Introduction to Internet #2

Introduction to Internet and Web

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정보컴퓨터공학부

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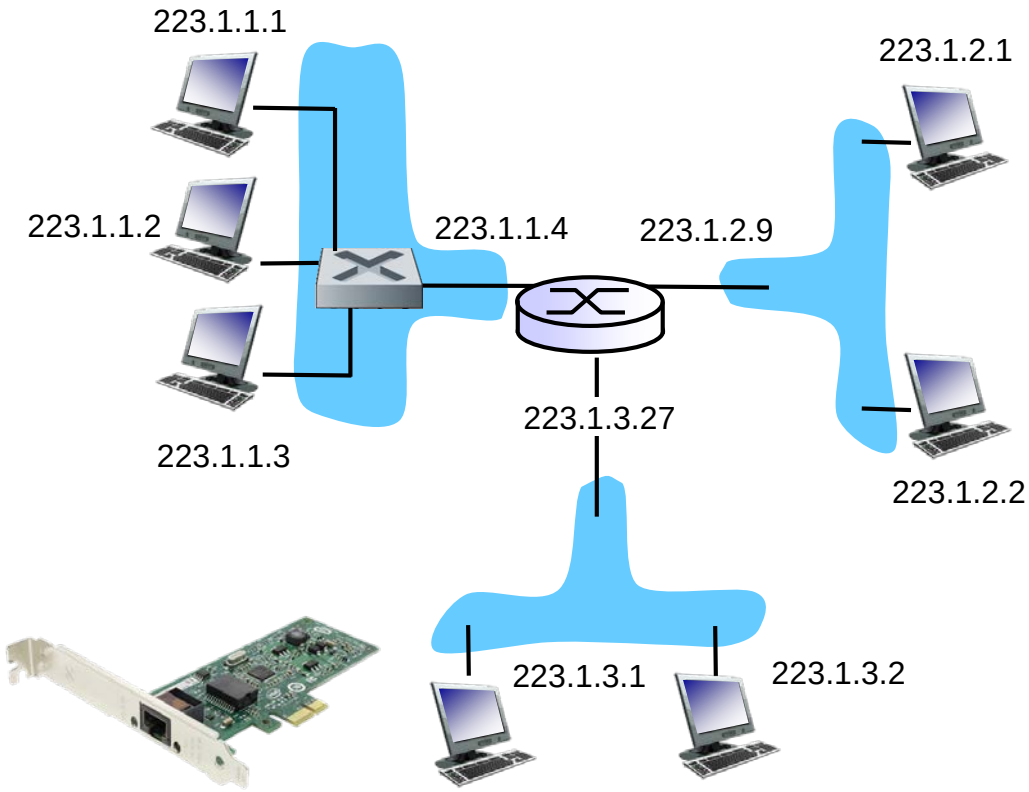
- Datagram Forwarding
- Domain Name System

