



# Network Systems

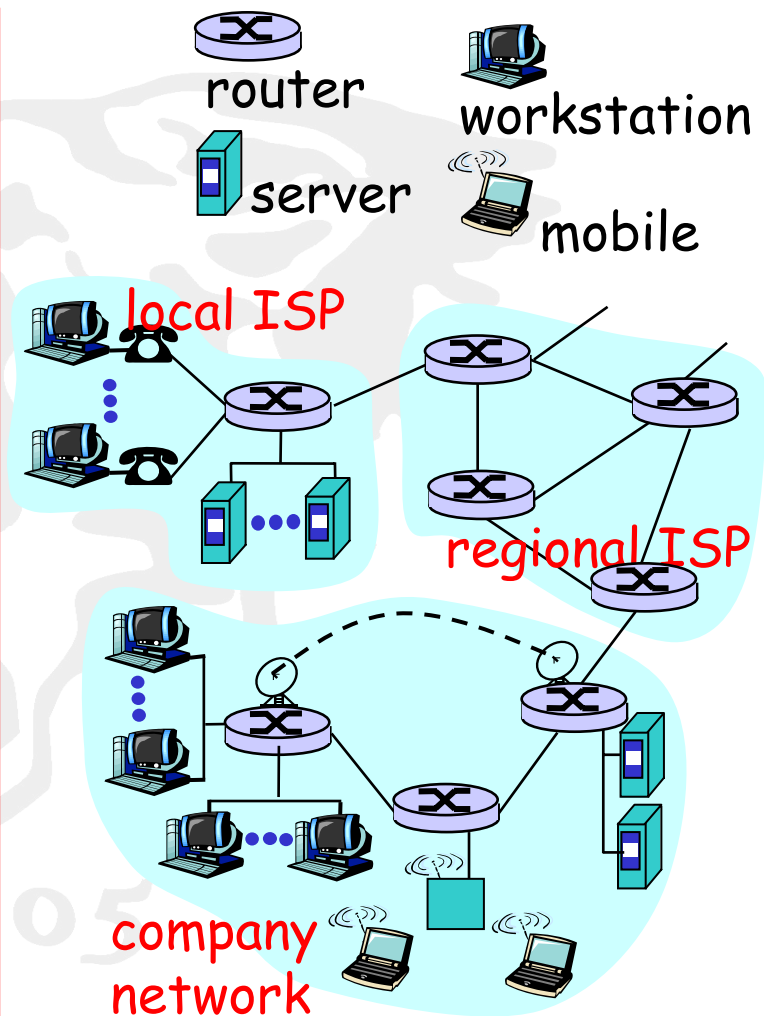
*hosts = end systems*

*communication links*

- ❑ fiber, copper, radio, satellite
- ❑ transmission rate = **bandwidth**

*data transfer equipments:*

- ❑ forward packets (chunks of data)
- ❑ Router, Switch





# Communication Model

## end systems (hosts):

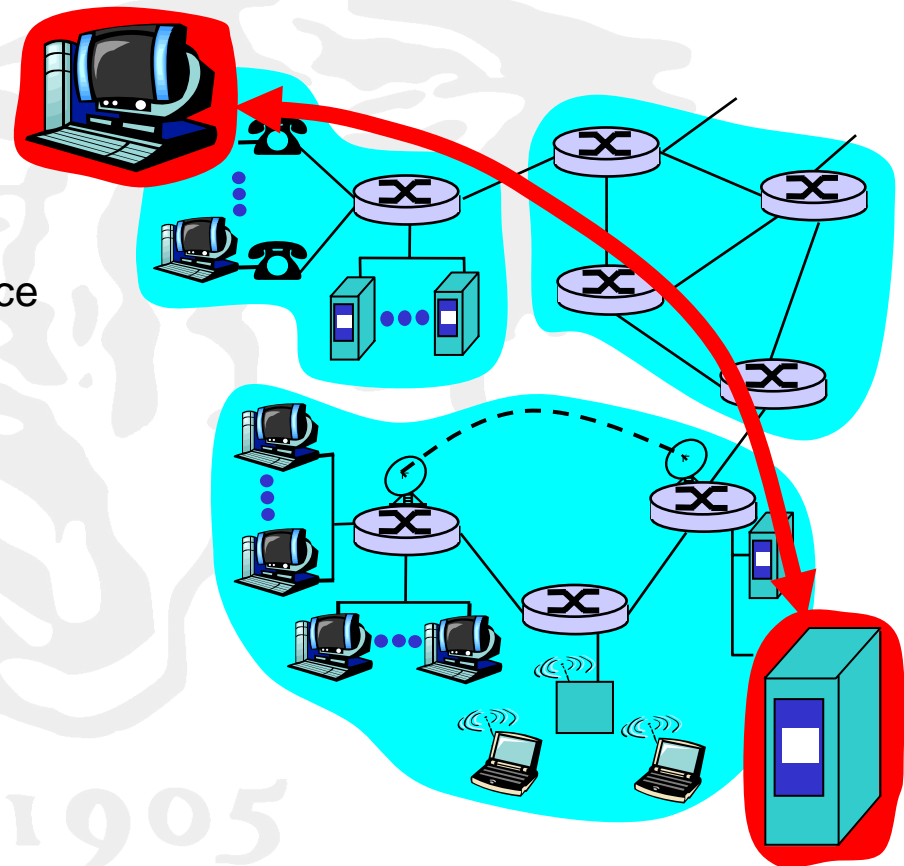
- ❑ run application programs
- ❑ e.g. Web, email
- ❑ at "edge of network"

## client/server model

- ❑ client host requests, receives service from always-on server
- ❑ e.g. Web browser/server; email client/server

## peer-peer model:

- ❑ minimal (or no) use of dedicated servers
- ❑ e.g. SoriBada





# Circuit Switching Vs Packet Switching

## Circuit Switching

- ❑ Dedicated circuits are used for data delivery
- ❑ e.g. telephone network

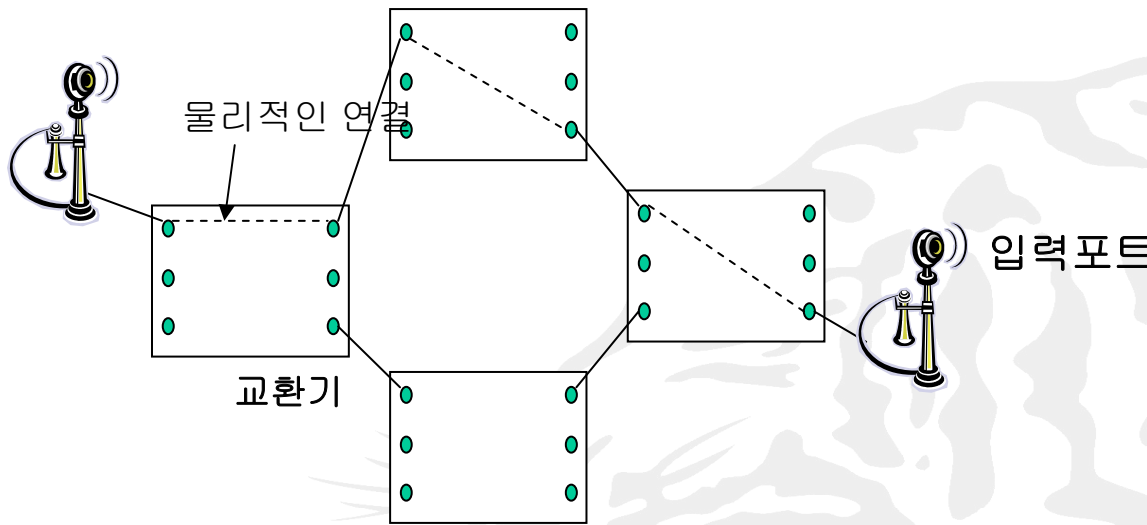
## Packet Switching

- ❑ Packets are used for data delivery
- ❑ e.g. postal system

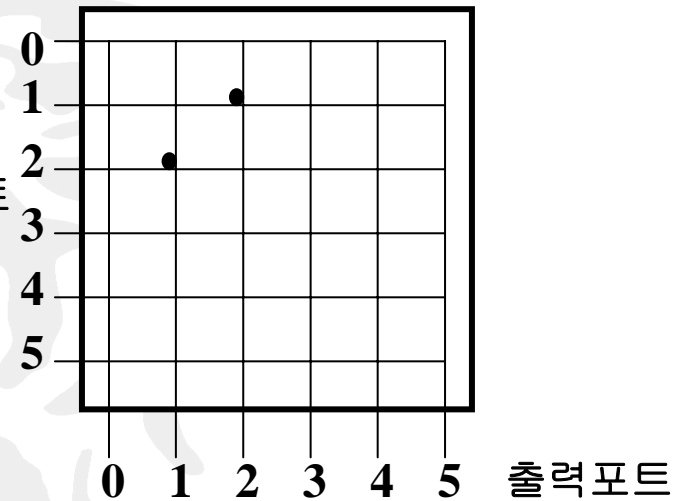
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# Circuit Switching Network



