

## chapter 4



# Local Area Networks - Connectivity

연결성

# CHAPTER OBJECTIVES

- Describe the purpose of a repeater and indicate where <sup>①</sup>repeaters are used.
- Discuss different <sup>②</sup>hub technologies and where hubs are used.
- Discuss <sup>③</sup>bridge technology and identify where bridges are used.
- Discuss <sup>④</sup>switch technologies.
- Compare the differences between routing and switching. <sup>⑤</sup>router
- List the functions of a gateway, and identify the reasons that <sup>⑥</sup>gateways are implemented.

# CHAPTER OBJECTIVES (cont'd)

- Identify the three layers of network **backbone**
- Describe the Internet Protocol and provide examples of different IP address classes. <sup>현주(중요)</sup>
- Identify different methods of assigning IP addresses and the business impact of **DHCP**. <sup>Router</sup>  
<sub>유동IP 할당 해준다</sub>
- List and describe other LAN communications protocols and their importance.
- Describe the network management protocol, **SNMP**.  
<sub>Simple Network Management Protocol</sub>

# LAN DEVICES

- These are the hardware components that provide the interfaces among servers, workstations, and media types in a LAN. ①~⑥
- LAN devices provide a variety of functions.
- Repeaters, hubs, bridges, switches, routers, and gateways are common LAN devices.

# LAN DEVICES

Layer 1

- ① **Repeater** – extends the distance over which a signal can be transmitted.
  - It's an OSI layer 1 device.
  - A repeater receives a signal from a media segment, cleans the signal, amplifies it, and then sends the signal onto the next media segment.
  - Repeaters are commonly built into LAN devices such as hubs or switches.

독립적으로 이용하지 않는다.

# LAN DEVICES

②  
농지 경영

- Hubs – are LAN devices to which servers, workstations, printers, and other computing devices can be connected.
  - Hubs are OSI layer 1 devices.
  - Hubs do not interpret data – that is, they're unaware of source and destination addresses.
  - All packets flowing through a hub are broadcast to all other devices that are connected to the hub.

