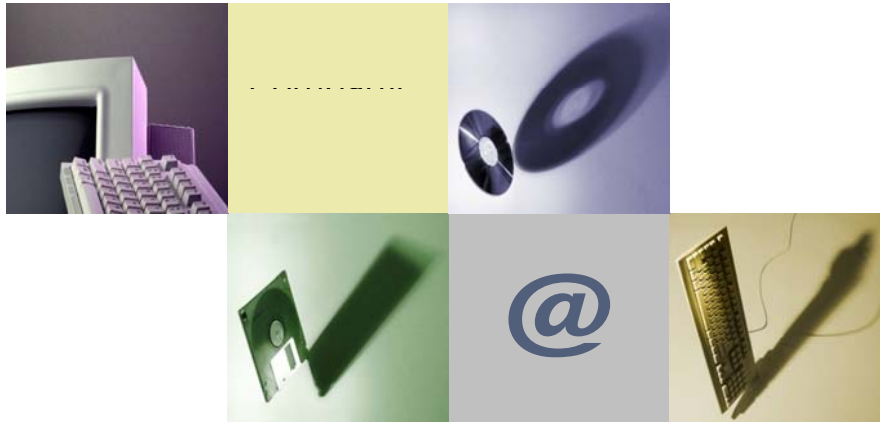


Data Communications



Digital Computer Concept and Practice

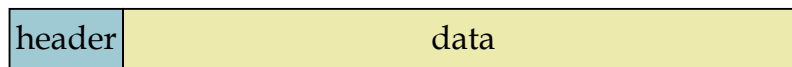
Data Communications

- Process in which two or more computers or devices transfer data, instructions, and information



Features

- Digital data
 - Durability of noise
 - Advanced IC technology → cheap
 - Fiber-optics → high speed
- Packets
 - A packet is a formatted block of data carried by a packet mode computer network
 - Header and data



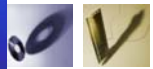
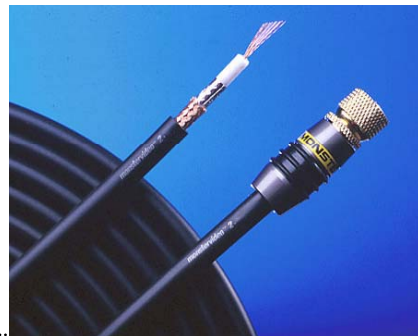
Components

- Source + Destination + Communication channel
- Transmission media (cable/wireless)
 - Transmission quality
 - Cable: media itself
 - Wireless: frequency
- Hardware
 - Modem, Hub, Router, etc.



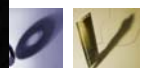
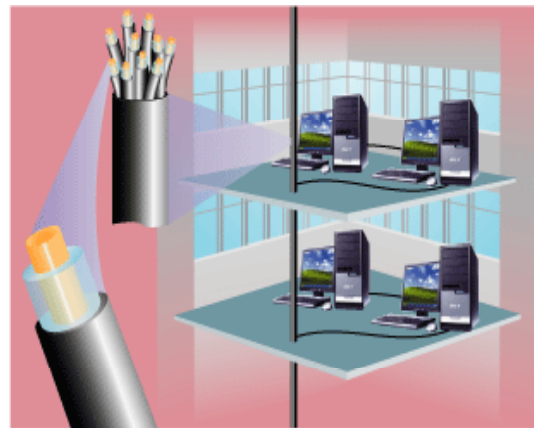
Cable Media

- Twisted pair
 - Telephone systems or local area network (LAN)
- Coaxial cable
 - As a high-frequency transmission line to carry a high-frequency or broadband signal
 - Long-distance telephone network, cable TV (CATV), and short-distance network



Cable Media

- Fiber optics
 - Capable of carrying significantly more data at faster speeds than wire cables
 - Less susceptible to interference (noise) and therefore more secure
 - Thinner and lighter
 - Expensive



Wireless Media

- To transport information through the air or outer space without wires
- Types
 - Radio waves
 - Infrared waves
 - Ground microwaves
 - Satellite microwaves

↓ high frequency



Wireless Media

- (1) Radio waves
 - Relatively long wavelength in the electromagnetic spectrum
 - AM / FM radio broadcasts
- (2) Infrared waves
 - Short distance communications (remote controls of TV, video and audio)
 - Directional, cheap



