Introduction to Internet #2

Introduction to Internet and Web

부산대학교 정보·의생명 공학대학
정보컴퓨터공학부

부산대학교
PUSAN NATIONAL UNIVERSITY

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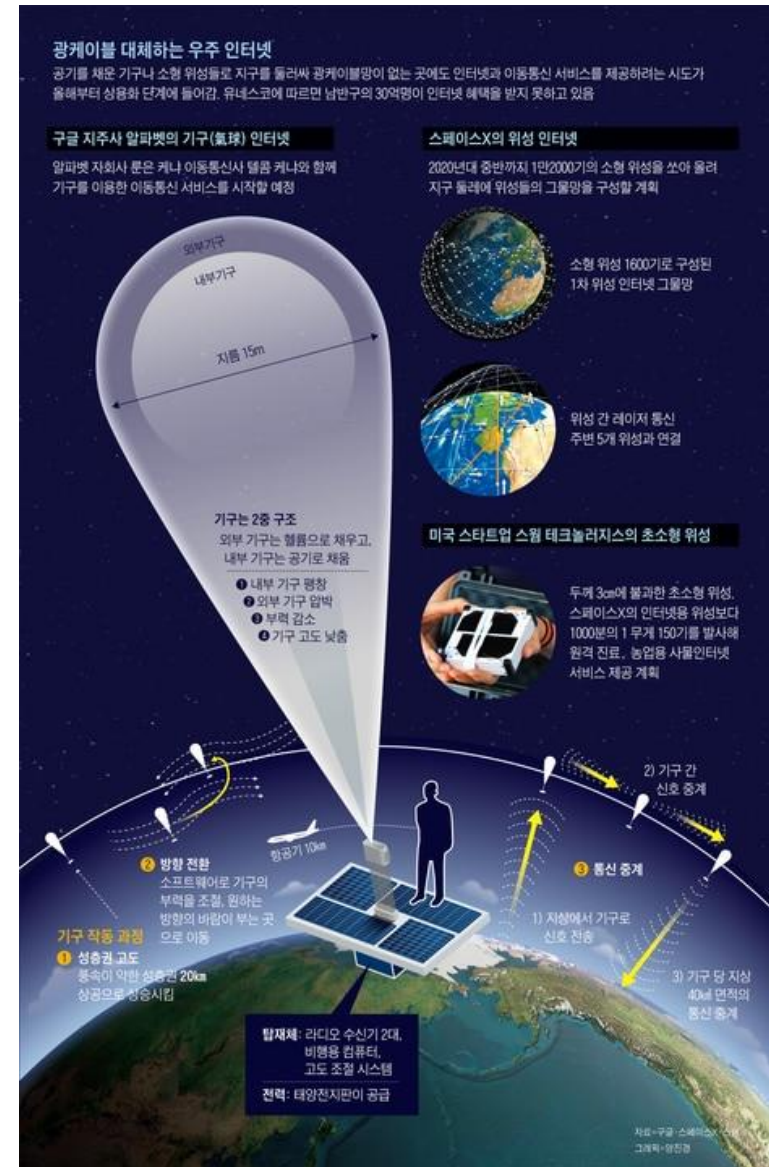
01. IP ADDRESSING

Introduction to IP Address

❖ **IP address**: 32-bit identifier for host, router interface

❖ **Interface**: connection between host/router and physical link

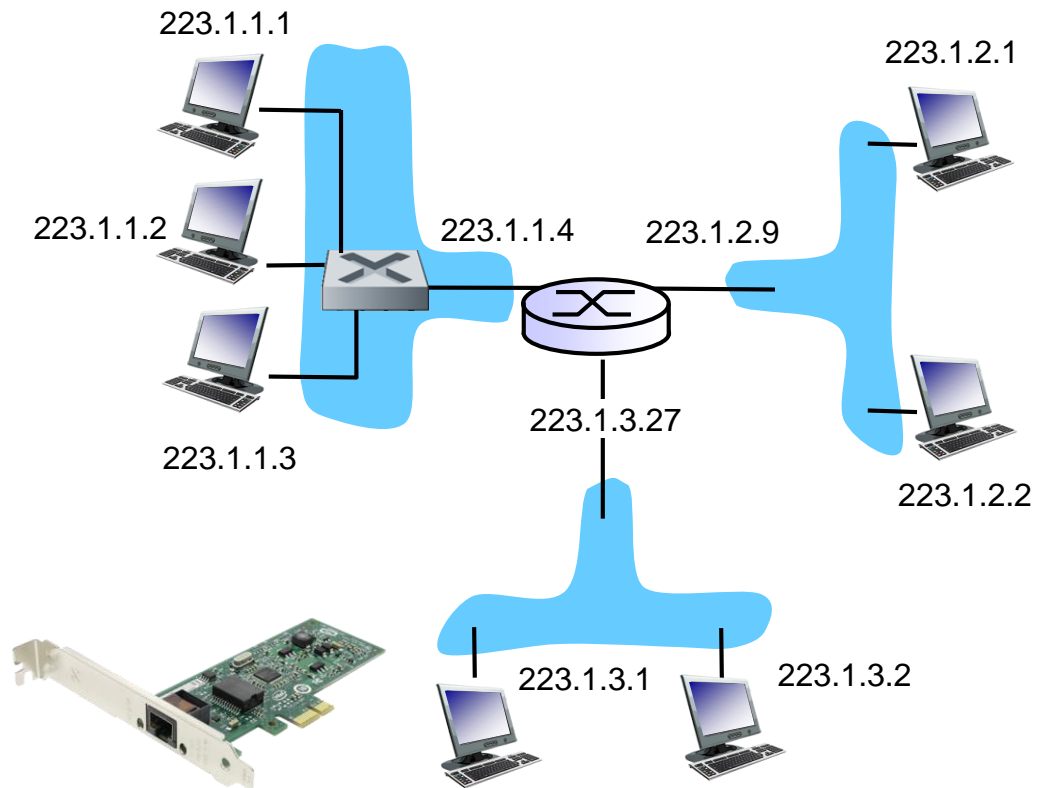- Router's typically have multiple interfaces
- Host typically has one or two interfaces (e.g., wired Ethernet, wireless 802.11)
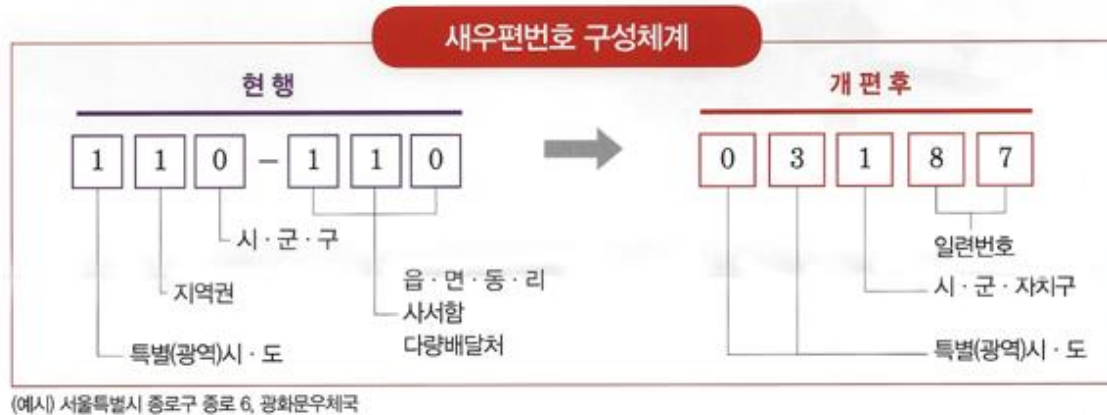
❖ **IP address associated with each interface**