/PTV

방송

unicast  
1:1

multicast  
1:(n)  
some

broadcast  
1:(n)  
All

# Simple LAN Hubs

옛날 hub



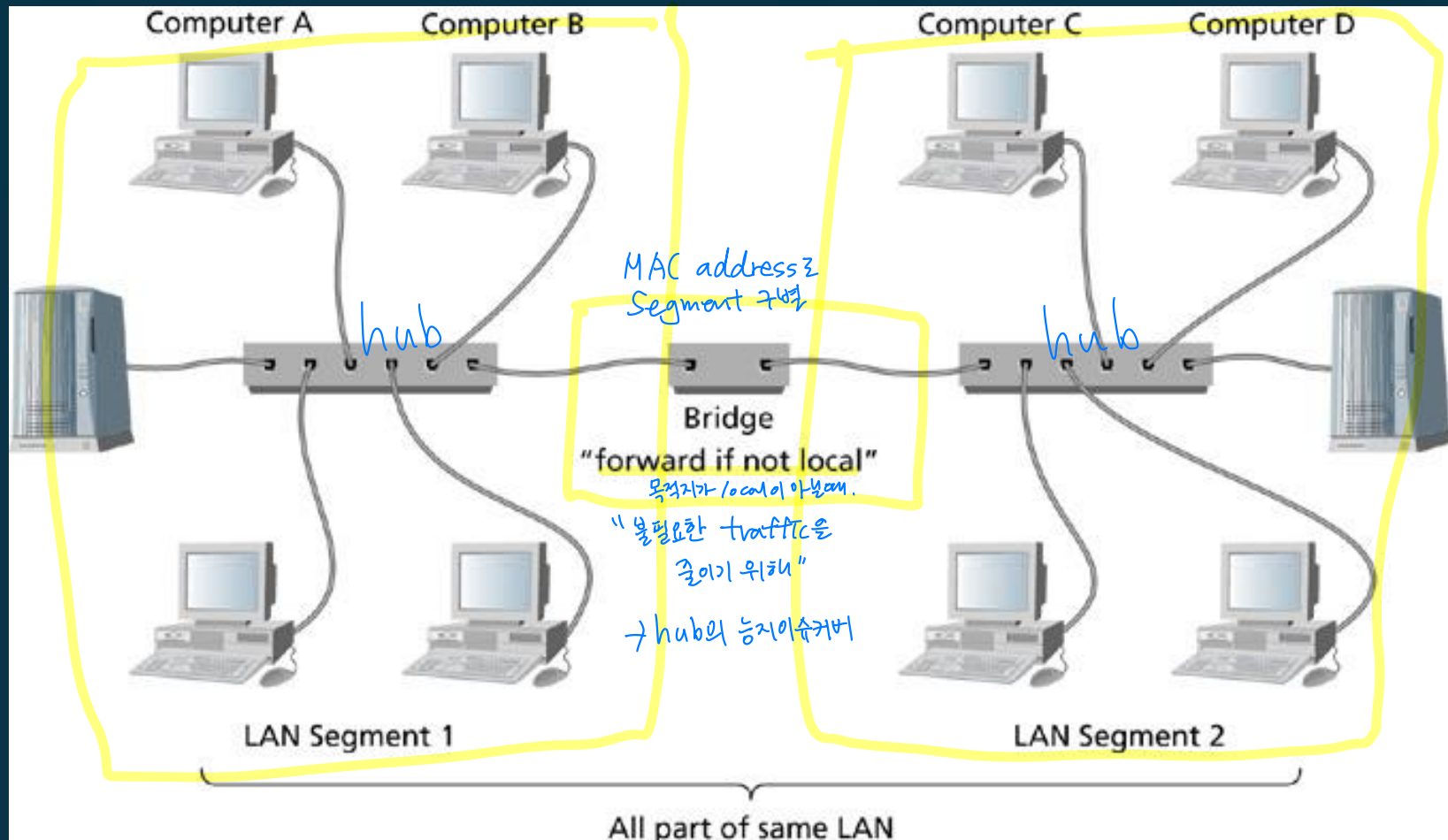
# LAN DEVICES

- OSI  
Layer 2
- ③ Bridges LAN 안에서 segment끼리 연결.

- Are LAN devices that connect two or more LAN segments while simultaneously filtering network data transmissions between the segments.
- Bridges are sometimes referred to as “forward if not local” LAN devices.
- A bridge can improve overall LAN performance.



# LAN Bridge Connecting Two LAN Segments



# LAN DEVICES

- Bridges (cont'd)
  - Have a built-in algorithm that learns the MAC (Media Access Control) address of each network card in each computing device on each LAN segment that is connected to the bridge.
  - MAC addresses are stored in a MAC address table.
  - The MAC address table is used in filtering data transmissions between LAN segments.

# LAN DEVICES

## OSI Layer 2 ④ Switches

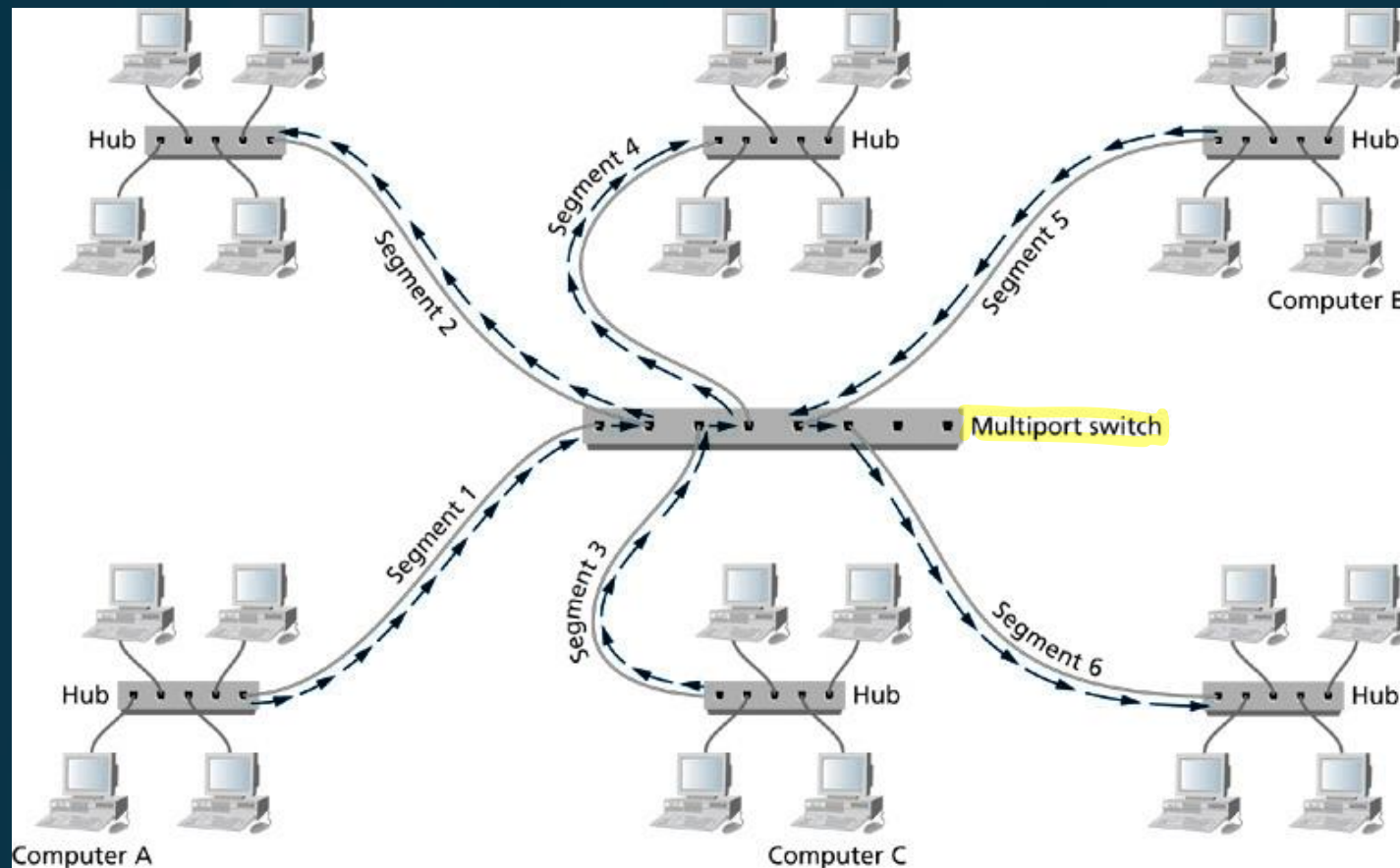
bridge보다 더 많은 device

bridge보다 성능 못.

multiport 기  
(여러 포트)

- Are very similar to bridges.
- Switch ports can be directly connected to individual PCs, servers, hubs, bridges, other switches, and to routers whereas:
  - Bridges were typically connected to hubs or other bridges.
- Switches use special hardware components that can read multiple ports simultaneously and establish multiple and simultaneous forwarding paths whereas:
  - Bridges generally had a single central processor that limited frame processing and forwarding to one frame at a time.