Wireless Media

(3) Ground microwaves

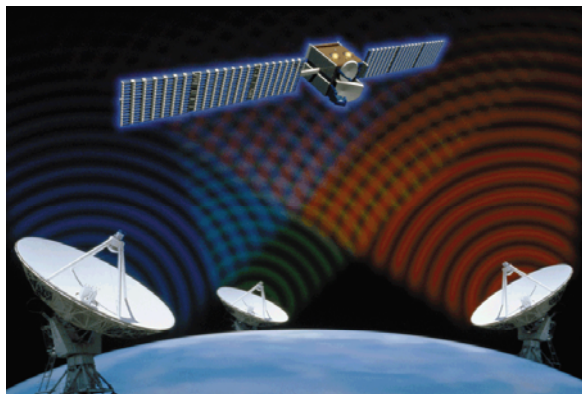
- Earth-based reflective dish used for microwave communications
- Must transmit in straight line with no obstructions
- Using 2 ~ 40 GHz bandwidth
- TV, PCS, wireless LAN, bluetooth



Wireless Media

(4) Satellite microwaves

- Space station that receives microwave signals from earth-based station, amplifies signals and broadcasts signals back to a number of earth-based stations
- Transmitted waves can be received on the all ground through a satellite antenna. → security issue



Mobile Phone

- Cellular systems
 - GSM, CDMA → 2G networks
 - W-CDMA → 3G networks



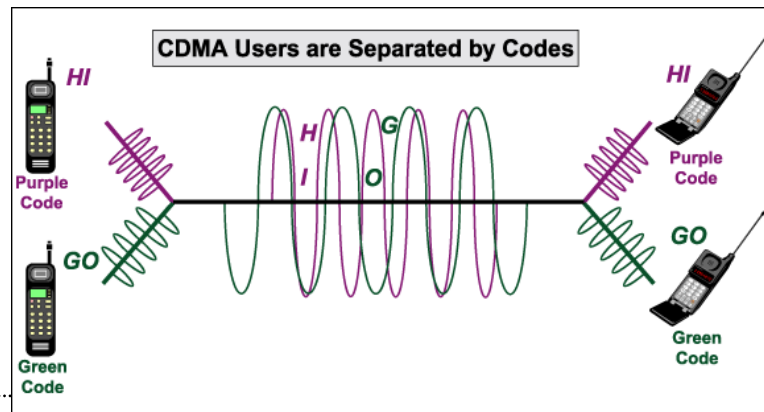
GSM (Global System for Mobile communications)

- GSM is the most popular standard for mobile phones in the world
- GSM uses a variation of TDMA (Time Division Multiple Access)
 - It digitizes and compresses data then sends it down a channel with two other streams of user data, each in its own time slot
 - 900 MHz or 1800 MHz frequency band



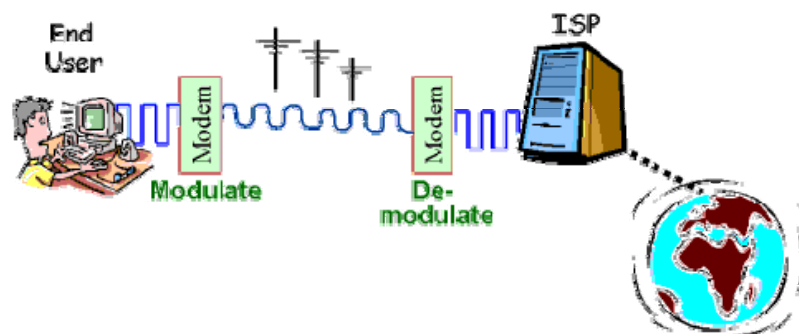
CDMA (Code Division Multiple Access)

- A channel access method utilized by various radio communication technologies
- It is a form of multiplexing, which allows numerous signals to occupy a single transmission channel, optimizing the use of available bandwidth



Hardware

- Modem (MOdulation + DEModulation)
 - Modem is a device that modulates an analog carrier signal to encode digital information and demodulates such a carrier signal to decode the transmitted information



Hardware

- Hub
 - Device that provides a central point for cables in network
 - Passive hub/active hub
 - cf.) IP sharer