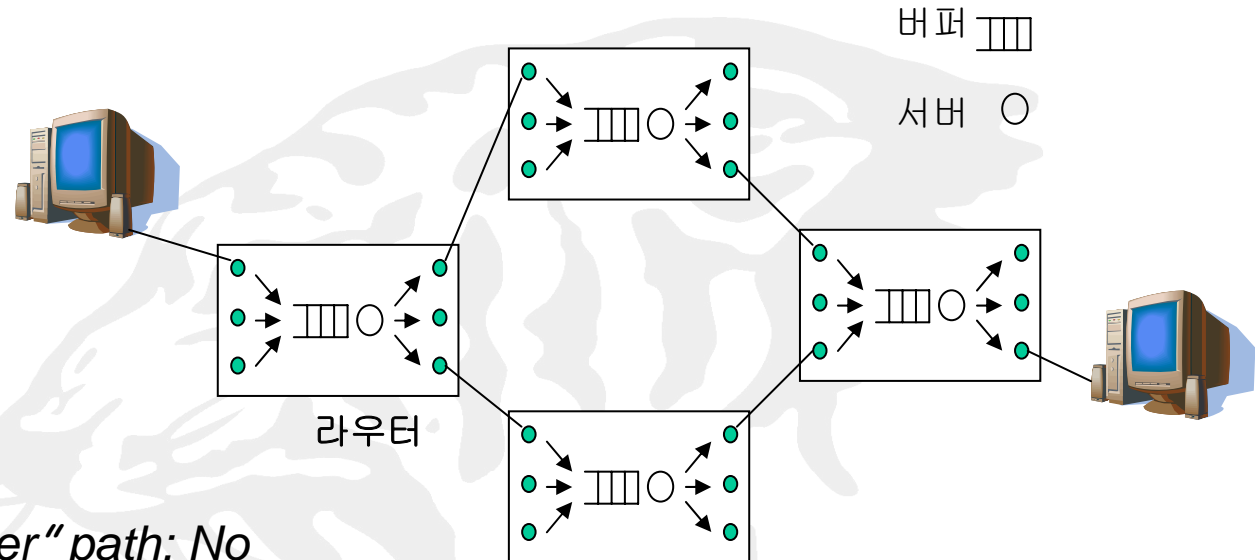
## Crossbar Switch



- Dedicated "copper" path: Yes
- Bandwidth available: Fixed
- Potentially wasted bandwidth: Yes
- Store-and-forward transmission: No
- Each packet follows the same route: Yes
- Call setup: Required



# Packet Switching Network



*Dedicated "copper" path: No*  
*Bandwidth available: Dynamic*  
*Potentially wasted bandwidth: No*  
*Store-and-forward transmission: Yes*  
*Each packet follows the same route: No*  
*Call setup: Not Needed*



# Communication Service

## *Connection-oriented service*

- ❑ *In-order data transfer*

## *Connectionless service*

- ❑ No in-order data transfer

## Reliable service

## Unreliable service

## TCP - Transmission Control Protocol

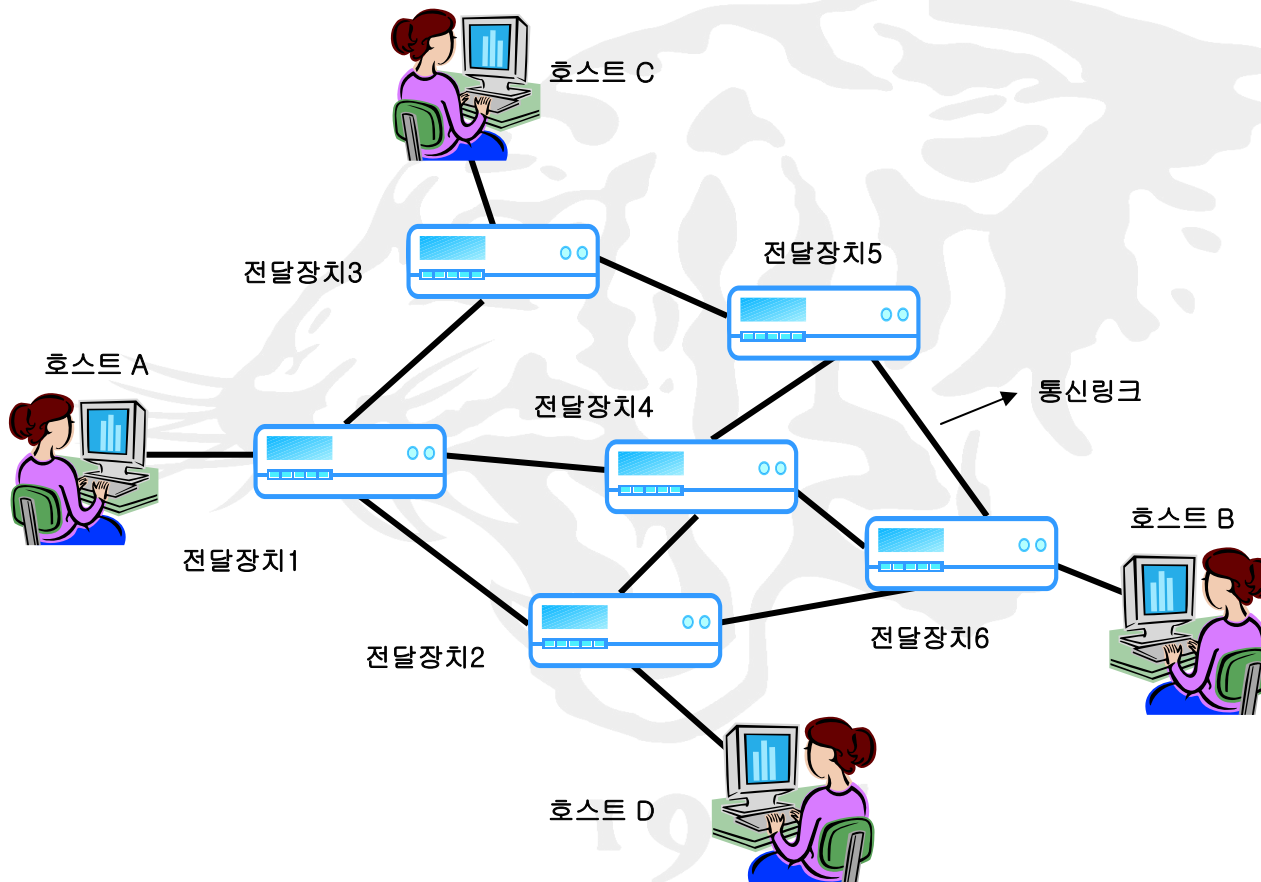
- ❑ Reliable connection-oriented service