# Data Propagation on a Multiport Switch



# LAN DEVICES

data를 저장 후 검사  
9.25 있으면 안넘겨줌.  
→ data 전송 신뢰성 ↑

복가기능 error checking 가능하면

속도 < 신뢰성 인 경우 사용.

ex - 은행과 Netflix

## • Store and Forward Switches

- Are designed to perform error checking on each frame after the entire frame has been received into the switch.
- If the frame is error free, the switch forwards the frame to the appropriate port.
- Bad frames are not forwarded which makes this switch type highly reliable.
- They are slower than other switch types because they hold onto each frame until it is completely received in to check for errors.

# LAN DEVICES

---

- Cut Through Switches
  - Do not perform error checking on frames.
  - Are faster than store and forward switches.
  - Read only the address information for each frame as frames enter the switch.

# LAN DEVICES

- Higher Layer Switches

- Traditional switches operate at OSI layer 2.
- Newer switches can incorporate functionality for OSI layer 3 and OSI layer 4.
- Layer 3 switches add routing capability.  
(스위치에 높은계층의 역할 탑재된 제품 개발중)
- Layer 4 switches add TCP port-level services.

L2 switch

L23 switch router 역할까지

L234 switch, port 번호 구분.

# LAN DEVICES

네트워크에서 중요한 장비.  
중요성 점점 증가

전송 횟수에 따른  
network를 이동하는  
data 양의 차이

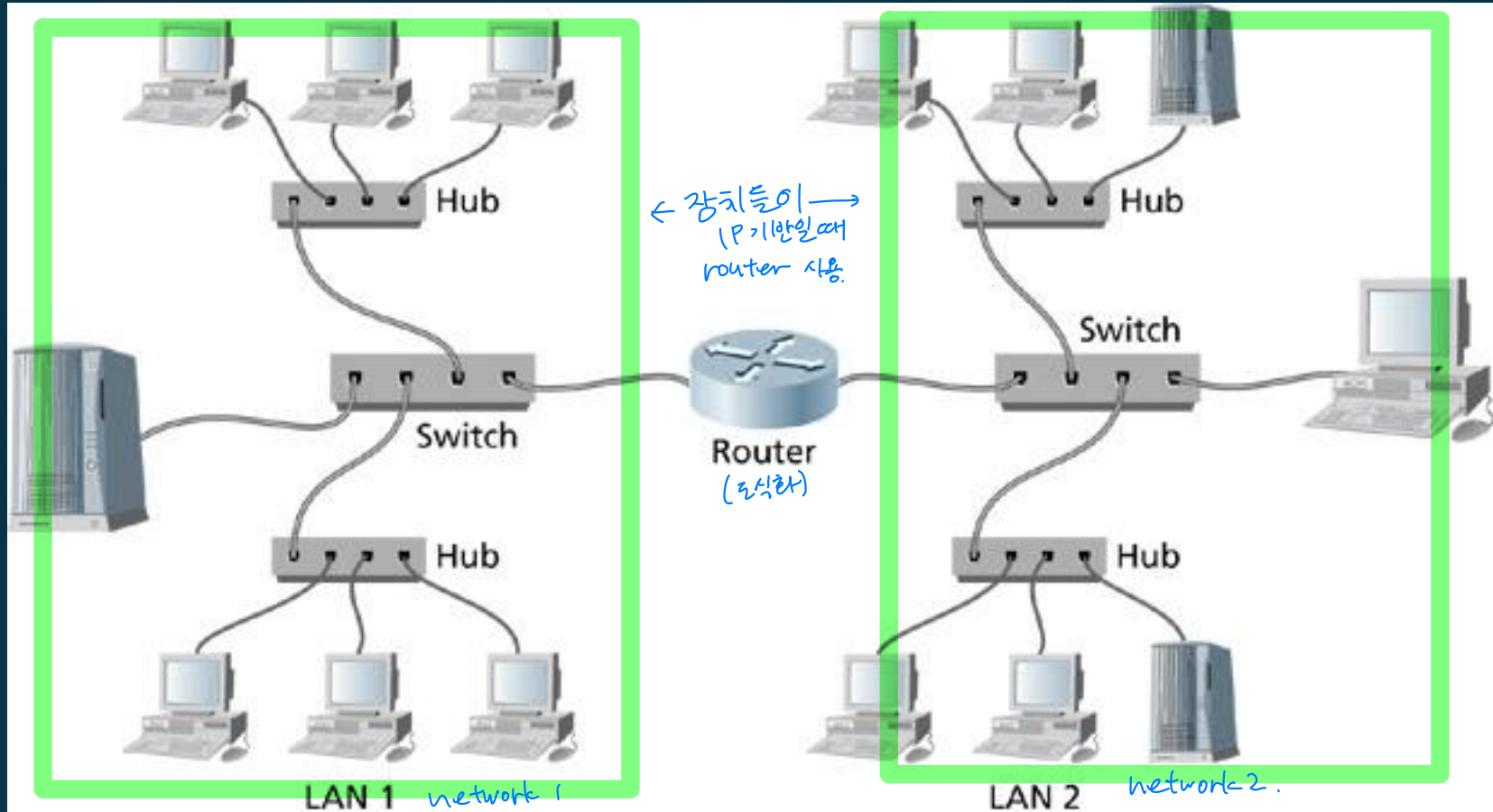
## • Routers

broadcast ↔ unicast.  
1GB 1번전송 ⇒ 1GB      1GB 4번전송 ⇒ 4GB

- Operate at OSI layer 3. (L3 장비) L3 switch 라고 하는 경우도 있다.  
(switch가 L3 역할을 조금 하는 것)
- Allow packets to flow between networks.
- Connect two or more networks, separate broadcast domains, and direct packets to their destinations based on IP addresses and across the best possible route.  
→ network의 edge에 위치.      broadcast 메시지를 걸러준다.  
최적의 경로 선정 (네비)
- Establish a path over which computers on one network can communicate with computers on another network.



# Two Networks Connected by a Router



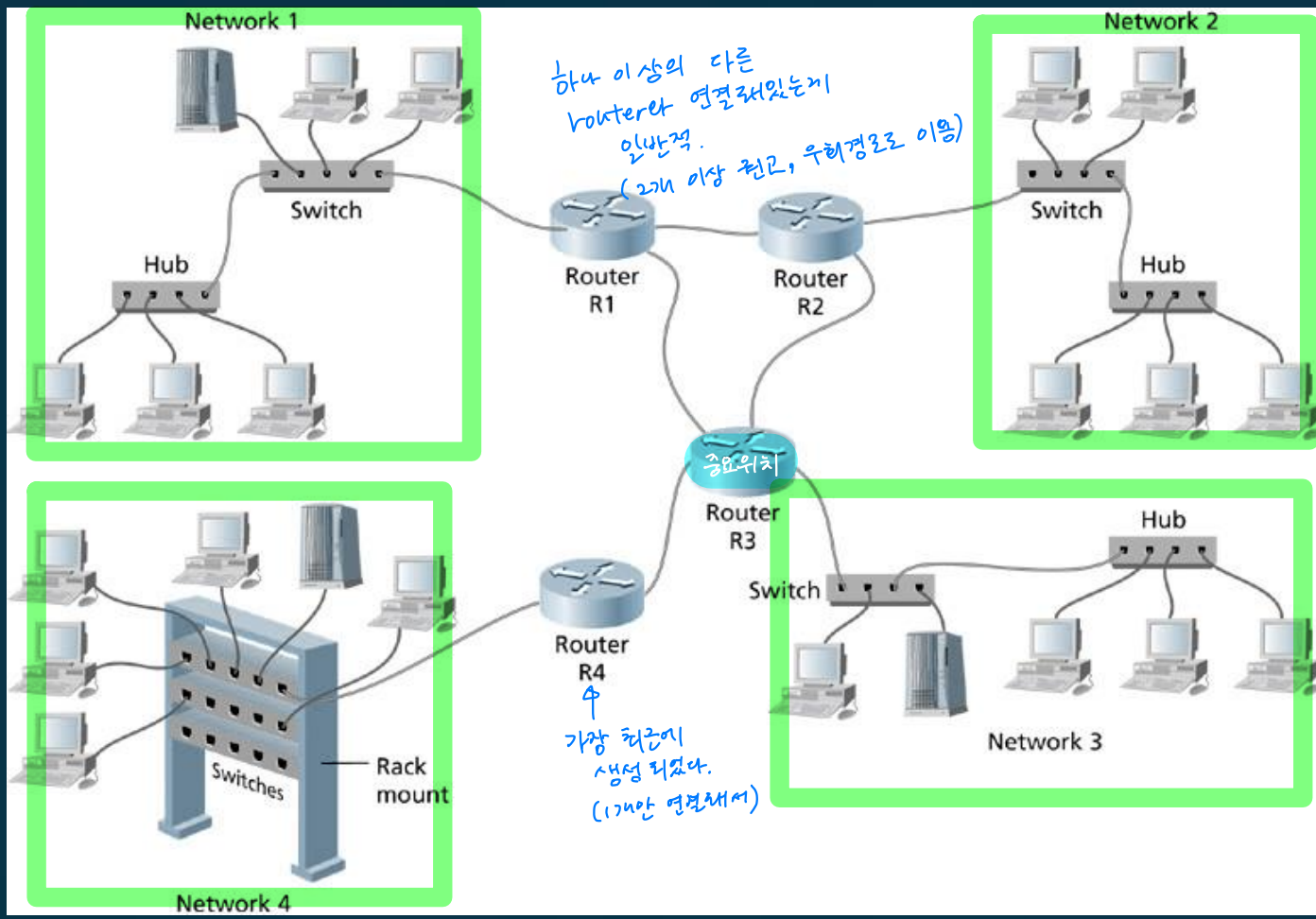
# LAN DEVICES

- Routers (cont'd)
  - Improve network security by filtering broadcasts.
  - Can be installed at the edge or border of a LAN to connect a LAN to distant networks.
  - Each router maintains a routing table that stores addresses of other networks and best paths and path costs to other networks.

