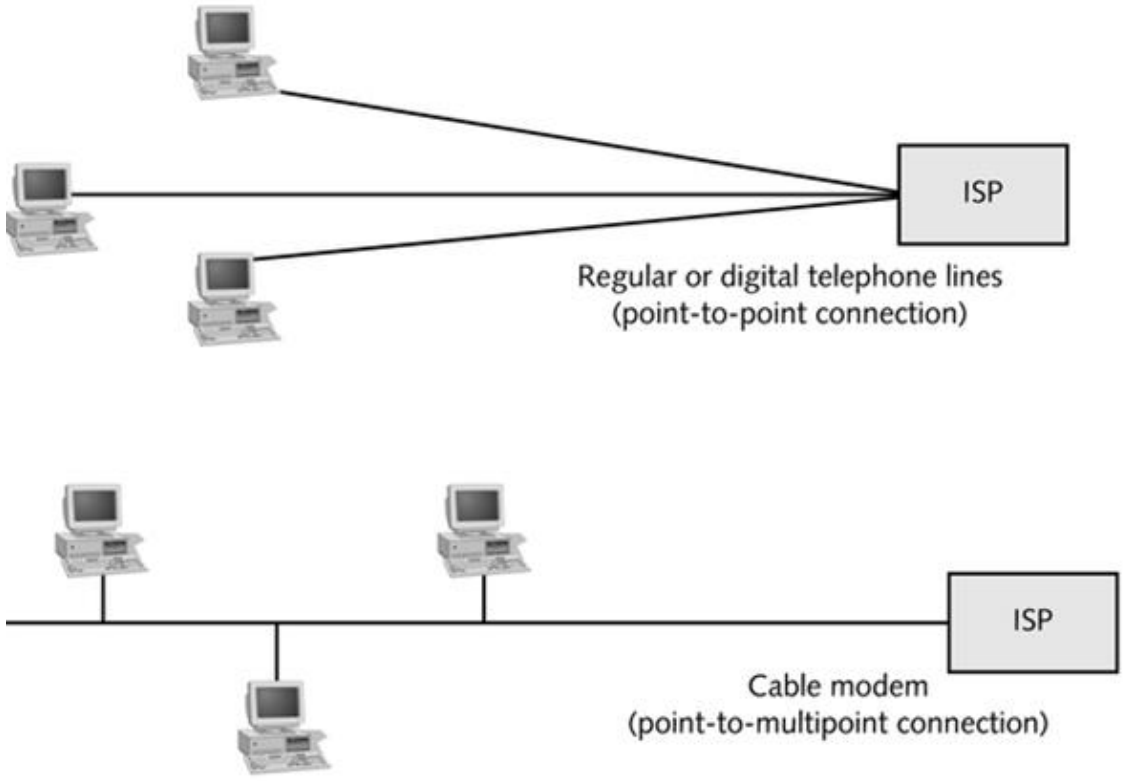
Cable Modem

Network Interface Card

- Uses a regular TV cable cord (e.g. cable TV lines) to connect to a TV cable wall outlet
- From the modem, a network cable connects to a NIC in the user's PC
- Broadband media (carries more than one type of transmission)
- Disadvantages
  - Point-to-multipoint connection can mean degradation in service
  - Lack of security