## UDP - User Datagram Protocol

- ❑ Unreliable connectionless service

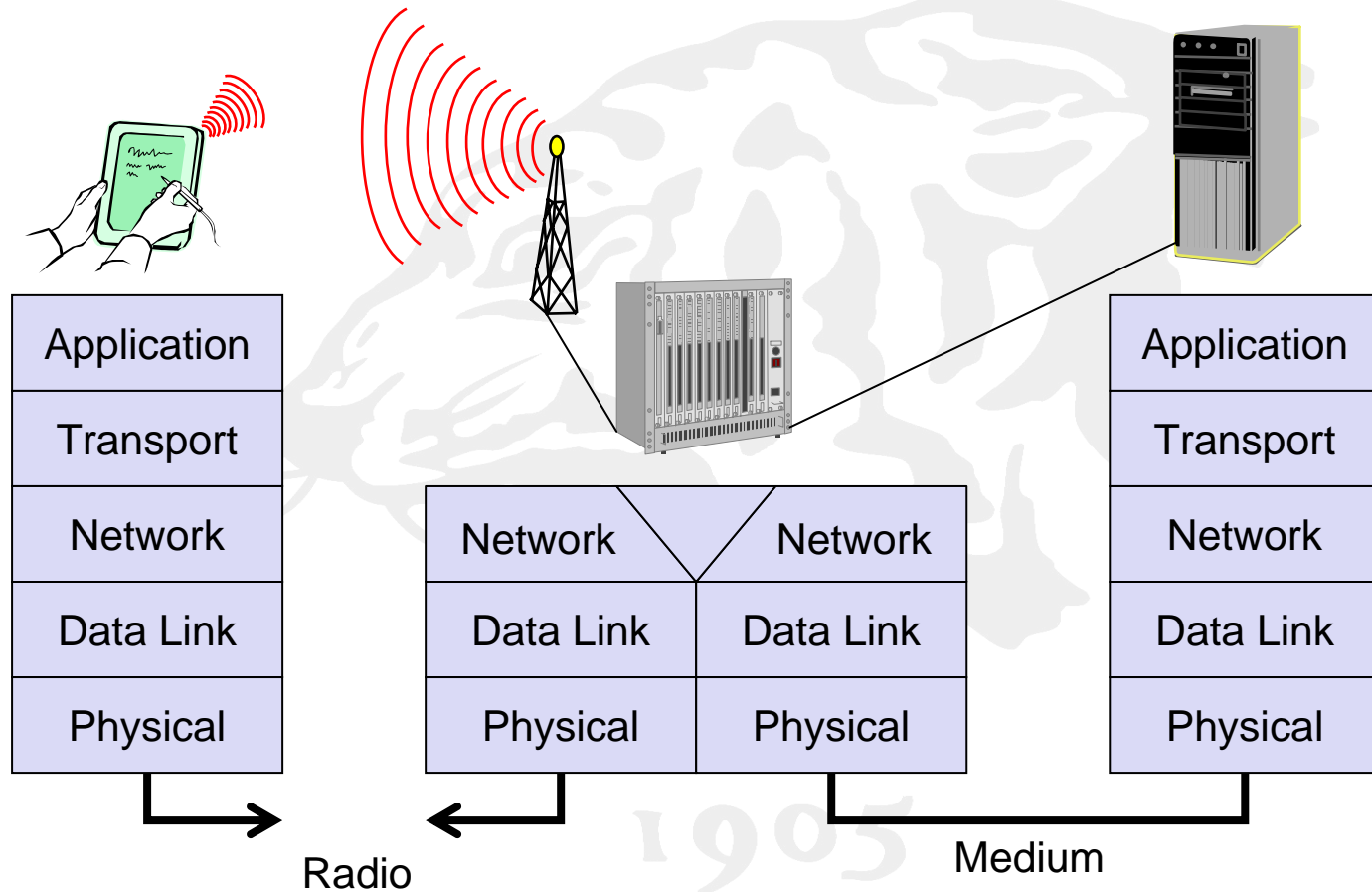


# Simple Computer Network





# Simple reference model used here







# Functions required for data transfer

*Routing*

*Error Control*

- ❑ ARQ(Automatic Repeat reQuest)
  - loss: acknowledgements and retransmissions
- ❑ FEC(Forward Error Correction)

*Flow Control:*

- ❑ sender won't overwhelm receiver

*Congestion Control:*

- ❑ senders "slow down sending rate" when network congested

Segmentation and Reassembly

Multiplexing and Demultiplexing



# Network Protocol

## 프로토콜이란

- 통신을 하기 위해 필요한 규약, 방법, 절차 등을 규정한 것
- 하나의 프로토콜이 통신에 필요한 모든 기능을 수행하지는 않는다
- 프로토콜들 간에는 계층화된 구조가 존재하며, 이를 나타낸 것이 프로토콜 스택이다

## OSI reference model의 프로토콜 스택

- Application, presentation, session, transport, network, datalink, physical

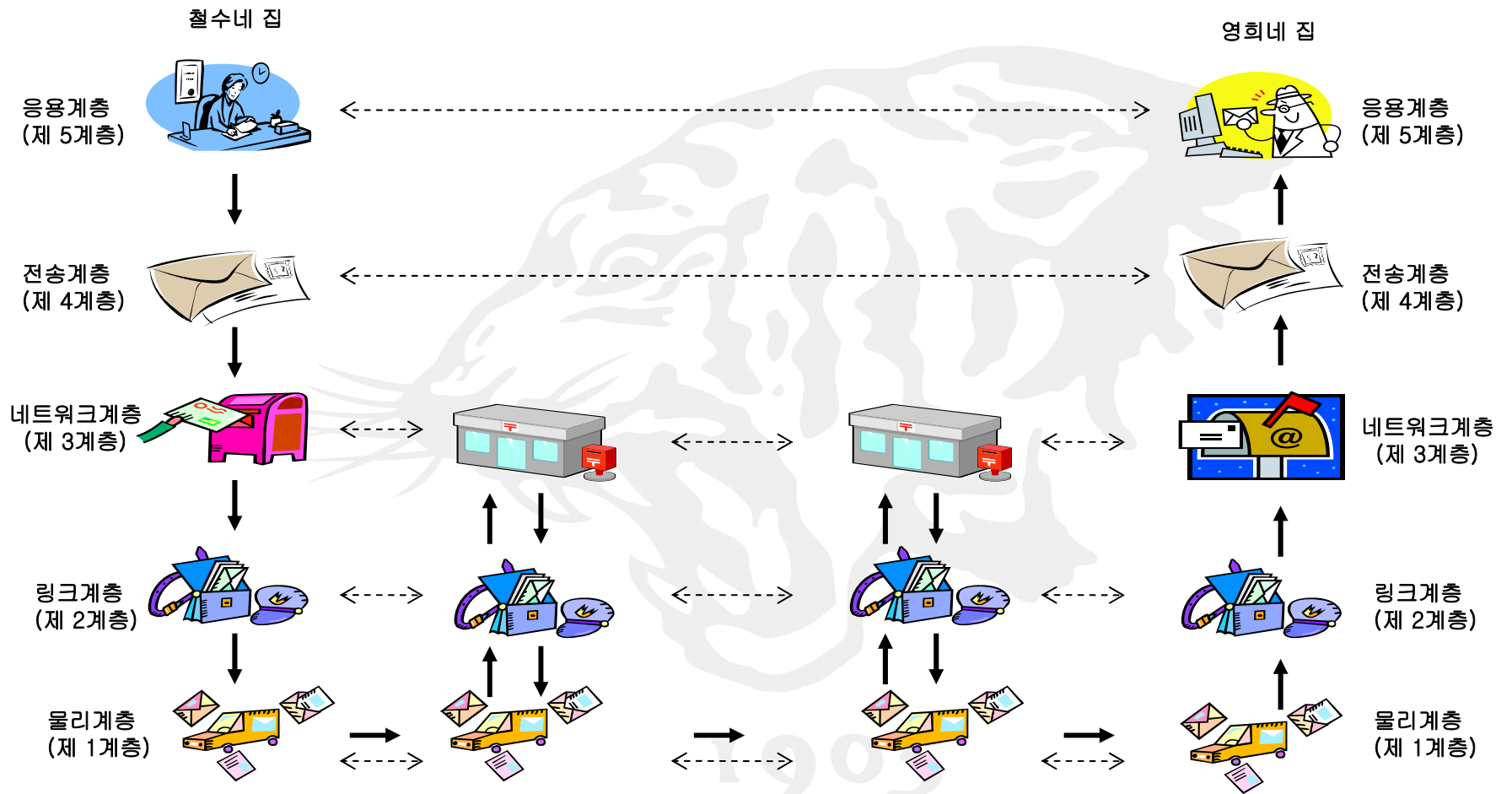
## Internet의 프로토콜 스택

- Application, transport, network, datalink, physical

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# 우편시스템의 계층적 구조





# Internet protocol stack

**application:** supporting network applications

- FTP, SMTP, HTTP

**transport:** data transfer between application processes

- TCP, UDP

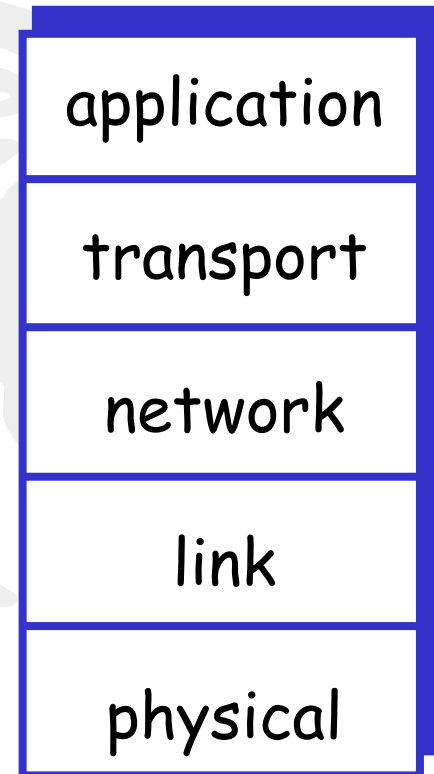
**network:** routing of packet from source to destination