[P주소기준으로 잭아감 → L3장비]

# Networks Interconnected by Routers

packet network.



Dynamic Routing

packet으로 분해해서 전송, router의 판단에 따라 도착순서 다를 수 있다.  
순서대로 assemble.

Static Routing.

경로를 지정해준다.

# LAN DEVICES

- Creating Routing Paths
  - **Static Routing** – a network administrator defines the paths to other networks, creates an entry for each path, assigns metrics to those paths, and manually enters this information into the routing table.  
경로 계산 시간 save. → 전송 시간은 짧아질수록, 길어질수록.
  - Static routing is effective when routing metrics are not expected to change over time.

네트워크에 대한 제어권이 확실할 때 사용  
→ 전반적인 performance ↑

# LAN DEVICES

- Creating Routing Paths (cont'd)
  - **Dynamic routing** – provides a mechanism for routers to automatically **accommodate new routes** and **changing network conditions** using sophisticated software known as a **dynamic routing algorithm**.
  - The routing algorithm is part of the router's operating system, and when a change is detected along any of the paths between the source and destination network, the routing algorithm recalculates optimal paths and updates the routing table.
  - The routing algorithm also exchanges updated information with other routers.

# LAN DEVICES

최근에 중요도 ↑ ...

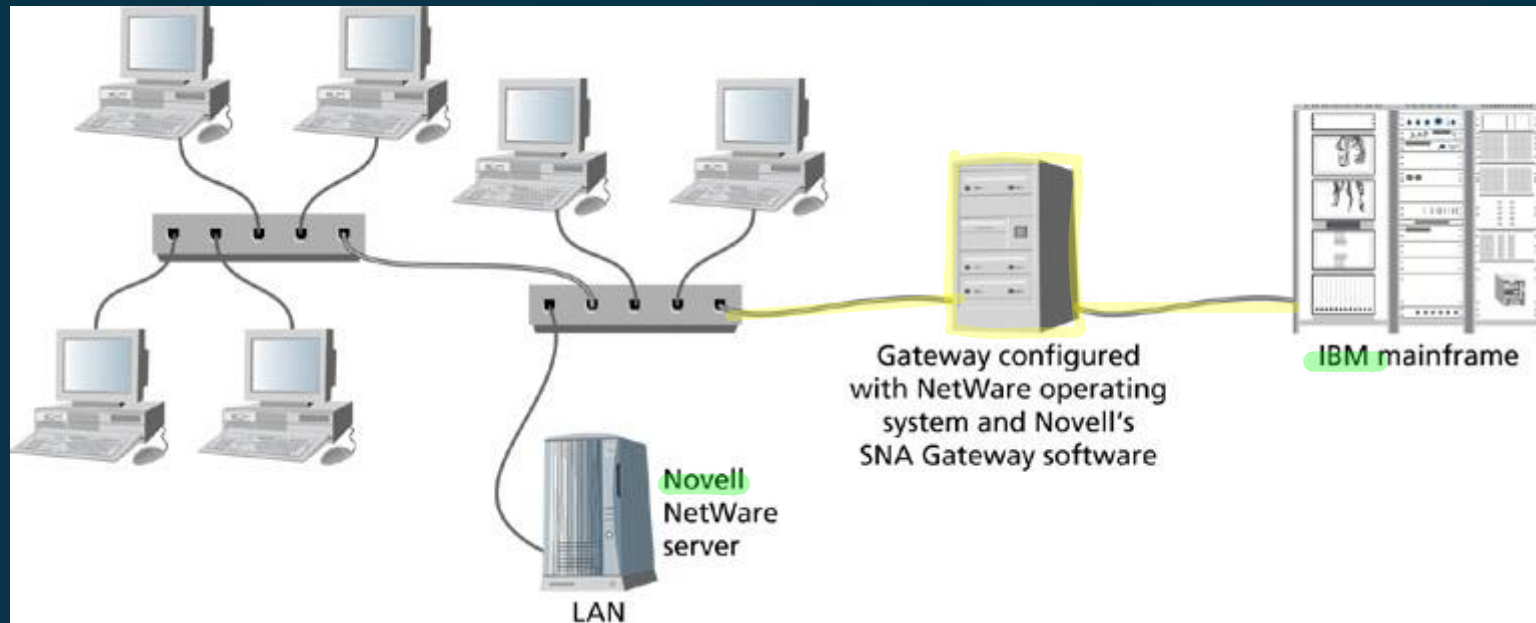
## • Gateways router과 비슷. L3

- A gateway is hardware or software or a combination of both that provides protocol translation or connectivity between disparate systems.
- Operate above OSI layer 3.
- Example use includes connecting a LAN to a mainframe computer, connecting a LAN e-mail system to external e-mail providers, and connecting a non IP network to the Internet.

router과 차이점 : router는 IP 장비끼리,  
Gateway는 다른 장비간도 가능

but, IP화되고있기 때문에 Gateway ↓

# Connecting Client Workstations to a Mainframe through Novell's SNA Gateway Software



# LAN BACKBONES

중요한 역할!