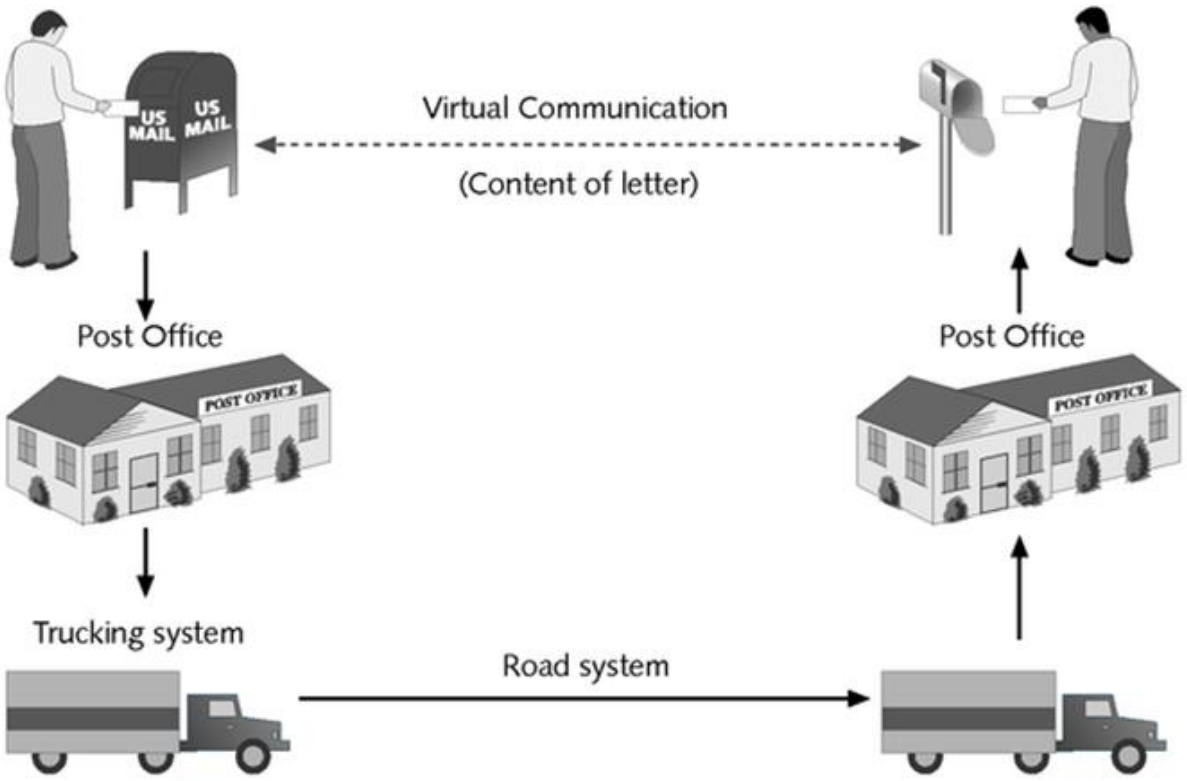


Cable Modem



Telephone lines provide you with a private line to your ISP, but you share cable modem with others in your neighborhood

