Review- 목표 (Objectives)

- 목표
  - 1. 데이터 통신의 이해
  - 2. 데이터 통신 기초기술 습득
  - 3. 데이터 통신 활용기술 습득

- 질문
  - What is communication?
  - What is data communication?
  - Then, What is Computer Network?
  - What are the Basic components of data communication system
  - What is the difference between Data Communication and Network?

Review- 용어에 대한 정의

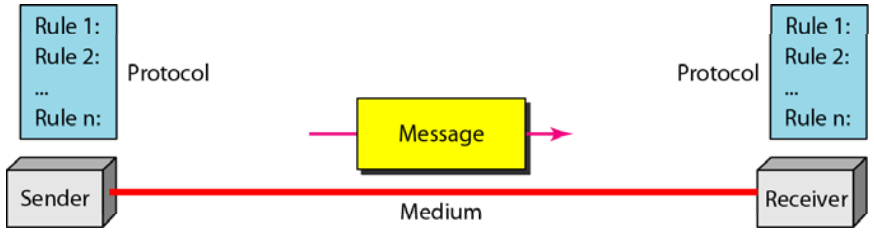
- 광의의 통신 = 의미 있는 정보의 전달 (신문 방송: Mass Media)
- IT 통신 = 송수신기 사이의 의미 있는 정보의 전달 (전화망 등)
- 데이터 = 표현된 정보, 바이너리 기호로 표현된 정보
- 데이터 통신 = 정보처리가 가능한 기기 사이에서 전기적인 통신회선을 통하여 바이너리로 표현된 정보를 송수신하는 통신형태
- 컴퓨터 통신 = 정보처리가 가능한 기기사이의 데이터의 송수신 및 이와 관련된 데이터의 처리 포함
- 네트워크= 하드웨어와 소프트웨어, 케이블링의 조합으로 여러 컴퓨터 장치들이 서로 통신할 수 있게끔 하는 것 (의미)
  - 컴퓨터 통신을 제공하기 위한 하드웨어와 소프트웨어, 케이블링과 정보 전달을 위한 프로토콜의 조합 (구성)
  - 프로토콜 = 정보처리가 가능한 기기사이에 원활한 통신서비스 제공을 위한 통신규약

1-1 Summary of Data Communications

- What is communication?
  - The exchange of information between individuals using a common set of symbols, signs, behavior or language.
- What is data?
  - *refers to information presented in whatever form is agreed upon by the parties creating and using the data.*
- What is data communication?
  - The exchange of data between two devices via some form of transmission medium such as a wire cable
- What is Computer Network?
  - A set of devices connected by communication links
    하드웨어와 소프트웨어, 케이블링의 조합으로 여러 컴퓨터 장치들이 서로 통신할 수 있게끔 하는 것 (의미)
- What is basic components of data communication system?
  - Message/Sender/Receiver/Medium/Protocol
- What is the difference between Data Communication and Network?
  - Computer Network=데이터 통신 + network Intelligence (topology)

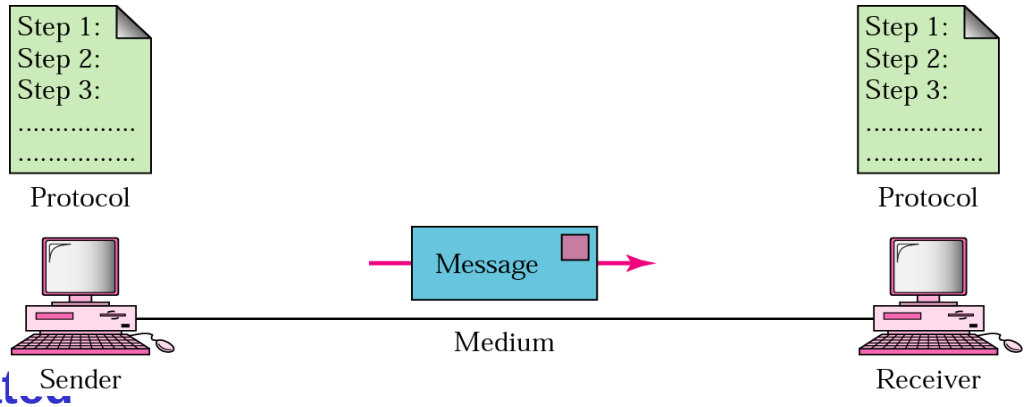
a. 데이터통신의 목적

- 데이터통신이란 무엇인가??
  - 정보처리가 가능한 기기 사이에서 전기적인 통신회선을 통하여 바이너리로 표현된 **정보를** **송수**신하는 통신형태 (의미)
  - The exchange of data between two devices via some form of transmission medium such as a wire cable
- 데이터=표현된 의미 (데이터 : 정보가 해석 처리 등에 적합하도록 표현된 형태 (숫자나 문자))
  - 정보(information) =의미 : 중요한 뜻을 가진 사실이나 개념
  - 신호(signal): 정보는 내용, 신호는 전기적인 표현 형식



- 데이터 통신의 목적
  - **데이터의 전달 (delivery of data):** deliver data to the correct destination
  - 정확성 (Accuracy): deliver data accurately
  - 한시성 (Timeliness): deliver data in a timely manner
  - Jitter: the variation in the packet arrival time (uneven delay in delivery of data)

b. 데이터통신의 구성요소



- 데이터통신의 구성 요소

1. **Message: data to be communicated**
2. **Medium: the physical path by which a message travels from sender to receiver (twisted pair, coaxial cable, radio wave)**
3. **Protocol: a set of rules that govern data communications (Ethernet framing, PPP, ARP,…)**
4. **Sender: the device that sends the data message (Computer, handset)**
5. **Receiver: the device that receives the message (Computer, handset)**

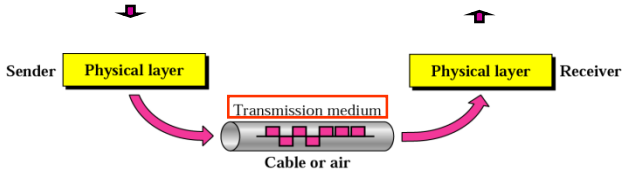
b.1 Message

- **Information:**
  - Text, numbers, images ,audio, video, etc.