- **Network Backbones** (고속전송 매체 + 연결장치 + HW + SW)  
도시간 연결 때.
  - Are the combination of hardware, media, protocols, and architecture that form the high-speed communications links between two networks.



# Simple Backbone

cloud. (서버를 network에 연결).



# LAN BACKBONES – BACKBONE DESIGN

- Backbone Fault Tolerance and Load Balancing
  - ✧ – **Fault tolerance** provides the ability to continue transmitting data across the backbone in the event that a backbone device or data path fails. network 장애가 생겨도 이용 가능
  - ✧ – **Load balancing** provides the ability to transmit data that's going to the same destination across multiple paths simultaneously. traffic 분산 능력
  - Requires the implementation of **duplicate distribution layer switches**, **duplicate core layer switches**, and redundant cabling to establish the extra data paths. 분산해결, 백업

# BACKBONE DATA TRANSMISSION ARCHITECTURES

---

- Any network backbone should incorporate a high-speed data transmission architecture.
- Examples include FDDI, ATM, Gigabit Ethernet, and 10 Gig Ethernet.

# LAN PROTOCOLS

- **Protocols** are the rules that specify how services and devices exchange information.
- Protocols define the ways in which data can be packaged, how data can access a network medium, how data can be transported, how data is reassembled at the destination, and so on.

ex- TCP/IP , HTTP , SMTP , UDP , Internet Protocol

# LAN PROTOCOLS

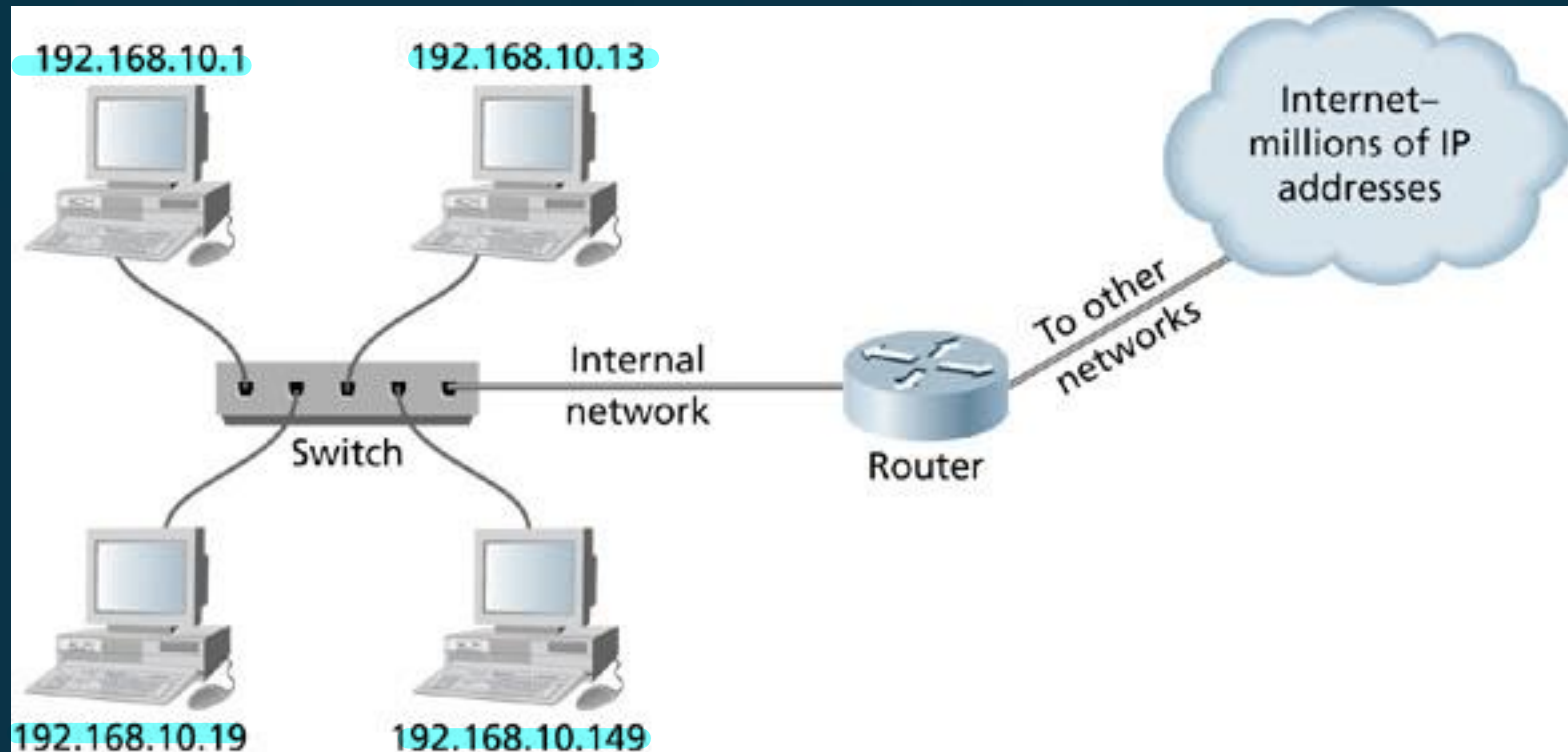
- Communications Protocols
  - Allow us to send and receive information from remote data sources.
  - Are the building blocks for information exchange.
  - The Internet Protocol is an example of a communications protocol.