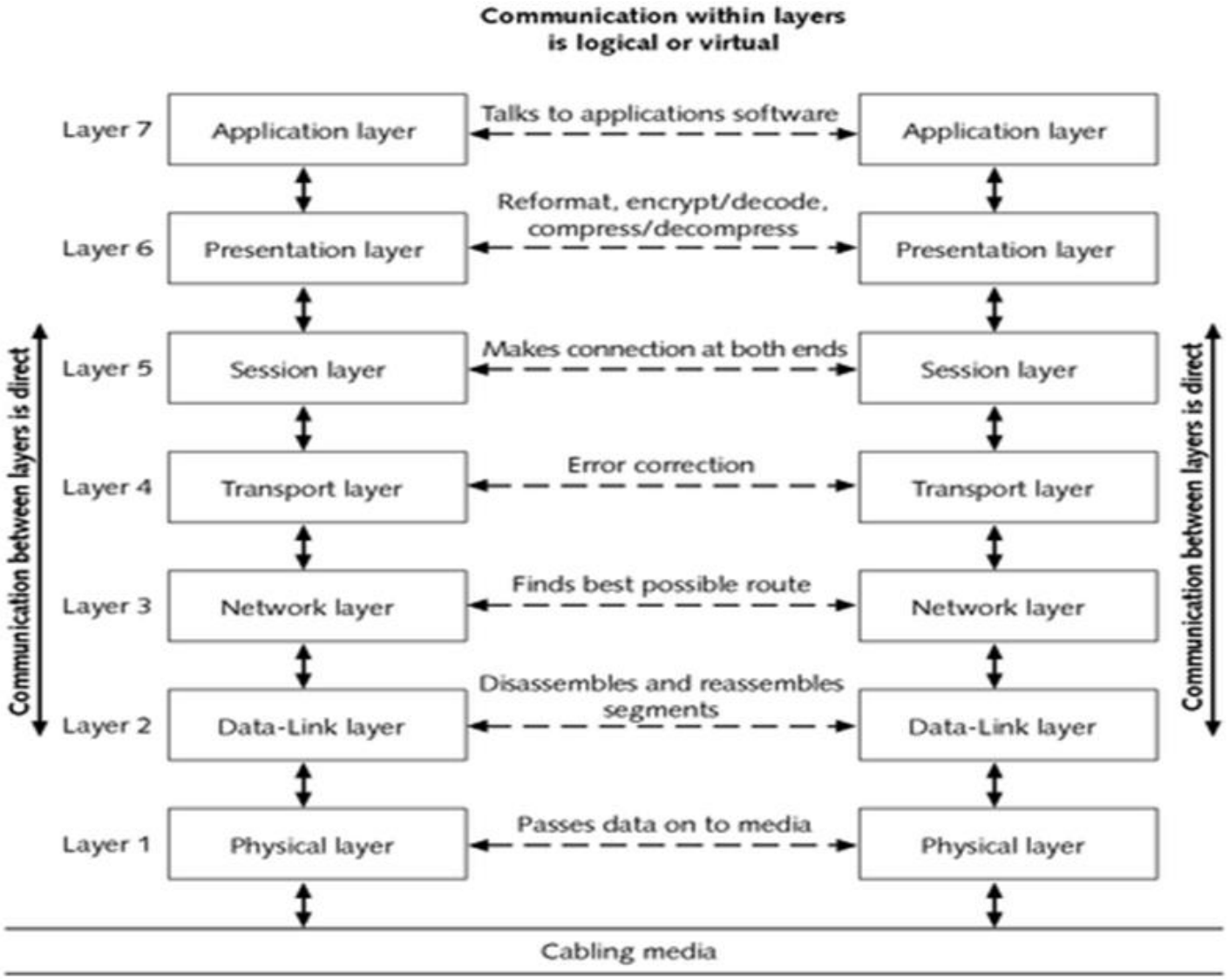
The OSI Model and the Internet



Communication is virtual between sender and receiver, but direct between adjacent system in the postal service

Understanding the OSI Model

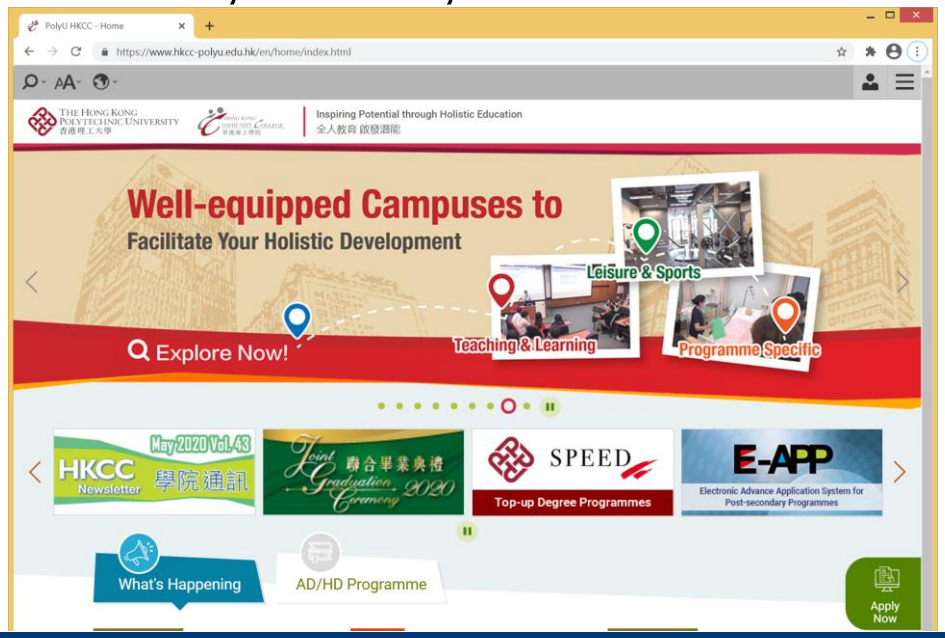
- In early 1980s, manufacturers began to standardize networking so that networks from different manufacturers could communicate
  - International Organization for Standardization (ISO)
  - Institute of Electrical and Electronics Engineers (IEEE)
- Open Systems Interconnect (OSI)
  - A networking model developed by ISO to identify and standardize all the levels of communication needed in networking



The OSI reference model identifies seven layers of network communication within software and firmware

Application Layer

- Provides the interface for application software, such as Web browsers or Web servers, to set up communication with another application software.
  - e.g. Web Browser, E-mail, Chat Rooms



Presentation Layer

- Receives requests for files from the Application layer and presents the requests to the Session layer
- Reformats, compresses, or encrypts data as necessary
  - e.g. ASCII, Unicode