- IP, routing protocols

**link:** data transfer between neighboring network elements

- PPP, Ethernet

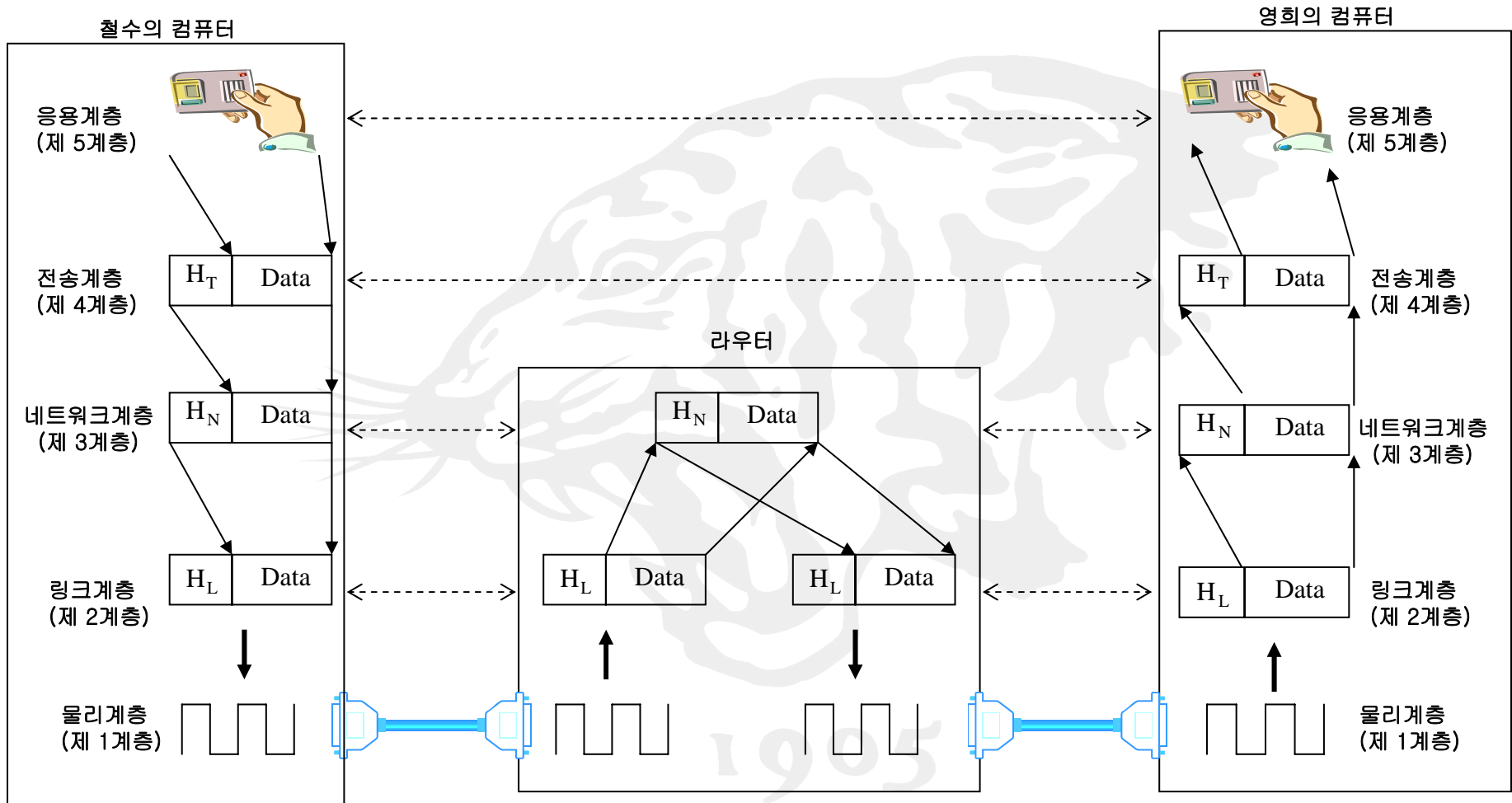
**physical:** bits "on the wire"



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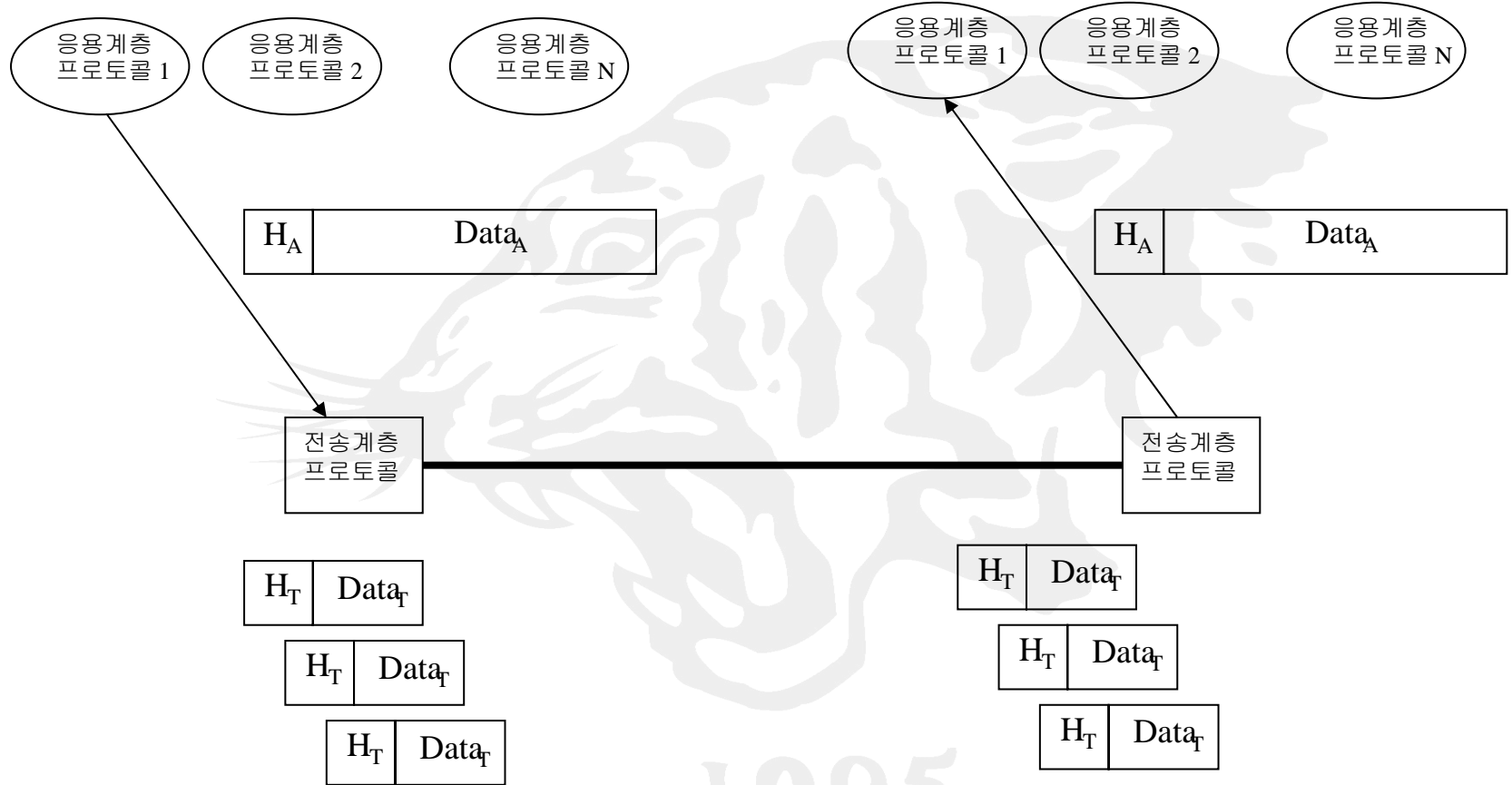