게이머 통신의 근간!

# LAN PROTOCOLS

- **The Internet Protocol** Internet 주소.
  - Provides an addressing scheme for networks and nodes to uniquely identify individual networks and the devices connected to those networks. (Internet에서 식별번호 부여받고 활동.  
⇒ IP주소필요.)
  - Allows network devices to be located anywhere in the world so that source and destination devices can exchange information.

# Internet Protocol and Data Communication



# LAN PROTOCOLS

- IP Addressing

- Most common implementation of IP addressing today is IPv4.
- With IPv4, each IP address is comprised of a 32-bit binary address that is divided into four 8-bit octets.

$$\text{IPv4 } 32\text{ bits} = 2^{32}$$

$$\text{IPv6 } 128\text{ bits} = 2^{128}$$

all IP trend.



# IP Address for a Network Device Using IP's 32-bit Binary Addressing



나눠서 10진수로 표현!

# LAN PROTOCOLS

---

- IP Addressing (cont'd)
  - IP addresses can be represented in numeric dotted decimal form or in binary form.
  - Dotted decimal form can be converted to binary using powers of 2 to achieve the binary equivalent.

# Binary to Dotted Decimal Conversion Grid


IPv4 10진수. IPv6 16진수.

192								.	168								.	10								.	149								IP address
$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$		$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$		$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$		$2^7$	$2^6$	$2^5$	$2^4$	$2^3$	$2^2$	$2^1$	$2^0$	$2^n$ power
128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1	Decimal equivalent
1	1	0	0	0	0	0	0		1	0	1	0	1	0	0	0		0	0	0	0	1	0	1	0		1	0	0	1	0	1	0	1	Binary representation of an IP address

# LAN PROTOCOLS



## • IP Addressing (cont'd)

- IP Addressing also uses subnet masking to separate the network portion of the IP address from the node portion.  
 $\text{network id} + \text{node id.}$   
(지역번호나 회사)

NW와 node  
구분하는 방법 custom.
- The subnet mask is also a 32-bit combination of binary digits.
- If the subnet mask contains a binary 1 digit, then the corresponding binary digit in the IP address is part of the network address.
- If the subnet mask contains a binary zero digit, then the corresponding binary digit in the IP address is part of the node address.

IPv6는 지역기반주소가 없어(주소 어려움, 너무 다양한 device)

# Separating an IP Address into its Network and Node Portions

Class C address

IP address	205	122	10	5	Dotted decimal
Subnet mask	255	255	255	0	Dotted decimal
	$2^7$ $2^6$ $2^5$ $2^4$ $2^3$ $2^2$ $2^1$ $2^0$	$2^7$ $2^6$ $2^5$ $2^4$ $2^3$ $2^2$ $2^1$ $2^0$	$2^7$ $2^6$ $2^5$ $2^4$ $2^3$ $2^2$ $2^1$ $2^0$	$2^7$ $2^6$ $2^5$ $2^4$ $2^3$ $2^2$ $2^1$ $2^0$	
	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	
IP address	1 1 0 0 1 1 0 1	0 1 1 1 1 0 1 0	0 0 0 0 1 0 1 0	0 0 0 0 0 1 0 1	Binary format
Subnet mask	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	Binary format
Network address				Node address	

# LAN PROTOCOLS

- The Internet Protocol has 5 different address classes:
  - **Class A** – the first binary digit in the first octet is always a binary zero. Addresses range from 1 to 126 in the first octet. Default subnet mask is 255.0.0.0. *1c3*
  - **Class B** – the first two binary digits in the first octet begin with the binary digits, 10. Addresses range from 128 to 191 in the first octet. Default subnet mask is 255.255.0.0. *2c2*
  - *255* **Class C** – the first three binary digits in the first octet begin with the binary digits, 110. Addresses range from 192 to 223 in the first octet. Default subnet mask is 255.255.255.0. *3c1*

# LAN PROTOCOLS

- Address classes (cont'd)
  - **Class D** – is used for IP multicasts. The first four binary digits of the first octet begin with 1110. Addresses range from 224 to 239 in the first octet.
  - **Class E** – is reserved and used in broadcast transmissions within a defined network. The first octet ranges from 240 to 255.

방송용 (IPv6 버전)

# Network and Node Portions of IP Addresses

## Class A address

95	122	140	89
subnet 255	0	0	0
2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>	2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>	2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>	2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>
128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1
0 1 0 1 1 1 1 1	0 1 1 1 1 0 1 0	1 0 0 0 1 1 0 0	0 1 0 1 1 0 0 1
1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
Network address			
Node address			

## Class B address

162	242	129	118
255	255	0	0
2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>	2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>	2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>	2 <sup>7</sup> 2 <sup>6</sup> 2 <sup>5</sup> 2 <sup>4</sup> 2 <sup>3</sup> 2 <sup>2</sup> 2 <sup>1</sup> 2 <sup>0</sup>
128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1
1 0 1 0 0 0 1 0	1 1 1 1 0 0 1 0	1 0 0 0 0 0 0 1	0 1 1 1 0 1 1 0
1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
Network address			
Node address			



# LAN PROTOCOLS

- Assigning IP Addresses
  - **Manual IP Address Assignment** – each LAN device is assigned a static IP address. Requires that each device be manually configured with an IP address.
  - **Automatic IP Address Assignment** – is achieved with DHCP. Configuration of a range of addresses takes place on a **DHCP** server, and manual assignment of IP addresses is reduced to devices that require such a manual assignment.