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**

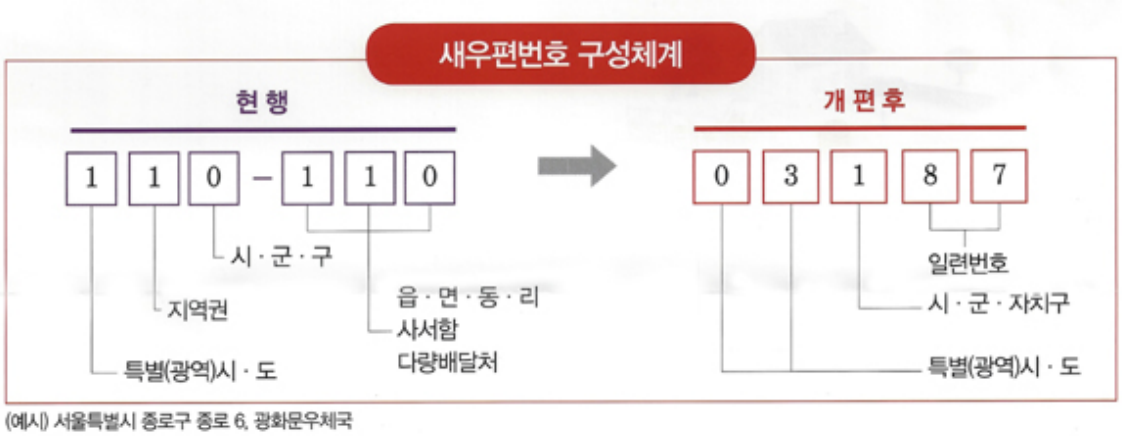


223.1.1.1 = 11011111 00000001 00000001 00000001

223 1 1 1

Hierarchical Addressing

- Korean postal system



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=AOvVaw0Z4wtVpluH4N3PFxGbw2eQ&ust=1530701281466061