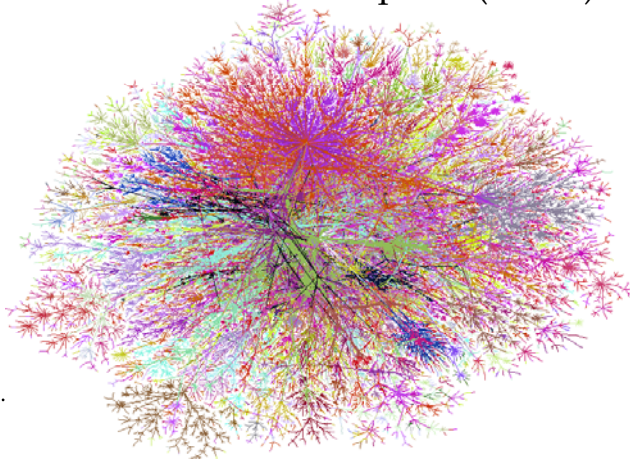
Hardware

- Router
 - Connects computers and transmits data to correct destination on networks
 - Routers forward data on internet using the fastest available path



Internet

- A large network made up of a number of smaller networks irrespective of OS or kinds of computers
- A worldwide, publicly accessible series of interconnected computer networks that transmit data by packet switching using TCP/IP protocol
- Internet is decentralized
 - Each internet computer (a host) is independent



Different colors based on IP address
<http://research.lumeta.com/ches/map>



Requirements of Internet Uses

- Computer
- Modem or LAN card
- Browser
- ISP (Internet Service Provider)
 - A company or business that provides access to the internet and related services
- NIC (Network Information Center)
 - IP address, domain name

Internet protocol
Internet address
Internet services (WWW, E-mail, FTP)



(1) Internet Protocol

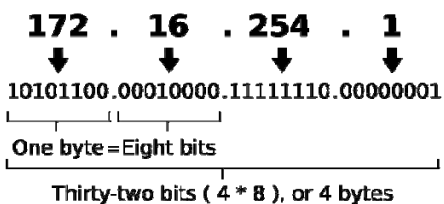
- Protocol
 - Can be defined as a set of rules governing the syntax, semantics and synchronization of communication
 - Communication by sending or receiving packets
 - Rules for converting a “message” into “packets”
- TCP/IP
 - A set of rules to enable computers to communicate over internet
 - TCP (Transmission Control Protocol)
 - IP (Internet Protocol)



(2) Internet Address

- IP address (IPv4)
 - A unique identifier for a computer or device on a TCP/IP network
 - Uses 32-bit addresses, which limits the address space to 2^{32} possible unique addresses → IPv6 (128-bits)
 - Written as four numbers separated by periods

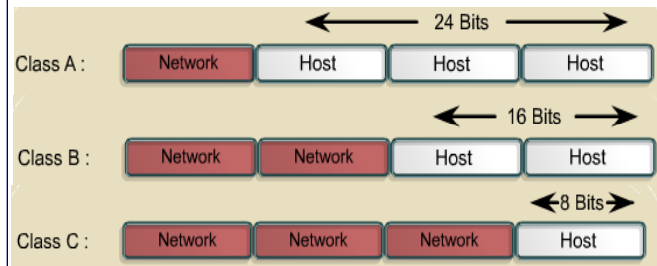
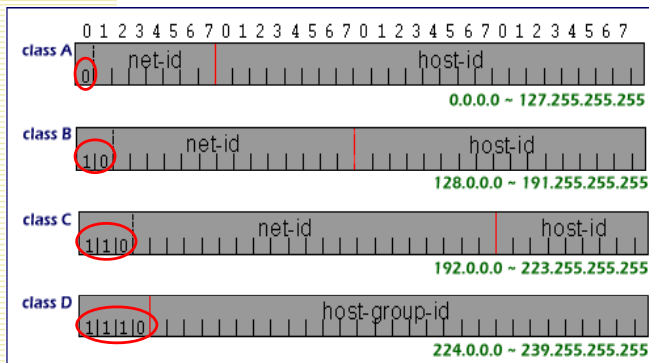
An IPv4 address (dotted-decimal notation)



- Network address + host address
cf.) MAC (Media Access Control) address



IP Address Class (optional)



- Class A: large organizations, governments
- Class B: medium-sized organizations
- Class C: small organizations



Port

- Several programs in a computer use the same network → Assign a unique number (port) to each program
- Port number is a way to identify a specific process to which an internet or other network message is to be forwarded when it arrives at a server.
- Needs “IP address” and “port” to communicate with other computers
- Common port numbers
 - WWW: 80
 - FTP: 21
 - Telnet: 23



