

# March 12 Notes

DHCP: IP address held by client for however much time set up for: lease

## Windows IP Configuration

```
Host Name . . . . . : H6-G09LAB
Primary Dns Suffix . . . . . : BC.Baruch.Cuny.Edu
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : BC.Baruch.Cuny.Edu
```

## Ethernet adapter Ethernet:

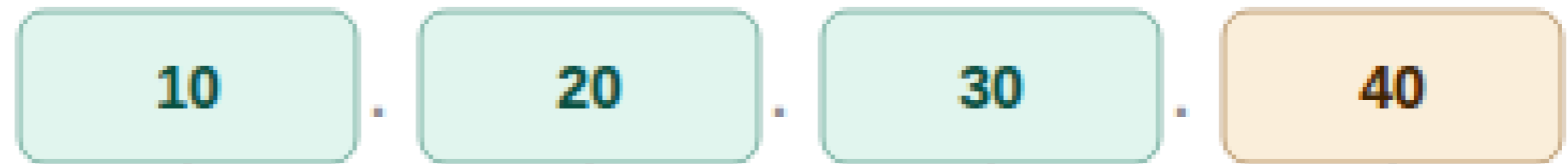
```
Connection-specific DNS Suffix . : bc.baruch.cuny.edu
Description . . . . . : Intel(R) Ethernet Connection (14) I219-LM
Physical Address. . . . . : 00-BE-43-D7-35-0F
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . . : Yes
Link-local IPv6 Address . . . . . : fe80::9b87:eb32:6839:6551%5(Preferred)
IPv4 Address. . . . . : 10.30.124.132(Preferred)
```

```
Lease Obtained. . . . . : Friday, March 13, 2026 7:32:20 AM
Lease Expires . . . . . : Saturday, March 21, 2026 7:32:21 AM
```

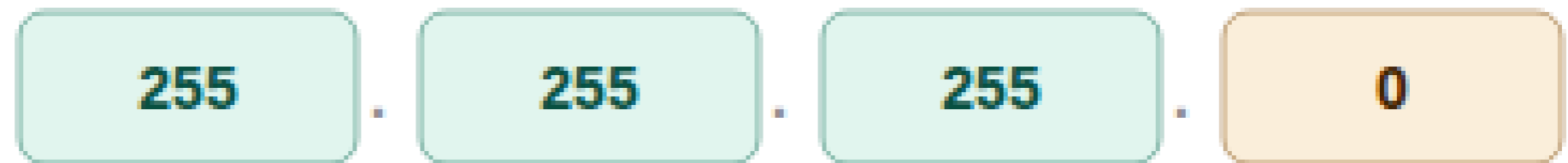
# March 12 Notes

## Network-Node Octets Based on Subnet Mask

IP address



Subnet mask



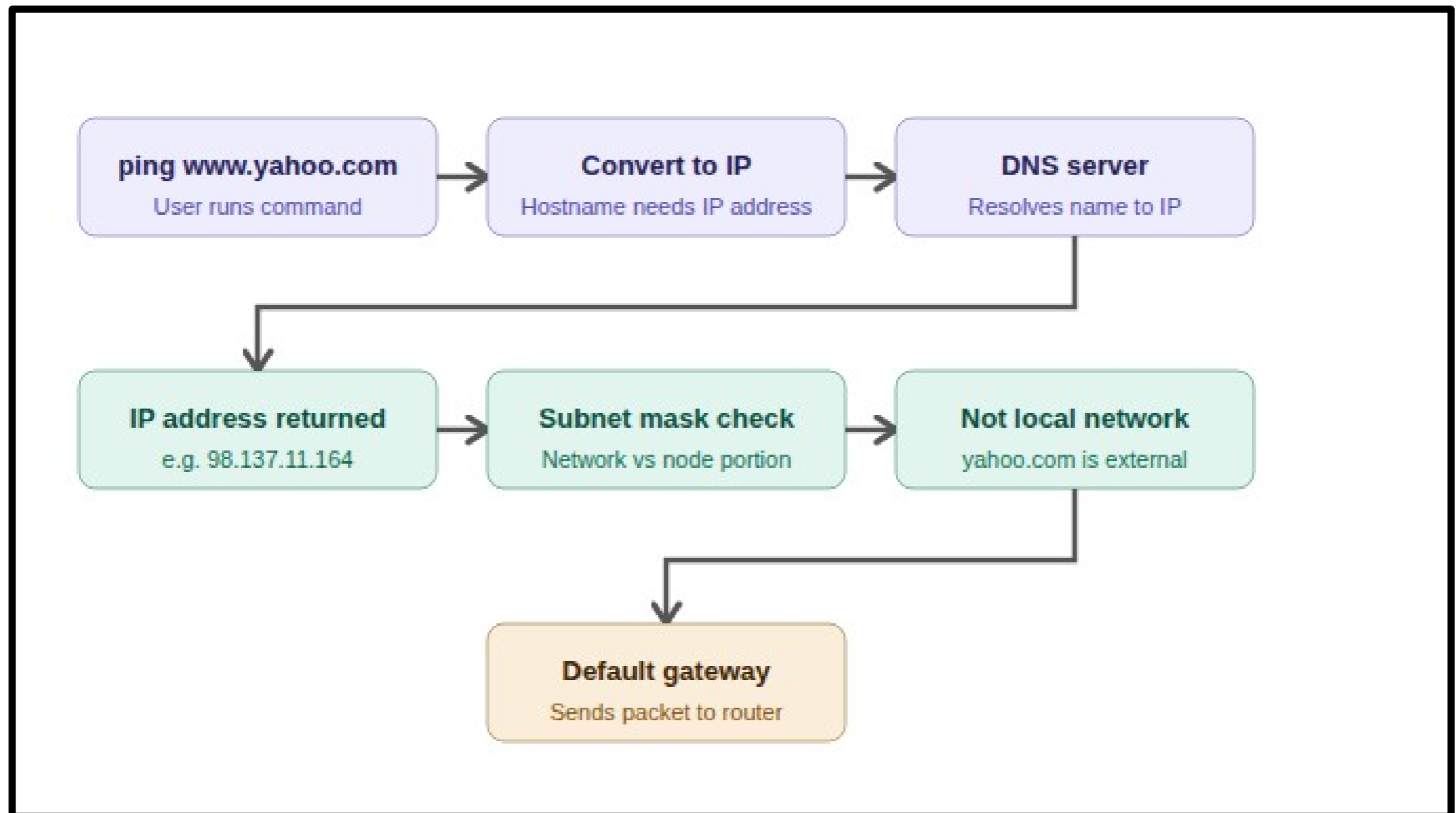
Network

Node



# March 12 Notes

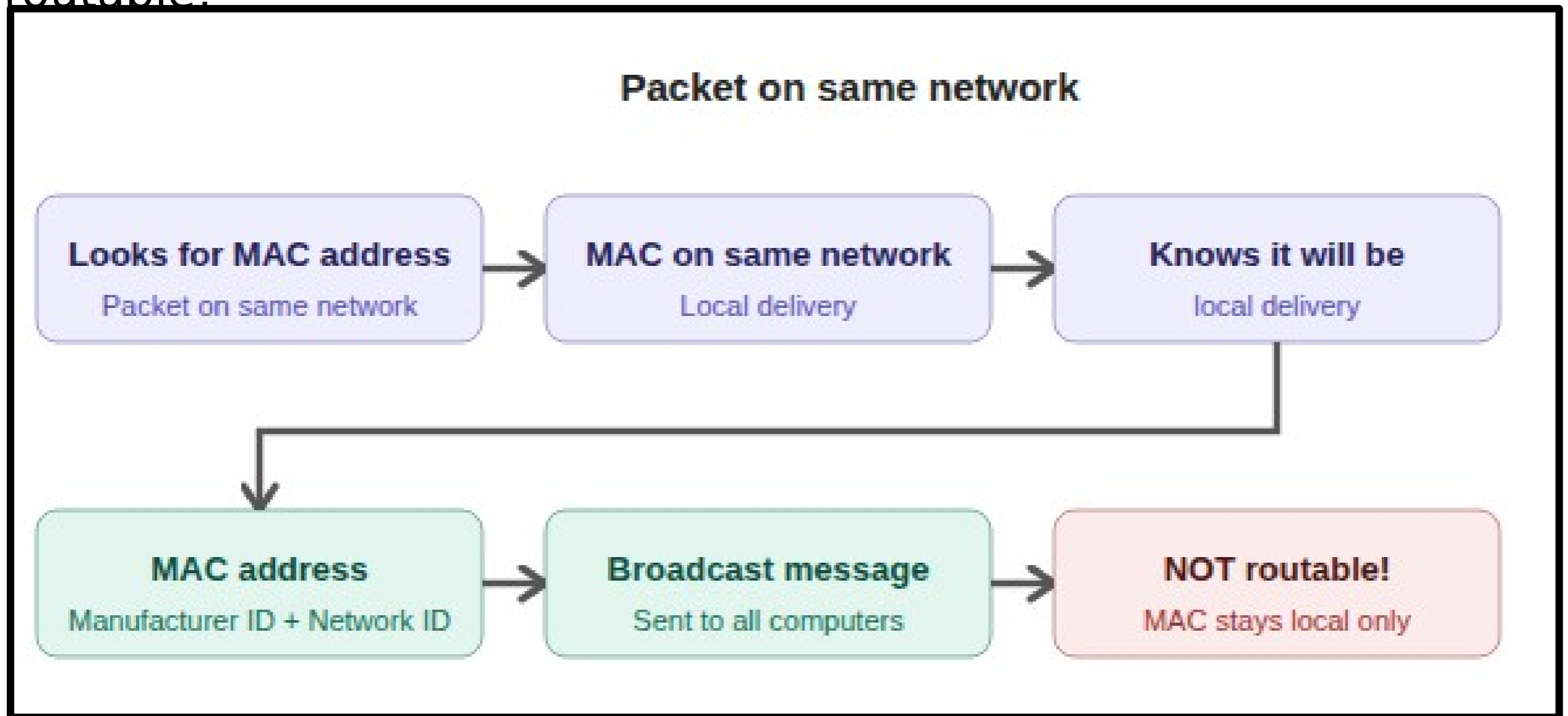
ping command: ping [www.yahoo.com](http://www.yahoo.com) > convert to IP address > uses DNS server to convert > get IP Address > subnet mask will determine network and node > sees yahoo.com is not on local network > sends ping packet to default gateway [usually a router]



# March 12 Notes

Packet on same network:

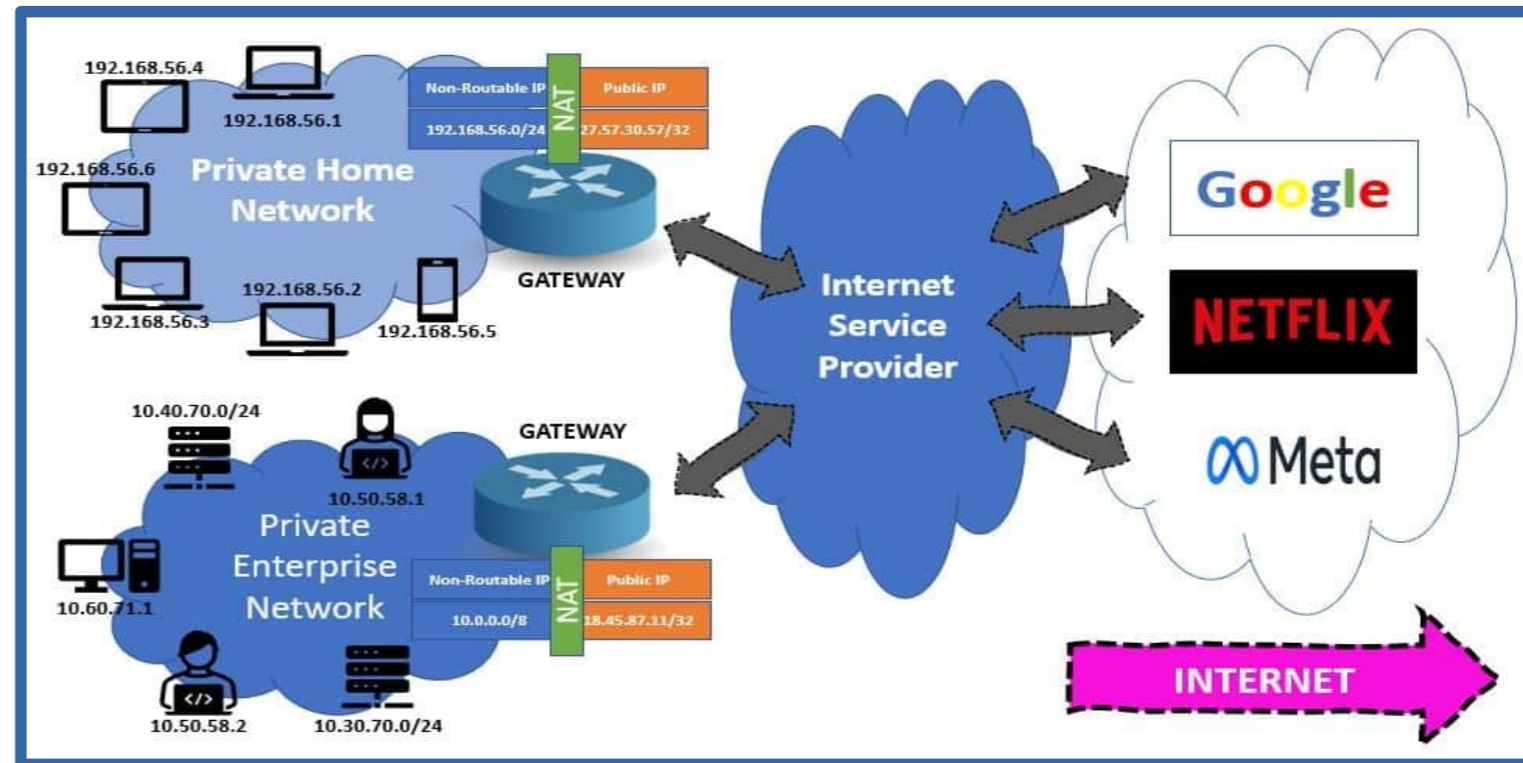
Looks for MAC address > MAC on same network > local delivery > [MAC address is Manufacturer ID + Network ID > Broadcasts message to all computer on network > MAC addresses are NOT routable!



IP Addresses allow computers to connect to network  
**ROUTABLE!!**



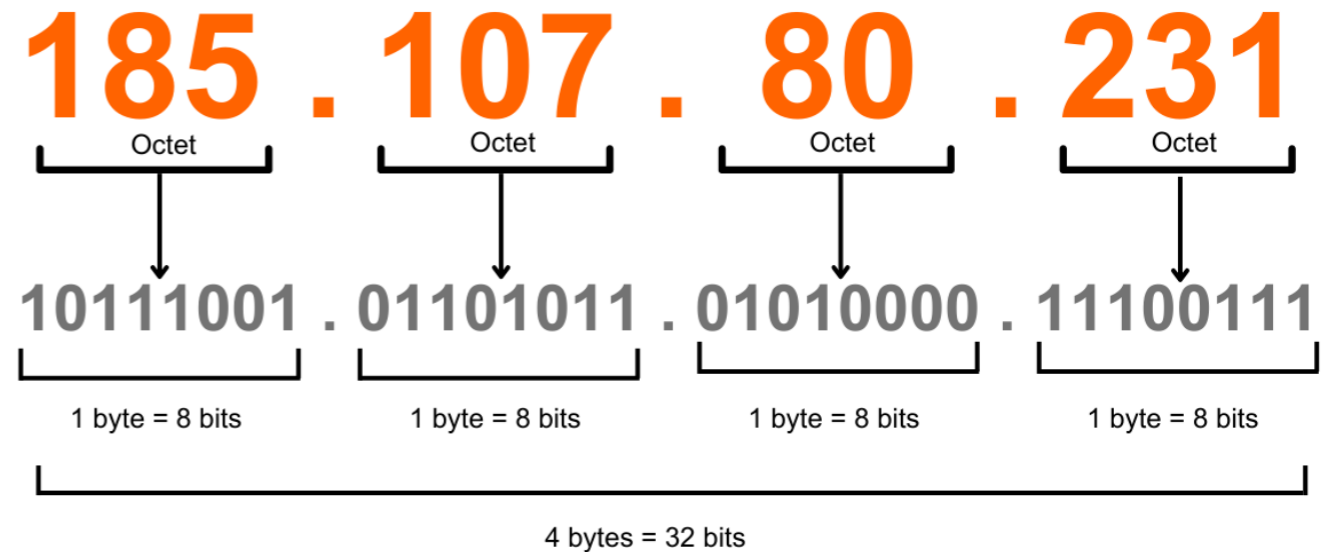
Routable IP addresses allow the Internet to exist  
No routable addresses; no Internet!