- **Data: represented message**
  - Bits and Bytes: a series of 1's and 0's known as *bits*
    - In most systems, a byte consists of 8 bits
    - Usually each byte represents a single character (ASCII)
      - A-Z, a-z, 0-9
      - punctuation characters(e.g., @, #, %)
      - special characters (LF, CR, ESC)
  - Bits and bytes are closely related to the binary number system. See Appendix in text for more information
    - Character Codes/Morse, Baudot/EBCDIC, ASCII, Unicode

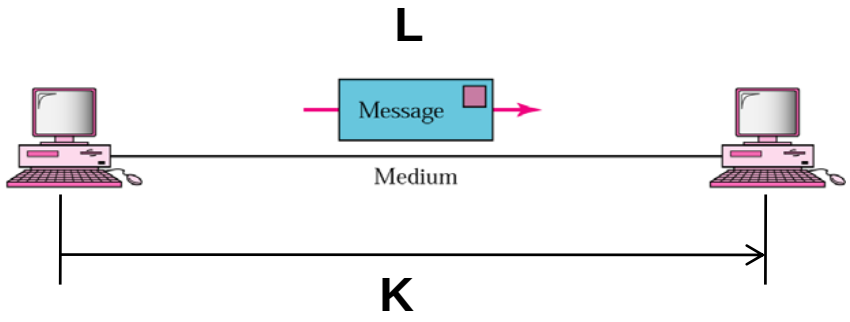
- 데이터 - 아날로그 : 음성, 화상
  디지털 : **Text,** 정수
- 신호 - 아날로그 : 전자기파
  (300-3400Hz음성, 4MHz화상)
  디지털 : 전압 펄스
  (NRZ, Biphase, Manchester..)

- **Transmission : deliver the data**
  - digital computers communicate through a series of 1's and 0's known as *bits*.



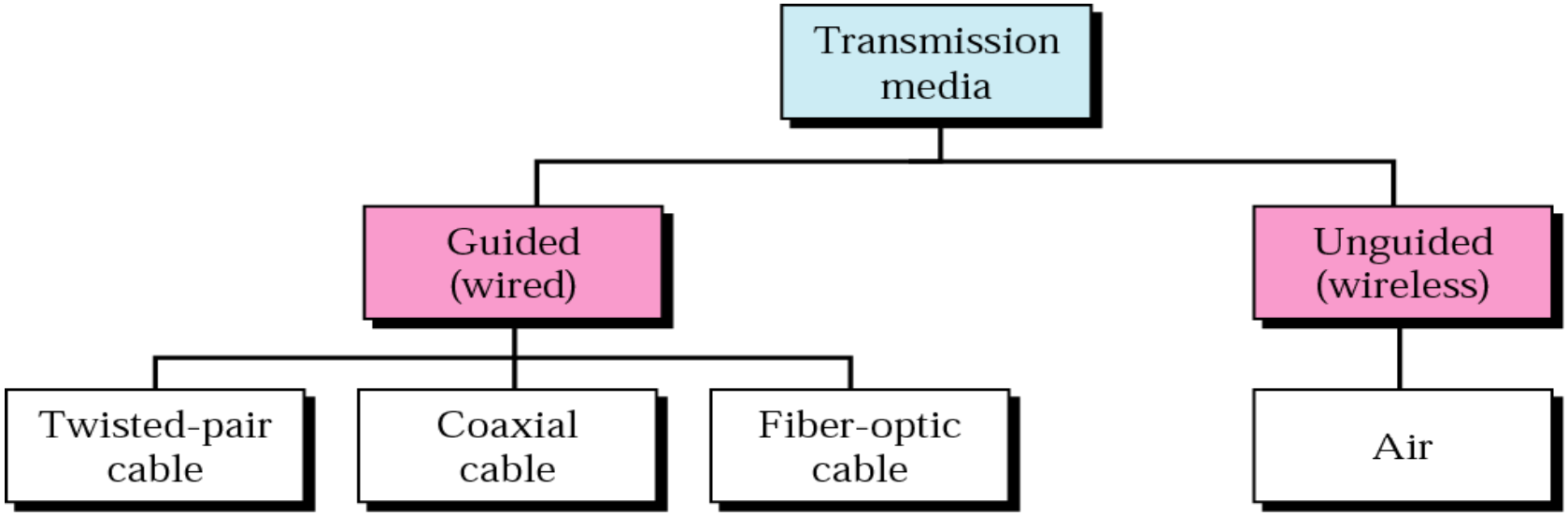
b.2 Data Transmission

- K distance
- Takes L/R seconds to transmit (push out) packet of L bits on to link or R bps
- Entire data must arrive at the correspondent (it can be transmitted on the link):



R data transmission rate

b.2 Transmission Media



- Medium: the physical matter that carries the transmission.
  - With **Guided media** the transmission flows along a physical guide. The three main types of guided media: twisted pair wiring, coaxial cable and optical fiber cable.
  - With **Wireless media** there is no wave guide and the transmission just flows through the air (or space). The main forms of wireless communications are radio, infrared, microwave, and satellite communications.

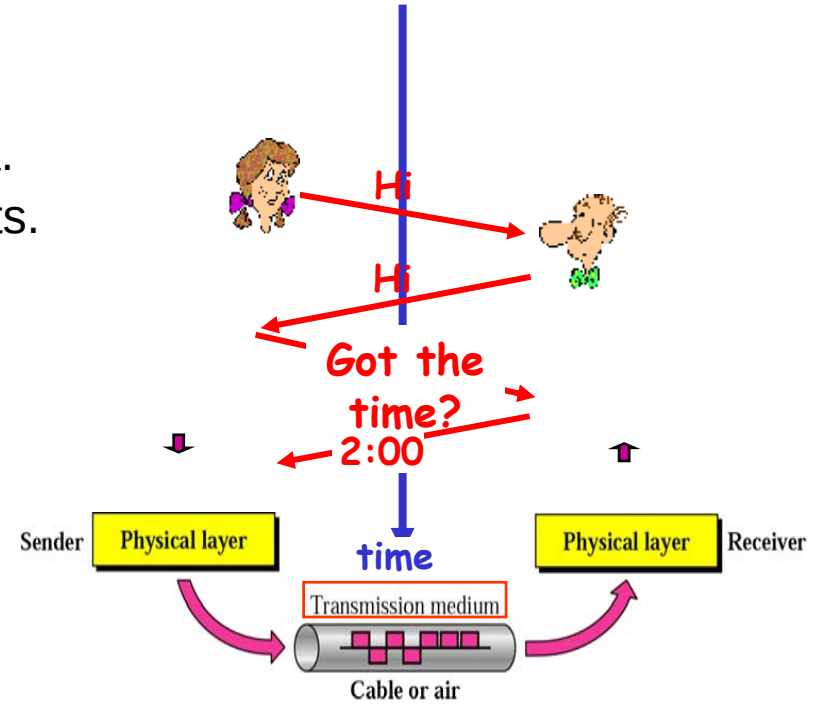
b.3 Protocols

- Protocol: A set of rules that governs data communication 다른 종류의 정보기기(entity) 사이의 원할한 통신을 가능하게 하는 약속된 통신 규약 (format, order of messages, actions)

