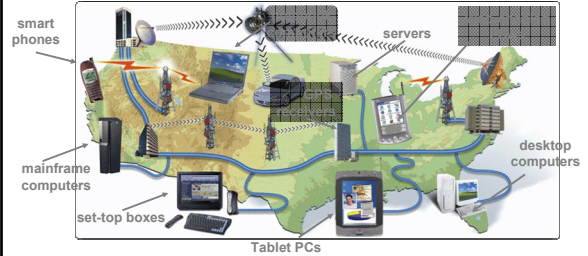


Communication and Network

Communication

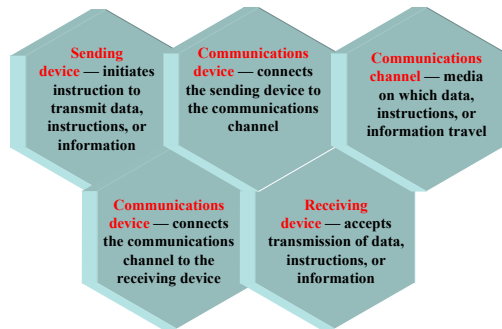
computer communication

- Process in which two or more computers or devices transfer data, instructions, and information via cables and wires or wirelessly mainframe computers



Communications

- What is needed for successful communications?



- global positioning system (GPS)

Step 1.
GPS satellites orbit Earth. Every thousandth of a second, each satellite sends a signal that indicates its current position to the GPS server.



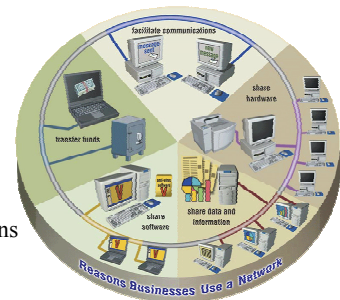
Step 2.
A GPS receiver (such as in a car, a PDA, a watch, a handheld device, or a collar) determines its location on Earth by analyzing at least 3 separate satellite signals from the 24 satellites in orbit.

An Old Way of PC-PC Communication

- PC A to floppy disk
- Then floppy disk to PC B
- Someone needs to carry the floppy disk from the location of PC A to PC B

Networks

- Collection of computers and devices connected via communications devices and transmission media



Internet

- First experimental Internet
 - 1969, ARPANET (Advanced Research Project Agency Network), UCLA
 - TELNET (Telecommunication Network Protocol)
 - FTP (File Transfer Protocol)
 - E-mail (Electronic mail)
- Late 70's, US Defense Dept. released the technology
- 1981, National Science Foundation (NSF) supported Computer Science Network (CSnet),
 - CSnet and ARPANET were connected => Internet
- Protocols: The rules that govern the communication between (通訊) 協定 different components within a computer system.

Internet

- In the beginning, only for government units, academia, research institutes, military units, companies...
- Internet Service Provider (ISP)
 - Everyone can use internet
 - <http://map.twnic.net.tw/>

Connecting to the Internet

- The principle
 - Transmission
 - Media and transmitter
- Network structure
 - LAN and WAN
 - Ethernet and IP routing

Person-Person Communication

- Polly writes a letter
- The letter reaches Tiffany
- The postal system carries the letter from Taipei to LA

Why that trouble?

Polly calls Tiffany!

Also person-person communication

Telephone Network

- Telephones connected by cables
- Conversations are transmitted through cables
- Use the cables and then no person needs to carry letters around

Computer Network

- Computers connected by cables
- Data are transmitted through cables
- Use the cables and then no person needs to carry data around

But...

How does voice or data go from one end of a cable to another end?

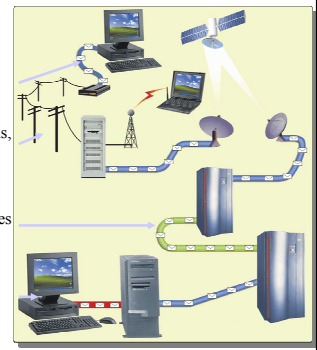
How is a request sent over the Internet using a communications channel?

Step 1. The sending device requests information using either a physical transmission media or a wireless transmission media.