• March 12 Class Notes Part 2

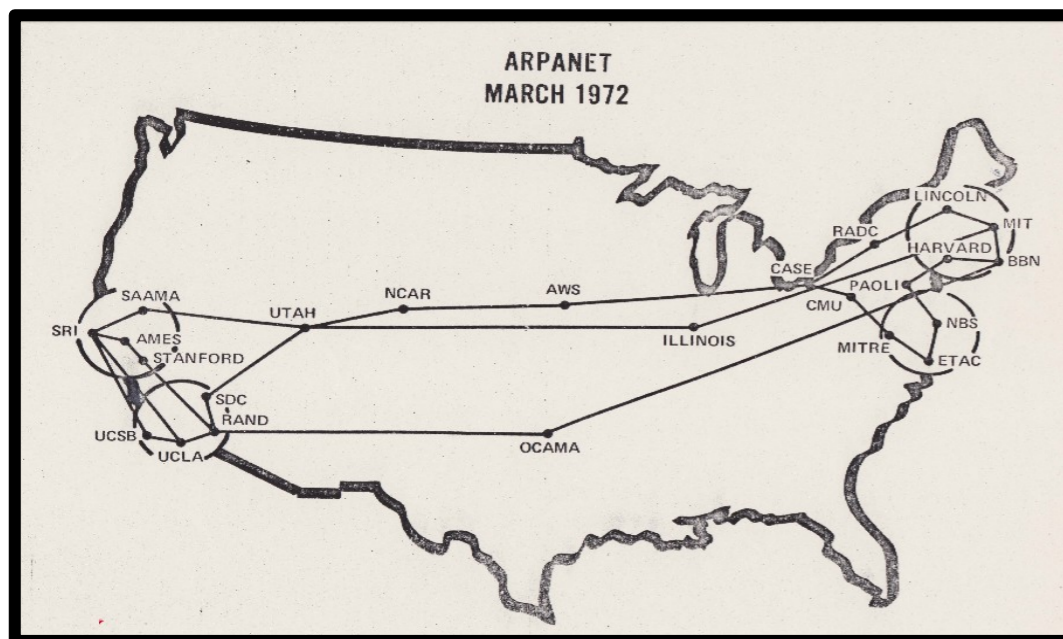
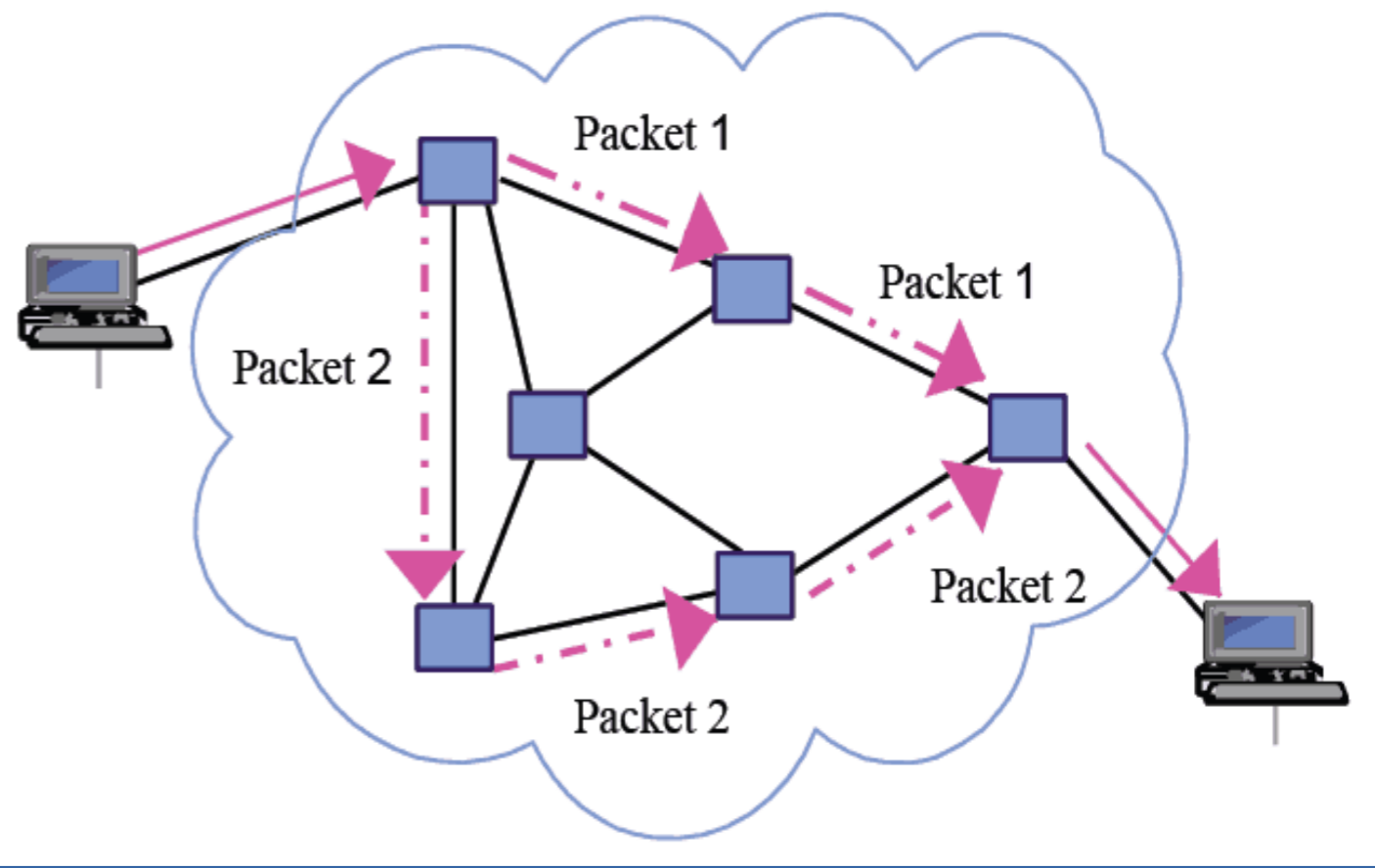
How many bits in IPv4 address?  
32 bits  
8 bits times 4

IPv4 Address Format



ARPANET – first routable network

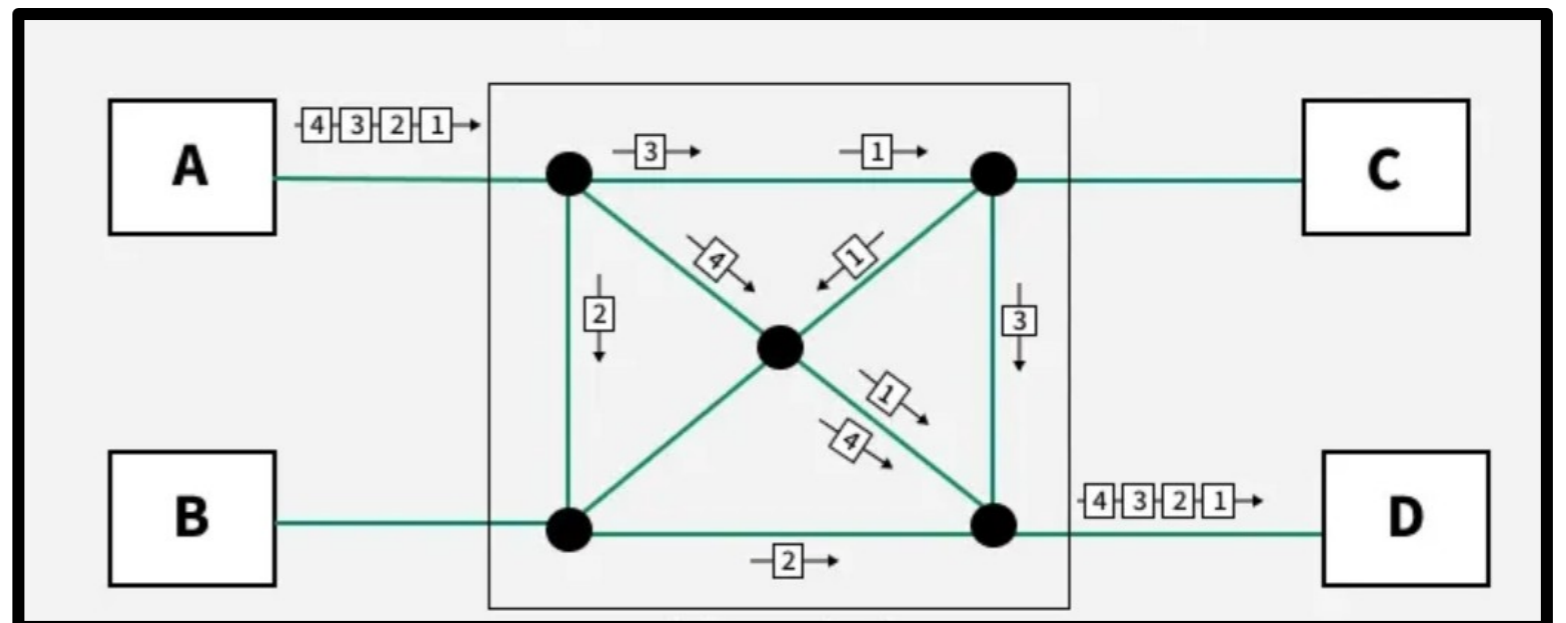
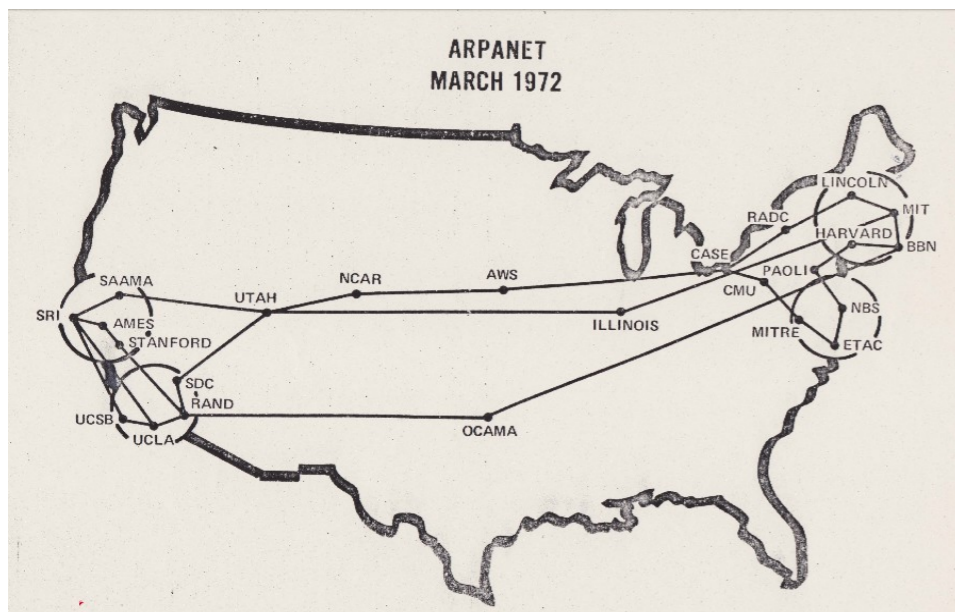
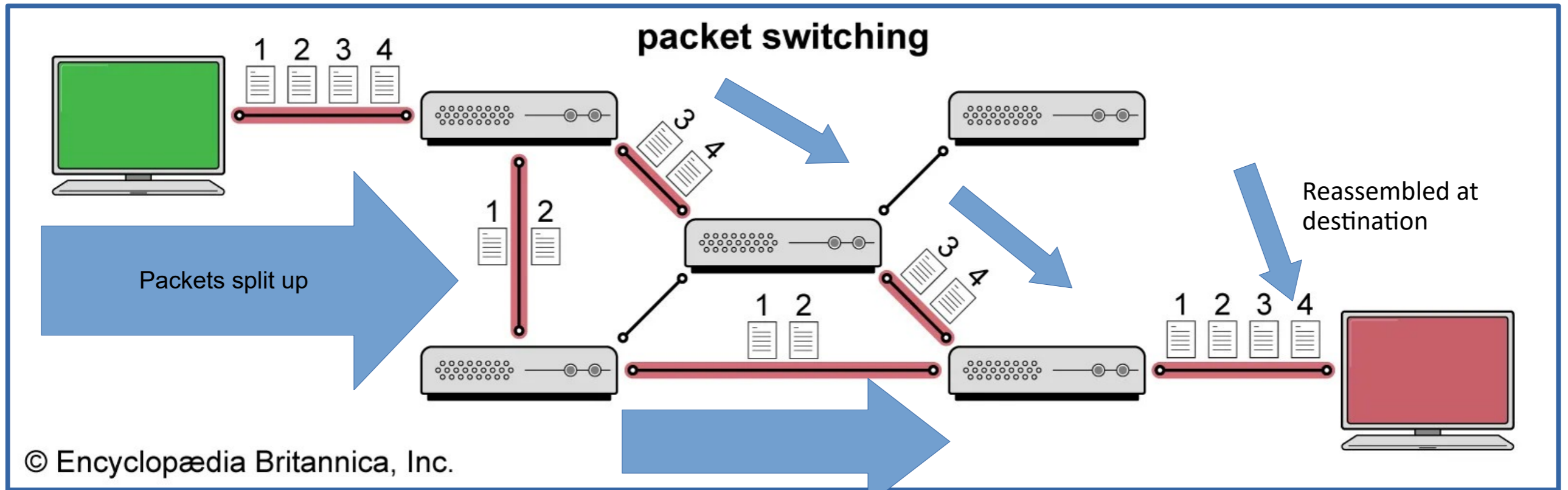
- Precursor to Internet
  - Data is chopped up into packets
  - Packets bounce from router to router
- ARPANET is a packet-switched network
- Each packet takes a different network path



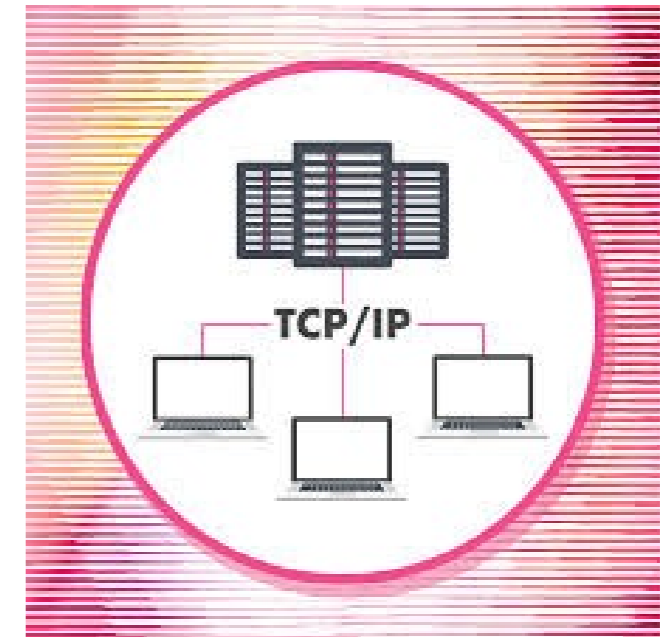
# Packet switching network

Packets are split up, take separate routes

Reassembled at destination



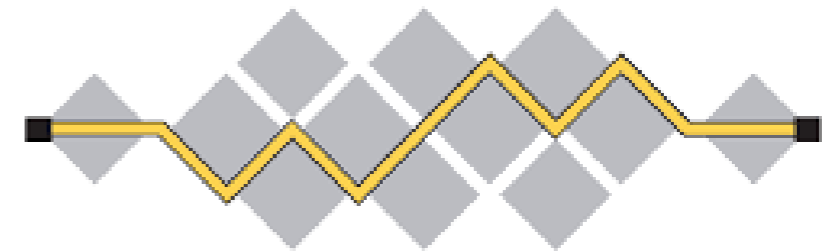
# Connected networks with a common protocol: TCP/IP