  Protocols define format, order of messages sent and received among network entities, and actions taken on message transmission, receipt

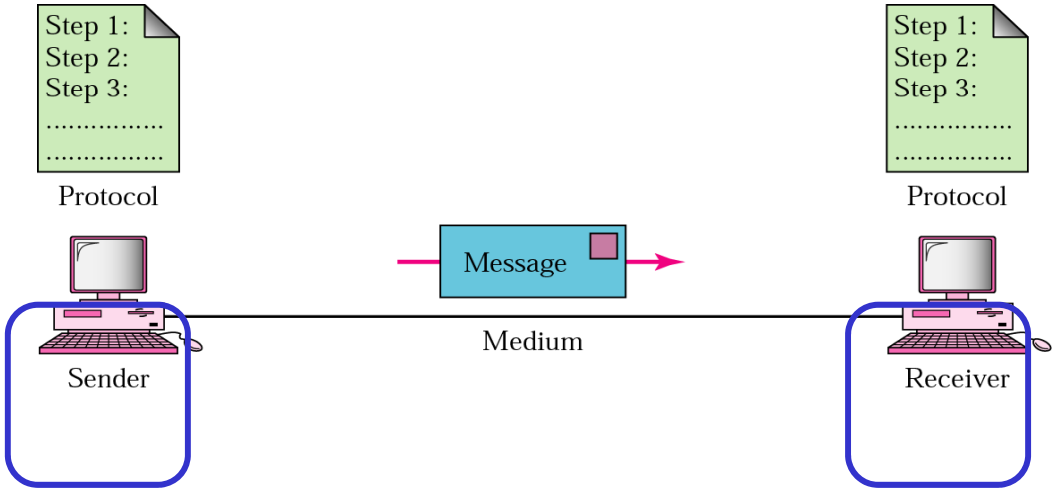
- Key elements of protocols
  - Syntax: the structure or format of the data.
  - Semantics: meaning of each section of bits.
  - Timing & procedure:
    when and how data can be sent.

- 표준화 기구
  - ITU-T/IETF/ISO/FCC/IEEE

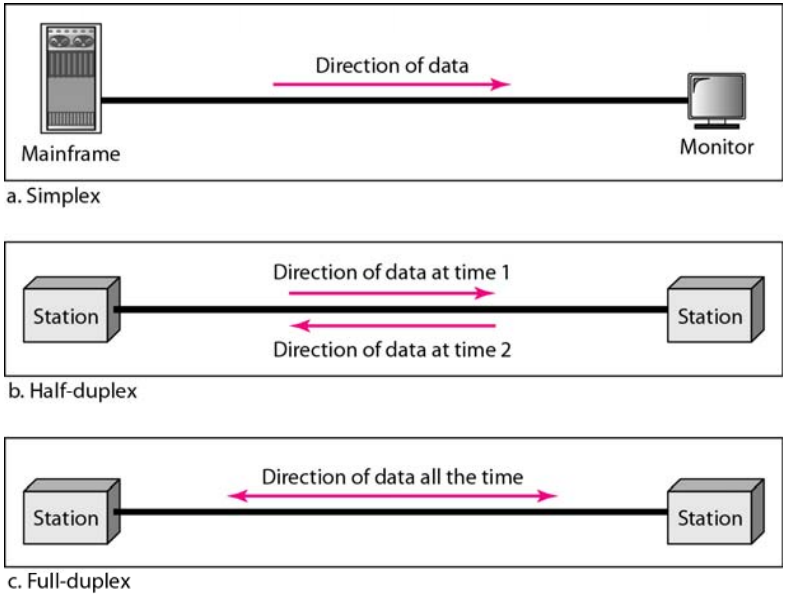


b.4 Communication Entity: Sender & Receiver

- **Entity**
  - Anything capable of sending or receiving information.



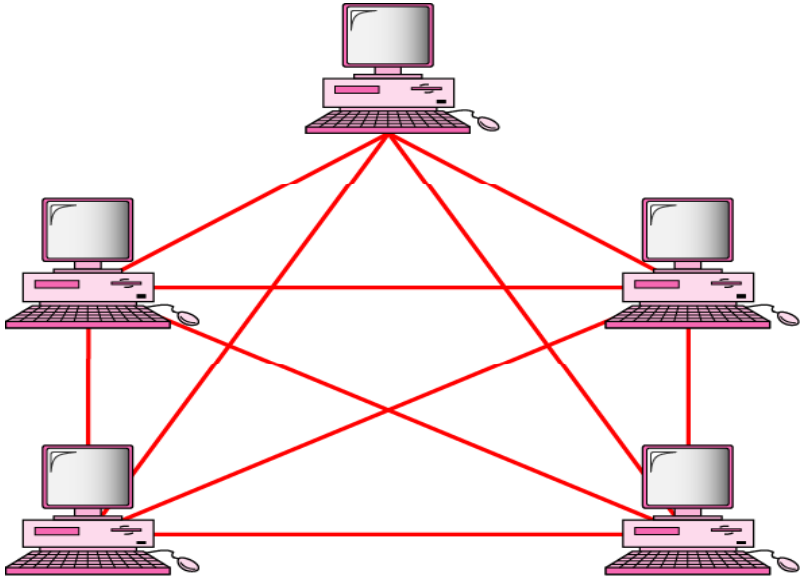
  - **Data flow (simplex, half-duplex, full-duplex)**

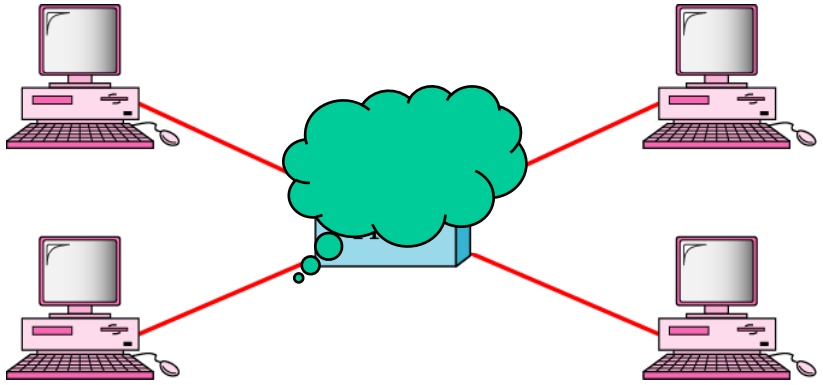


1-2 Extension to Networking Techniques

- Point to point communication usually not practical
  - Senders and receivers are very far apart
  - Large set of devices may require a link to many of the others at various times
- Solutions is to attach each device to a communication network