223.1.1.1
223.1.1.2
223.1.1.3
223.1.1.4
223.1.2.9
223.1.2.1
223.1.2.2
223.1.3.27
223.1.3.1
223.1.3.2

223.1.1.1 = 11011111 00000001 00000001 00000001

223   1   1   1

Hierarchical Addressing

- Korean postal system

새우편번호 구성체계

현행	개 편 후
1 1 0 - 1 1 0	0 3 1 8 7

현행:
- 시 · 군 · 구
- 지역권
- 특별(광역)시 · 도
- 읍 · 면 · 동 · 리
- 사서함
- 다량배달처

개 편 후:
- 일련번호
- 시 · 군 · 자치구
- 특별(광역)시 · 도

(예시) 서울특별시 종로구 종로 6, 광화문우체국

출처 - https://www.google.co.kr/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwidj-ru4ILcAhWCMN4KHT6ADjIQjRx6BAgBEAU&url=http%3A%2F%2Fwww.thedjnews.com%2Fnews%2FarticleView.html%3Fidxno%3D1493&psig=AOvVaw0Z4wtVpIuH4N3PFxGbw2eQ&ust=1530701281466061
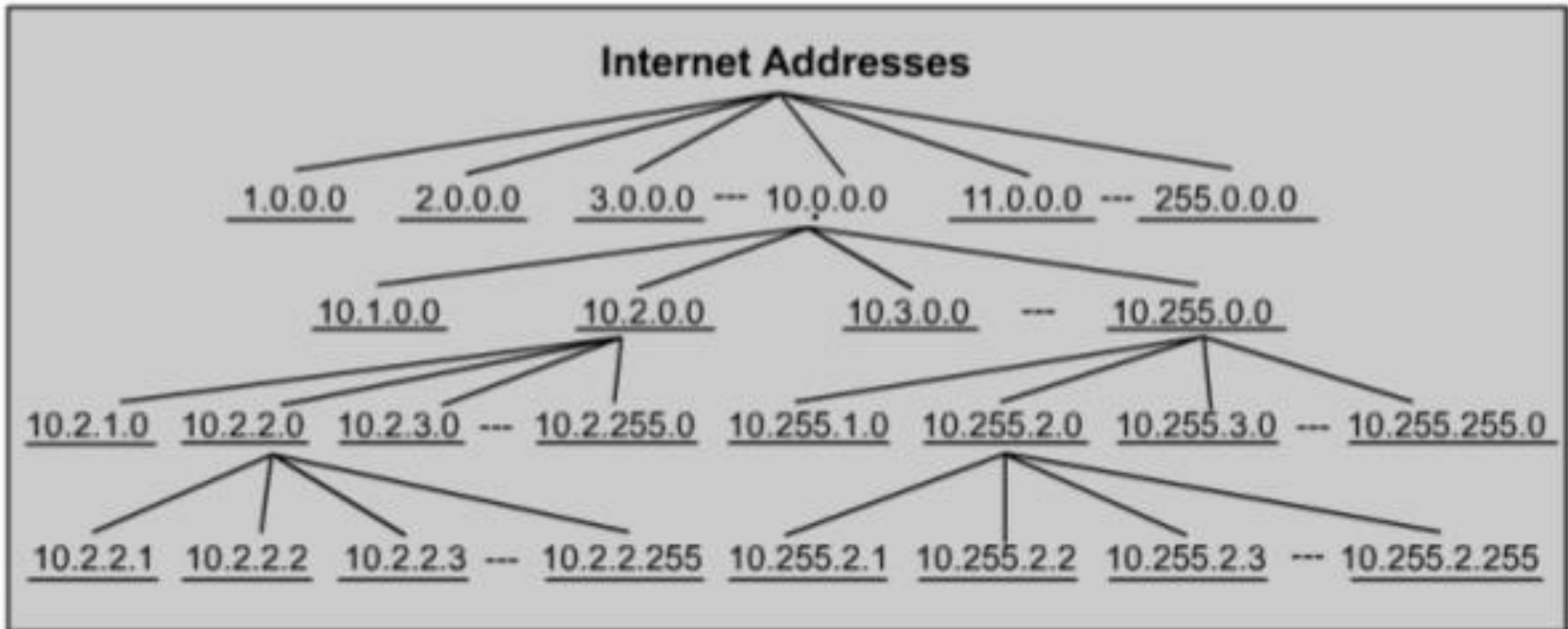
- Telephone number