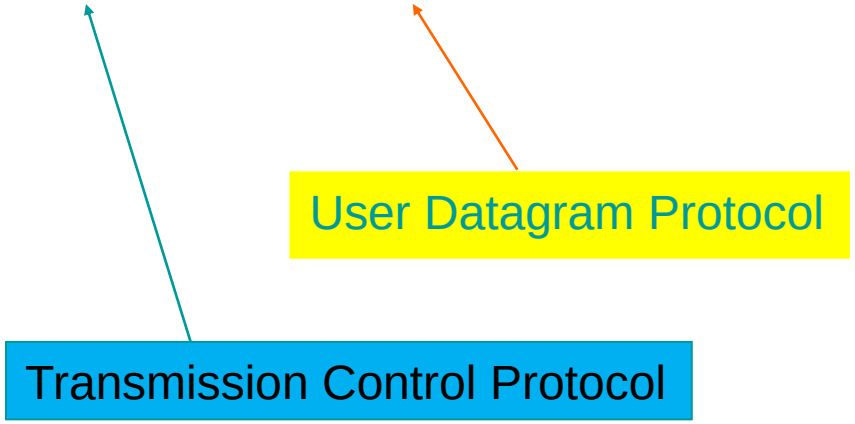
American Standard Code for Information Interchange

Session Layer

- Establishes and maintains a session between two networked stations or hosts

Transport Layer

- Responsible for error checking
- Requests a resend when the data is corrupted
- Guarantees successful delivery of data
  - TCP and UDP



Network Layer

- Divides a block of data into segments (data packets or datagrams) that are small enough to travel over a network
- Responsible for routing (finding the best possible route by which to send the data packets over a group of networks)
- Reassembles the packets once they reach their destination
  - e.g. IP, ARP, RARP, ICMP

Internet Control Message Protocol

Address Resolution Protocol

Reverse Address Resolution Protocol

Data Link Layer

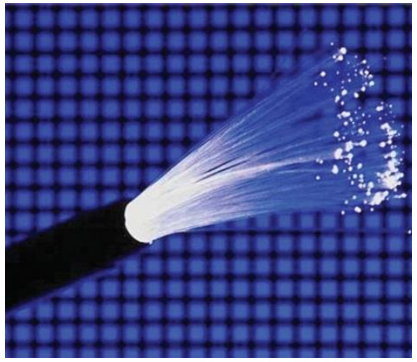
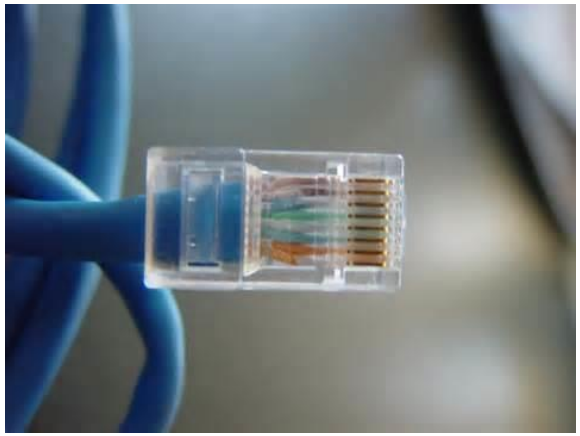
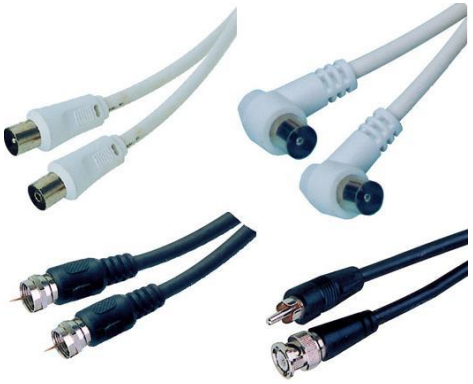
- Responsible for receiving packets of data from Network layer and presenting them to Physical layer, and does the reverse for incoming data
- If the packets received from Network layer are too large for Physical layer, Data Link layer further disassembles packets of data into smaller packets as needed to transport over the network
- On the receiving end, Data Link layer reconstructs the packets into their original size
  - e.g. Ethernet, ATM, Token Ring