Standards bodies make protocols; not government agencies or manufacturers



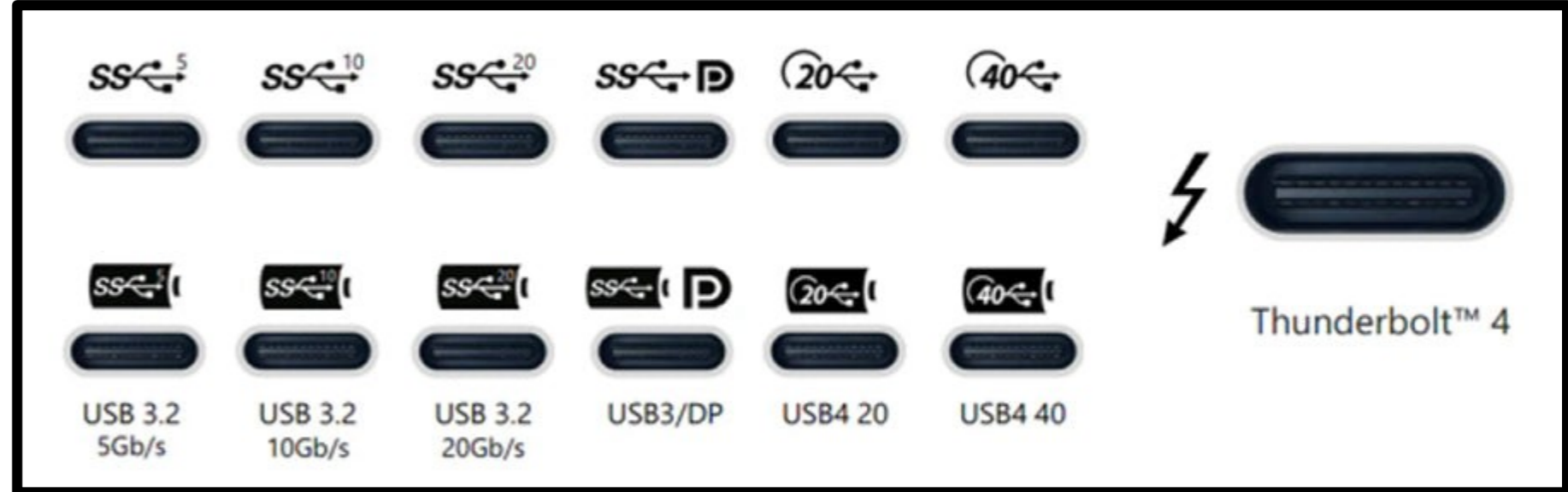
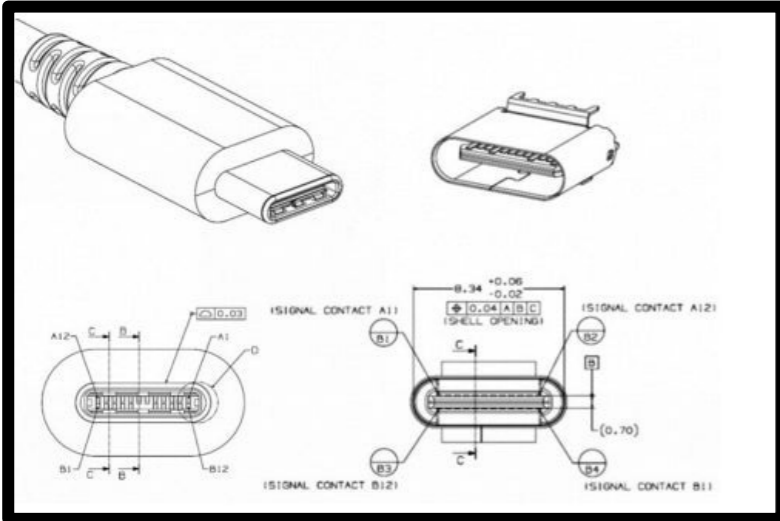
**IEEE**



**I E T F**<sup>®</sup>

- March 12 Class Notes Part 2

# Example of a standard: USB-C Voltage, length, data transfer



# Example of protocol standard: Wifi 802.11

## Wireless Standards 802.11a, 802.11b/g/n, and 802.11ac

	✓ PROS	✗ CONS
802.11b	Lowest cost; signal range is good and not easily obstructed	Slowest maximum speed; home appliances may interfere on the unregulated frequency band
802.11a	Fast maximum speed; regulated frequencies prevent signal interference from other devices	Highest cost; shorter range signal that is more easily obstructed
802.11g	Fast maximum speed; signal range is good and not easily obstructed	Costs more than 802.11b; appliances may interfere on the unregulated signal frequency
802.11n	Fastest maximum speed and best signal range; more resistant to signal interference from outside sources	Standard is not yet finalized; costs more than 802.11g; the use of multiple signals may greatly interfere with nearby 802.11b/g based networks

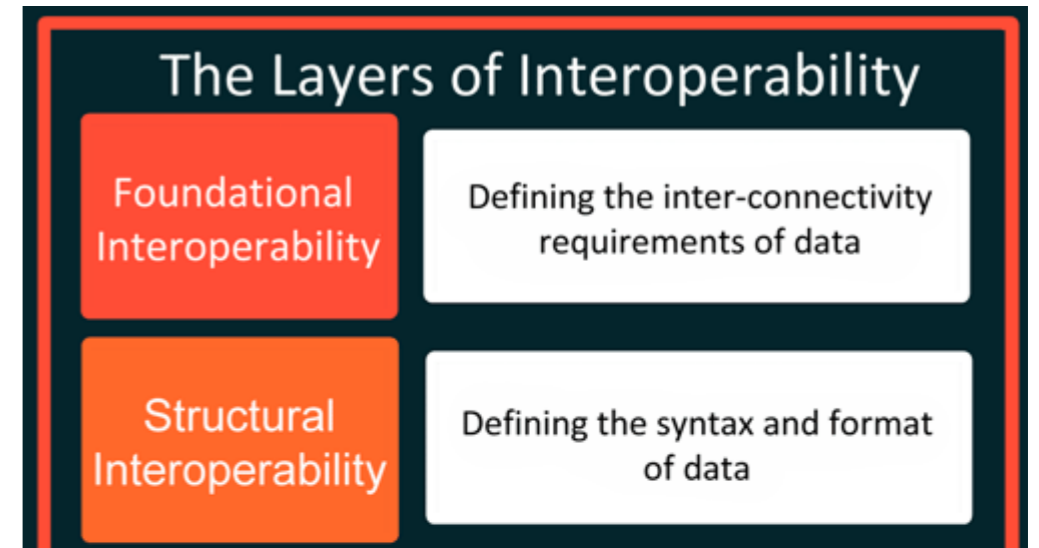
## 802.11 Wireless Standards

IEEE Standard	802.11a	802.11b	802.11g	802.11n	802.11ac
Year Adopted	1999	1999	2003	2009	2014
Frequency	5 GHz	2.4 GHz	2.4 GHz	2.4/5 GHz	5 GHz
Max. Data Rate	54 Mbps	11 Mbps	54 Mbps	600 Mbps	1 Gbps
Typical Range Indoors*	100 ft.	100 ft.	125 ft.	225 ft.	90 ft.
Typical Range Outdoors*	400 ft.	450 ft.	450 ft.	825 ft.	1,000 ft.

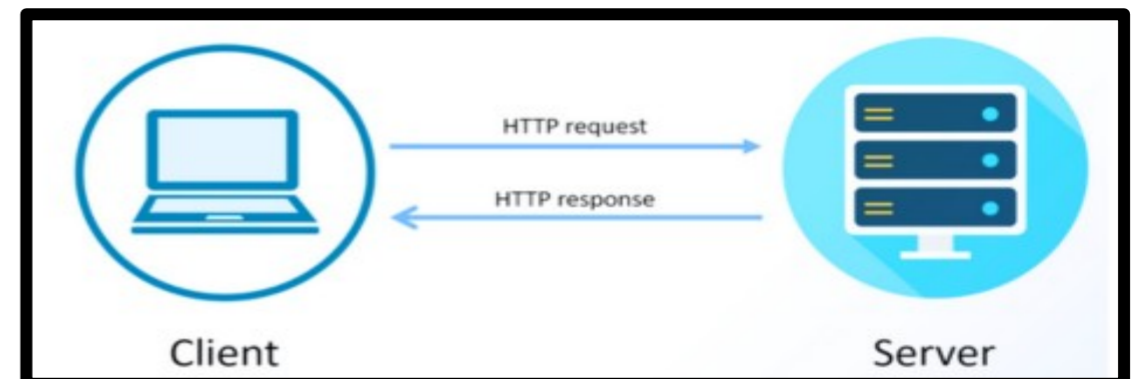
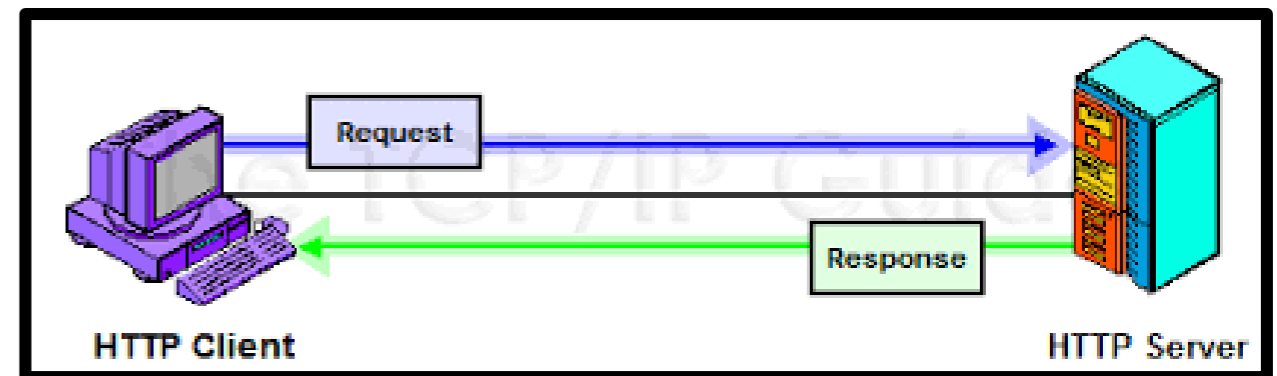
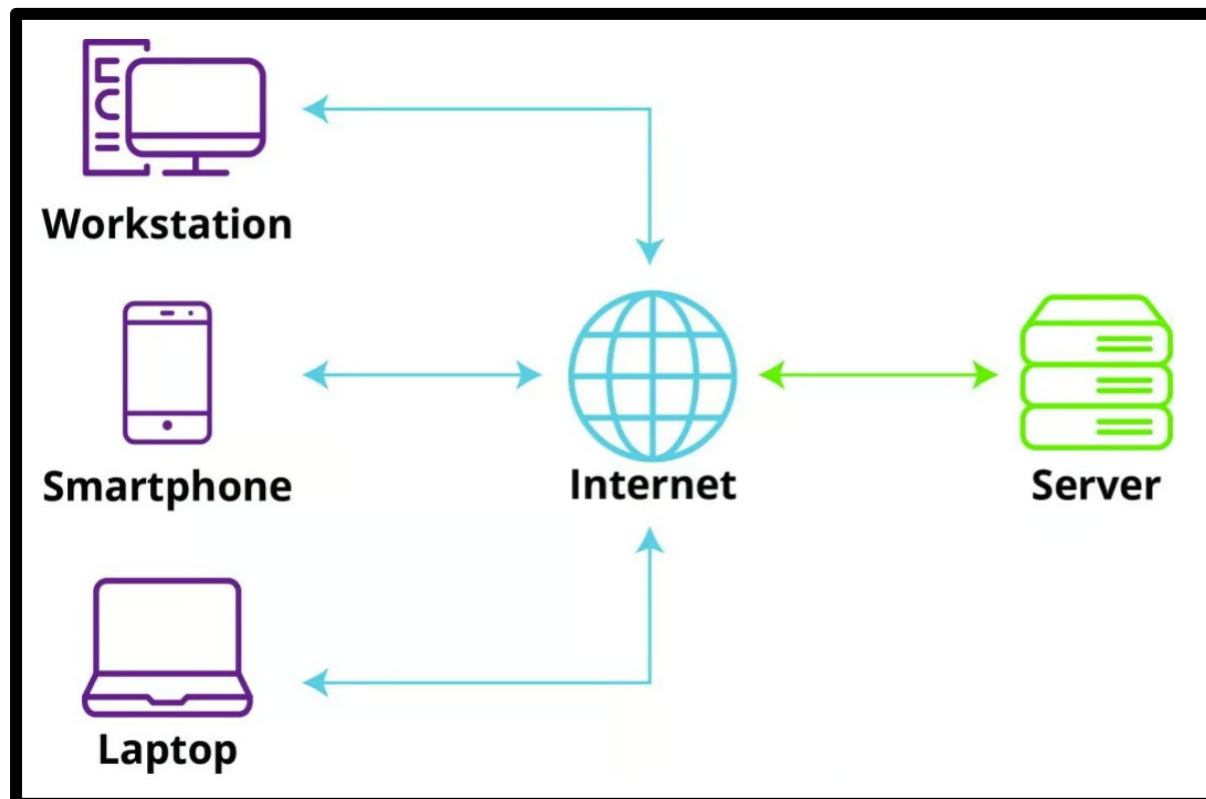
Standards making bodies use RFCs: Request for Comments