+ 8 2 - 5 1 - 5 1 0 - 5 5 5 5

local exchange
area code
country code

- IP address

1 6 4 . 1 2 5 . 7 0 . 1 2 5

host id
Bldg. Comp. Eng.
Pusan National University

Example: Hierarchical IP Address

IP Address Class
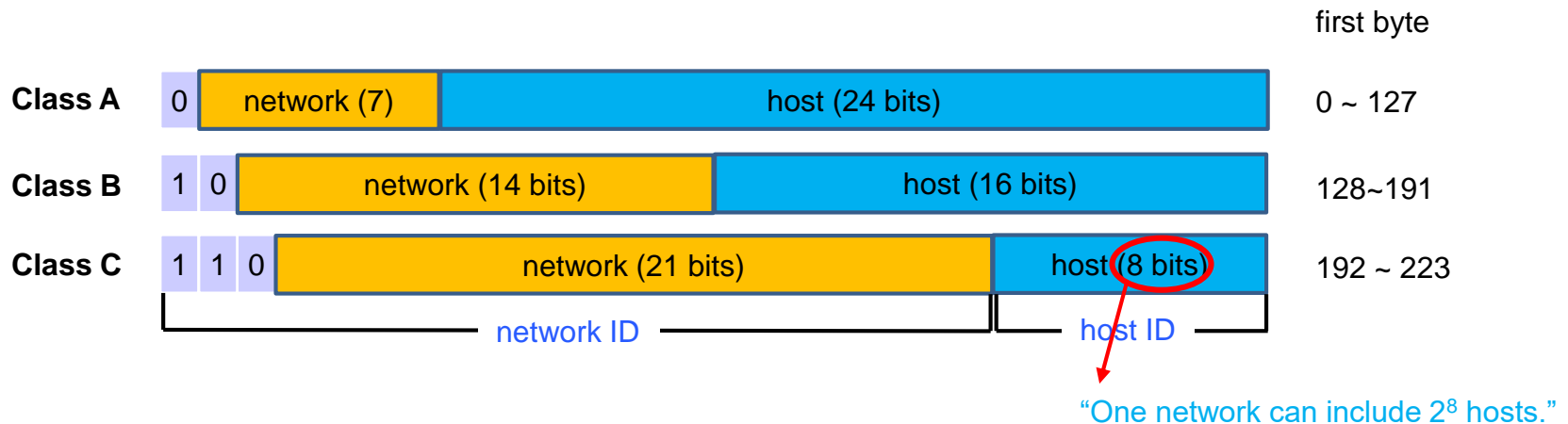
❖ **ICANN** **(Internet Corporation for Assigned Names and Numbers)**

- http://www.icann.org/

- allocates addresses

- manages DNS

- assigns domain names, resolves disputes

						first byte
Class A	0	network (7)	host (24 bits)			0 ~ 127
Class B	1	0	network (14 bits)	host (16 bits)		128~191
Class C	1	1	0	network (21 bits)	host (8 bits)	192 ~ 223

network ID ——————— host ID

"One network can include 2^8 hosts."

- Private addresses
10.0.0.0 ~ 10.255.255.255 (10.0.0.0/8) : 1 of A class
172.16.0.0 ~ 172.31.255.255 (172.16.0.0/12) : 16 of B classes
192.168.0.0 ~ 192.168.255.255 (192.168.0.0/16) : 256 of C classes

Subnets

❖ **Subnet:** a logical subdivision of an IP network

❖ **Why subnetworking?**

- Datagram forwarding performed by routers

- Hosts in a same network can reach each other without intervening router

- Too many hosts in a network increase maintenance overhead
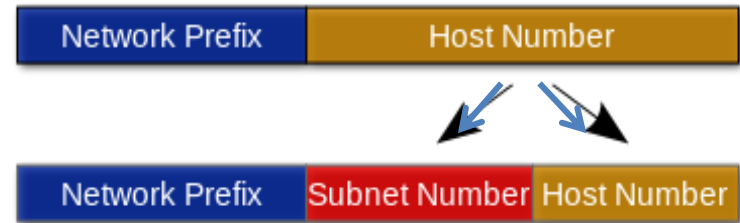
- "Divide and conquer"
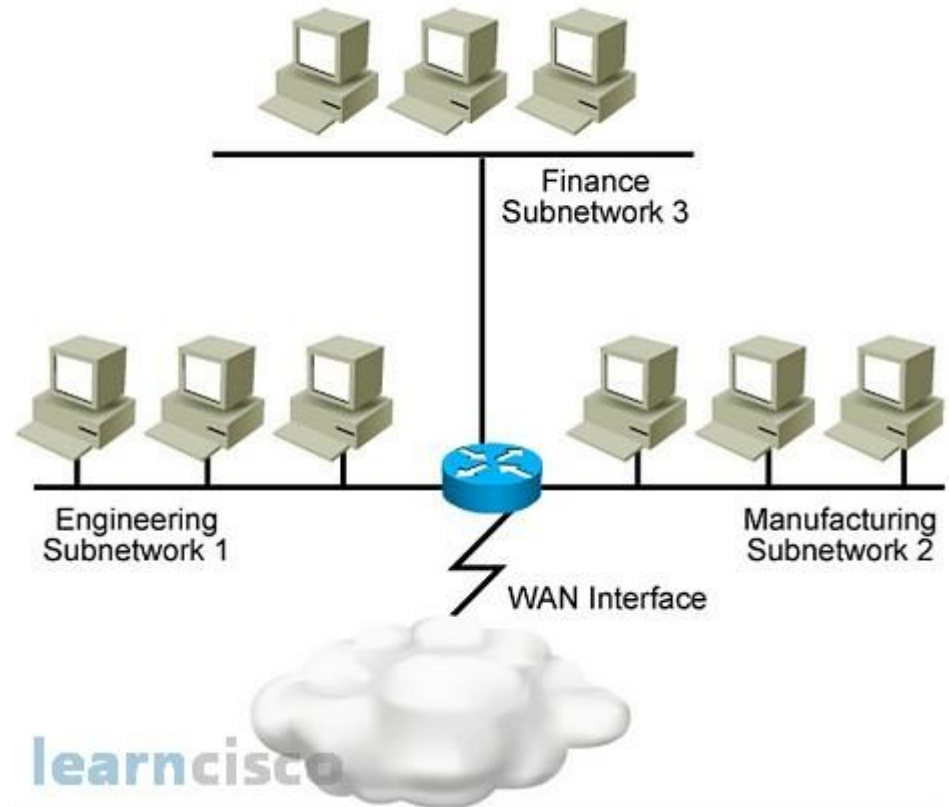
출처 - https://www.google.co.kr/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjWr4q3s4TcAhXGFogKHTNuC2gQjRx6BAgBEAU&url=http%3A%2F%2Fwww.learncisco.net%2Fcourses%2Ficnd-1%2Flan-connections%2Fnetwork-addressing-scheme.html&psig=AOvVaw24-bw_TTDQV85Eh-H39Ipq&ust=1530757596051182