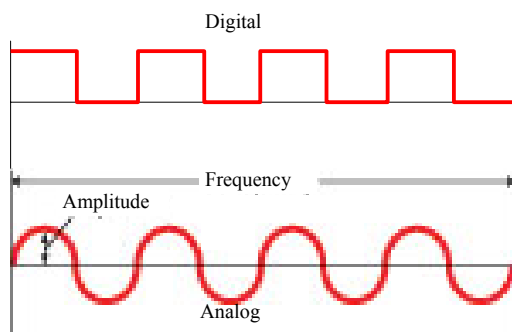
Step 2. When the request leaves the ISP, it travels over T1 lines, microwave stations, earth-based stations, and communications satellites until it reaches the Internet backbone.

Step 3. The request travels over T3 lines along the Internet backbone.

Step 4. The Request travels over T1 lines until it reaches the destination network server.



Believe it or not!



Pulses or Waves

- Going through the cables
- Carrying the 0/1 information
- Called **carrier pulses** or **carrier waves**

Going Through the Cables

- Electrical signal
- Optical signal

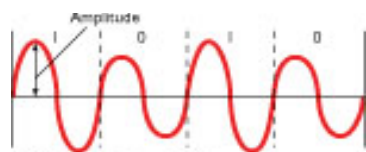
- EE's
 - Electronics engineering
 - Electro-optical engineering

Carrying 0 and 1

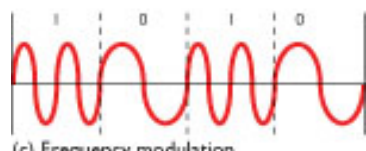
- Embody information in the waves
- The more, the merrier

- EE's
 - Communication engineering

For Example



(b) Amplitude modulation



(c) Frequency modulation

Transmission Media

- Physical
 - Twisted pair
 - Coaxial
 - Fiber optic

- Wireless

Physical Transmission Media

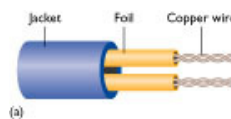
➤ Wire, cable, and other tangible materials used to send communications signals

Transfer Rates for Various Types of LANs Using Physical Transmission Media

| Type of Cable and LAN | Maximum Transfer Rate |
|---|-----------------------|
| Twisted-Pair Cable | |
| • 10Base-T (Ethernet) | 10 Mbps |
| • 100Base-T (Fast Ethernet) | 100 Mbps |
| • 1000Base-T (Gigabit Ethernet) | 1 Gbps |
| • Token ring | 4 Mbps to 16 Mbps |
| Coaxial Cable | |
| • 10Base2 (ThinWire Ethernet) | 10 Mbps |
| • 10Base5 (ThickWire Ethernet) | 10 Mbps |
| Fiber-Optic Cable | |
| • 10Base-F (Ethernet) | 10 Mbps |
| • 100Base-FX (Fast Ethernet) | 100 Mbps |
| • FDDI (Fiber Distributed Data Interface) | 100 Mbps |
| • token ring | |
| • Gigabit Ethernet | 1 Gbps |
| • 10-Gigabit Ethernet | 10 Gbps |

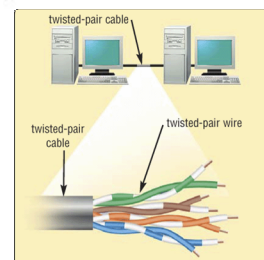
Twisted Pair

- Used for telephone systems and network cabling



- Electrical signals
- Copper
- Noise

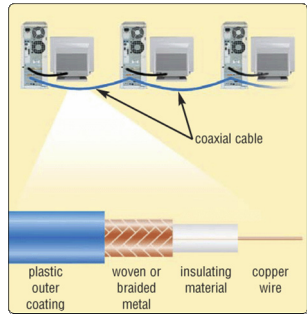
- Voice analog
- Cheap



Note: Phone and network cables are different!