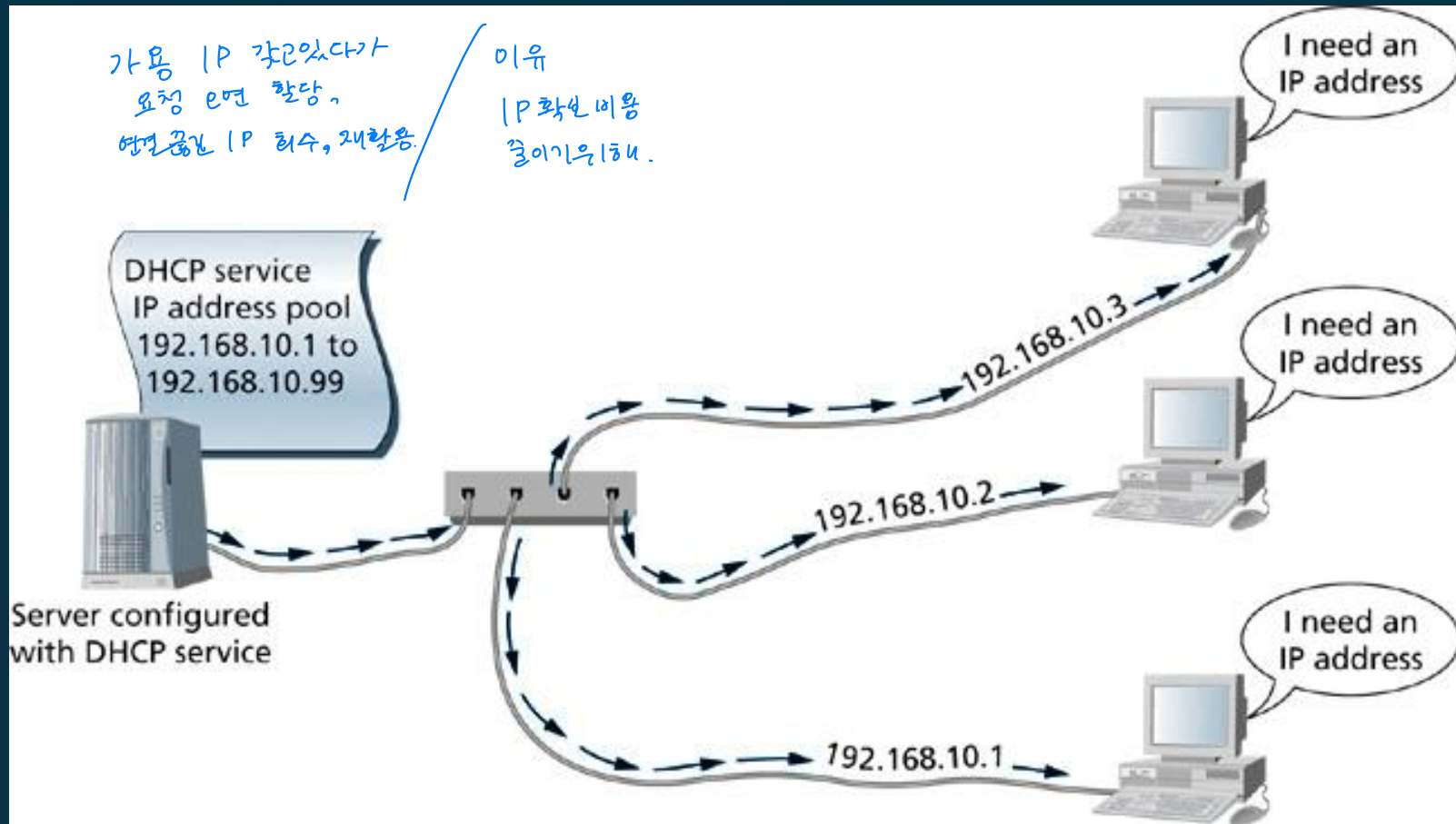
고정 IP (회사, 학교 등)

유동 IP (가정)

Dynamic  
Host  
Configuration  
Protocol

DHCP server - IP 할당해줌

# DHCP-Delivered IP Addresses



# LAN PROTOCOLS

이름없는 노트북

- Network Management



- **SNMP** is a standardized application layer protocol that is used to communicate with, monitor, and control network devices such as hubs, switches, routers, and even NICs for the purpose of collecting network traffic and performance statistics.
- SNMP works in conjunction with SNMP agent software, SNMP manager software, and MIBs (Management Information Base).

Simple  
Network  
Management  
Protocol

NOC : 통신회사의 상황실.  
(국보안시설)  
관제 시스템.

nw의 현재 상황 등을 전달하는  
protocol (nw관리를 위해).

거의 모든 nw 장비가 SNMP지원 (포함)