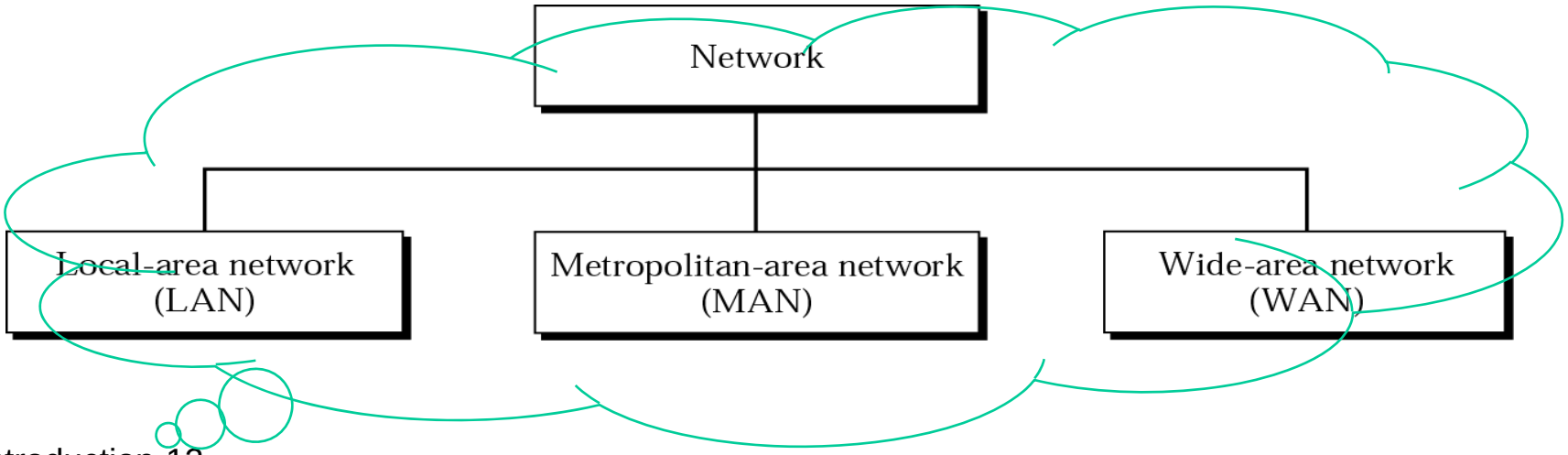
  A network is a set of devices (often referred to as nodes) connected by communication links.





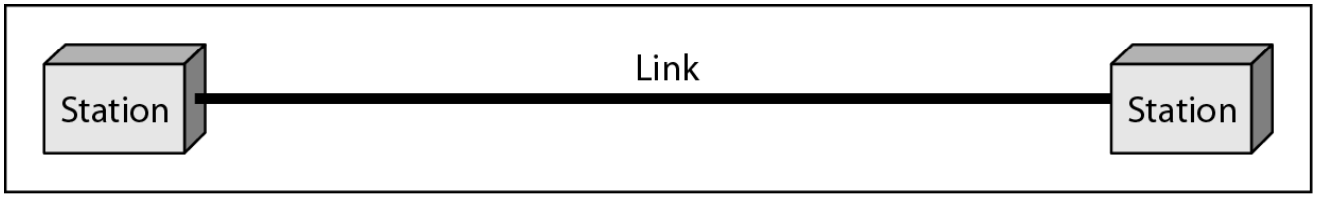
Networking Techniques

- Network
  - A set of devices connected by communication links
  - Components: Node, Link, Protocols
- Categories of network
  - Wide-area Networks (WANs)
  - Local-area Networks (LANs)
  - Metropolitan-area Networks (MANs)

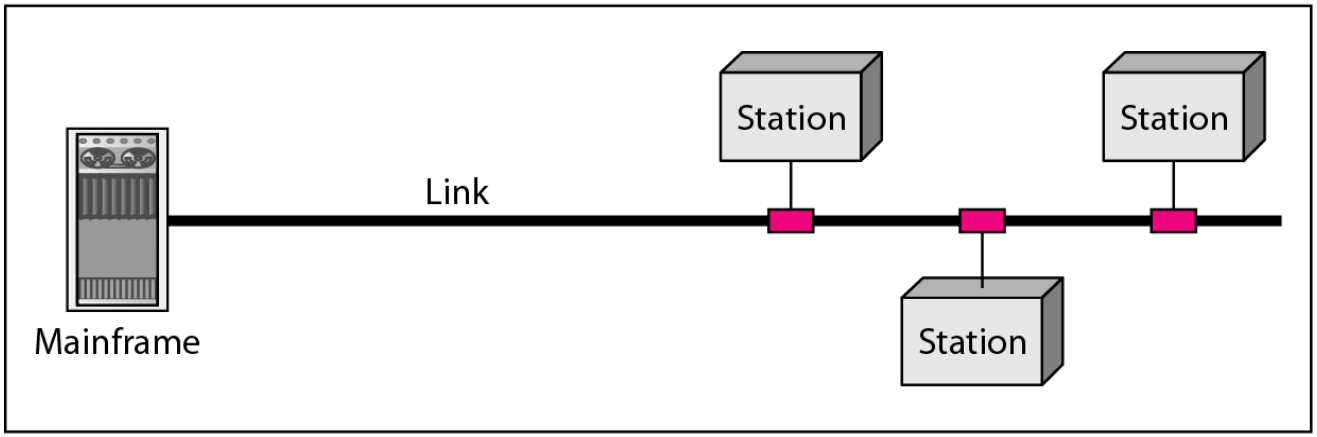


Networking Techniques (2)