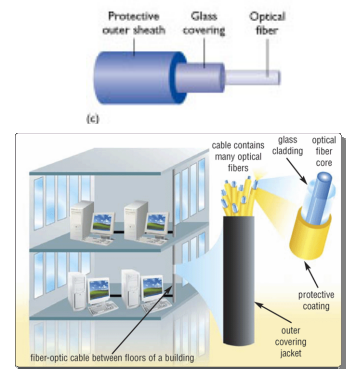
Coaxial Cable

- Often used for cable TV and Ethernet cable in bus topology
- Electrical signals
- Copper
- Little noise
- Data digital/analog
- Inexpensive



Fiber-Optic Cable

- Used in **backbone** cable, Fiber to the Home/Building (FTTH / FTTB)
- Light signals
- Fibers (glass)
- Less susceptible to interference (noise) and, therefore, more secure
- Ultra-high bandwidth
- Data digital
- Expensive



Backbone: major transmission Channels, on the ground and in the sea (<http://map.twinc.net.tw/> and see map)



Wireless Transmission Media

- Used when inconvenient, impractical, or impossible to install cables
- Includes Bluetooth and IrDA

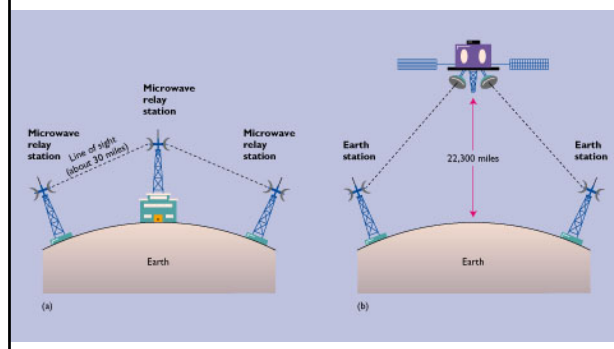
| Transmission Media | Maximum Transfer Rate |
|---------------------------------|-----------------------|
| Infrared | 115 Kbps to 4 Mbps |
| Broadcast radio | |
| • Bluetooth | 1 to 2 Mbps |
| • HomeRF | 1.6 Mbps to 10 Mbps |
| • 802.11b | 11 Mbps |
| • 802.11a | 54 Mbps |
| Cellular radio | |
| • 2G | 9.6 Kbps to 19.2 Kbps |
| • 3G | 144 Kbps to 2 Mbps |
| Microwave radio | 150 Mbps |
| Communications satellite | 1 Gbps |

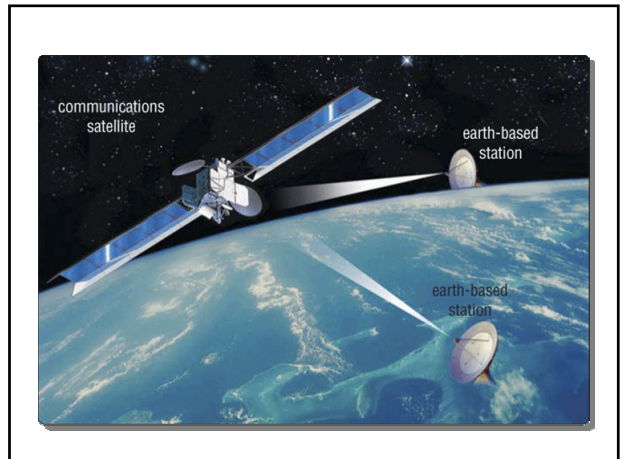
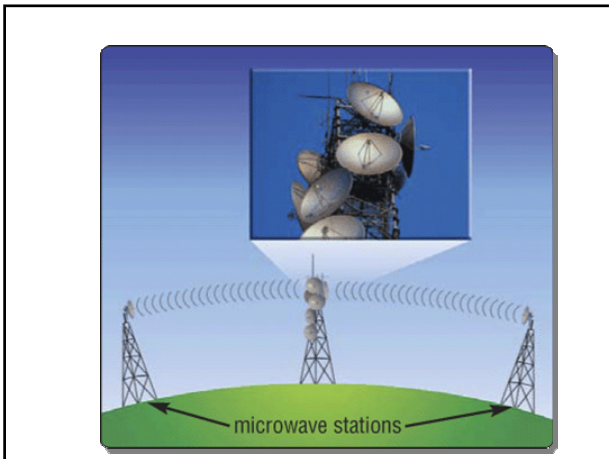
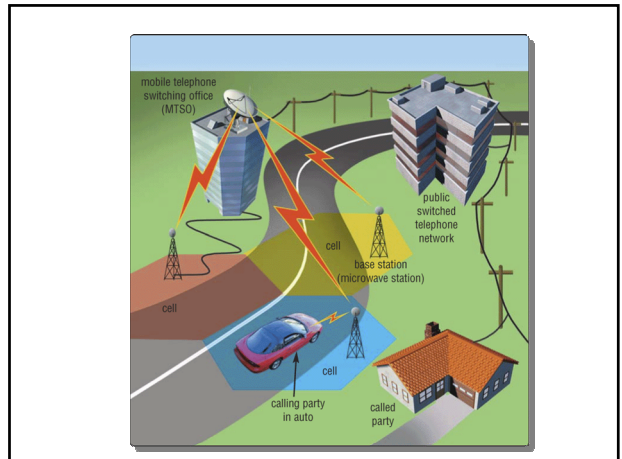
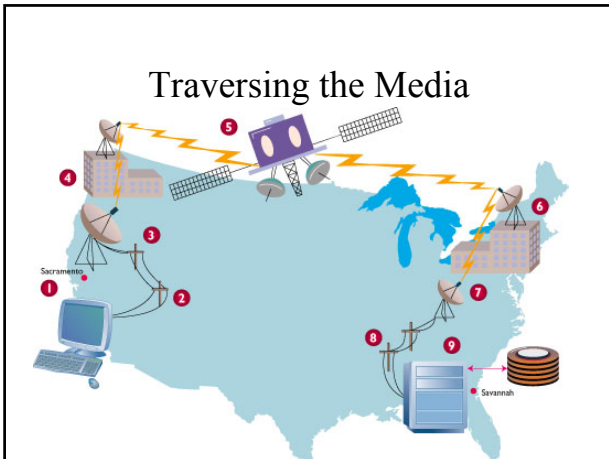
Microwave