Asynchronous Transfer Mode

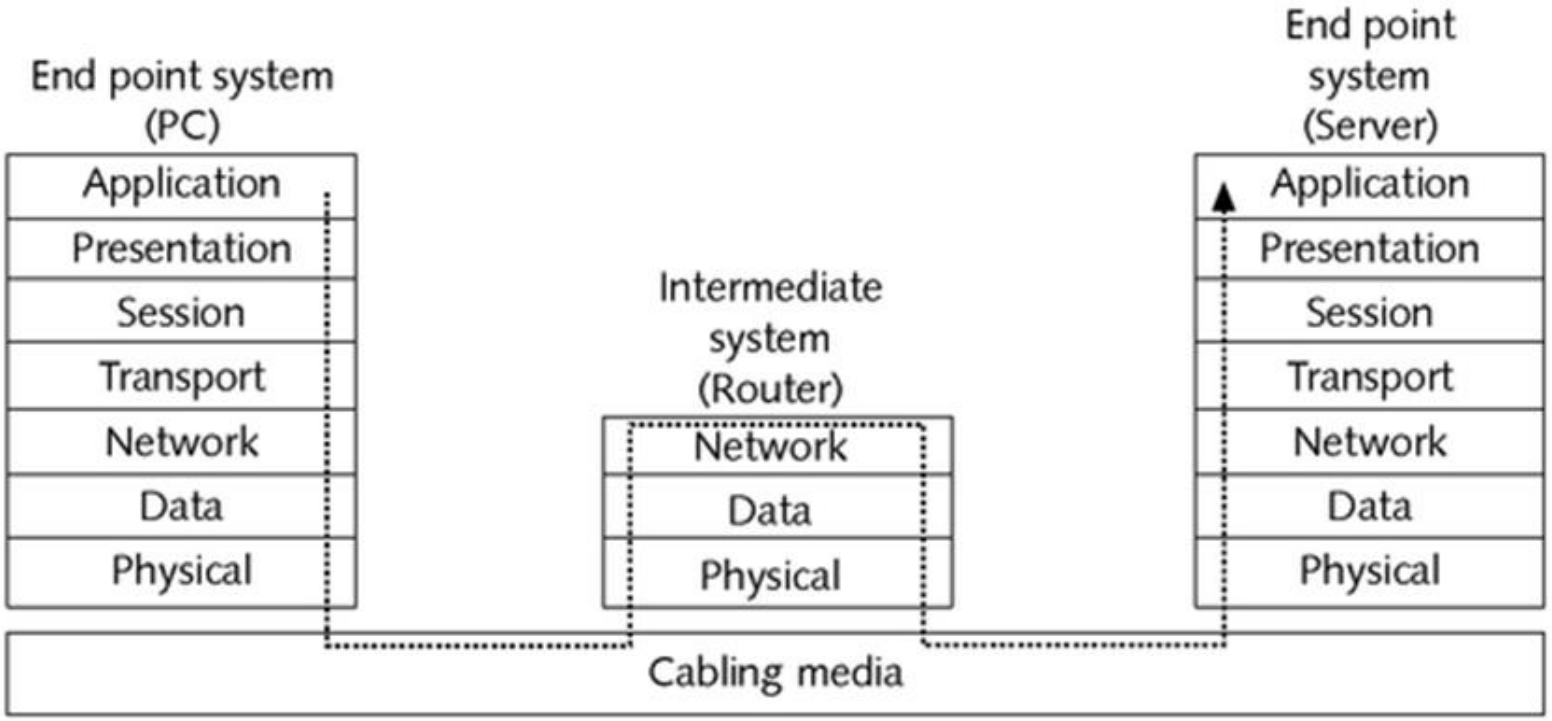
Physical Layer

- Passes data packets onto the cabling media
  - e.g. Cabling: Twisted-pair, Coaxial, Fiber Optic



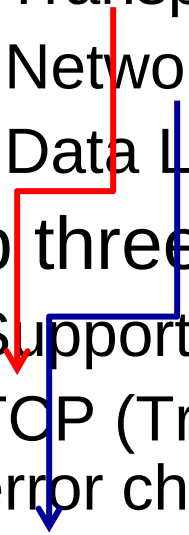

Network Devices and the OSI Model



The two end-point systems traverse all seven of the OSI layers, but intermediate devices such as a router may only interact with some of the layers