Subnet Mask

❖ **Division of IP address**

- subnet part: high order bits of host id
- host part: low order bits of host id

출처 - https://en.wikipedia.org/wiki/Subnetwork

❖ **How to decide the size of subnet number?**

- subnet mask: indicating the bits that will be used as the network number
- e.g., 255.255.255.0 => 24 bits are used as the network number
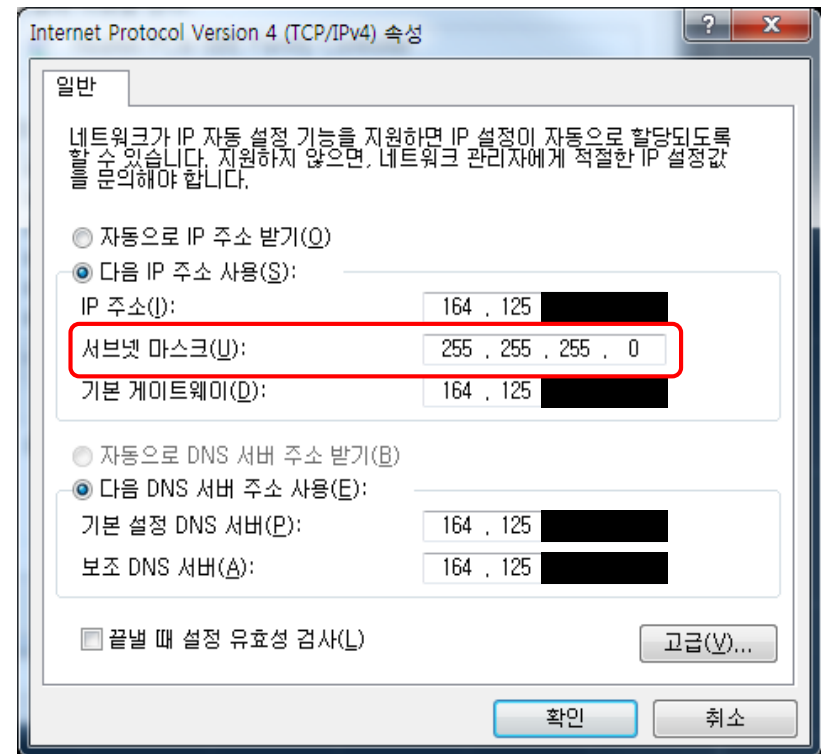
Subnetworking Example

❖ e.g., subnet ID is 5 bits long

- 2^5 = 32 subnets can exist

- each subnet can include 2^{11} hosts

- Binary number, decimal number
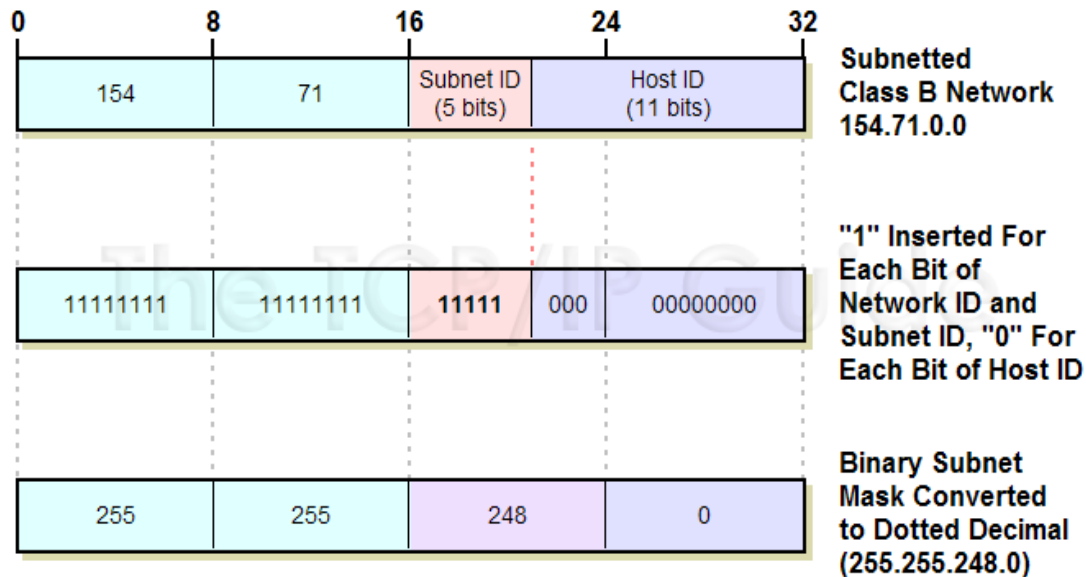
출처 -
https://www.google.co.kr/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjut7mQroTcAhVCdt4KHcrgD1AQjRx6BAgBEAU&url=http%3A%2F%2Fwww.tcpipguide.com%2Ffree%2Ft_IPSubnetMasksNotationandSubnetCalculations-2.htm&psig=AOvVaw2fWCIcQMJzIPoe3PYzjlZn&ust=1530756208997926

Subnetworking Example

❖ **An IP network can be a subnet by itself**

  ▪ e.g., Class C network with subnet mask /24

223.1.1.0/24
223.1.2.0/24
223.1.1.1
223.1.1.2
223.1.1.4
223.1.2.9
223.1.2.1
223.1.3.27
subnet
223.1.1.3
223.1.2.2
223.1.3.1
223.1.3.2
223.1.3.0/24
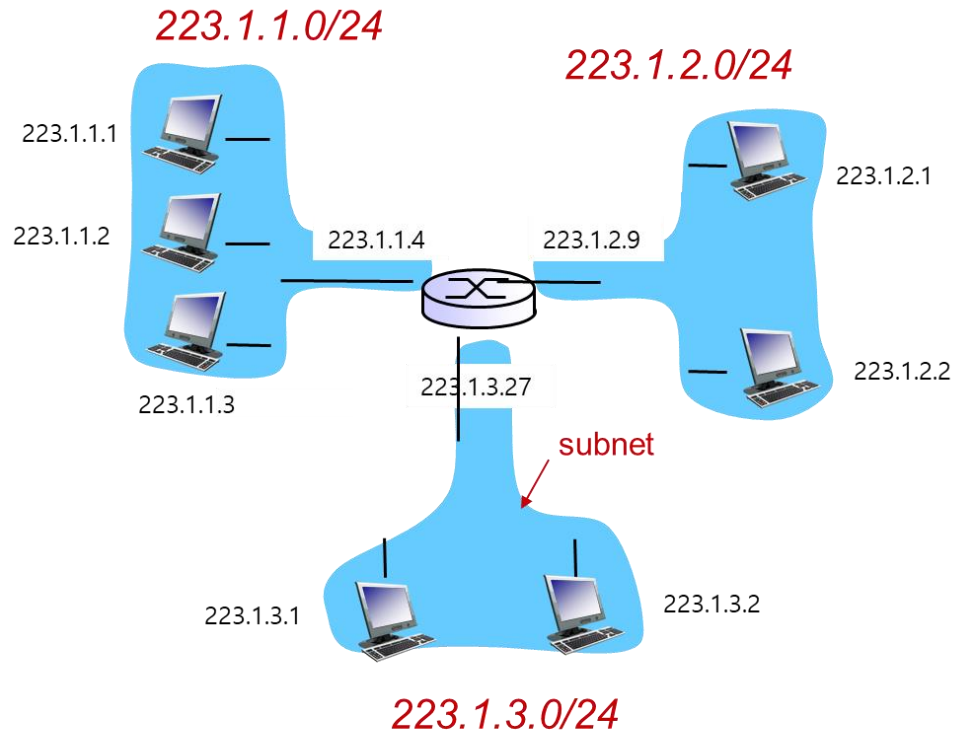
subnet mask: /24