**R** Request  
**F** or  
**C** omments

Standards allow for interoperability

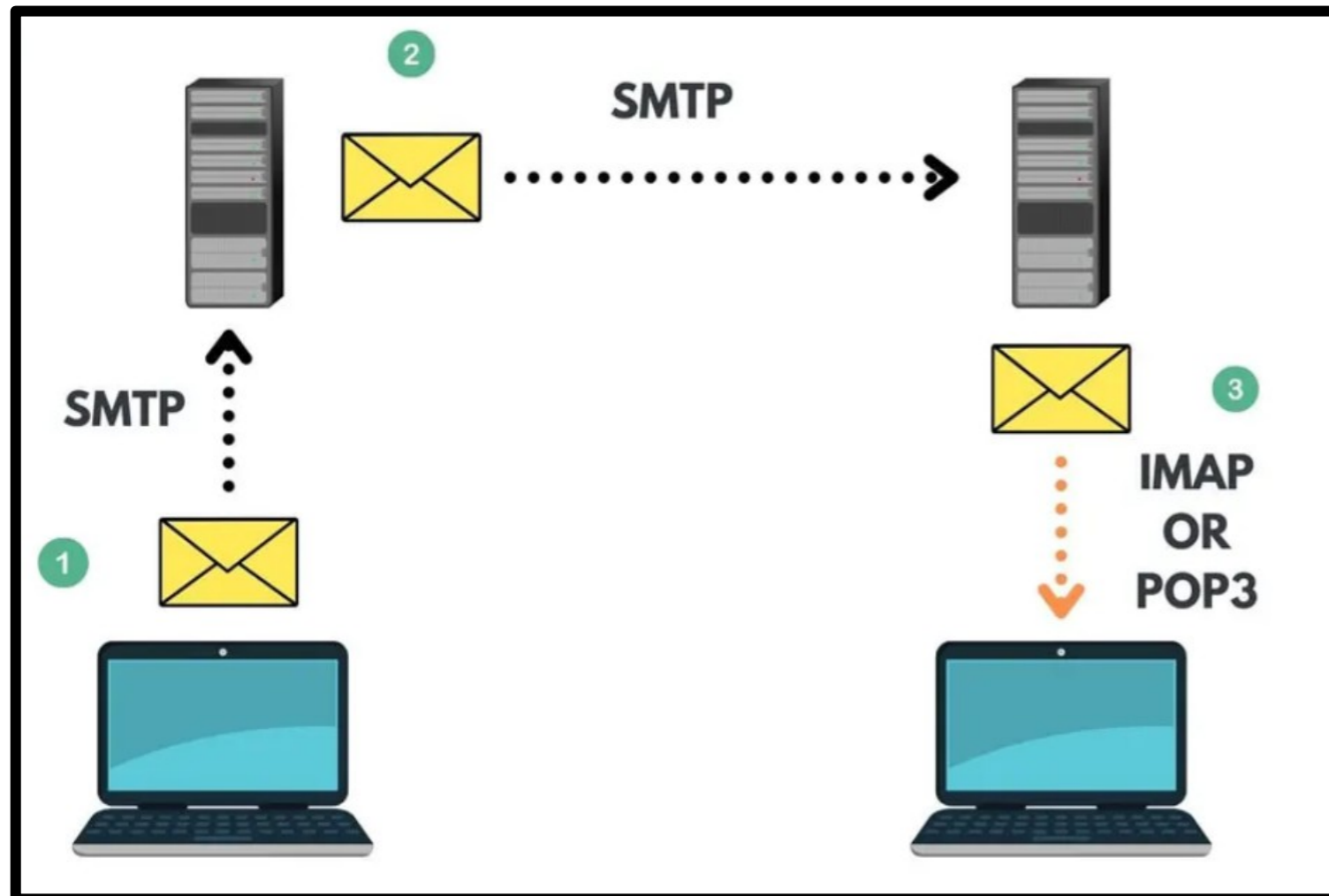


## Client-Server Model

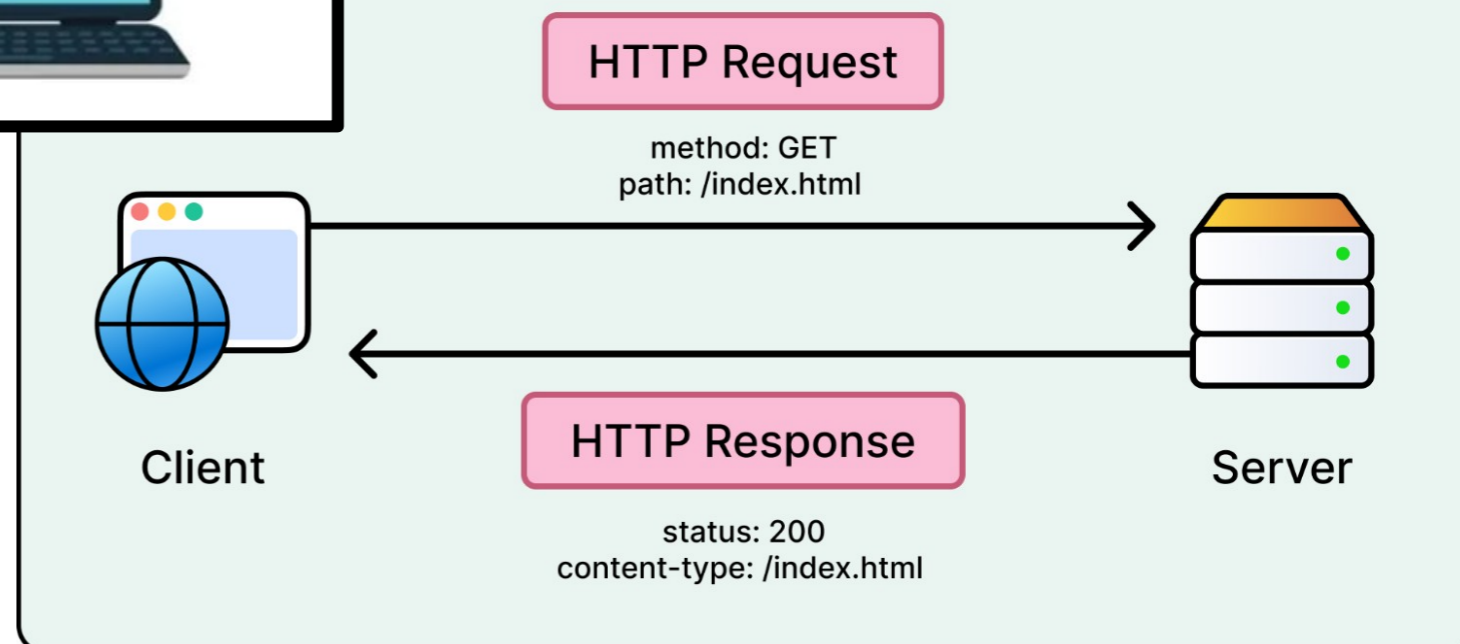


# Client-Server Process uses protocols to communicate:

SMTP & IMAP [email]  
HTTP [Web]



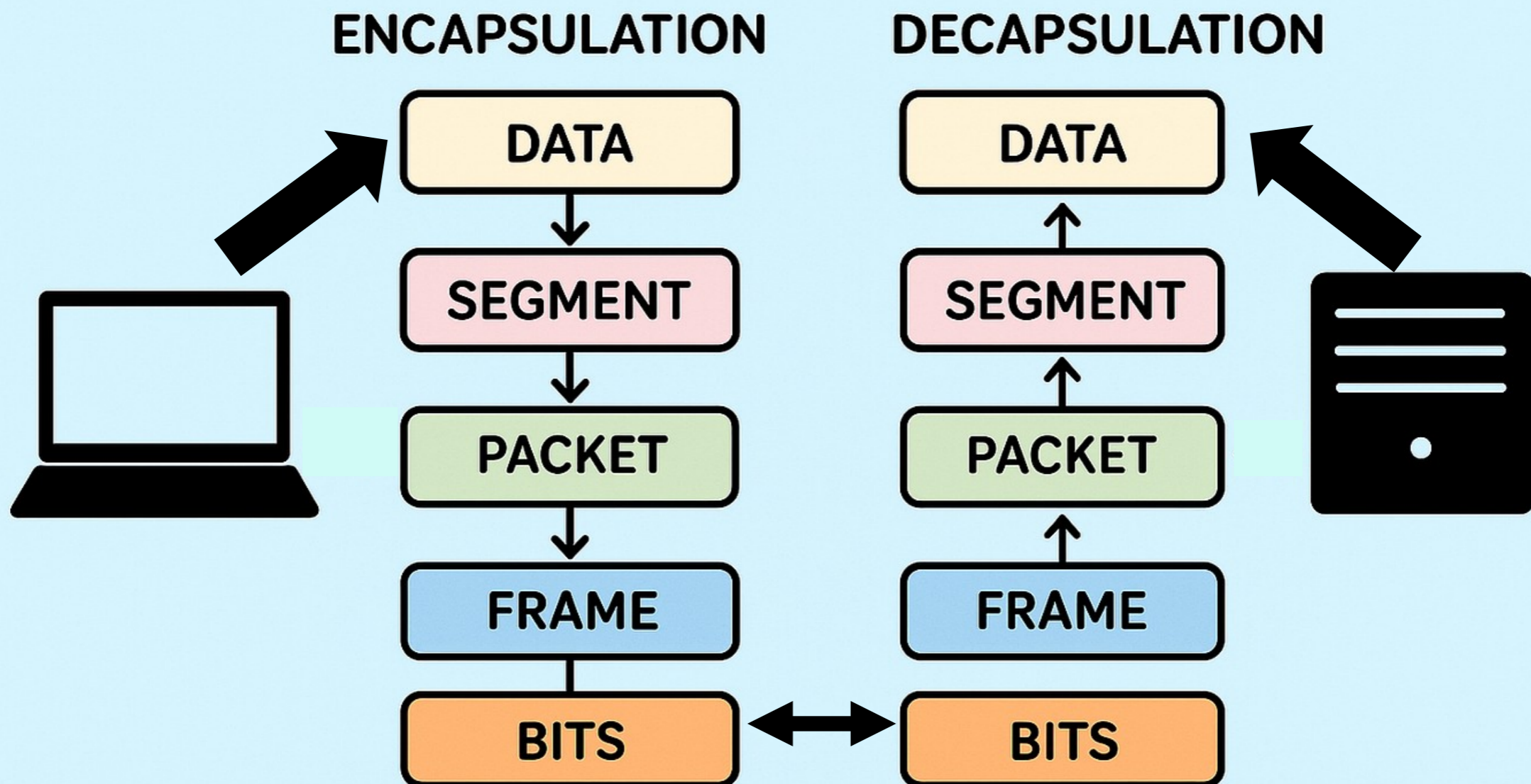
## Client Server Using HTTP



# Data Encapsulation

Each layer is placed in envelope  
Information added at each level

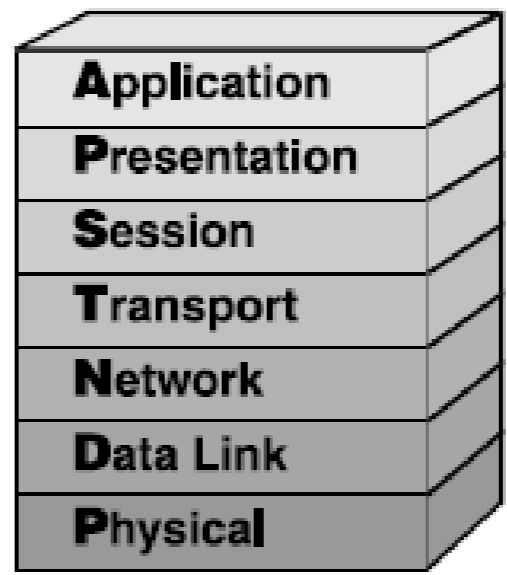
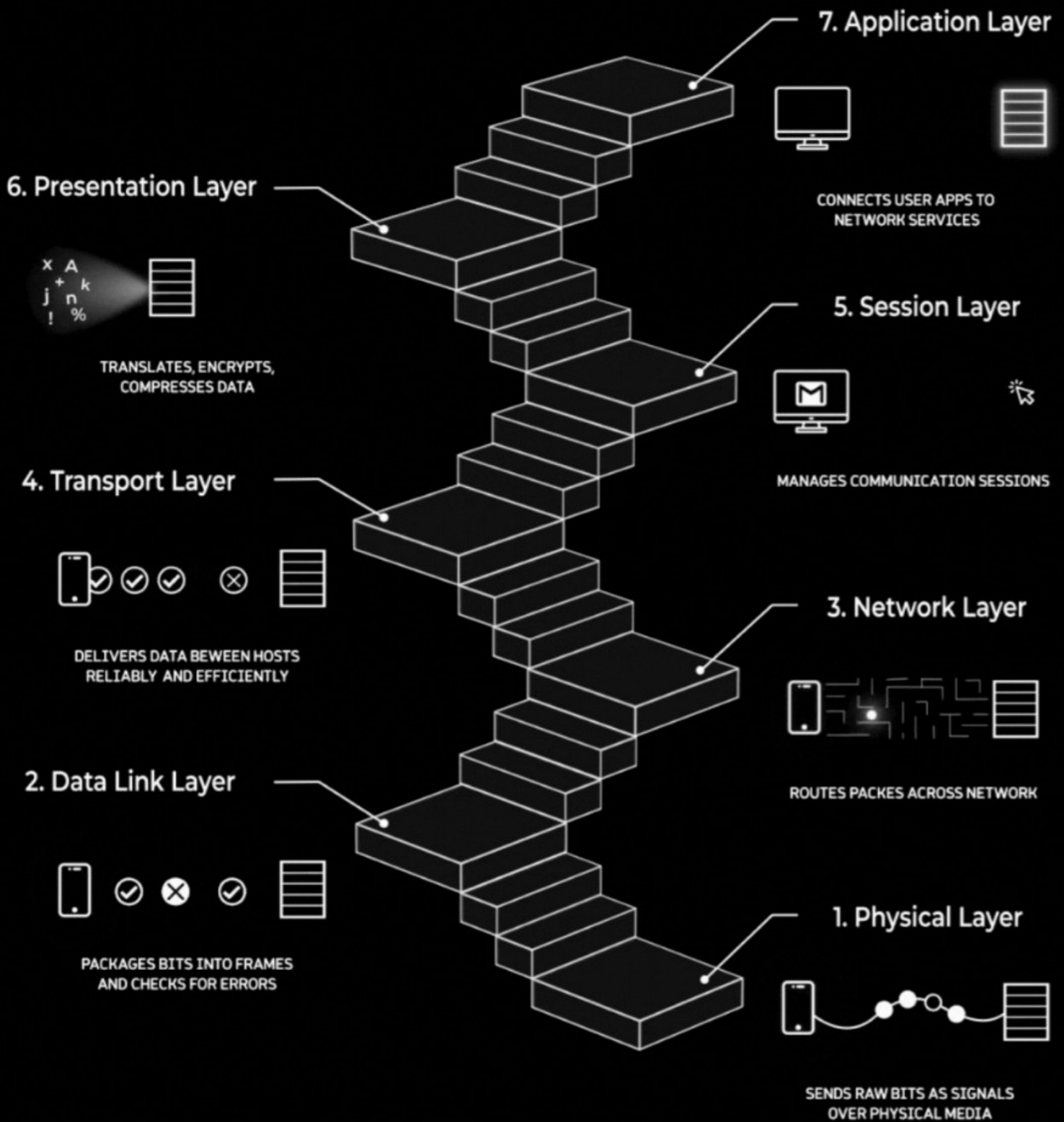
## DATA ENCAPSULATION AND DECAPSULATION