The OSI Model Applied to the Internet

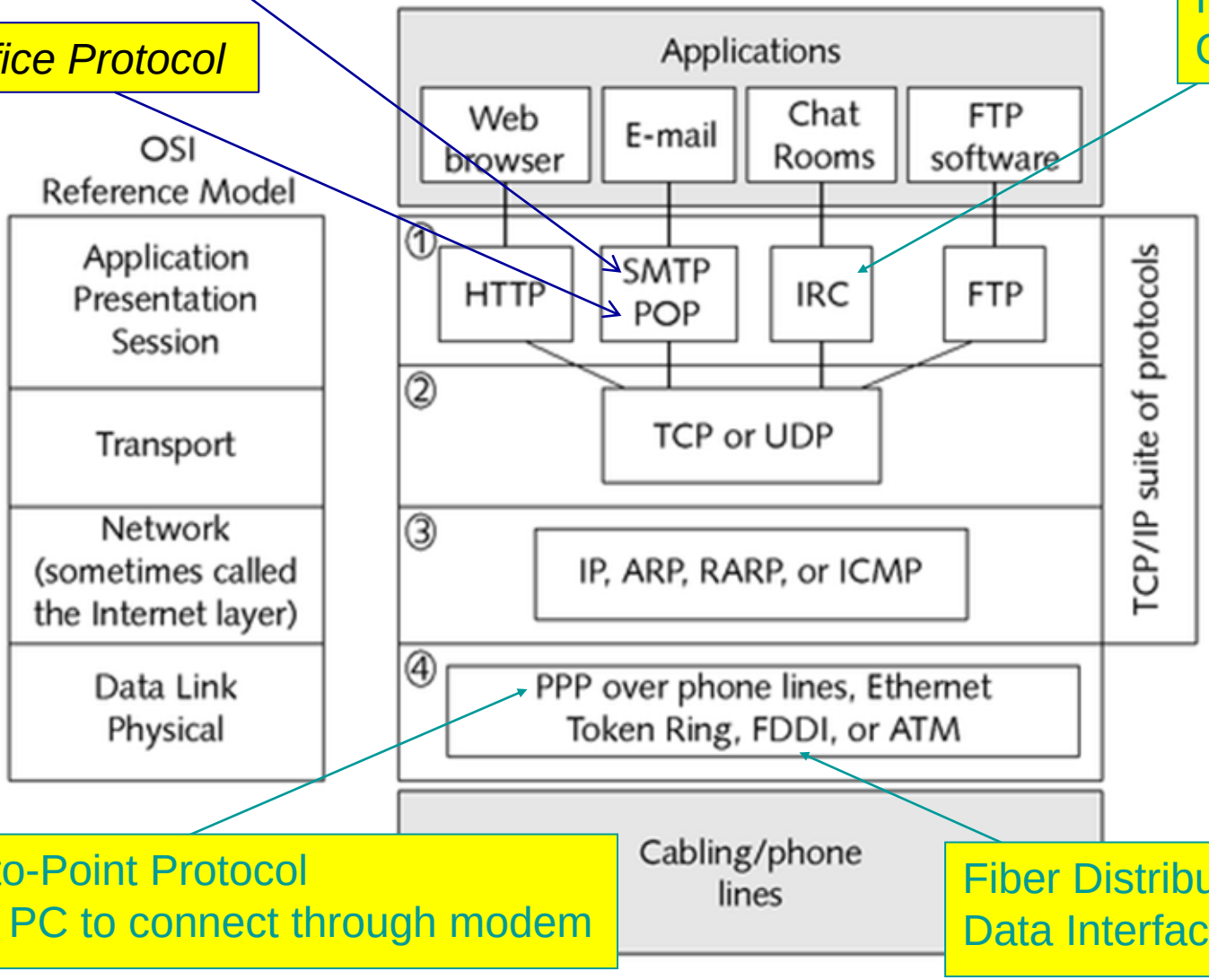
- Four major groupings
  1. Application, Presentation, and Session layers
  2. Transport layer
  3. Network layer
  4. Data Link and Physical layer
- Top three groups = TCP/IP Suite
  - Supports communication on the Internet
  - TCP (Transmission Control Protocol) is responsible for error checking
  - IP (Internet Protocol) is responsible for routing



Simple Mail Transfer Protocol

Post Office Protocol

Internet Relay Chat



Point-to-Point Protocol allows PC to connect through modem

Fiber Distributed Data Interface

An overview of networking software showing the relationships among components

The Application, Presentation, and Session Layers

- **Language** or **protocol** used by each application
  - Web browser: **HTTP**
  - E-mail: **SMTP** and **POP**
  - Chat room software: **IRC**
  - FTP software: **FTP**
- Application Program Interface (API)
  - Calls another program to perform a utility task