- *Types of connections*



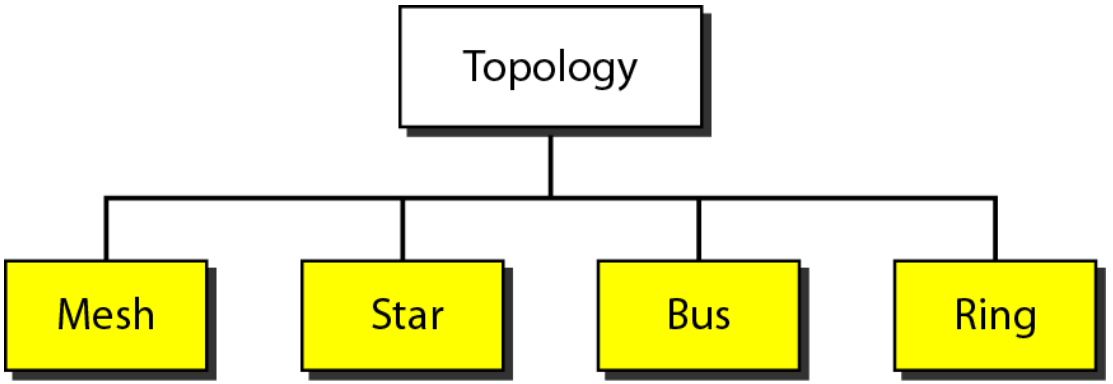
a. Point-to-point

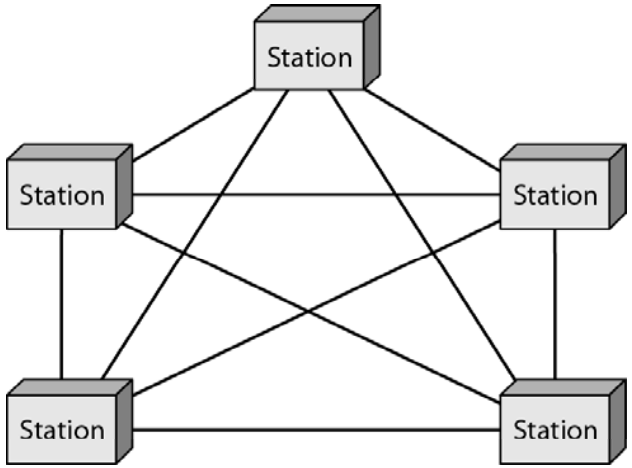


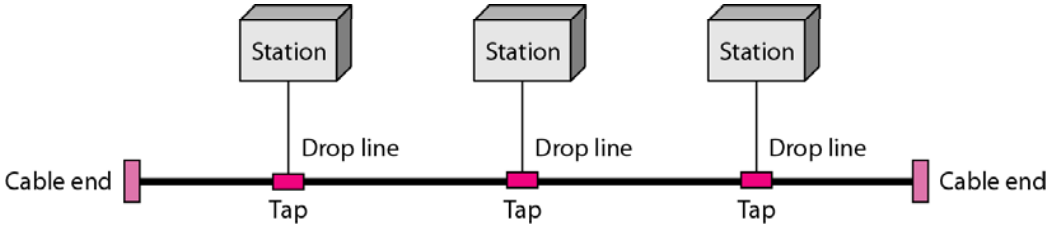
b. Multipoint

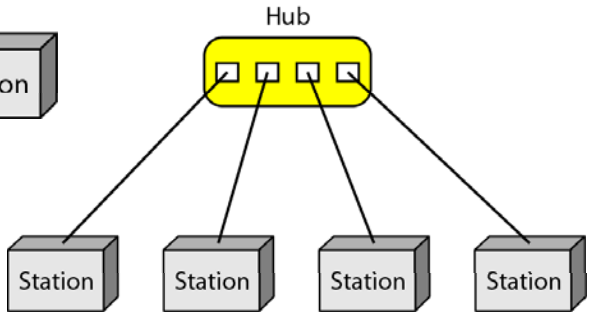
Networking Techniques (3)