# 컴퓨터 네트워크의 계층적 구조



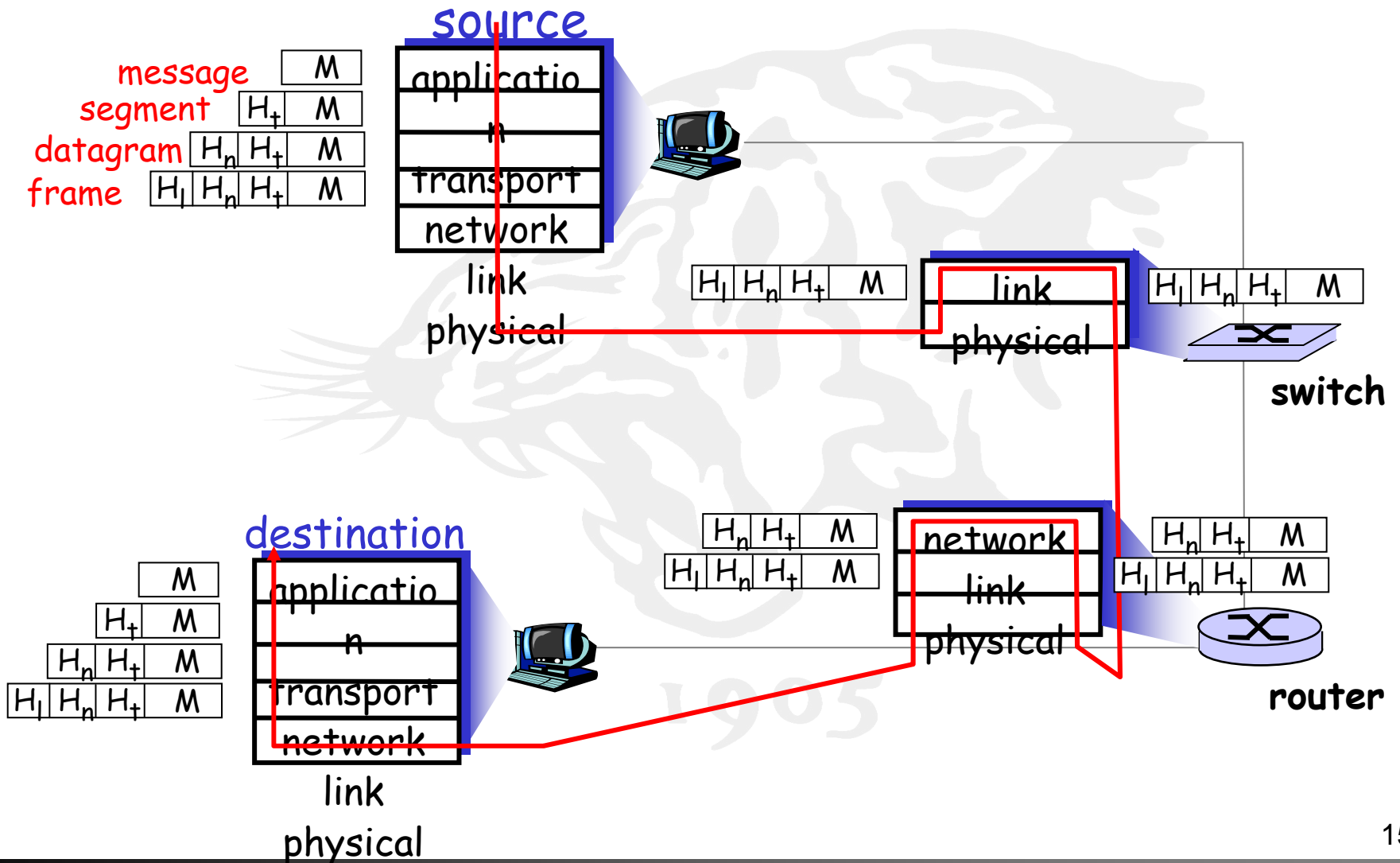


# 전송계층간의 논리적인 연결



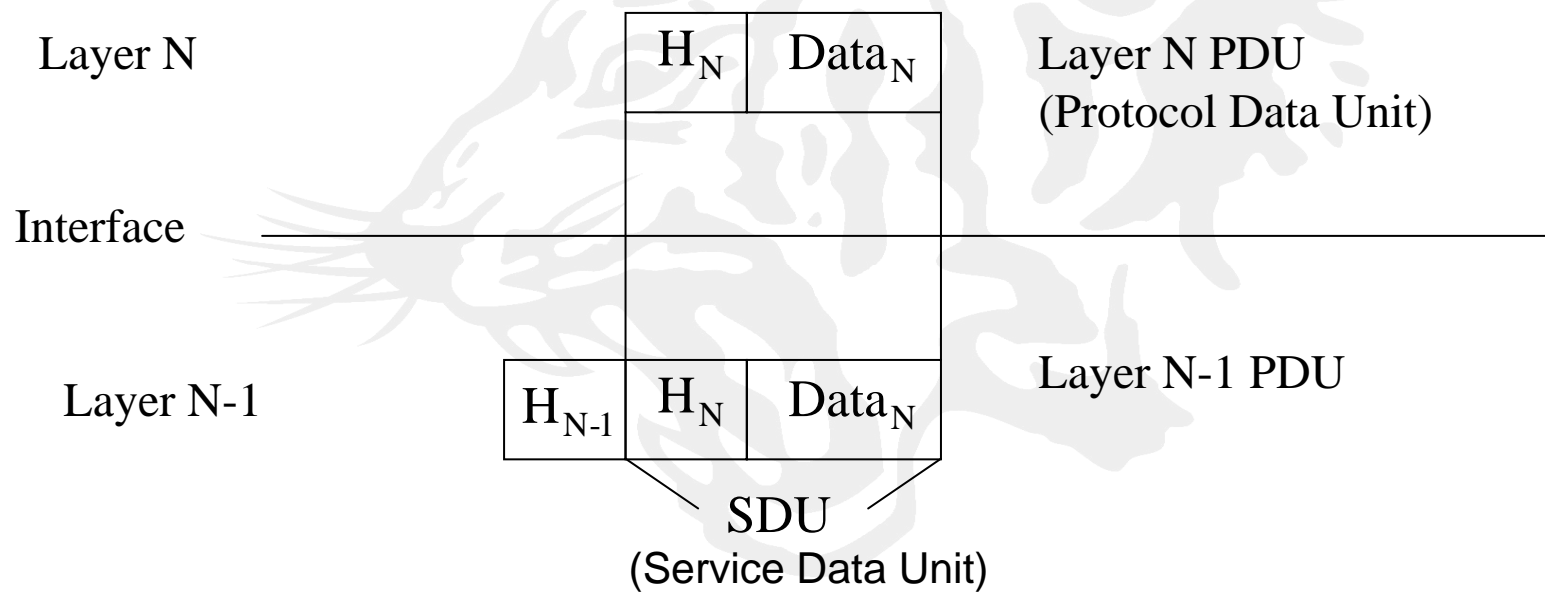


# Encapsulation





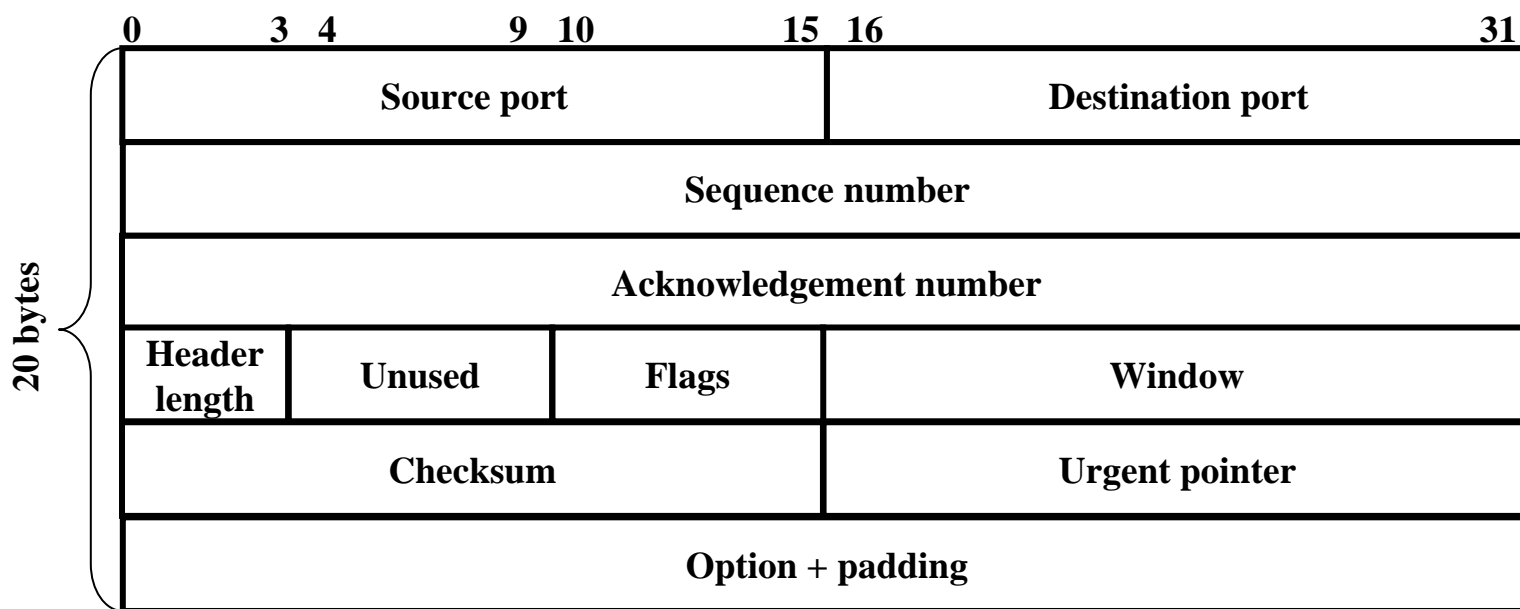
# SDU와 PDU의 관계



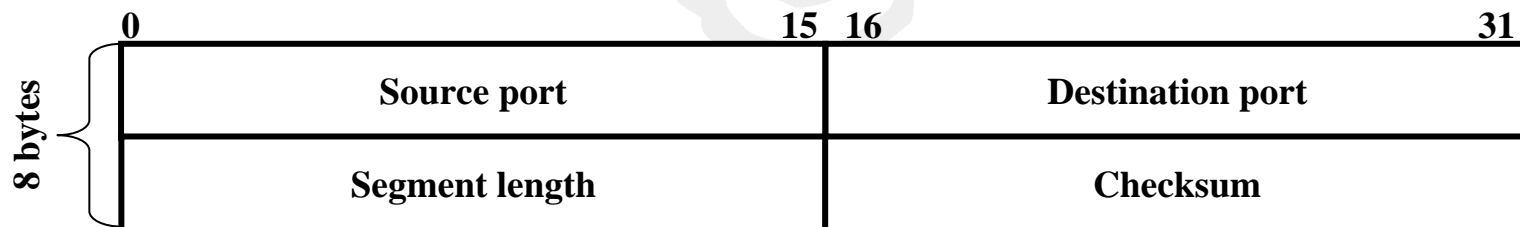




# TCP와 UDP



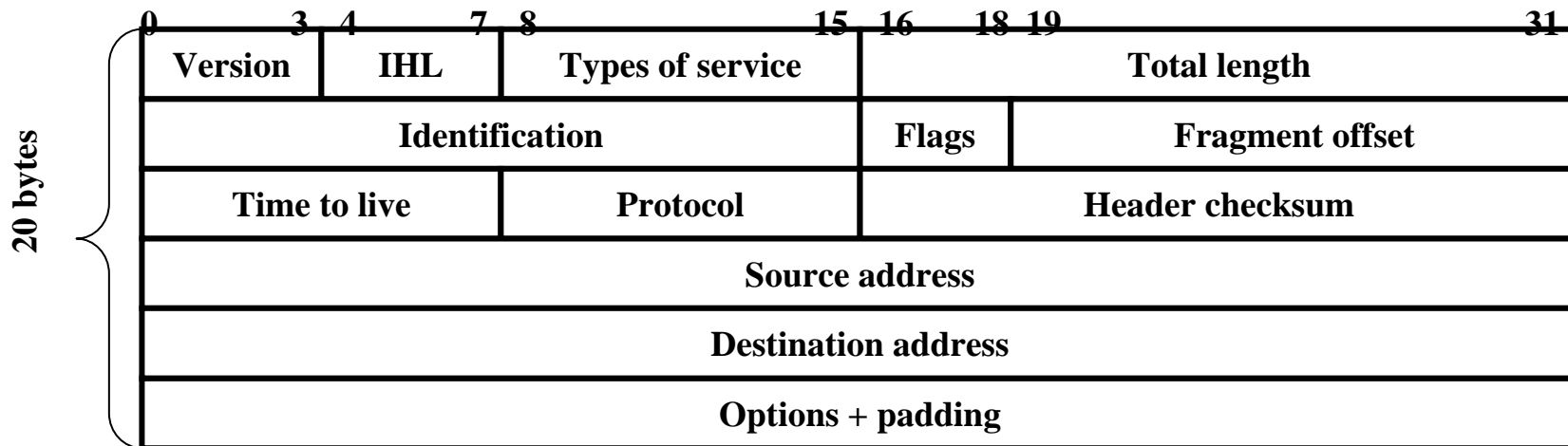