The Transport Layer

- Includes two protocols
  - TCP (Transmission Control Protocol)
    - Establishes a connection from host to host before it begins transmitting data (connection-oriented protocol)
    - Guarantees delivery
  - UDP (User Datagram Protocol)
    - Sends data without caring about whether or not the data is received (connectionless protocol)

The Network Layer

- TCP and UPD communicate with this layer which is responsible for routing
- IP (Internet Protocol)
  - The governing protocol at this layer, responsible for breaking up and reassembling data into packets and routing them to their destination

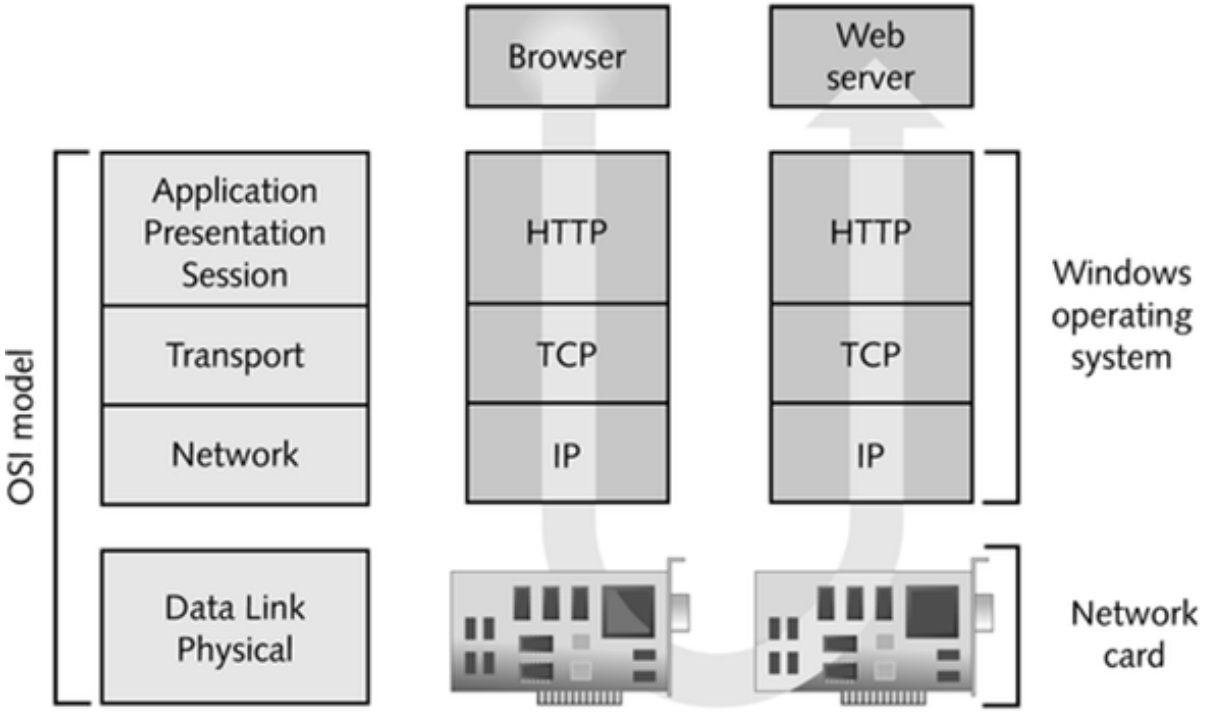
Other Supporting Protocols at the Network Layer

- ARP (Address Resolution Protocol)
  - Locates a host on a local network
- RARP (Reverse Address Resolution Protocol)
  - Discovers the Internet address of a host on a local network
- ICMP (Internet Control Message Protocol)
  - Communicates problems with transmission to devices that need to know about these problems

The Data Link and Physical Layers

- Most often covered by the firmware (software that is permanently stored on a microchip) on a single network interface card
- Protocol used depends on the type of physical network that the data is traveling on (Point-to-Point Protocol, Ethernet, Token Ring, FDDI and ATM)

The OSI Model Applied to a TCP/IP Network



When a browser sends a request to a web server, all layers of the OSI model are involved on both the client and the server