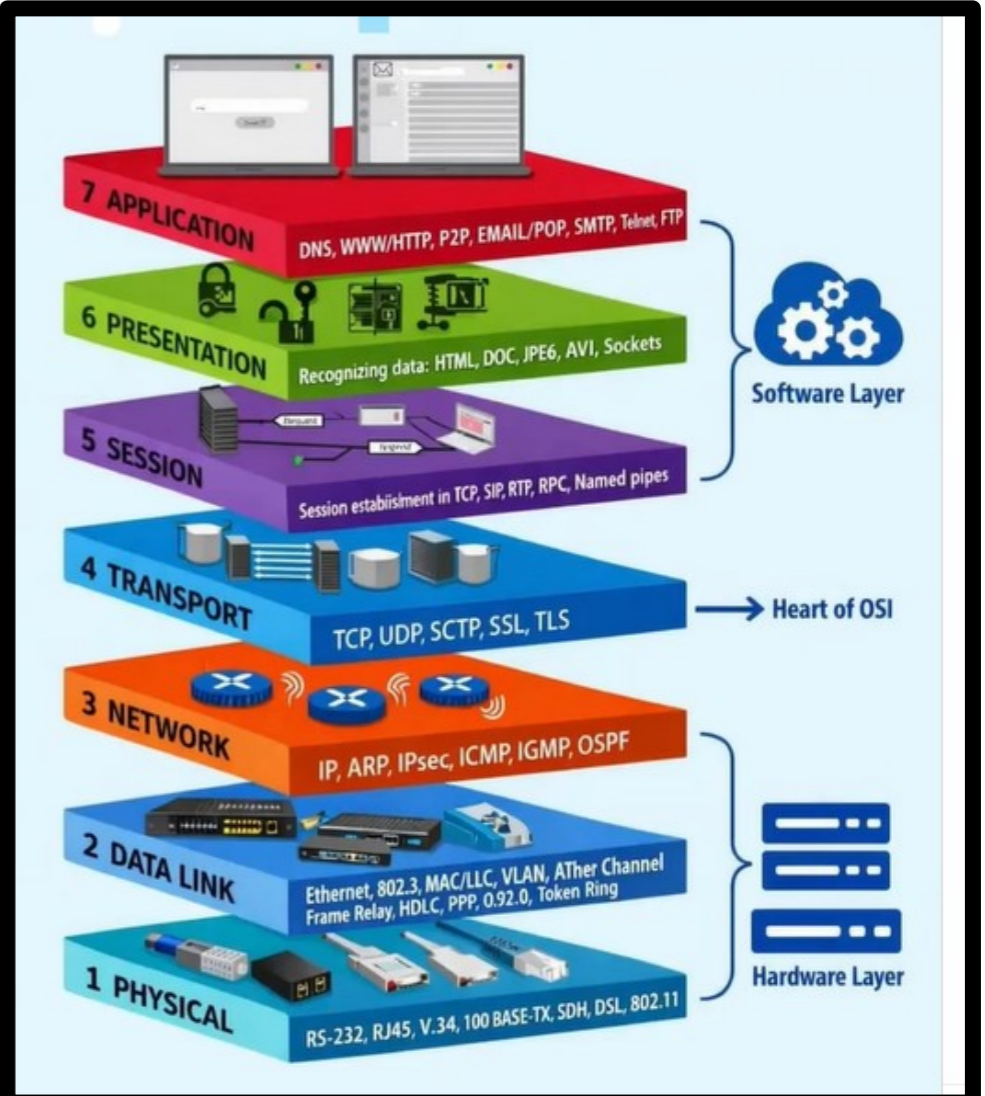
# OSI Model – 7 Layers

## OSI MODEL

© NEO KIM



All  
People  
Seem  
To  
Need  
Data  
Processing



# OSI Model – 7 Layers

## OSI Model

Data	Layer	
Data	Application Network Process to Application	Email, browser
Data	Presentation Data Representation and Encryption	.doc, .jpeg
Data	Session Interhost Communication	Est. connections
Segments	Transport End-to-End Connections and Reliability	TCP & UDP
Packets	Network Path Determination and IP (Logical Addressing)	IP addresses
Frames	Data Link MAC and LLC (Physical addressing)	MAC, topology
Bits	Physical Media, Signal, and Binary Transmission	Cables, connectors



All



People



Seem



To



Need



Data



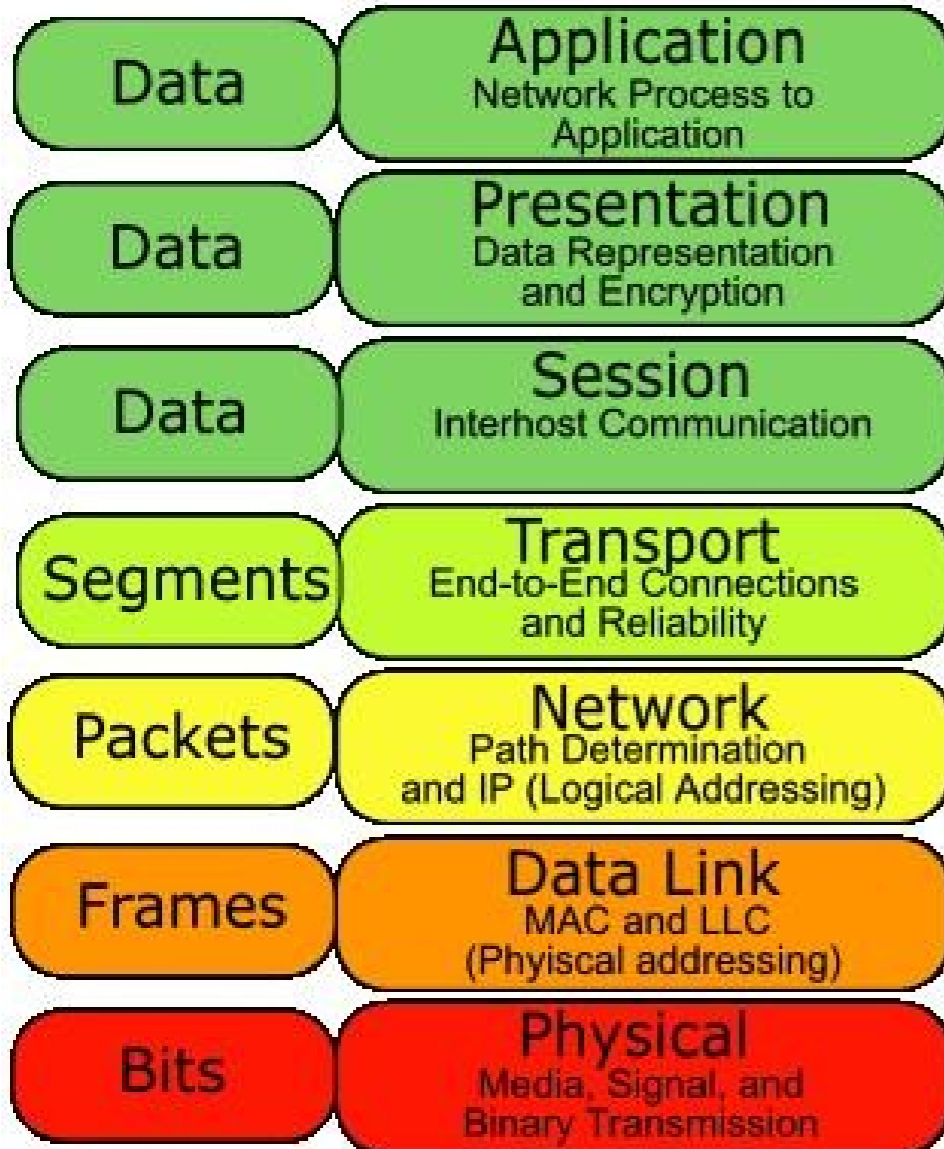
Processing

# OSI Model

Allows for changes; Modularity; Layering

## OSI Model

### Data Layer



Email, browser

.doc, .jpeg

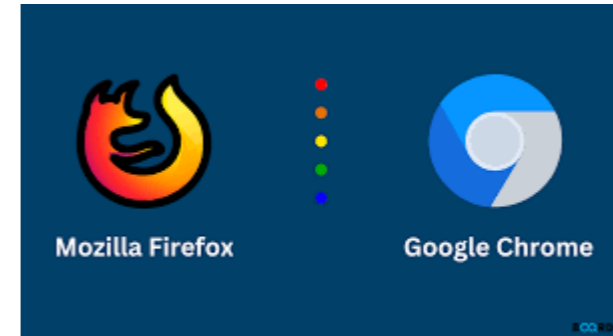
Est. connections

TCP & UDP

IP addresses

MAC, topology

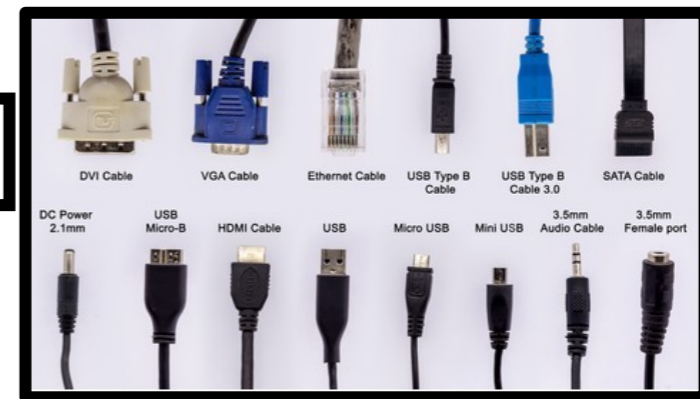
Cables, connectors



Change application



Change IP address

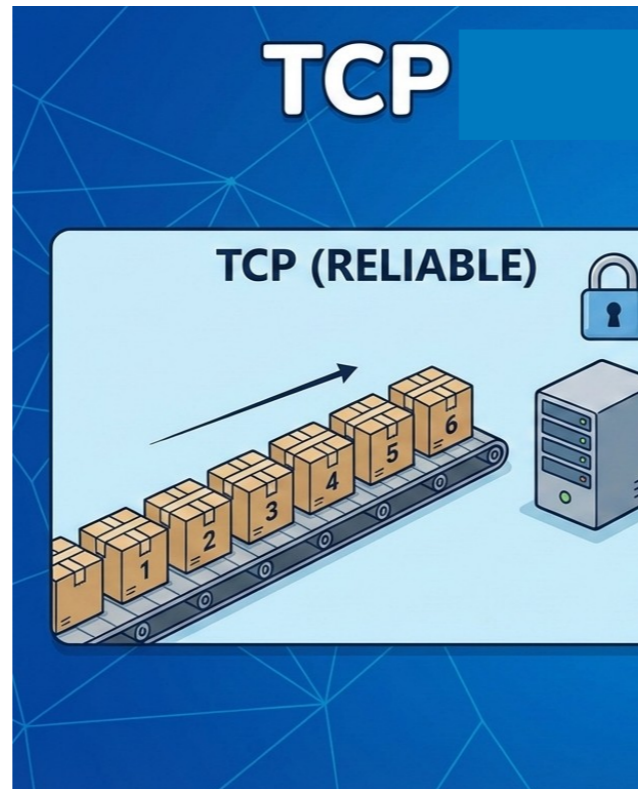


Change cables

# TCP vs UDP

## TCP

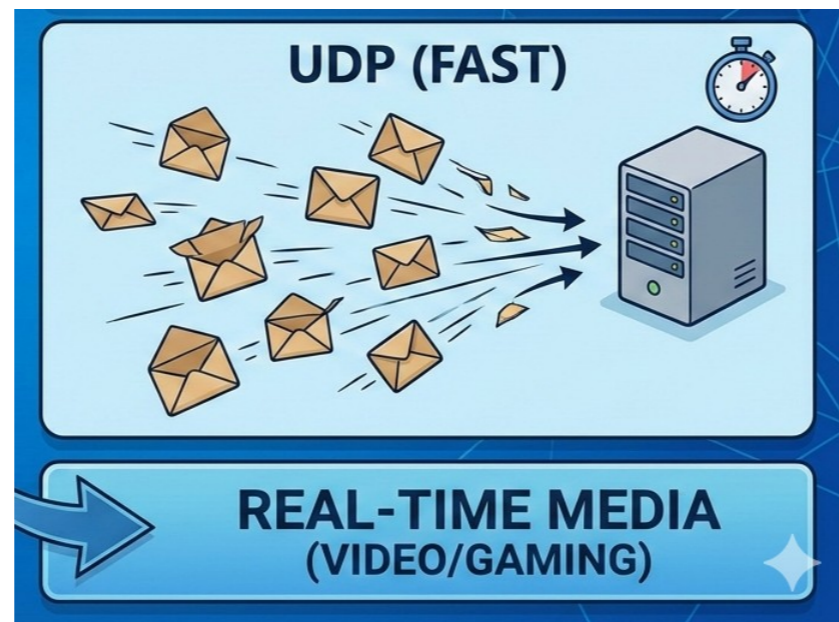
Host to Host; reliable



TCP

- **Slower but reliable transfers**
- **Typical applications:**
  - Email
  - Web browsing

UDP  
connectionless;  
broadcast;  
fast

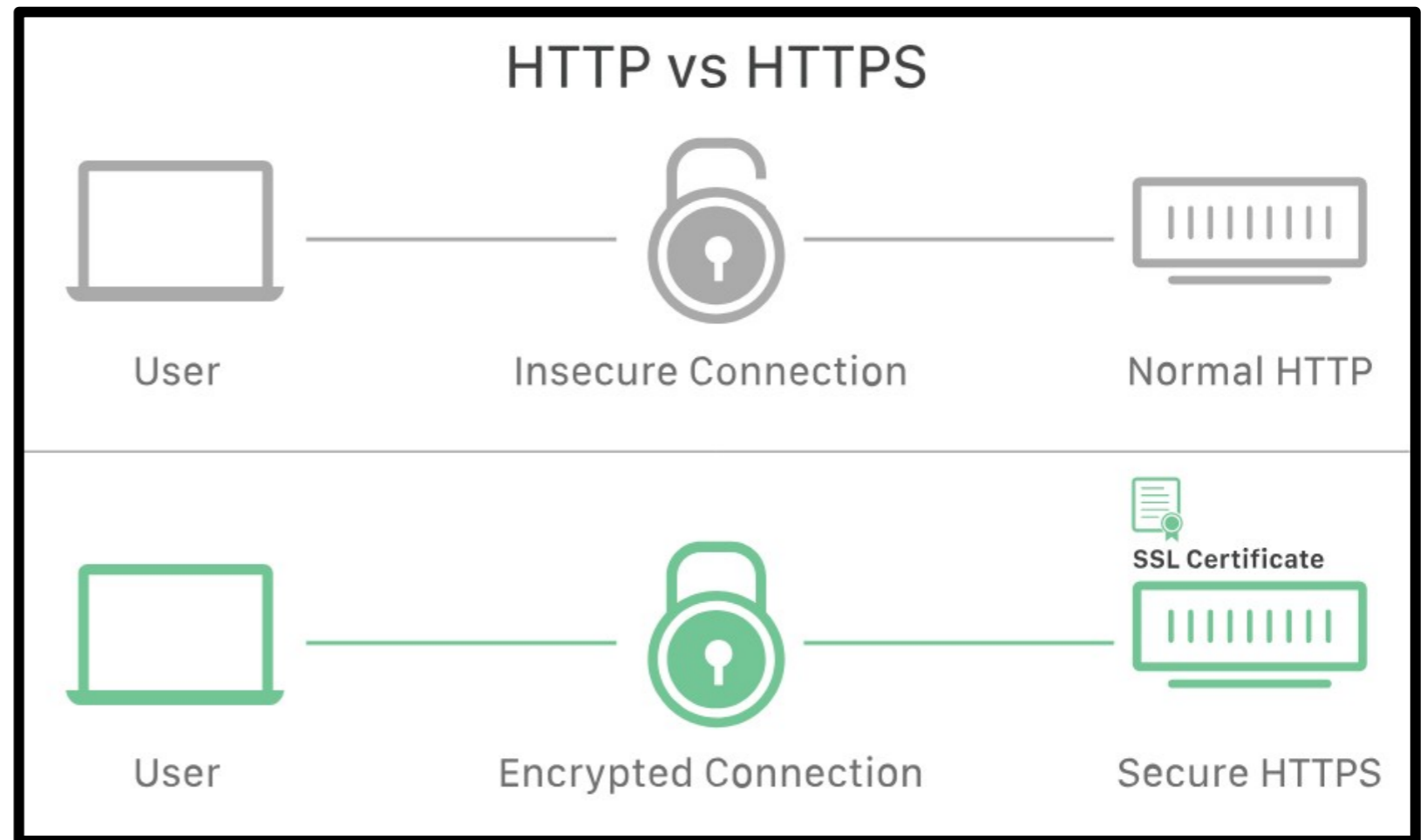
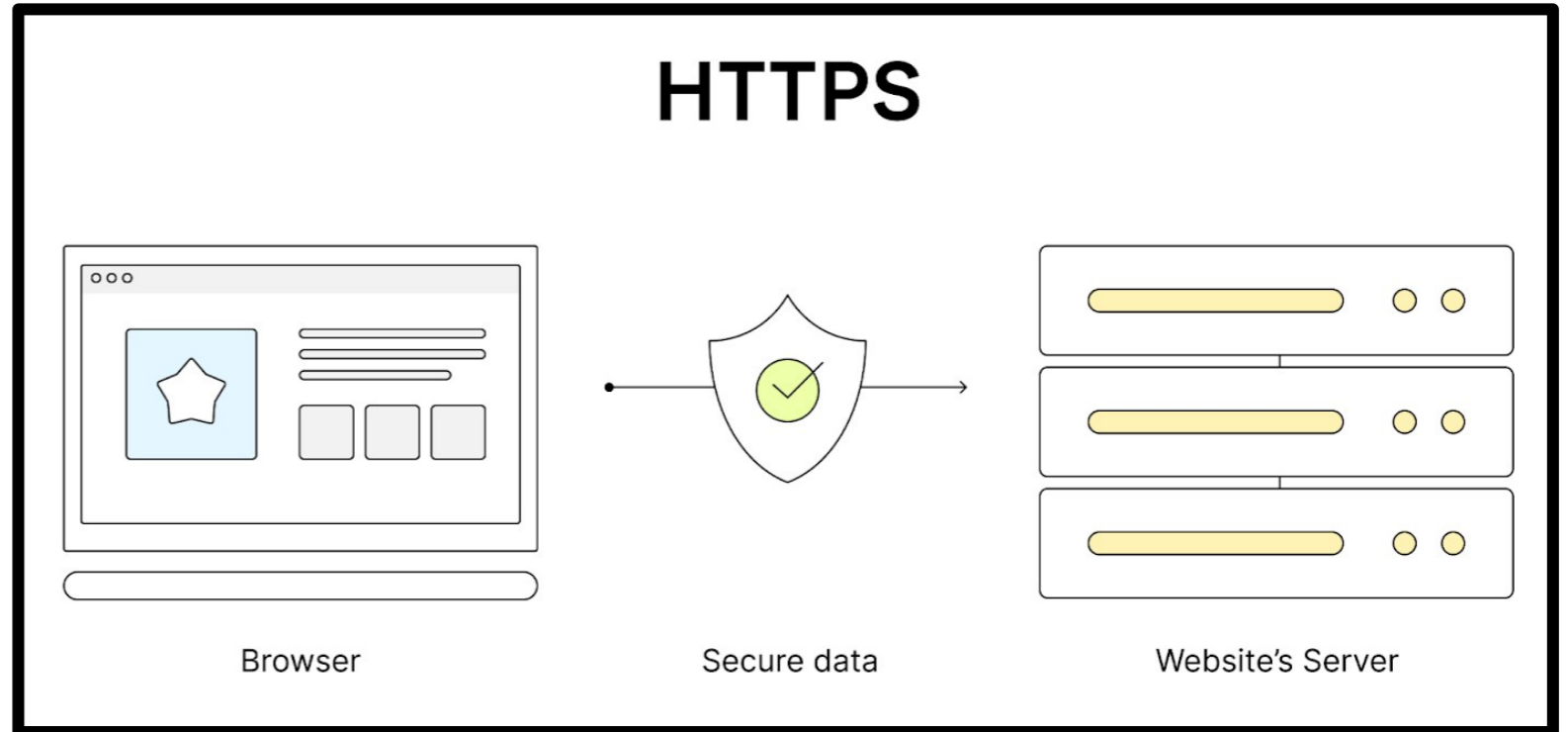