11111111 11111111 11111111 00000000

02. DATAGRAM FORWARDING

IP Network = Datagram Network

❖ **Routers: no state about end-to-end connections**

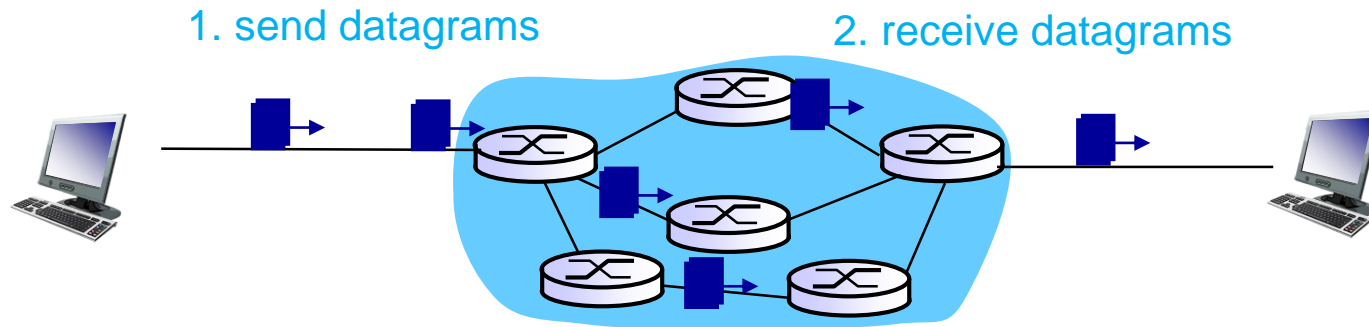- no network-level concept of "connection"

1. send datagrams

2. receive datagrams

❖ **Datagram forwarding**

- **destination-based forwarding**: forward based only on destination IP address (traditional)

- **generalized forwarding**: forward based on any set of header field values (SDN)

Destination-based Forwarding Table
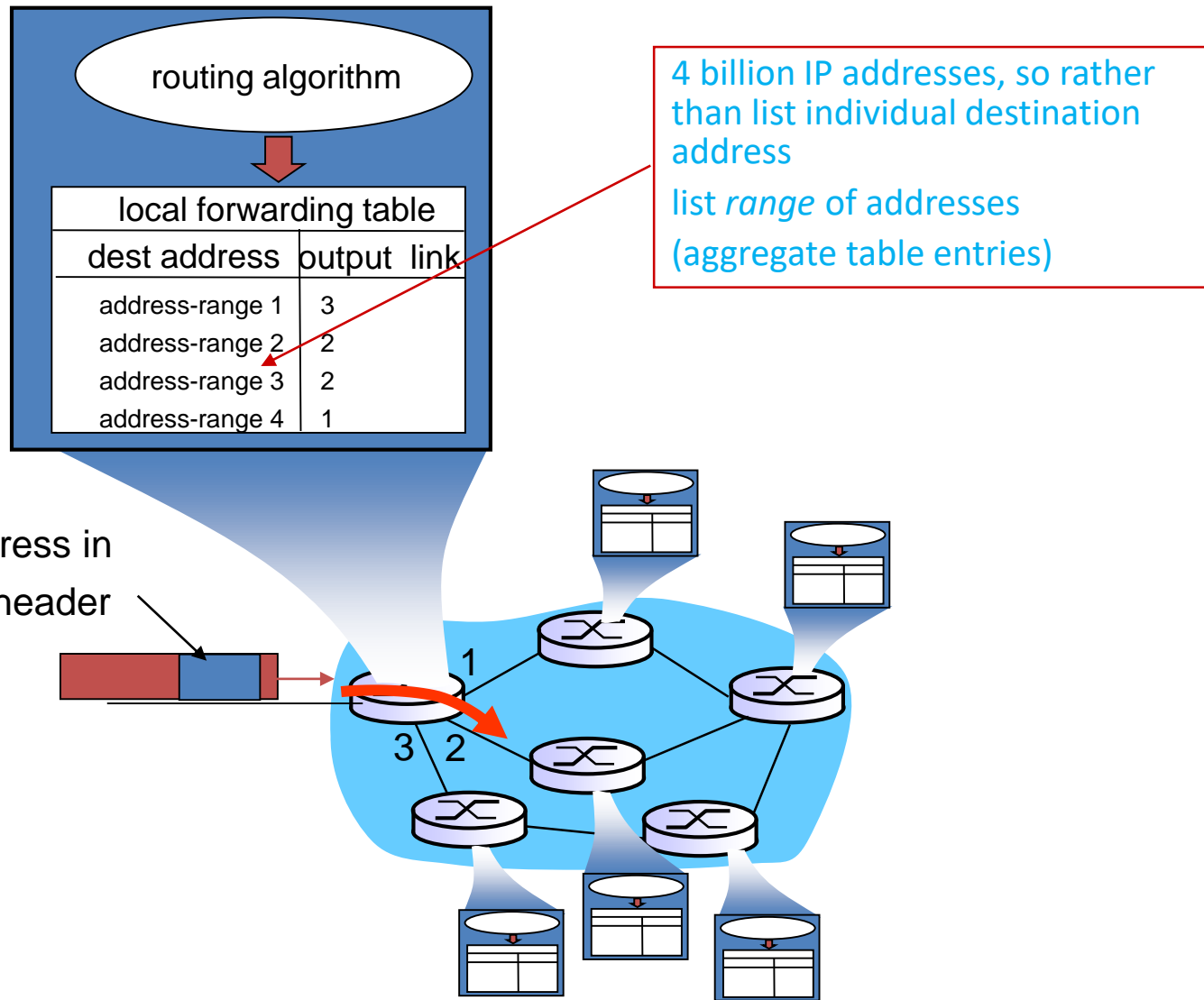
routing algorithm

local forwarding table

dest address	output link
address-range 1	3
address-range 2	2
address-range 3	2
address-range 4	1

4 billion IP addresses, so rather than list individual destination address

list *range* of addresses

(aggregate table entries)

IP destination address in arriving packet's header

1

3 2

Destination-based Forwarding

Destination Address Range	Link Interface
11001000 00010111 00010000 00000000 through 11001000 00010111 00010111 11111111	0
11001000 00010111 00011000 00000000 through 11001000 00010111 00011000 11111111	1
11001000 00010111 00011001 00000000 through 11001000 00010111 00011111 11111111	2
otherwise	3

Q: but what happens if ranges don't divide up so nicely?