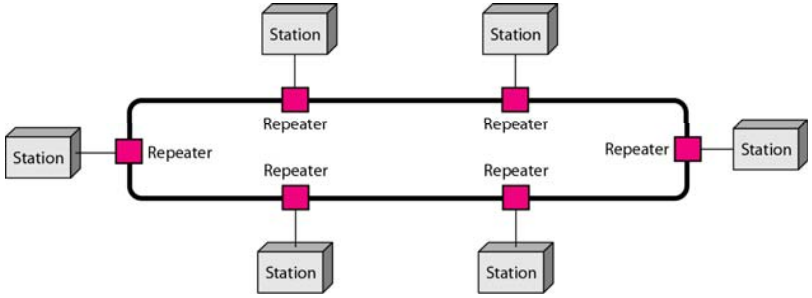
- *Topology*





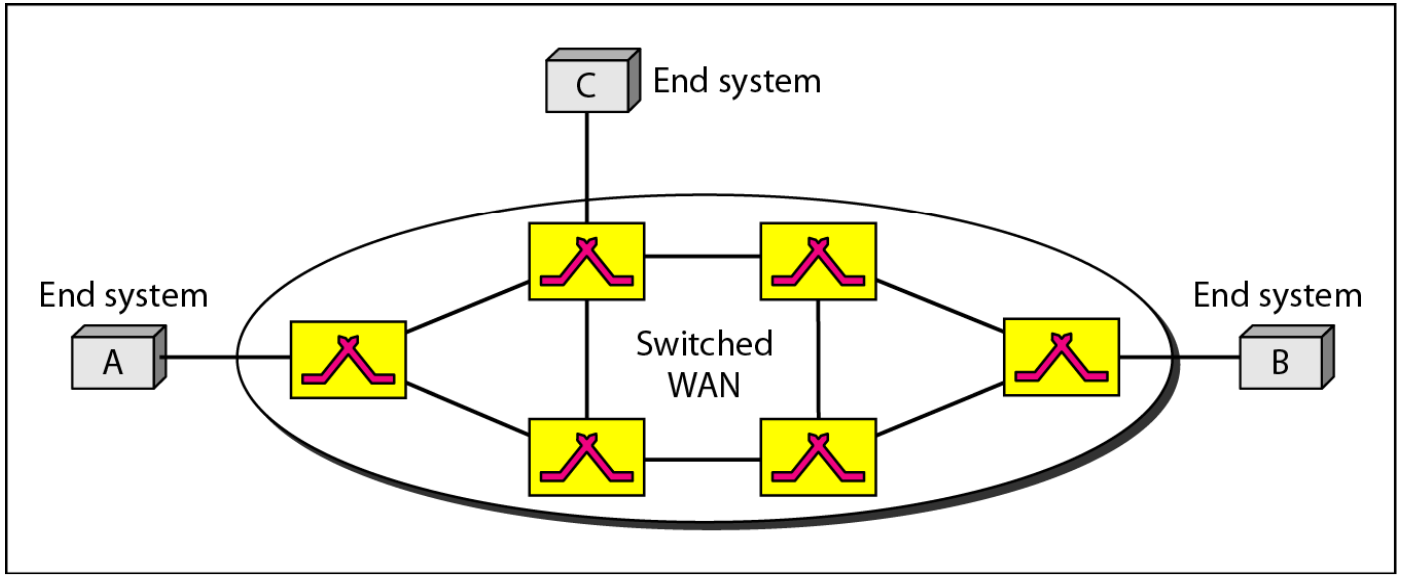




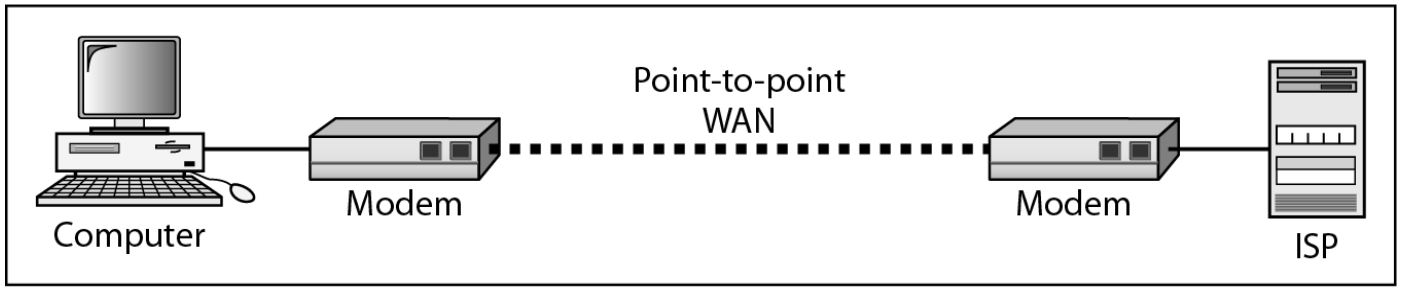


Networking Techniques (4)