UDP

- **Fast but non-guaranteed transfers ("best effort")**
- **Typical applications:**
  - VoIP
  - Music streaming

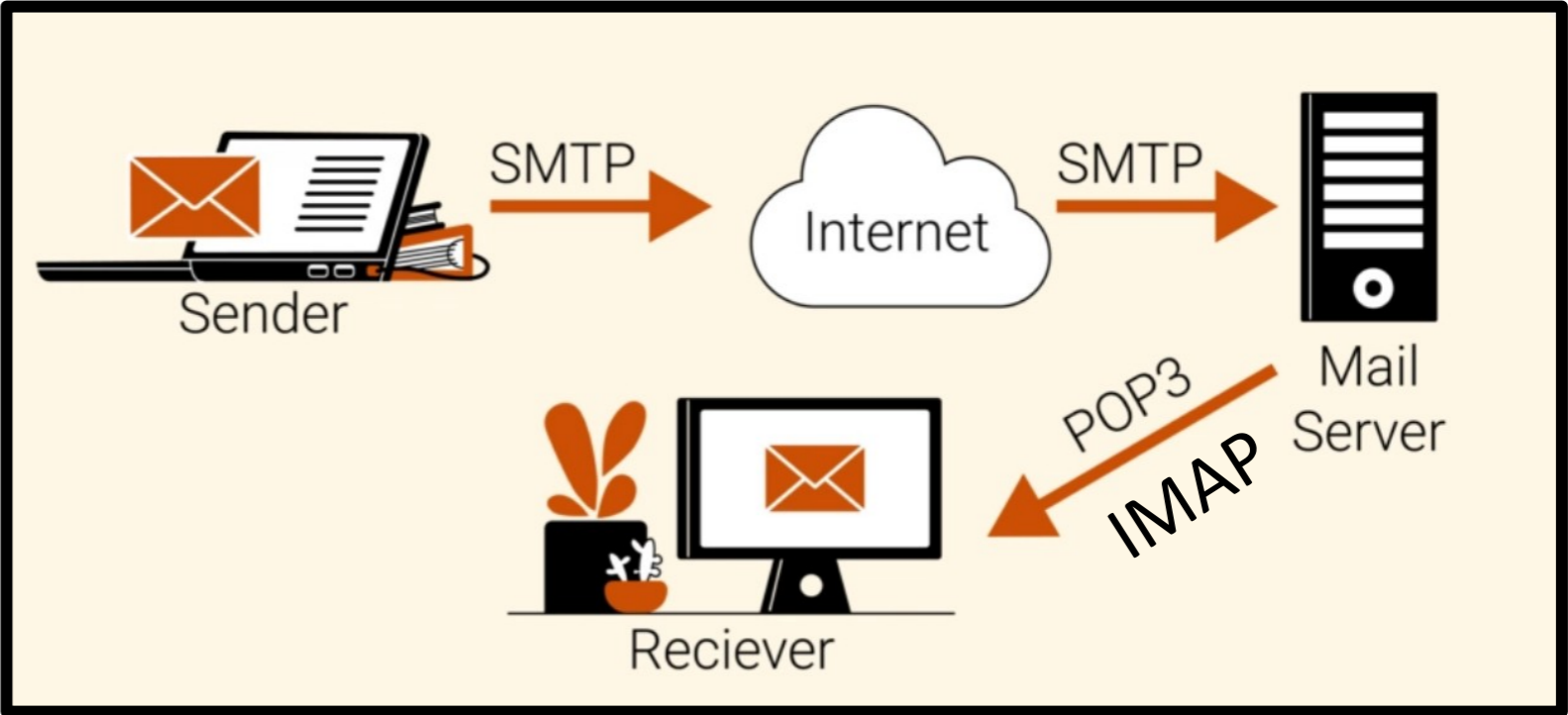
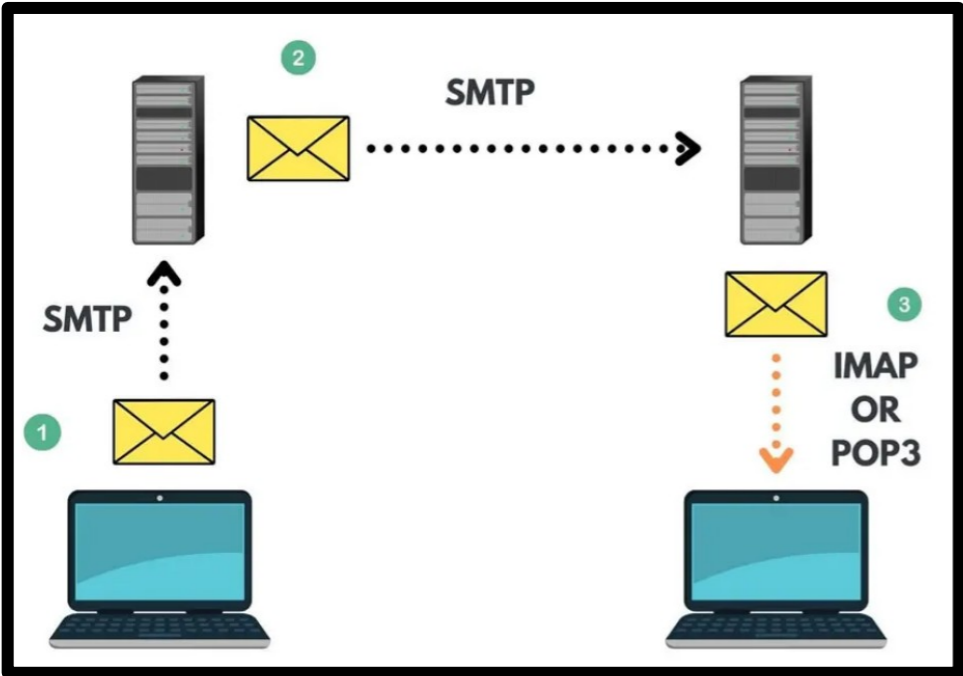
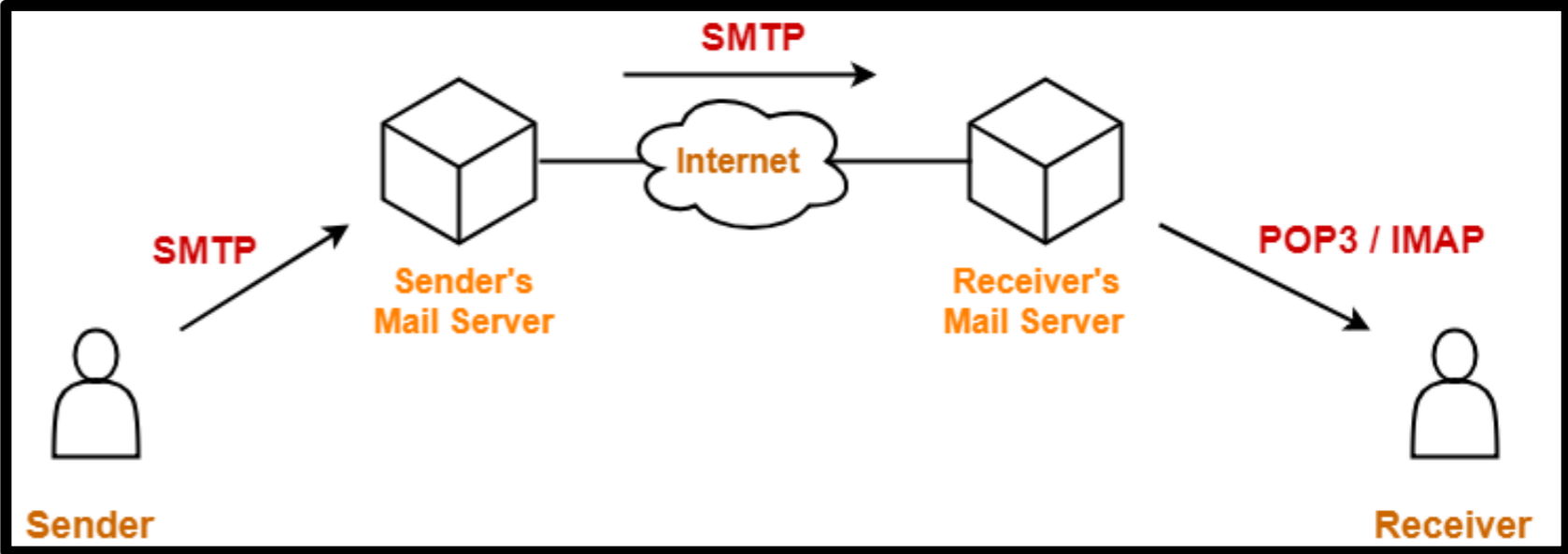
# Protocol Review