- Microwaves
- Line of sight
- Lots of noise
- Data digital/analogy
- Expensive
- Example
 - Cellular phone, Satellite



Satellite





Bandwidth

- Capacity
 - Max amount of data to be transmitted over a given time interval
- Depends on
 - Media type (microwave, twisted pair, coaxial, optical)
 - Coding of 0/1 information

PC to Medium Interface

- Twisted pair
 - Modem, ISDN, DSL
- Coaxial
 - Cable modem
- Optical (potential application)
 - Fiber to the Home (FTTH), Fiber to the Building (FTTB)
- Microwave
 - Wireless LAN, Cellular modem

What is a dial-up line?

- Temporary connection using telephone line for communications

- Costs no more than making regular call
- Computers at any two locations can establish a connection using modems and telephone network



What is a dedicated line?

- Always-on connection between two communications devices

- Four types are ISDN line, DSL, T-carrier line, and ATM

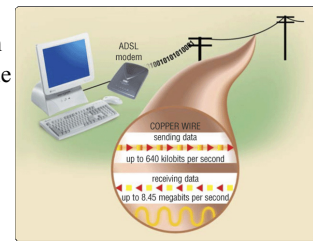
| Type of Line | Approximate Monthly Cost | Transfer Rates |
|-----------------|------------------------------|---|
| Dial-up | Local or long-distance rates | Up to 56 Kbps |
| ISDN | \$10 to \$40 | Up to 128 Kbps |
| DSL | \$40 to \$80 | 128 Kbps to 8.45 Mbps |
| Cable TV (CATV) | \$30 to \$50 | 128 Kbps to 10 Mbps |
| Fractional T1 | \$150 to \$350 | 128 Kbps to 768 Kbps |
| T1 | \$1,000 or more | 1.544 Mbps |
| T3 | \$10,000 or more | 44,736 Mbps |
| ATM | \$8,000 or more | 155 Mbps to 622 Mbps, can reach 10 Gbps |

Dialup (Modem)

- For transmission over the telephone network
- Convert digital data to analog signal
- Sender side
 - Digital to analog
 - **M**odulation
- Receiver side
 - Analog to digital
 - **D**emodulation
- 56Kbps (28K bps ..)

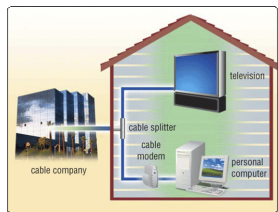
DSL

- **D**igital **S**ubscriber **L**ine
- For transmission over the telephone network
- Digital-analog conversion
- Sending data over multiple frequencies
- Several times faster than 56Kbps
 - provider dependant
- No one standard
 - ADSL, SDSL, etc



Cable Modem

- For transmission over cable TV network
- Digital-analog conversion
- Always on
- 10Mbps
- Users sharing cables also share bandwidth



ISDN

- **I**ntegrated **S**ervices **D**igital **N**etwork
- For transmission over the telephone network
- No conversion
- 128Kbps

Cellular Modem

- For transmission over wireless cellular network
- Analog-digital conversion
- Slower than modem

Access Network

- Ways for users to connect to the Internet
- Depending on
 - Where you are
 - What bandwidth required
 - How much they cost
- Select from below
 - Modem, ISDN, DSL
 - Cable modem
 - Cellular modem

Questions?