- Switched vs. Point-to-point



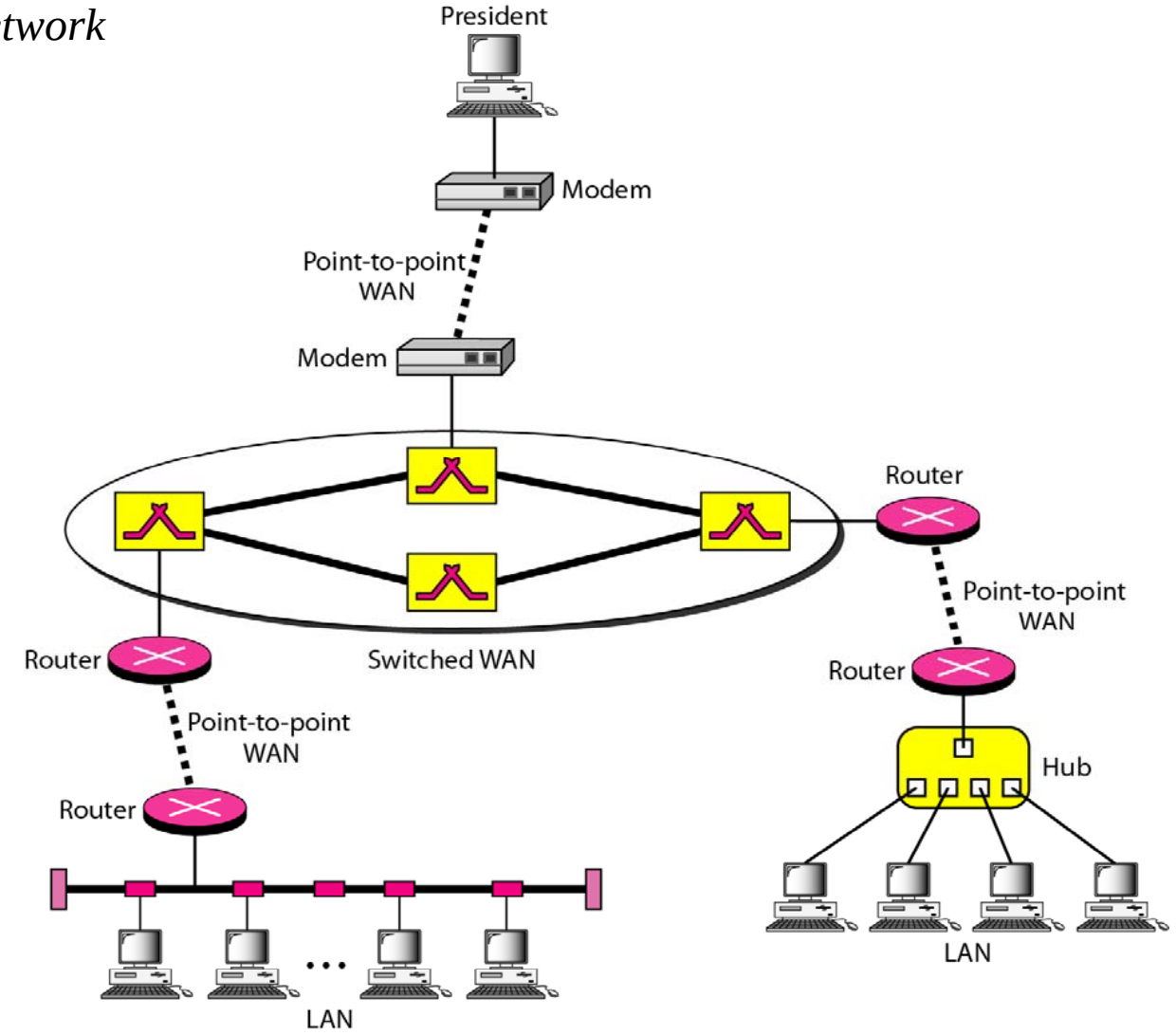
a. Switched WAN



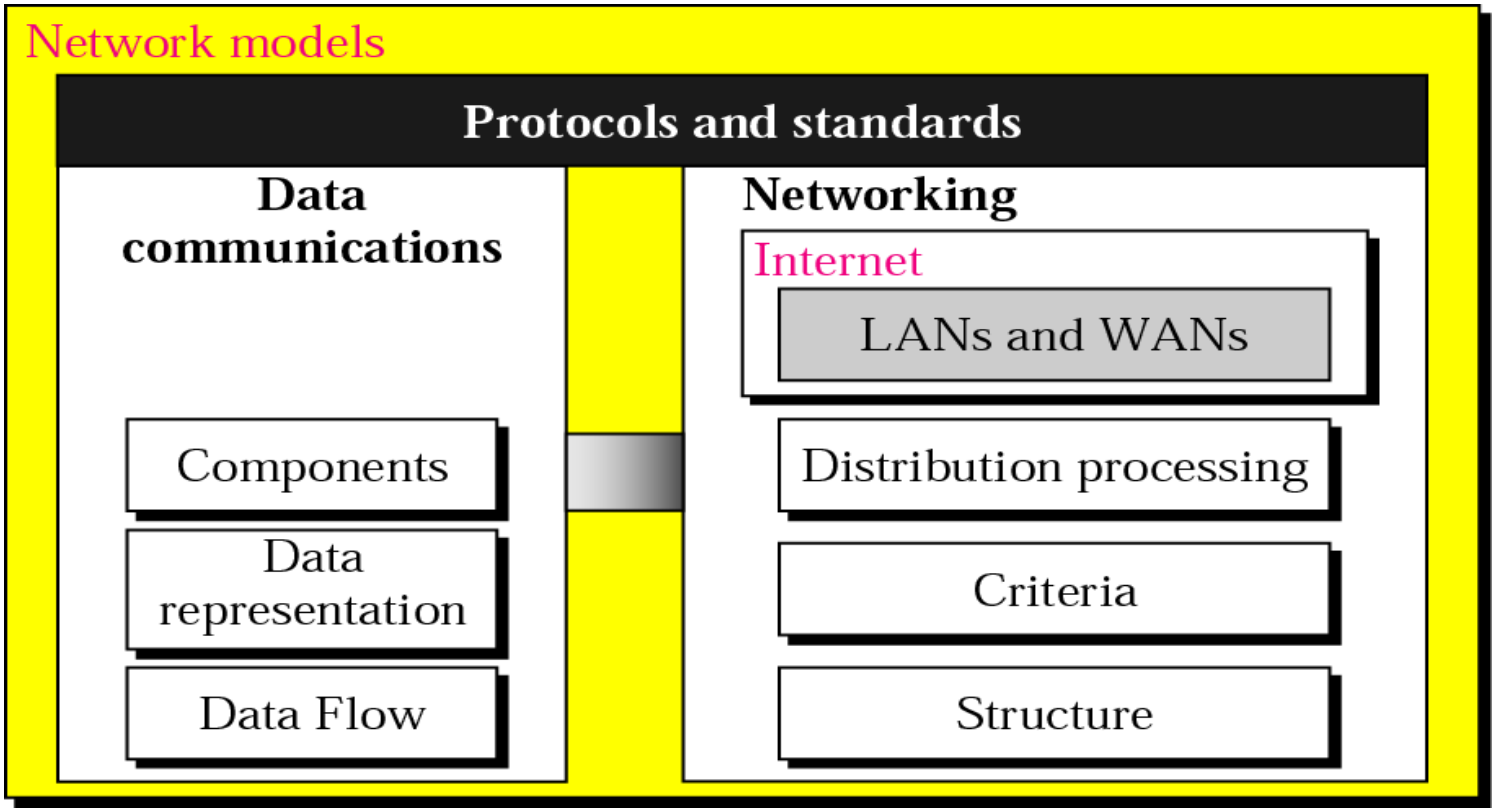
b. Point-to-point WAN

Networking Techniques (5)

- *A heterogeneous network*



Summary: Data Communication vs Network



1-3. 인터넷이란?

- 인터넷=웹?
- 인터넷=네트워크이다. 네트워크의 네트워크이다. TCP/IP 네트워크다.
  - 기업형 네트워크는 특수한 사용자만이 사용가능 하다. 그러나 인터넷은 어느 누구나 규정된 TCP/IP 프로토콜만 사용하면 연결이 가능하다. 또한 기업형 네트워크도 인터넷 연결이 가능하다.
  - TCP/IP란? 미국방성에서 개발한 표준 통신 프로토콜로 transmission control protocol/Internetworking protocol의 약자다. IP는 네트워크에서 데이터 그램 형식의 패킷을 최종 사용자에게 전달(라우팅)하기 위한 프로토콜이고 TCP는 종단간 사용자의 정보전달을 위한 세그멘트 분할, 재조합, 에러검출 등의 과정을 책임지는 프로토콜이다.
  - 역사:
    - 1967년 중반 미 국방성 산하 Advanced Research Projects Agency의 노력으로 구성된 ARPANET, 미국방성 장비들간의 메시지 교환이 가능하도록 하는 통신망
    - 1969년 (UCLA, UCSB, SRI, Univ. Utah)에 구현
    - 1972년 Vint Cerf와 Bob kahn 이 TCP 개념 정의 (Encapsulation, Datagram, Routing function) – UCLA 박사과정 학생 (L. Kleinrock)

1961-1980: Early packet-switching principles

- 1961: Kleinrock - queueing theory shows effectiveness of packet-switching
- 1964: Baran - packet-switching in military nets
- 1967: ARPAnet conceived by Advanced Research Projects Agency
- 1969: first ARPAnet node operational
- 1972:
  - ARPAnet demonstrated publicly
  - NCP (Network Control Protocol) first host-host protocol
  - first e-mail program
  - ARPAnet has 15 nodes
- 1970: ALOHAnet satellite network in Hawaii
- 1973: Metcalfe′s PhD thesis proposes Ethernet
- 1974: Cerf and Kahn - architecture for interconnecting networks
- late70′s: proprietary architectures: DECnet, SNA, XNA
- late 70′s: switching fixed length packets (ATM precursor)
- 1979: ARPAnet has 200 nodes

1990, 2000's: commercialization, the Web, new apps

- Early 1990's: ARPAnet decommissioned
- 1991: NSF lifts restrictions on commercial use of NSFnet (decommissioned, 1995)
- early 1990s: Web
  - hypertext [Bush 1945, Nelson 1960's]
  - HTML, HTTP: Berners-Lee
  - 1994: Mosaic, later Netscape
  - late 1990's: commercialization of the Web

Late 1990's – 2000's:

- more killer apps: instant messaging, P2P file sharing
- network security to forefront
- est. 50 million host, 100 million+ users
- backbone links running at Gbps

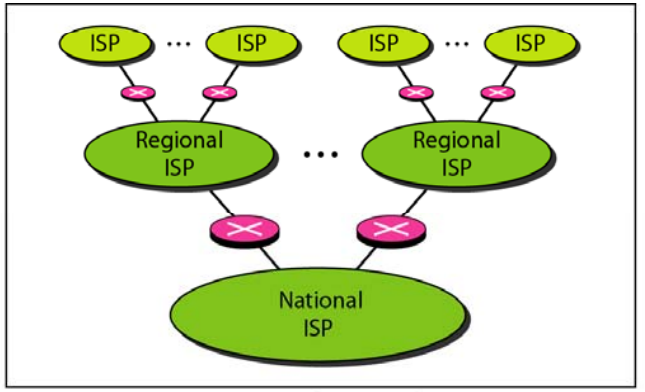
Cerf and Kahn's internetworking principles:

- minimalism, autonomy - no internal changes required to interconnect networks
- best effort service model
- stateless routers
- decentralized control