http: not secure  
https: secure;  
browser adds  
protocol



# Protocol Review

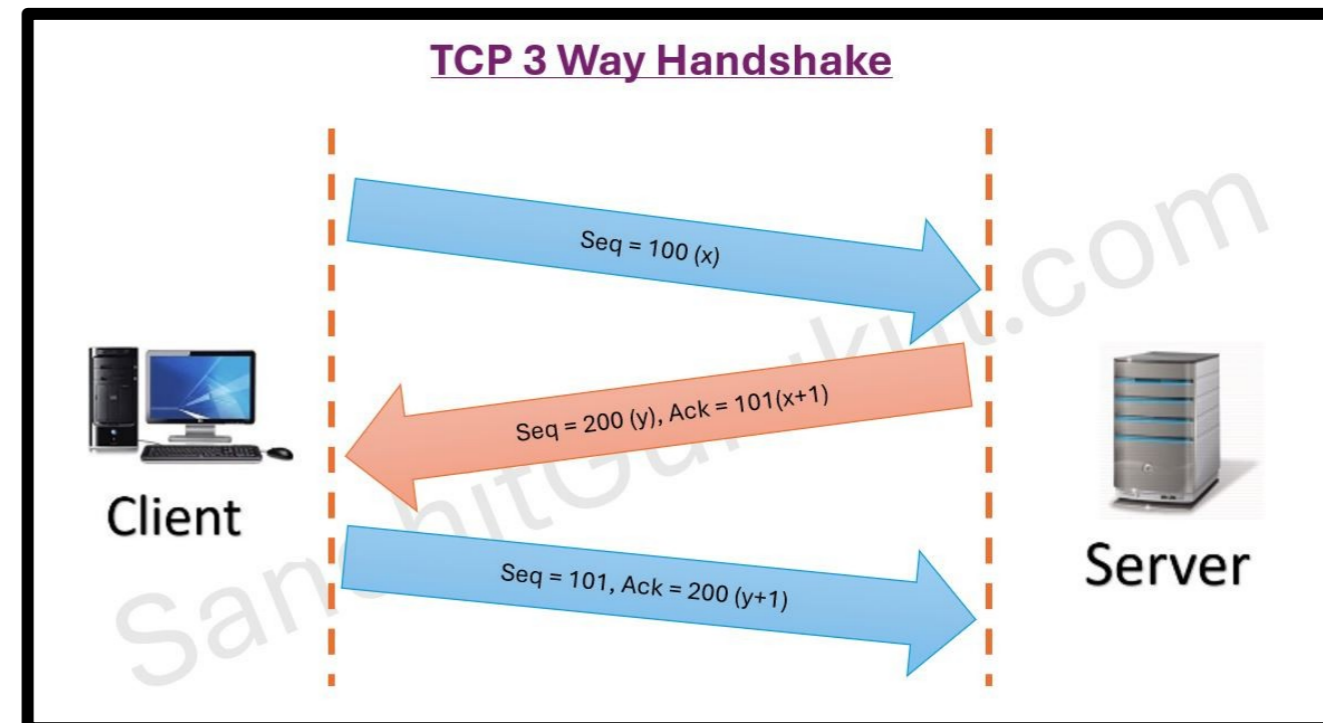
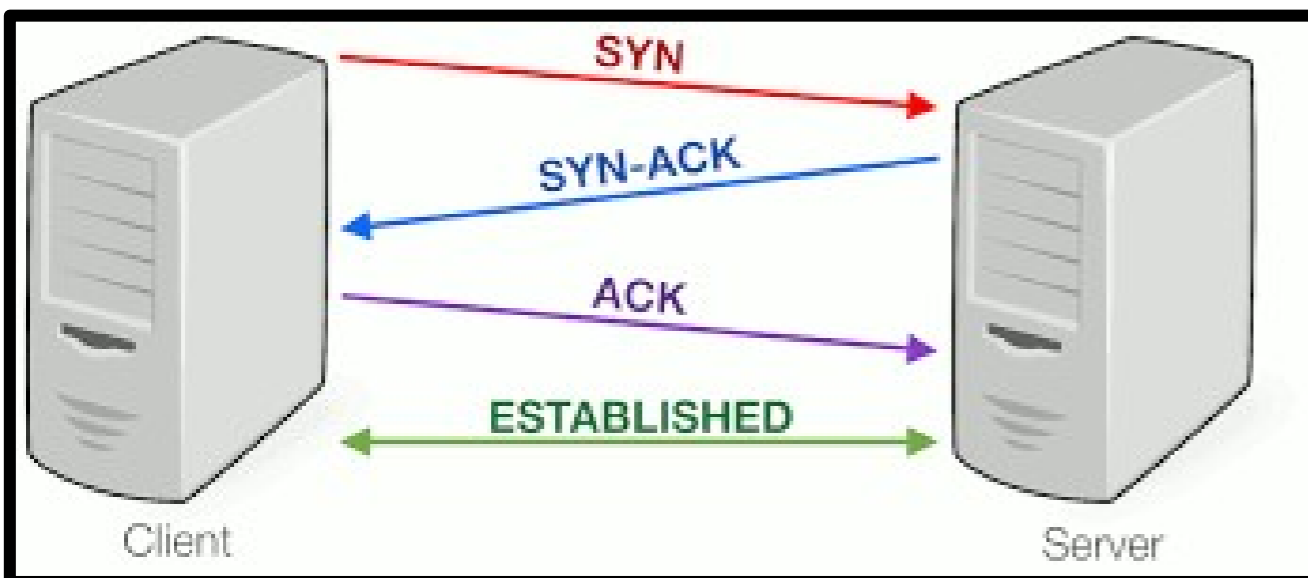
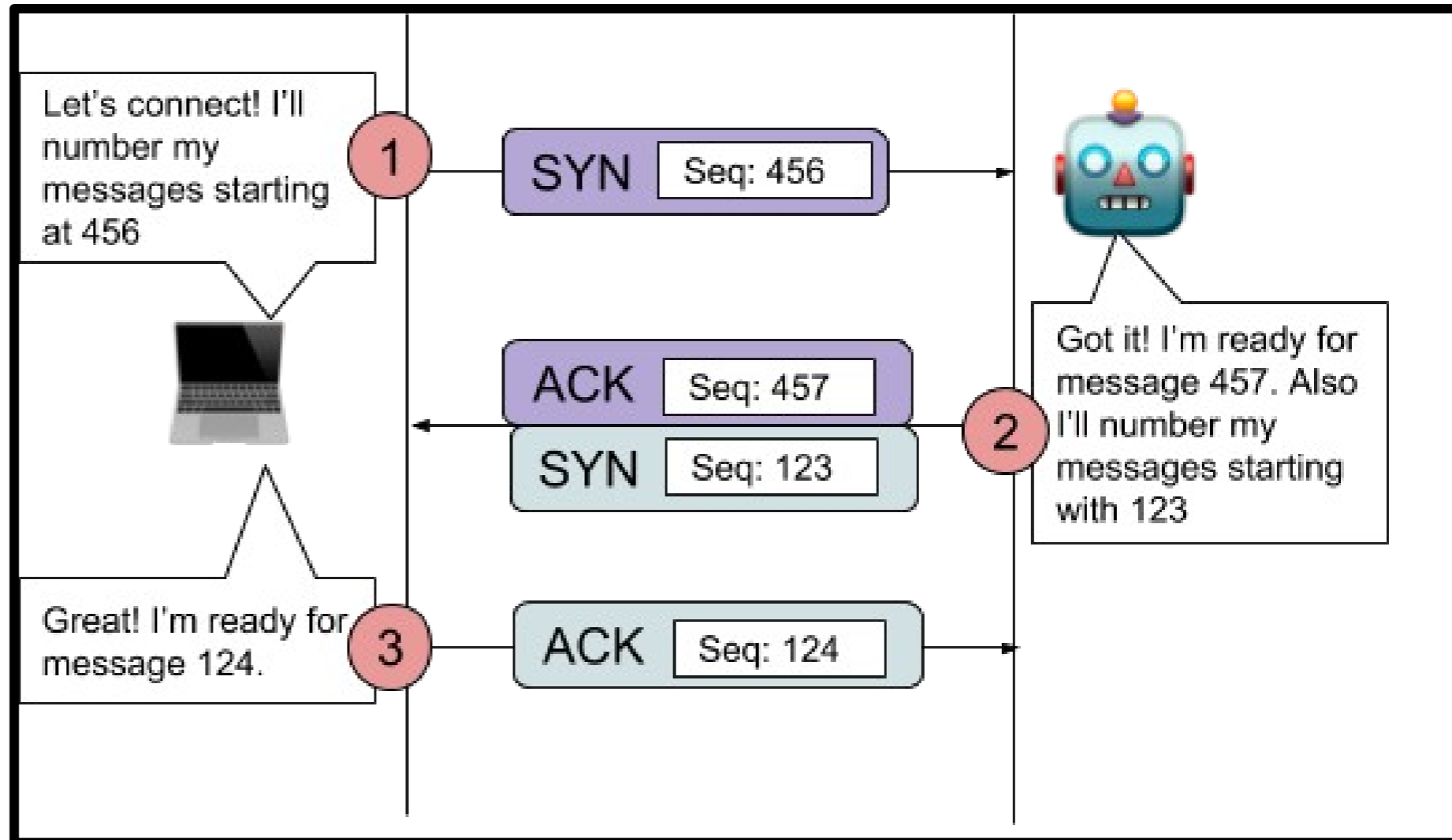
Email: knows SMTP, IMAP, POP3 protocols



# Protocol Review

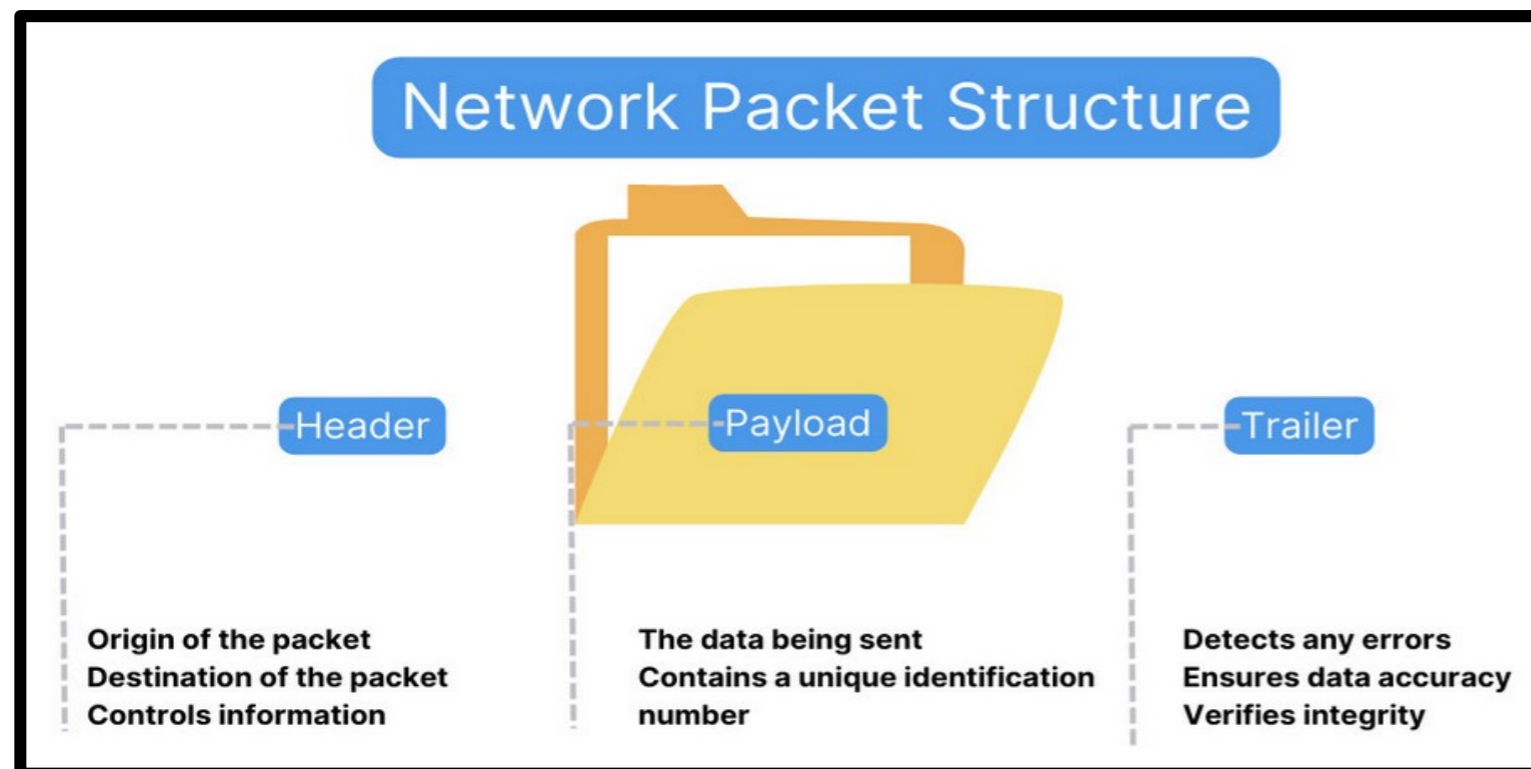
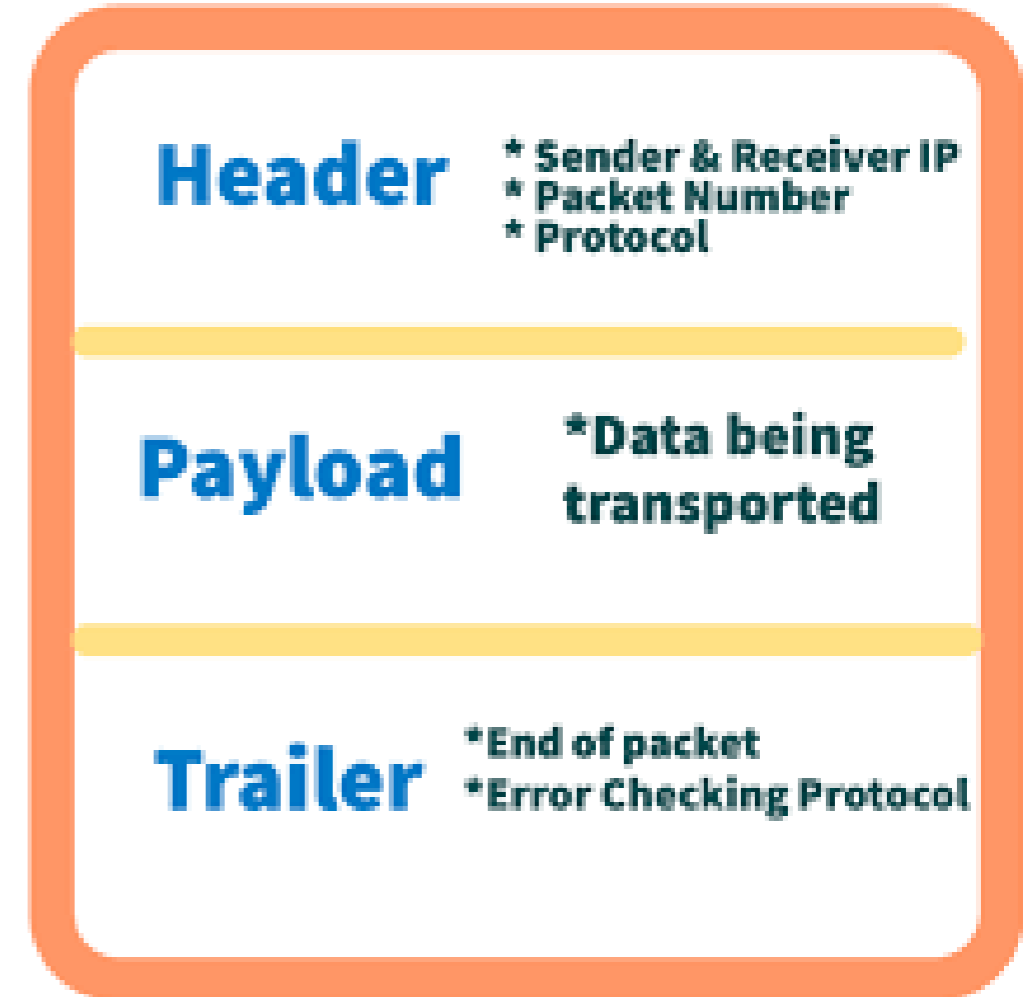
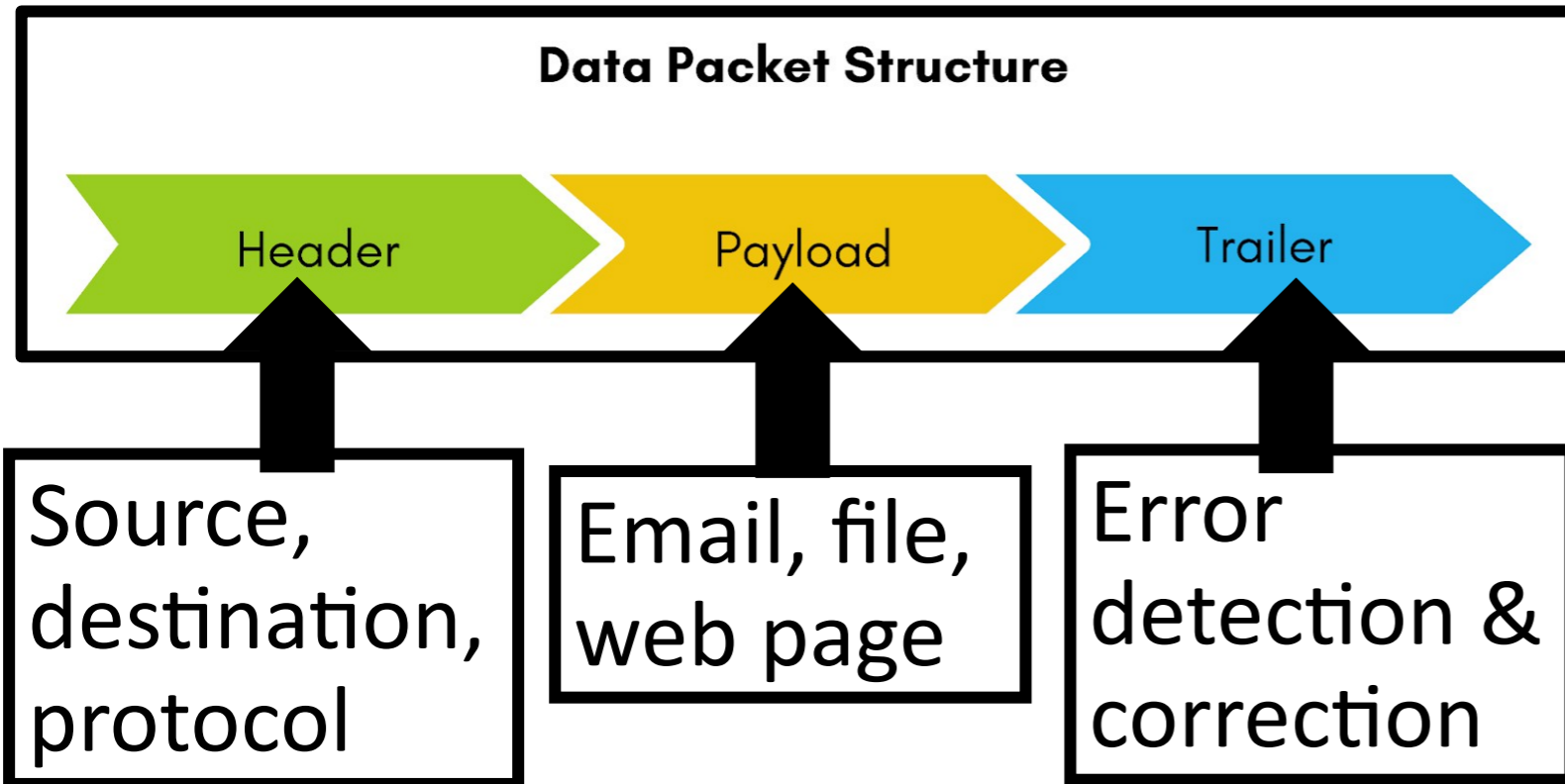
TCP handshake:  
3 way to  
confirm  
connection

SYN:  
Synchronize  
ACK:  
Acknowledge



# Message Syntax

3 pieces: Trailer, Data/Payload, Header



# Error Detection known as CRC

Error detection: divide by prime #; get a remainder; should be the same as sender; if not, something was corrupted

Remainder calculated by sender

Data sent to receiver

Data received

Remainder calculated by receiver



**The Remainder**  
is the portion of the dividend that cannot be fairly divided by the divisor.

$$\begin{array}{r} 5 \rightarrow \text{quotient} \\ \text{divisor} \leftarrow 2 \overline{) 11} \rightarrow \text{dividend} \\ \underline{-10} \\ 1 \rightarrow \text{remainder} \end{array} \quad \rightarrow \quad 11 \div 2 = 5 R 1$$

Request resend of message [TCP]

Different remainder; message corrupted

Same remainder; message intact



Error sending file  
Your file couldn't be sent at this time.  
Please try again later.