Longest Prefix Matching

Longest prefix matching

when looking for forwarding table entry for given destination address, use *longest* address prefix that matches destination address

Destination Address Range	Link interface
11001000 00010111 00010*** ********	0
11001000 00010111 00011000 ********	1
11001000 00010111 00011*** ********	2
otherwise	3

examples:

DA: 11001000 00010111 00010110 10100001   which interface?

DA: 11001000 00010111 00011000 10101010   which interface?

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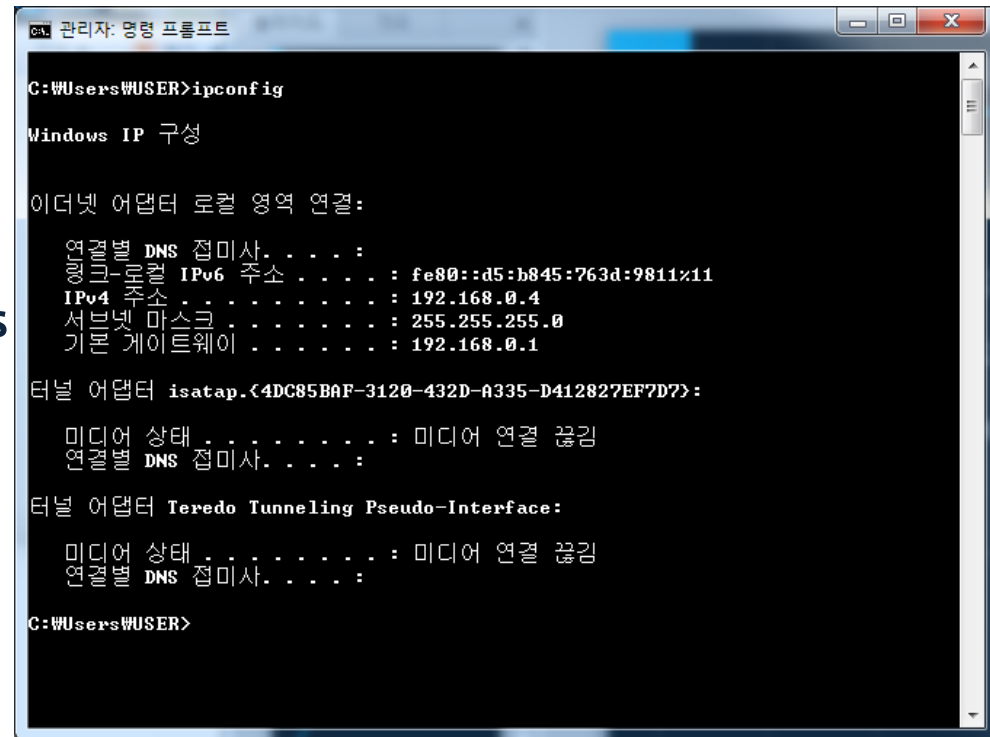
03. DOMAIN NAME SYSTEM

IP Address

❖ `ipconfig` command

❖ IP address is 32-bit long, represented by 4 numbers between 0~255

❖ Hard to remember the IP address of a server by the numbers

❖ Instead, people use the name of servers such as www.pusan.ac.kr

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Domain Name System

❖ **Actually, the most important part of the Internet for internetworking**

❖ **Brief view of the DNS operation**

출처 - https://help.ubnt.com/hc/en-us/articles/115005817467-Intro-to-Networking-Domain-Name-System-DNS-
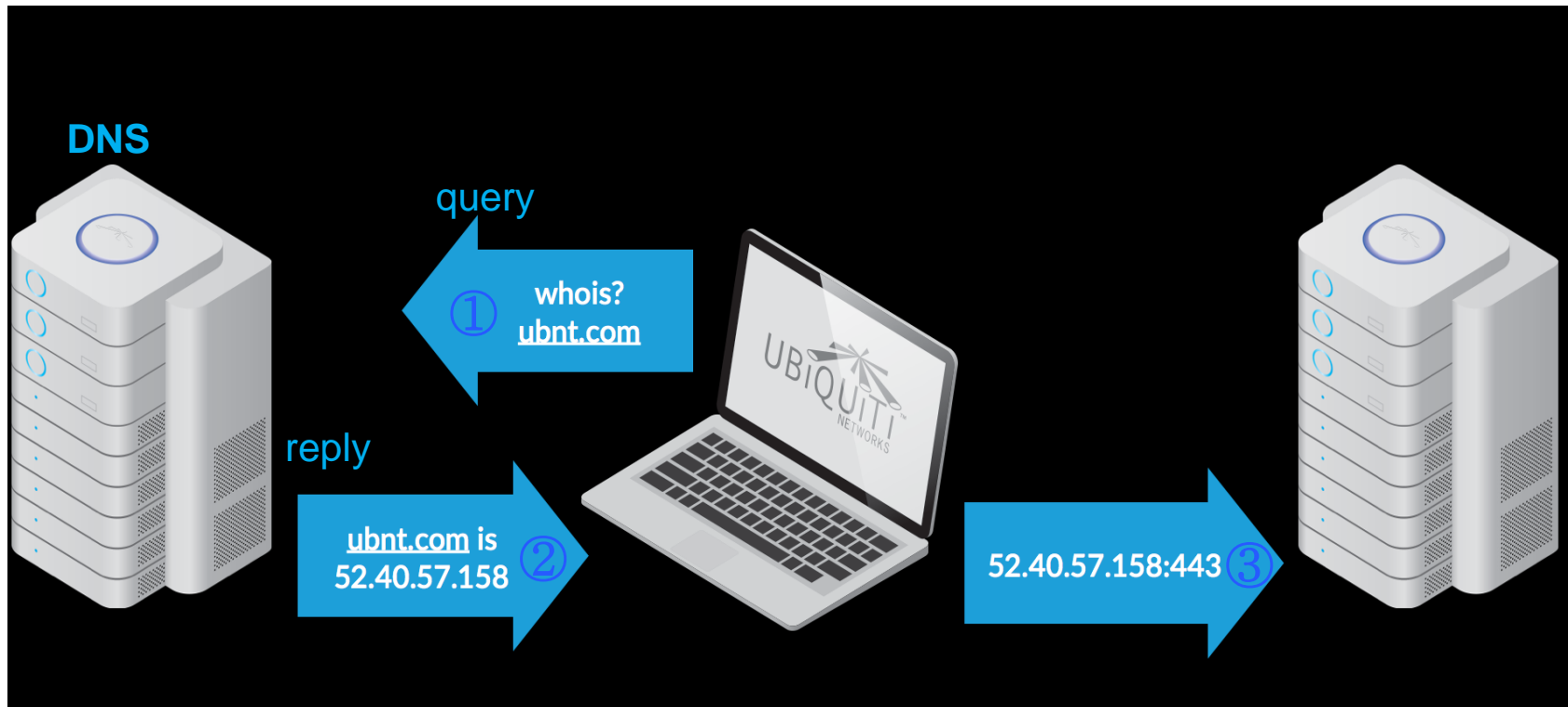
Domain Name System