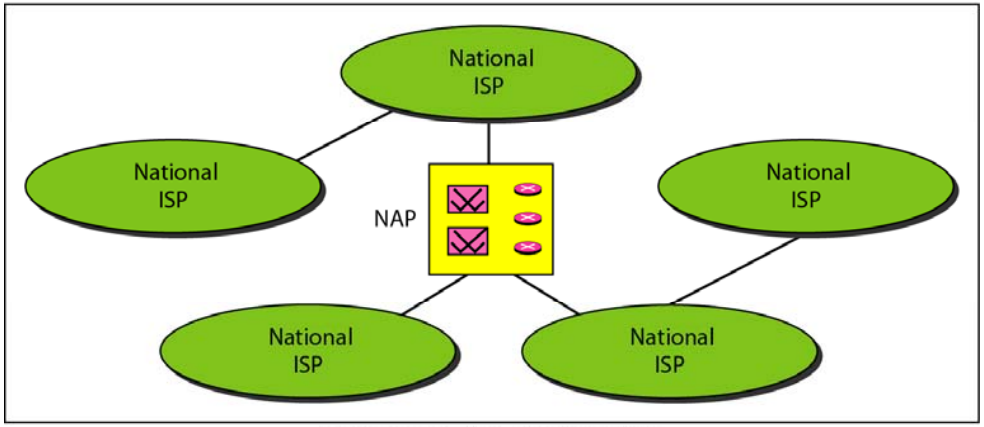
define today's Internet architecture

Internet structure: network of networks

- roughly hierarchical
- at center: "tier-1" ISPs (e.g., UUNet, BBN/Genuity, Sprint, AT&T), national/international coverage
  - treat each other as equals



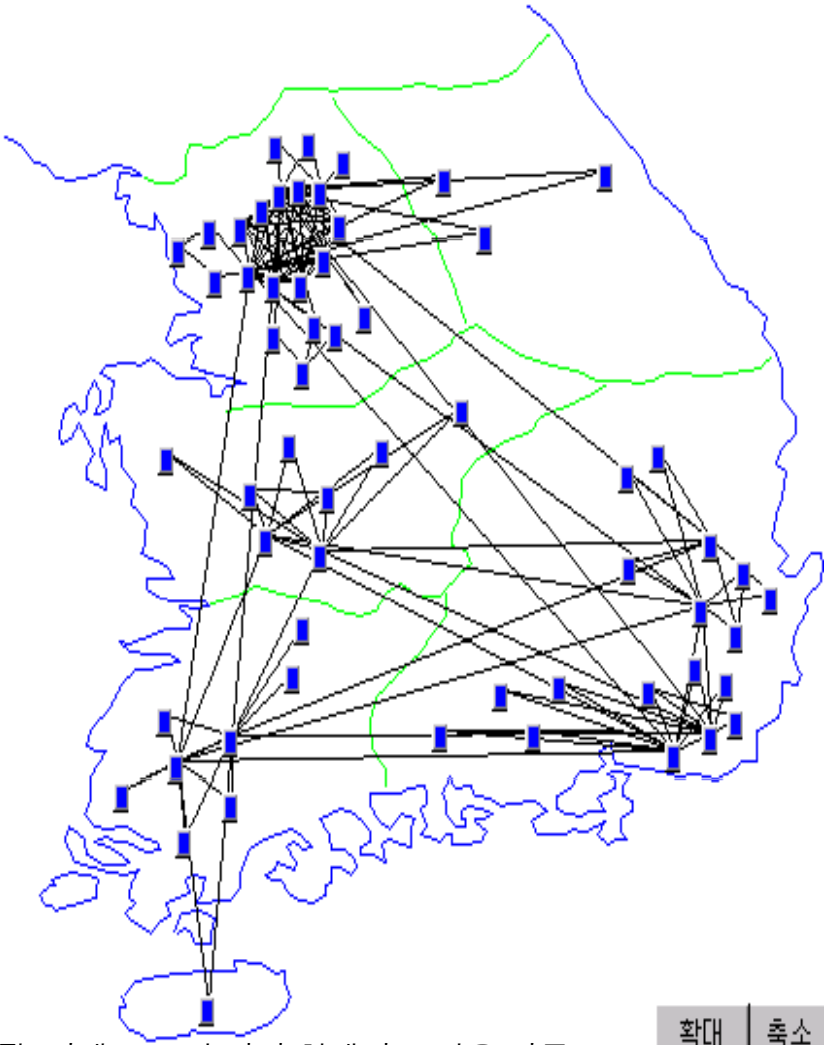
a. Structure of a national ISP



b. Interconnection of national ISPs

Tier-1 ISP: e.g., KT

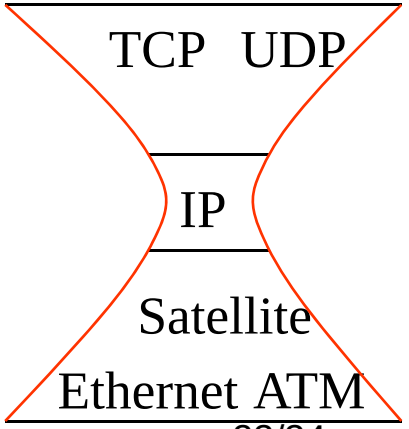
Korea backbone network



토폴로지= 네트워크가 노드와 에지로 구성된 연결 그래프로 정의됨. 이때 노드의 연결 형태와 모양을 이름

Next Topic= 1-4 Protocol

- 프로토콜
  - 프로토콜의 정의 : 서로 다른 시스템에 존재하는 개체(entity)간의 원활한 통신을 위해 서로 약속된 통신 규약 (*rule*)
  - entity의 예 : 사용자 프로그램, FTP, DB관리자
  - 시스템 예 : 컴퓨터, 단말기
  - 예 : 전화통화, 컴퓨터통신
- 프로토콜의 특성 : 계층구조(5 or 7layer), 대칭/비대칭(peer-to-peer/client-server), 표준/비표준(OSI/TCP)
- 프로토콜의 표준화
  - 컴퓨터간의 통신에 있어서 호환성을 위해->통신작업의 구조적 정의
업체:표준화에 따른 사용의 확대, 시장의 확대
고객:어느 시스템도 상호운용가능
  - ISO에서 1977년 구성-> OSI model
  - ITU에서 1984년 X.200으로 발표
  - OSI Model : 7 layered model
  - **Internet Model: 5 Layerd model**



Homework: Recommended Reading

- **From Web:**
  - *THE **DESIGN PHILOSOPHY**. OF THE DARPA **INTERNET**. **PROTOCOLS**. David D. Clark. Massachusetts Institute of Technology. Laboratory for Computer Science. Cambridge, Ma. 02139*
  - *nms.lcs.**mit**.edu/6829-papers/darpa-**internet**.pdf*