(a) TCP header



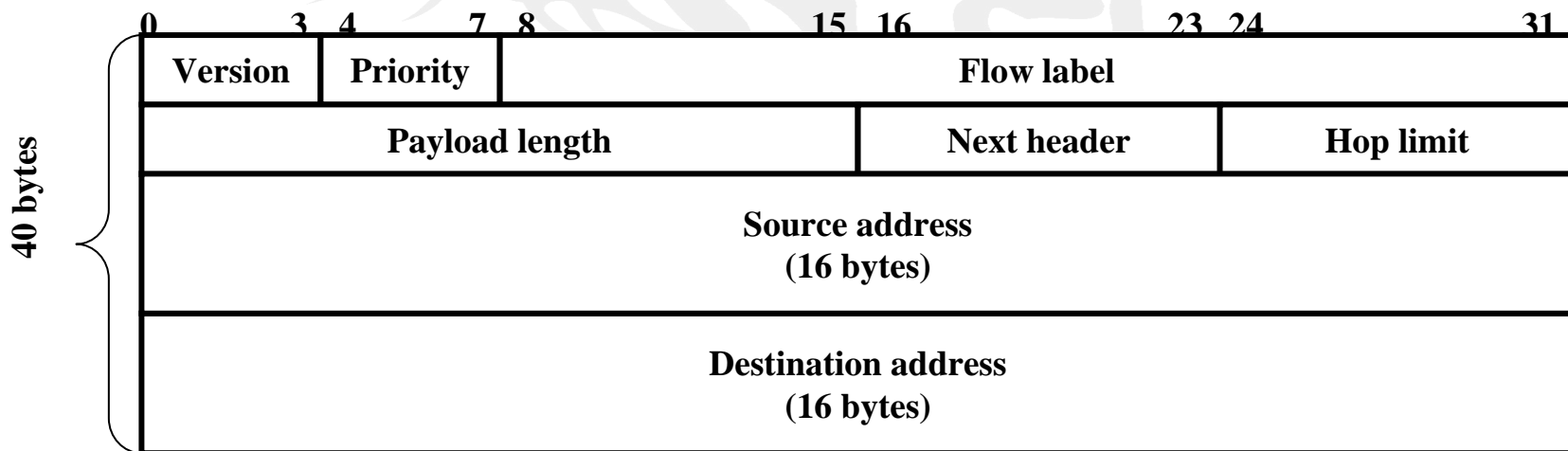
(b) UDP header



# IP



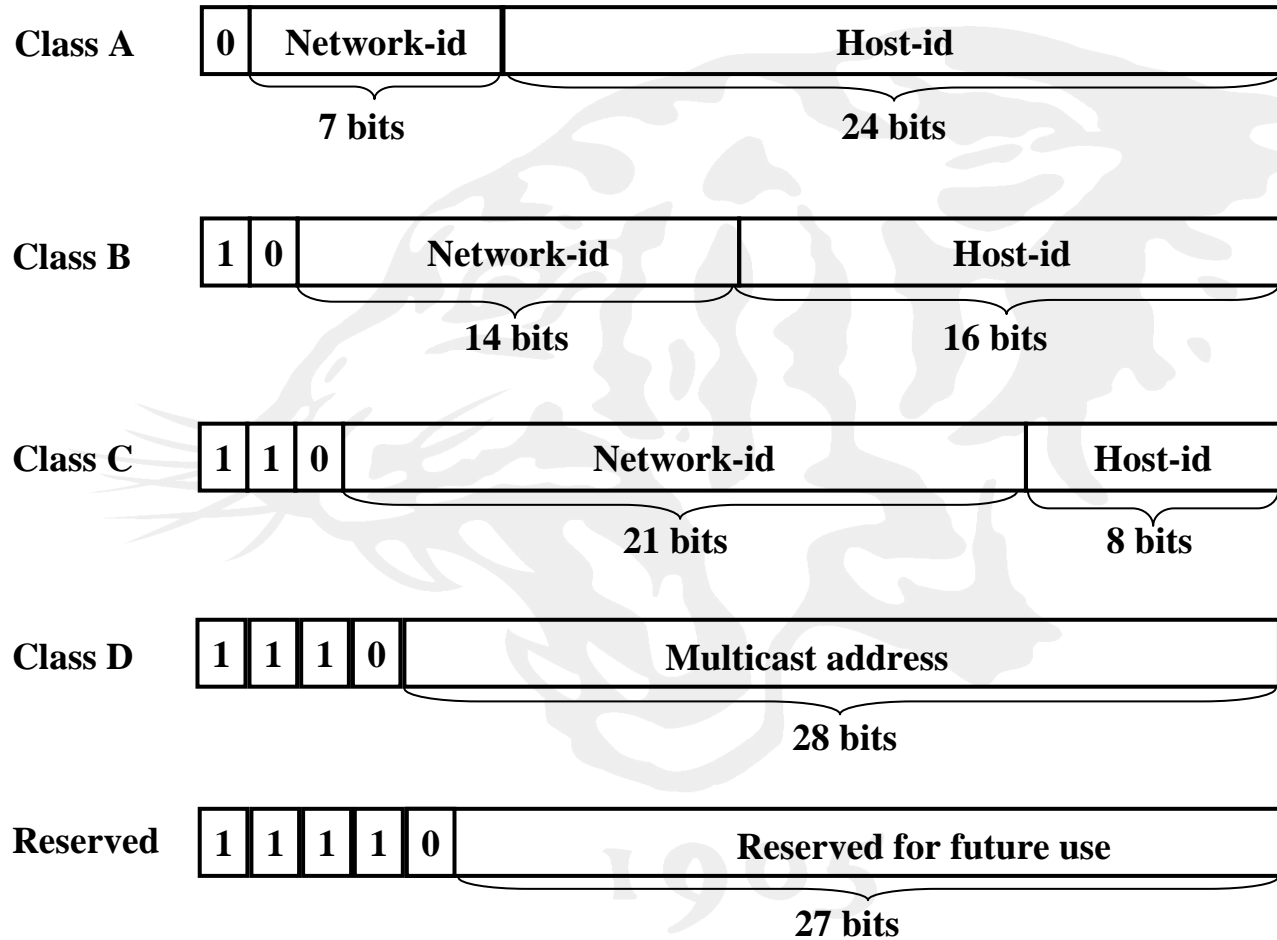
(a) IPv4



(b) IPv6

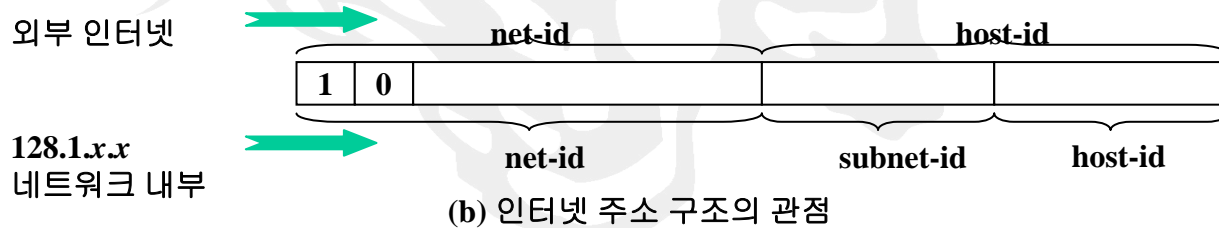
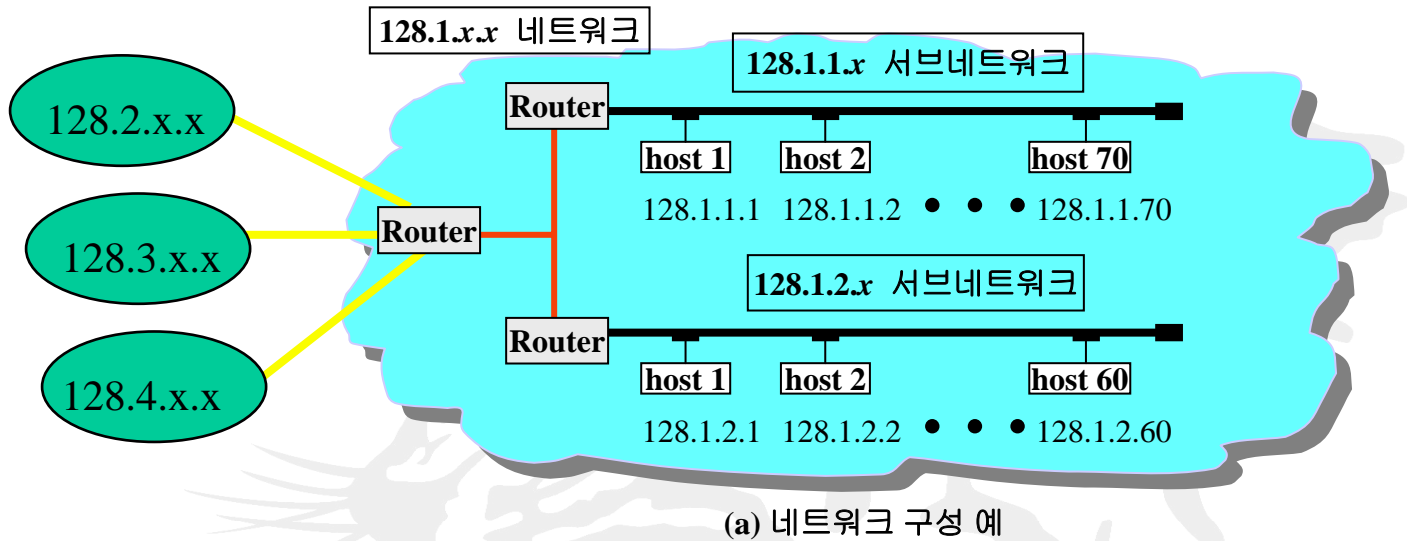


# IP 주소체계





# IP Address Masking

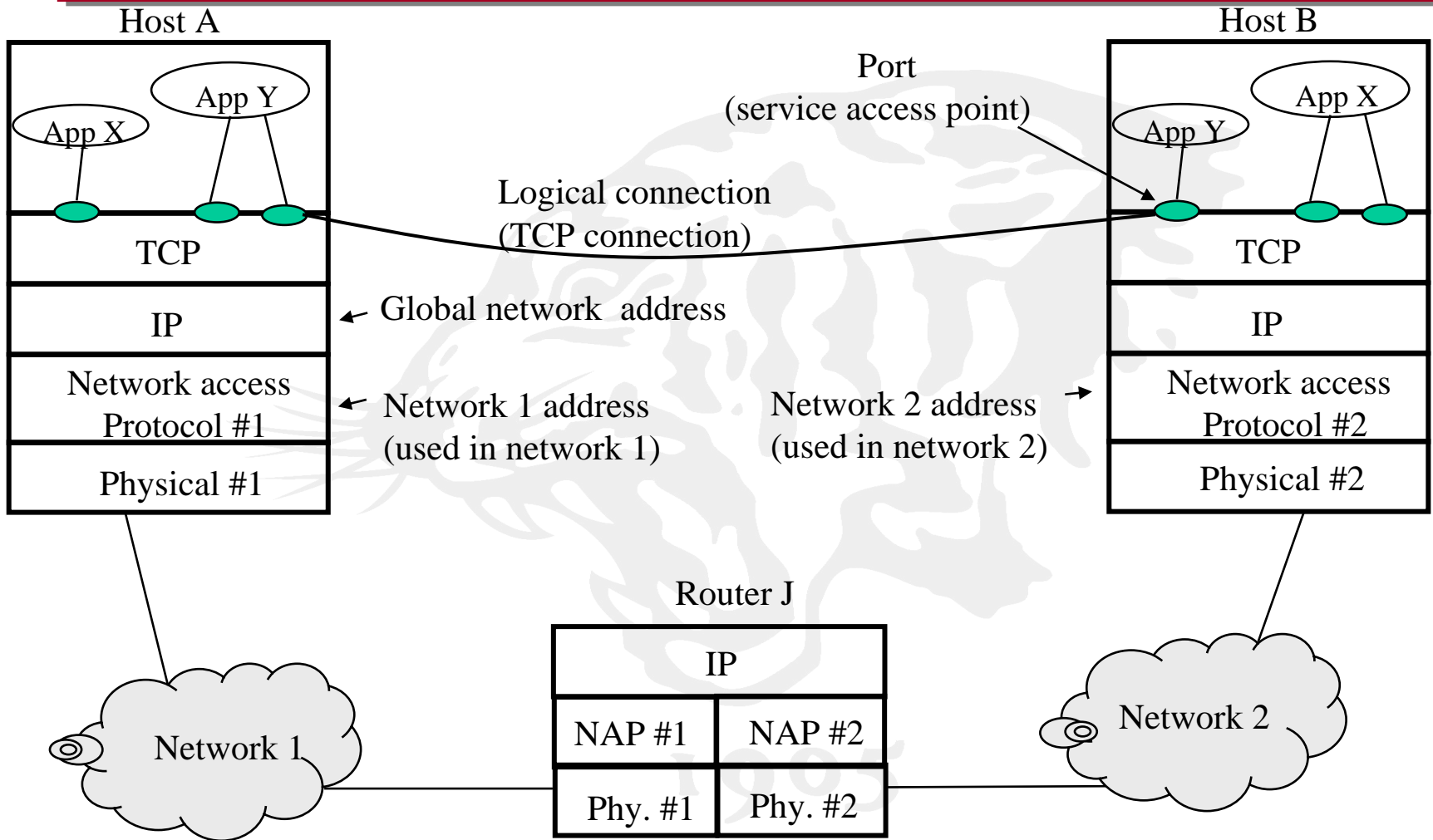


$$\begin{array}{l}
 \text{외부} \\
 \wedge \\
 \begin{array}{l}
 128.1.1.x \\
 255.255.0.0 \\
 128.1.0.0
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 128.1.2.x \\
 255.255.0.0 \\
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 \begin{array}{l}
 128.1.2.x \\
 255.255.255.0 \\
 128.1.2.0
 \end{array}
 \end{array}$$