❖ DNS services

- hostname to IP address translation

- load distribution
  - replicated Web servers: many IP addresses correspond to one name

❖ <u>Distributed database system</u>

❖ Why not centralize DNS?

- single point of failure

- traffic volume

- distant centralized database

Not scalable!!!

DNS: Distributed & Hierarchical Database
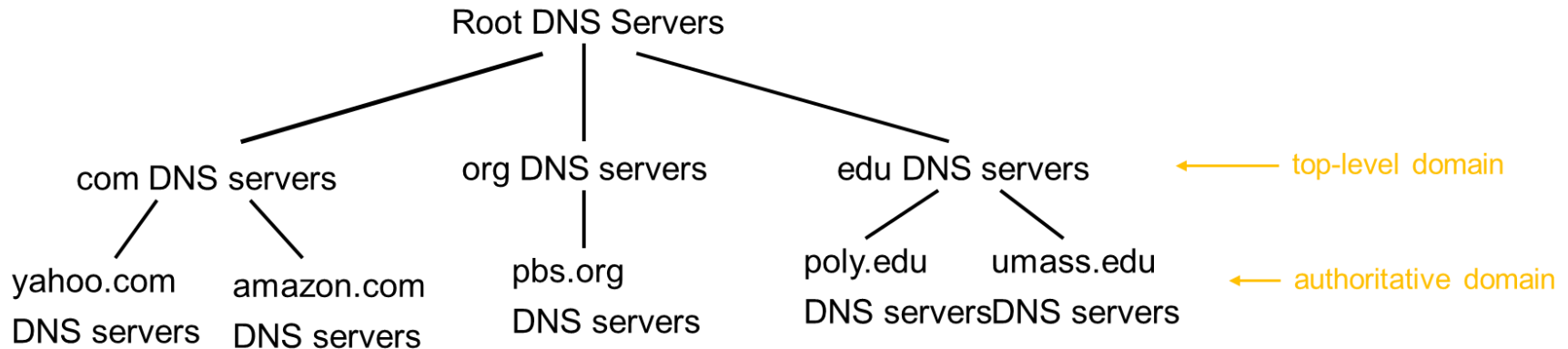
Client wants IP for www.amazon.com; 1st approximation:
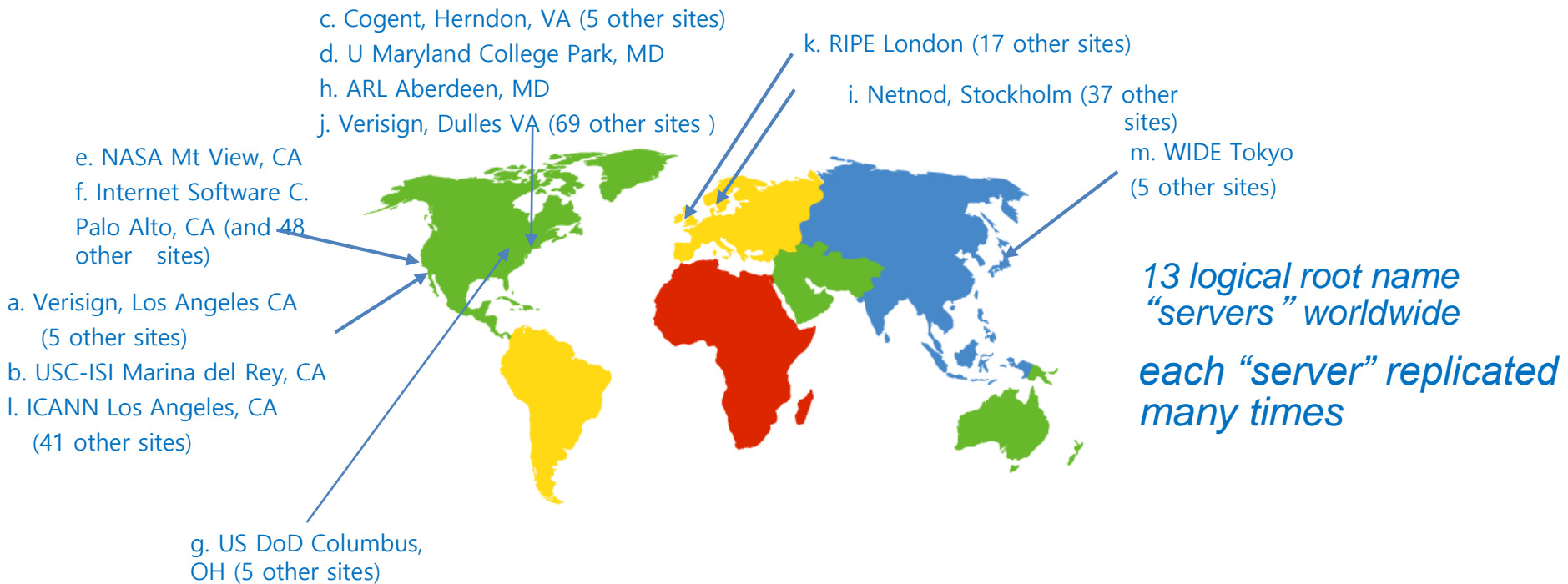
1. **Client queries Root server to find <u>com</u> DNS server**

2. **Client queries com DNS server to get <u>amazon.com</u> DNS server**

3. **Client queries amazon.com DNS server to get IP address for <u>www.amazon.com</u>**