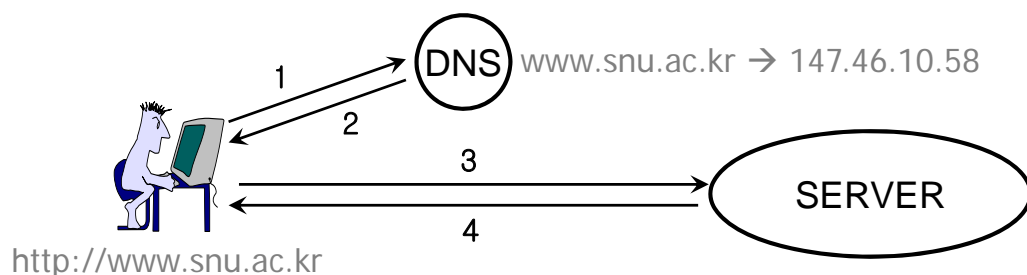
DNS (Domain Name System)

- IP address only?
- Domain name
 - Human-readable computer names
 - e.g. 147.46.10.20 → portal.snu.ac.kr
 - Host name + domain name
 - portal.snu.ac.kr
 - host
 - domain

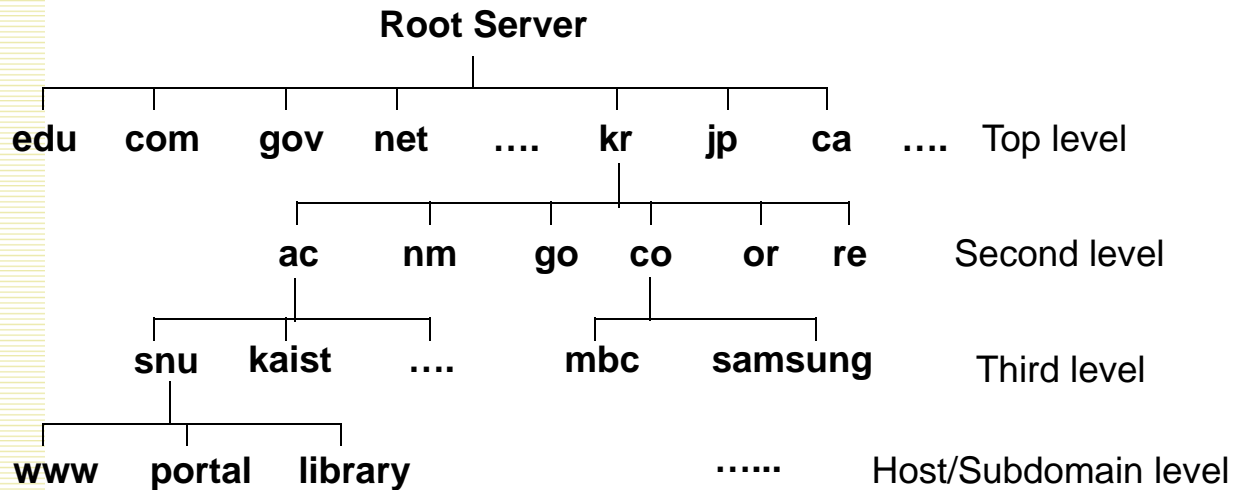


DNS (Domain Name System)

- DNS
 - DNS server translates a domain name into the corresponding IP address.
 - If a host does not know the IP address of a domain name → ask a designated name server
 - e.g. SNU: 147.46.80.1, 147.46.37.10



Domains



www	.	snu	.	ac	.	kr
Host Name		Seoul National Univ.		School		Korea



URL (Uniform Resource Locator)

- Global address of documents and other resources on the World Wide Web
- URL format

Protocol://Domain (IP) address [:Port number] / Directory / File

- e.g. <http://www.naver.com:80/index.html>



(3) Internet Services

- WWW (World Wide Web)
 - Supports text, images, videos, and other multimedia and navigates between them using hyperlinks.
 - Internet Explorer, Firefox, Netscape, ...
- E-mail (Electronic Mail)
 - Internet mailing systems
 - Web mail service: Hanmail, Hotmail, Gmail, etc
 - Mailer: Outlook Express, Thunderbird
- FTP (File Transport Protocol)
 - Used to transfer data (file) through a network.
 - ALFTP, Cute FTP



Internet Services

- Telnet
 - Telnet is a common way to remotely control servers.
 - Windows telnet program
- Internet chatting
 - IRC (Internet Relay Chatting): mIRC
 - IM (Instant messenger): MSN (Live) messenger, NateON
- P2P (peer to peer)
 - Napster, eMule, Pruna