Network Structure

- LAN
- WAN

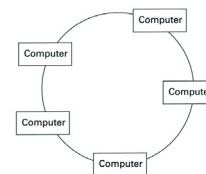
LAN

- Local Area Network
- A small number of connected computers within close proximity
- Usu. < 2 KM

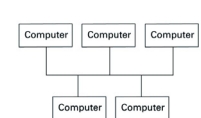
Constructing a LAN

- Ring
- Bus
- Star
- Irregular

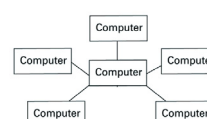
a. Ring



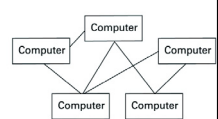
b. Bus



c. Star

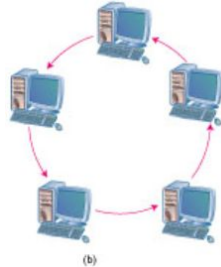


d. Irregular



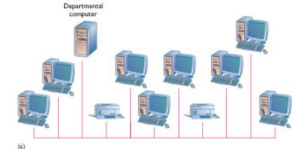
Ring

- Each computer keeps passing transmitted data in order (using Token)
- No signal collision, more efficient
- Any computer down, network down (can be solved double rings)



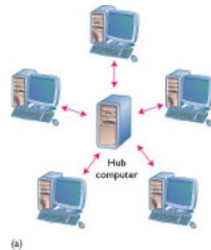
Bus

- Shared medium
- Just throw the data on the network
- Lower cost
- Bus down, network down
- Collision
- Dumb star network



Star

- Central point routes all data transmissions
- Central point down, network down
- Cost higher than bus



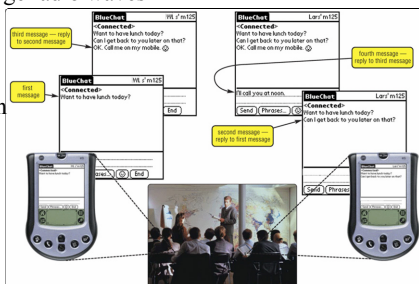
Networks

- **TCP/IP** (Transmission Control Protocol/Internet Protocol) technology transmits data by breaking it up into small pieces, or packets
 - Commonly used for Internet transmissions
- **802.11** is family of standards for wireless LANs

| Standard | Transfer Rates |
|-----------------|--------------------|
| 802.11 | 1 or 2 Mbps |
| 802.11a | Up to 54 Mbps |
| 802.11b (Wi-Fi) | Up to 11 Mbps |
| 802.11g | 20 Mbps and higher |

Bluetooth

- Short-range radio waves transmit data between Bluetooth devices



Intranet

Internal network that uses Internet technologies

Makes information accessible to employees

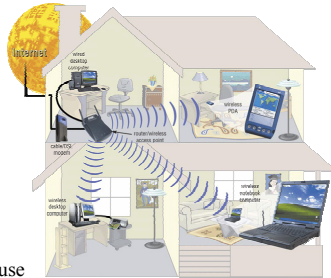
Typically includes connection to Internet

External access allows customers or suppliers to access part of company's intranet

Home Networks

- Multiple computers connected in home
- Several types of home networks

- **Ethernet** — connect computers via cable
- **Powerline cable** — use electrical lines in house
- **Phoneline** — use telephone lines
- **HomeRF (radio frequency)** — wireless

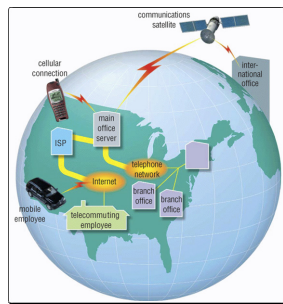


Metropolitan area network (MAN)

- connects LANs in city or town
- 2~ 10 KM

Wide area network (WAN)

- Network that covers large geographic area using many types of media
- Usu. > 10 KM



Internet – Structural View