DNS: Root Name Servers

❖ **Contacted by local name server that can not resolve name**

❖ **Location of root name servers**

- there are 247 root servers as of fall 2011

c. Cogent, Herndon, VA (5 other sites)
d. U Maryland College Park, MD
h. ARL Aberdeen, MD
j. Verisign, Dulles VA (69 other sites)

k. RIPE London (17 other sites)

i. Netnod, Stockholm (37 other sites)

m. WIDE Tokyo (5 other sites)

e. NASA Mt View, CA
f. Internet Software C. Palo Alto, CA (and 48 other sites)

a. Verisign, Los Angeles CA (5 other sites)
b. USC-ISI Marina del Rey, CA
l. ICANN Los Angeles, CA (41 other sites)

g. US DoD Columbus, OH (5 other sites)

13 logical root name "servers" worldwide

each "server" replicated many times

DNS: Top-Level Domain (TLD) Servers

❖ **Responsible for com, org, net, edu, aero, jobs, museums, and all top-level country domains, e.g.: uk, fr, ca, jp, kr**

❖ **"Any language possible besides English alphabet" (June 20th, 2011)**

❖ **Network Solutions maintains servers for .com TLD**

❖ **Educause for .edu TLD**

출처 - https://youcanbefound.com/do-top-level-domains-tlds-matter-for-seo-com-vs-brand/
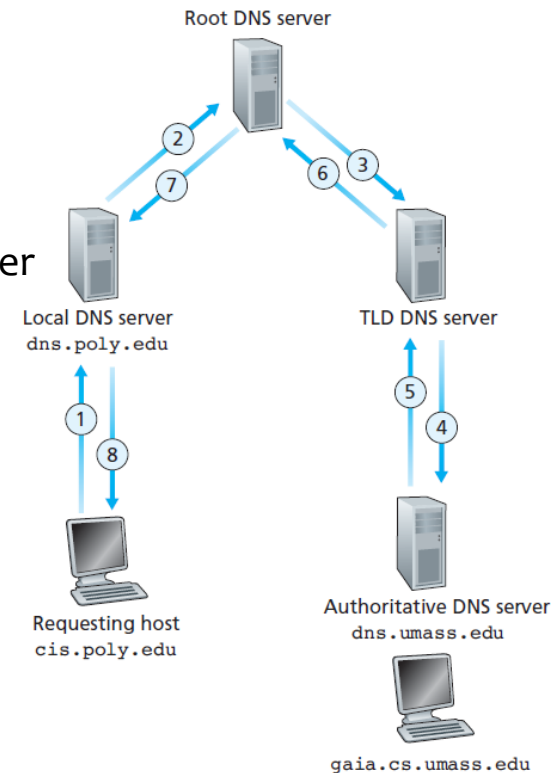
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DNS: Authoritative Servers & Local Servers

❖ **Authoritative Servers**

- organization's own DNS server(s), providing authoritative hostname to IP mappings for organization's named hosts

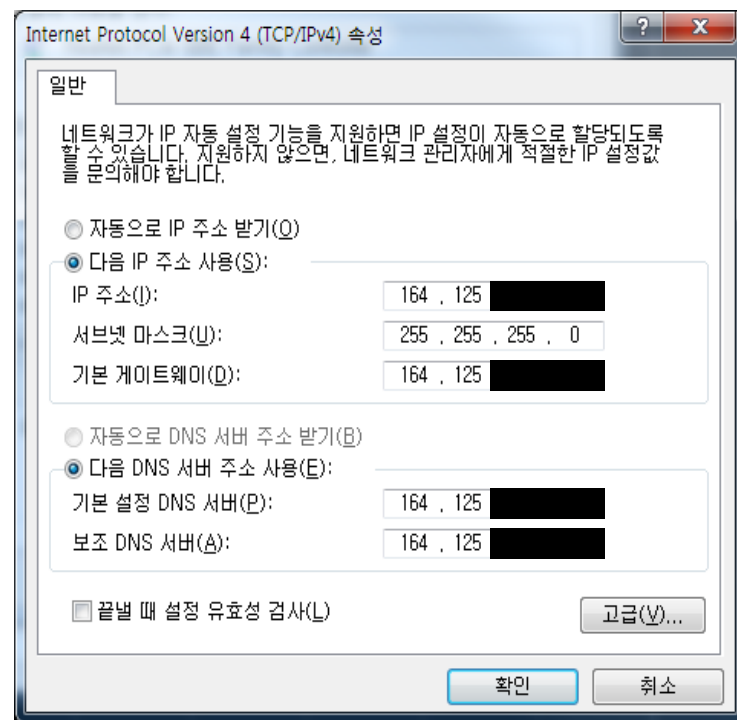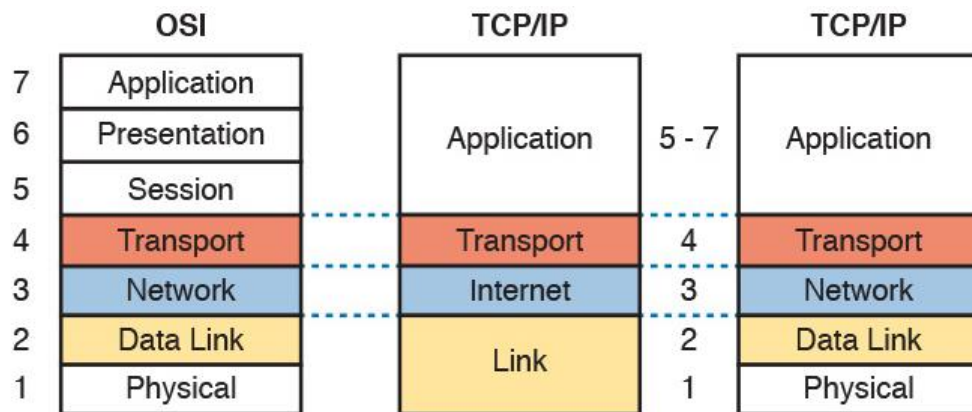- can be maintained by organization or service provider

❖ **Local DNS servers**

- does not strictly belong to hierarchy

- each ISP (residential ISP, company, university) has one
  - also called "default name server"

- when host makes DNS query, query is sent to its local DNS server
  - has local cache of recent name-to-address translation pairs
  - acts as proxy, forwards query into hierarchy

➢ **IP address**

➢ **Subnet Mask**

➢ **DNS server**

https://www.youtube.com/watch?v=5o8CwafCxnU&list=LLOvthjKPpJZN8
bPHCM0xZXA&index=11&t=4s