(c) 주소 마스킹 예

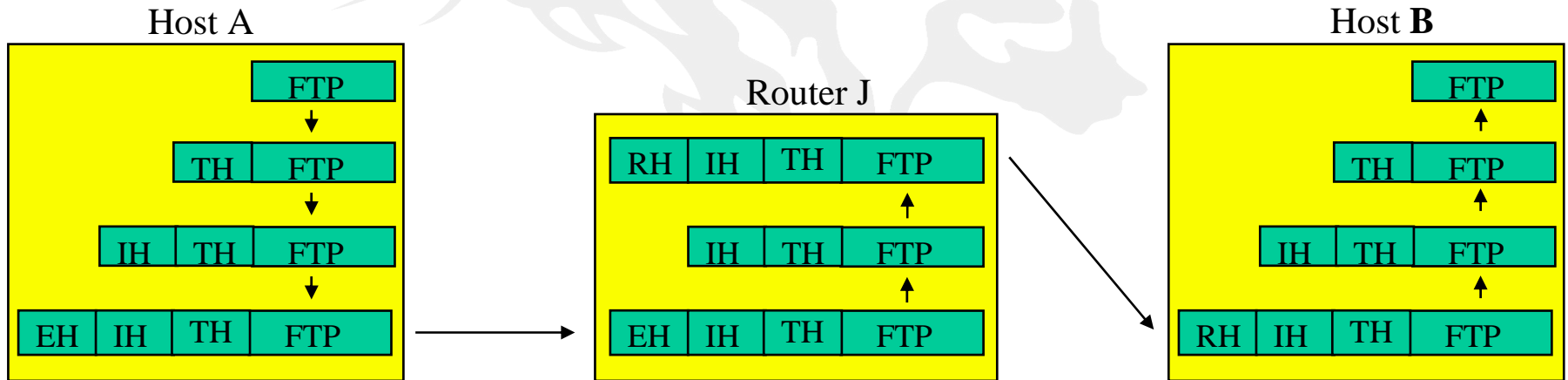
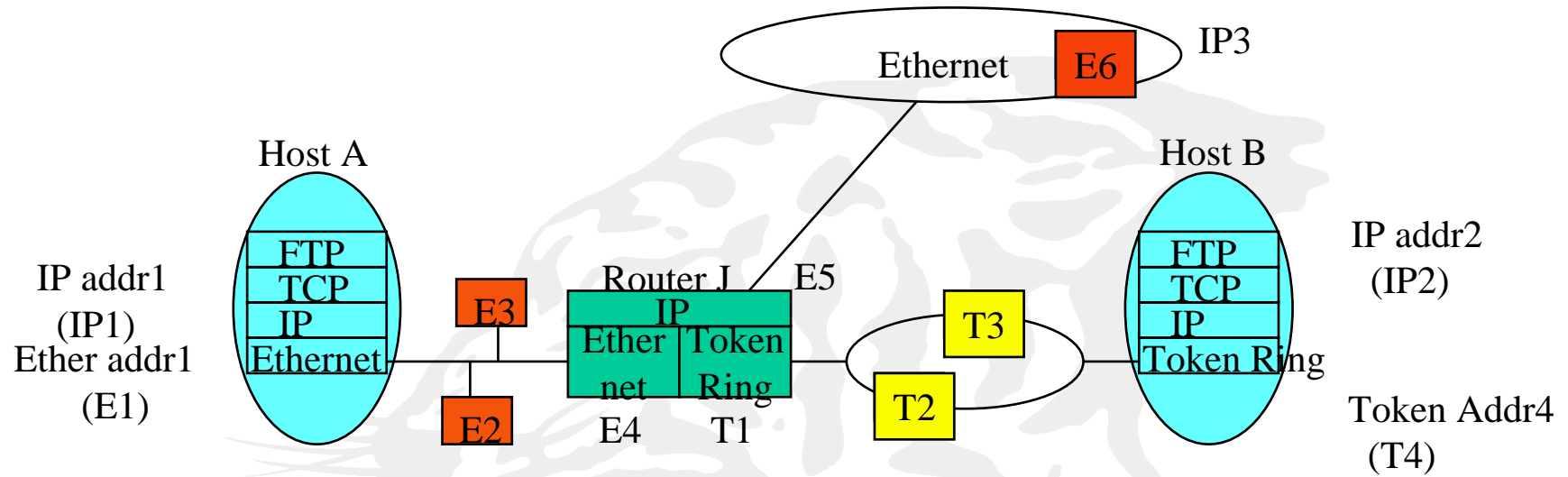


# TCP/IP 네트워킹 개념



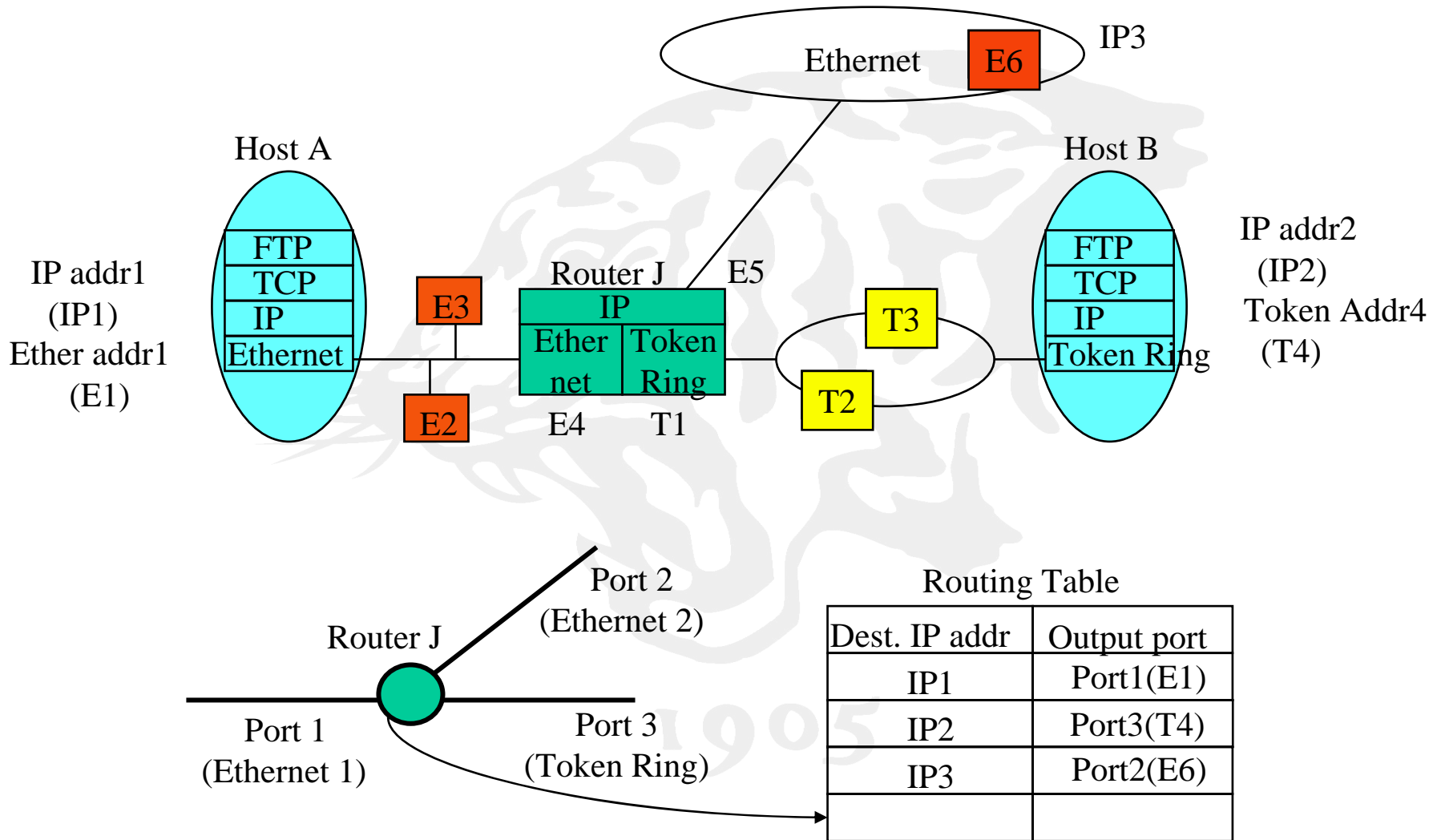


# TCP/IP Internetworking





# TCP/IP Internetworking





# 네트워크/패킷/프로토콜

WellKnown Port by IANA (Internet Assigned Numbers Authority RFC1700)

번호	키워드		키워드		키워드		키워드
1	TCPMUX	23	Telnet	101	Hostname	143	Imap
7	Echo	25	Sntp	102	Iso-tsap	163	Cmip-main
9	Discard	37	Time	109	POP2	164	Cmip-agent
11	Systat	42	Nameserver	110	POP3	177	Xdmcp
13	DayTime	43	Nickname	111	Sunrpc	179	Bgp
17	Qotd	53	Domain	113	Auth(ident)	194	Irc
19	Chargen	70	Gopher	115	Sftp	220	Imap3
20	Ftp-data	79	Finger	117	Uucp-path	389	Ldap
21	ftp	80	http	119	nntp	443	https
22	SSH	95	supdup	123	ntp	515	Printer