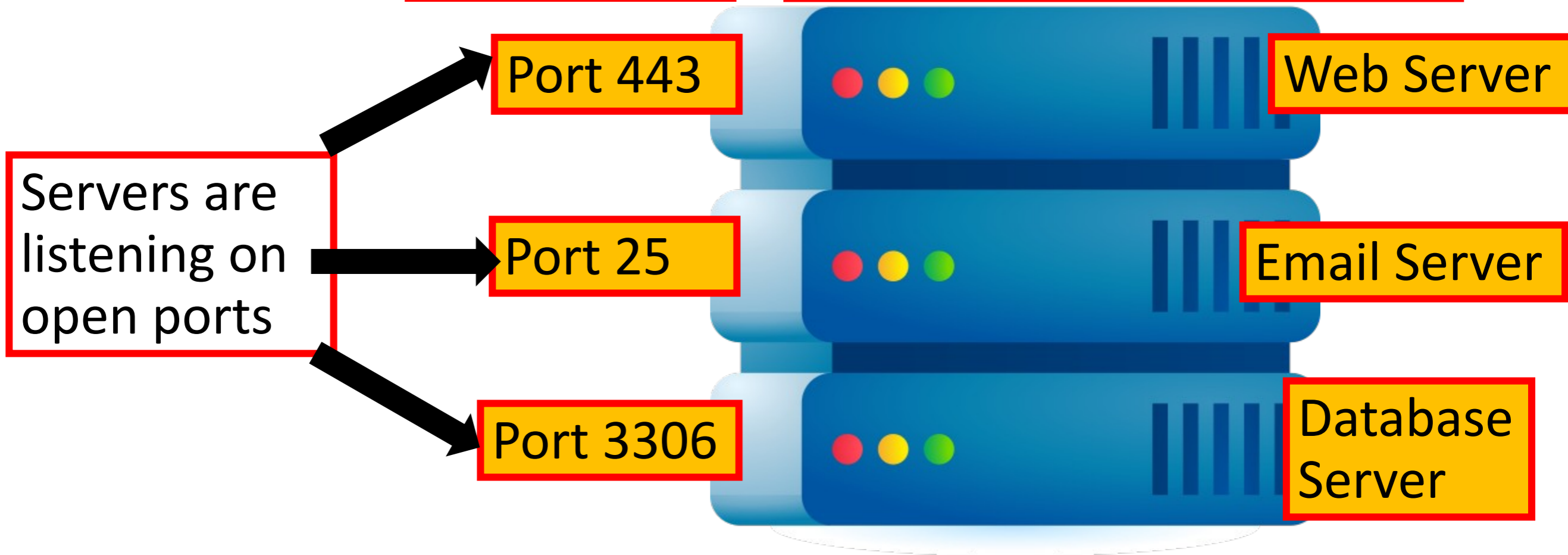


# Ports

Port Numbers: identify particular service or application on server

Service Ports

1 Physical Computer Server



[www.yahoo.com:443](https://www.yahoo.com:443) - connect to Yahoo.com on secure server port number 443

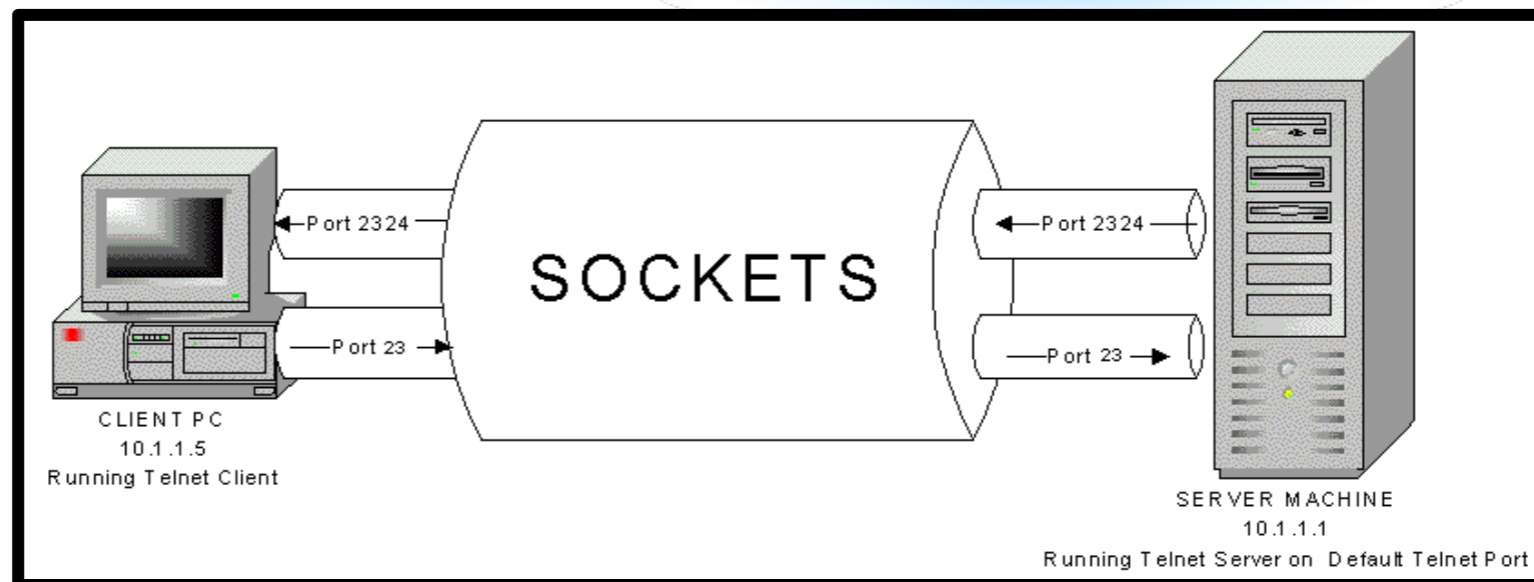
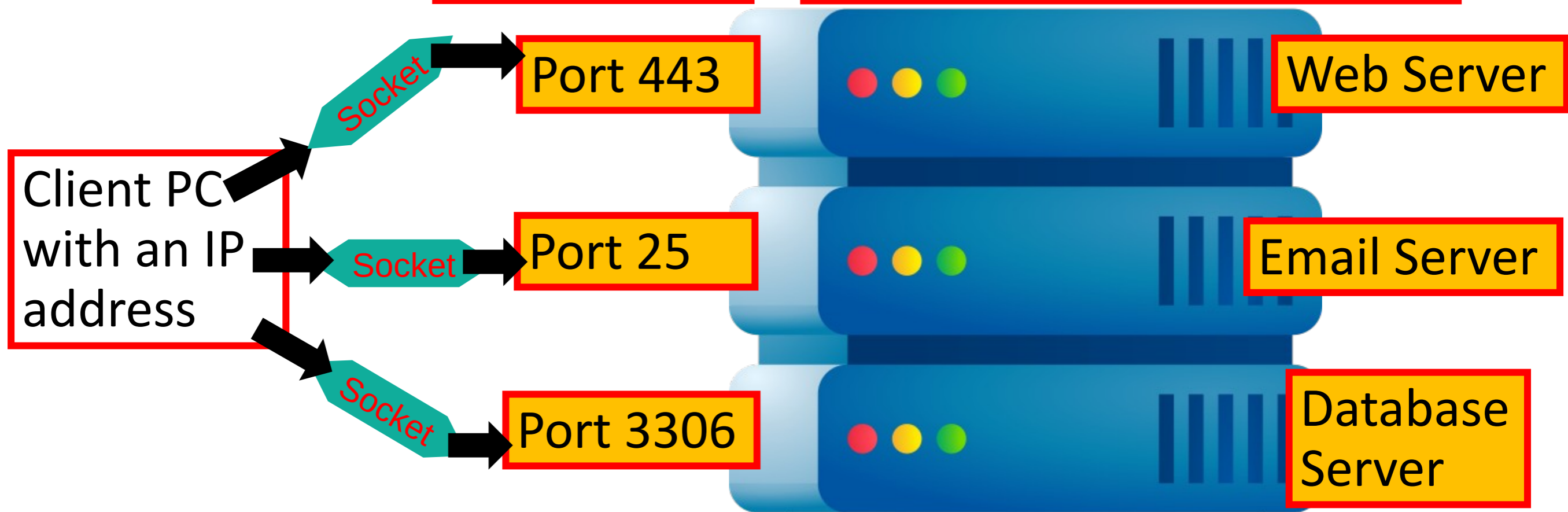
[www.yahoo.com:80](http://www.yahoo.com:80) - connect to Yahoo.com on regular server port number 80

# Sockets

Socket is an IP address plus a port number

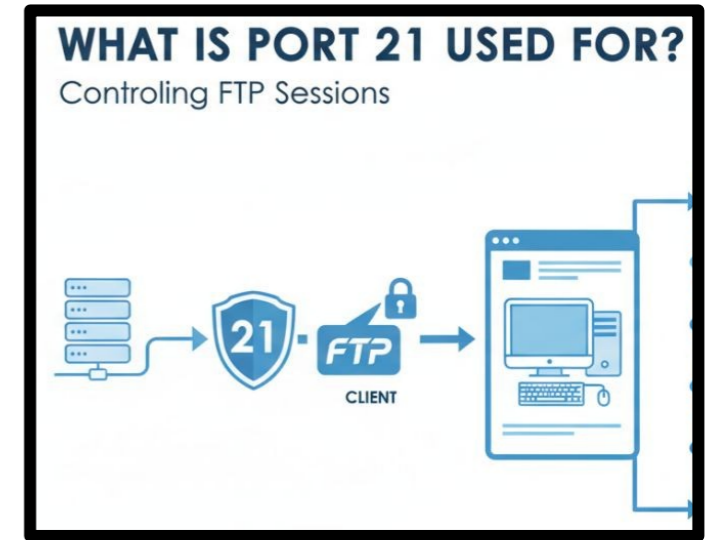
Service Ports

1 Physical Computer Server



# Ports Details

65,535 ports in total  
Each is a different service



## Service Ports

## Service or Application

Port 21

ftp: file transfer protocol

Port 23

telnet: connect to another computer

Port 80

http: regular web server

Port 25

SMTP: email server

Port 443

https: secure web server

Port 37

Time protocol: used for logs, receipts, transactions

PORT

443

SERVICE

HTTPS

HYPERTEXT  
TRANSFER  
PROTOCOL  
SECURE

# Ports Details

3 categories of ports:  
Well known– Registered ports – Dynamic Ports

Category

Port numbers

Well Known

1-1023; standard ports across all operating systems

Registered

1024-49151; bought by corporations; not universal!

Dynamic

49151-65535; return information to client, ie: web server information

## NETWORK PORTS

Well-known Ports

0 - 1023

Registered Ports

1024 - 49151

Dynamic Ports

49152 - 65535

### WELL-KNOWN PORTS



Ports 0-1023

"The Front Door"  
(HTTP, SSH, DNS)

### EPEHERMAL PORTS



Ports 49152- 65535

"The Return Address"  
(Temporary, Random)

# Ports Details

## How Do Dynamic Ports Work? Randomly Selected

Web Client  
Computer



Request from  
client



Port  
80

Web Server

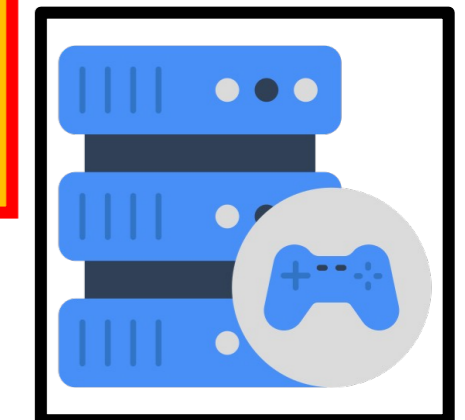


Data from  
server



Comes back on  
random dynamic  
port, ie:  
Port 49153  
Port 50181

Note: can be  
a web server,  
email server,  
game server



# Encoding

Taking data and turning it into 0s and 1s  
Text into data

ASCII: American Standard Code for Information Interchange

ASCII	Char	Hex	Bin
81	Q	51	0101 0001
82	R	52	0101 0010
83	S	53	0101 0011
84	T	54	0101 0100
85	U	55	0101 0101



Computer interprets capital "S" as the number "83" when the capital "S" is pressed on the keyboard

# Encoding

## Other character sets used

### Kanji: Japanese characters

行 \ 列	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	NUL	DLE	SP	0	@	P	`	p	↑	↑	未定義	ー	夕	ミ	↑	↑
1	SOH	DC1	!	1	A	Q	a	q	↑	↑	。	ア	チ	ム	↑	↑
2	STX	DC2	"	2	B	R	b	r	↑	↑	「	イ	ツ	メ	↑	↑
3	ETX	DC3	#	3	C	S	c	s	↑	↑	」	ウ	テ	モ	↑	↑
4	EOT	DC4	\$	4	D	T	d	t	↑	↑	、	エ	ト	ヤ	↑	↑
5	ENQ	NAK	%	5	E	U	e	u	未定義	未定義	・	オ	ナ	ユ	未定義	未定義
6	ACK	SYN	&	6	F	V	f	v	未定義	未定義	ヲ	カ	ニ	ヨ	未定義	未定義
7	BEL	ETB	'	7	G	W	g	w	未定義	未定義	ア	キ	ヌ	ラ	未定義	未定義
8	BS	CAN	(	8	H	X	h	x	未定義	未定義	イ	ク	ネ	リ	未定義	未定義
9	HT	EM	)	9	I	Y	i	y	未定義	未定義	ウ	ケ	ノ	ル	未定義	未定義
10	LF	SUB	*	:	J	Z	j	z	未定義	未定義	エ	コ	ハ	レ	未定義	未定義
11	VT	ESC	+	;	K	[	k	{	未定義	未定義	オ	サ	ヒ	ロ	未定義	未定義
12	FE	FS	,	<	L	¥	l		未定義	未定義	ヤ	シ	フ	ワ	未定義	未定義
13	CR	GS	-	=	M	]	m	}	未定義	未定義	ユ	ス	ヘ	ソ	未定義	未定義
14	SO	RS	.	>	N	^	n	~	未定義	未定義	ヨ	セ	ホ	ッ	未定義	未定義
15	SI	US	/	?	O	_	o	DEL	↓	↓	ッ	ソ	マ	ッ	↓	未定義

UTF8: Wide range characters @ 1.1 million


- Universal character set for all possible languages, including historical languages, Braille, music, or emojis
- Used on more than 20 billion devices worldwide

# Parity Used for Error Detection

Check for number of 1's

01 01 10 01 - even number of 1's

01 01 11 01 - odd number of 1's



On an even parity system, an odd # of 1's is wrong

Single bit errors only