- Telephone number

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

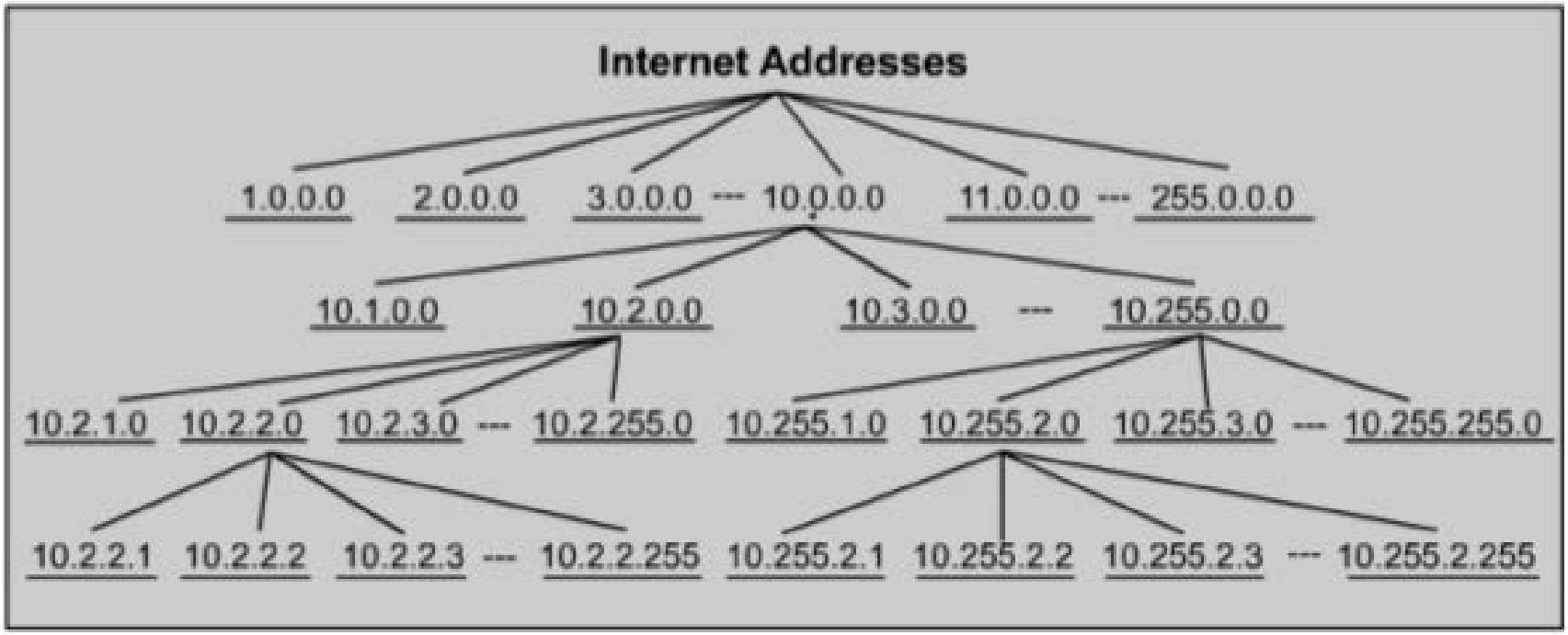
local exchange
area code
country code

- 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

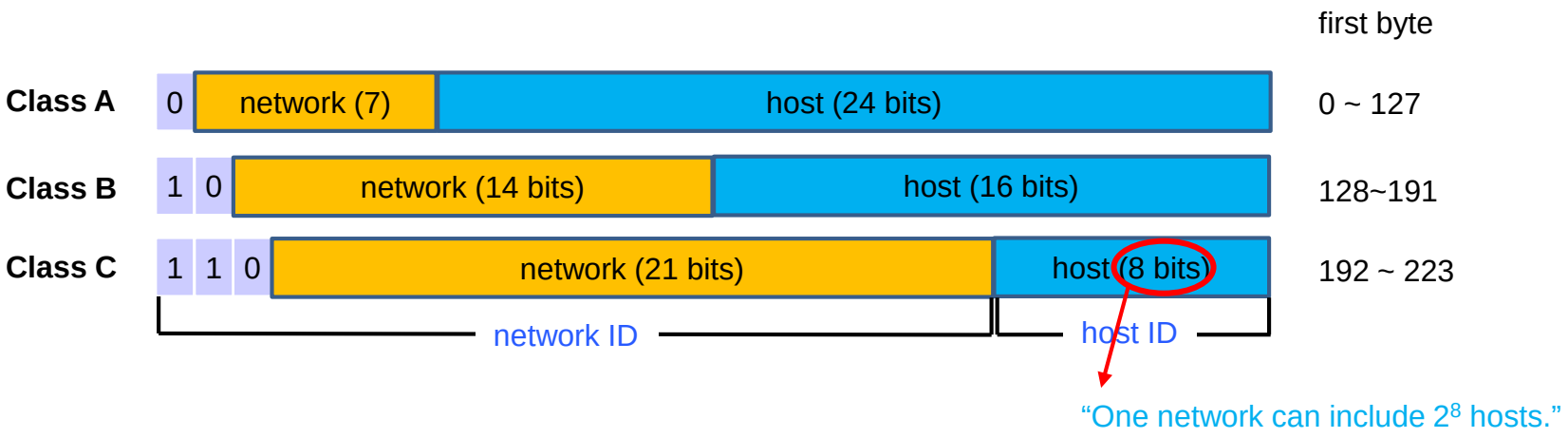


출처 -
https://www.google.co.kr/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwj537vo44LcAhWVA4gKHWWiAPwQjRx6BAgBEAU&url=https%3A%2F%2Fwww.slideshare.net%2Fwelcometofacebook%2Fm06-35513859&psig=AOvVaw0kd7fRzS5vV-Is5QZC2_lB&ust=1530700263742351

IP Address Class

❖ ICANN (Internet Corporation for Assigned Names and Numbers)

- http://www.icann.org/
- allocates addresses
- manages DNS
- assigns domain names, resolves disputes



- 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

IP address block

❖ https://xn--3e0bx5euxnjje69i70af08bea817g.xn--3e0b707e/jsp/infoboard/stats/ipCurrent.jsp?nationCode1=KR

국가선택 대한민국 조회 전체국가 csv 다운로드 엑셀 다운로드

국가	시작주소	끝주소	프리픽스(/24)	할당일자
대한민국	14.128.128.0	14.128.255.255	/17	2010.09.15
대한민국	14.129.0.0	14.129.255.255	/16	2010.08.12
대한민국	14.138.0.0	14.138.255.255	/16	2010.09.09
대한민국	14.192.80.0	14.192.95.255	/20	2010.09.20
대한민국	45.112.88.0	45.112.95.255	/21	2015.02.26
대한민국	45.112.96.0	45.112.111.255	/20	2015.02.26
대한민국	45.112.112.0	45.112.119.255	/21	2015.02.26
대한민국	45.112.152.0	45.112.159.255	/21	2015.03.03

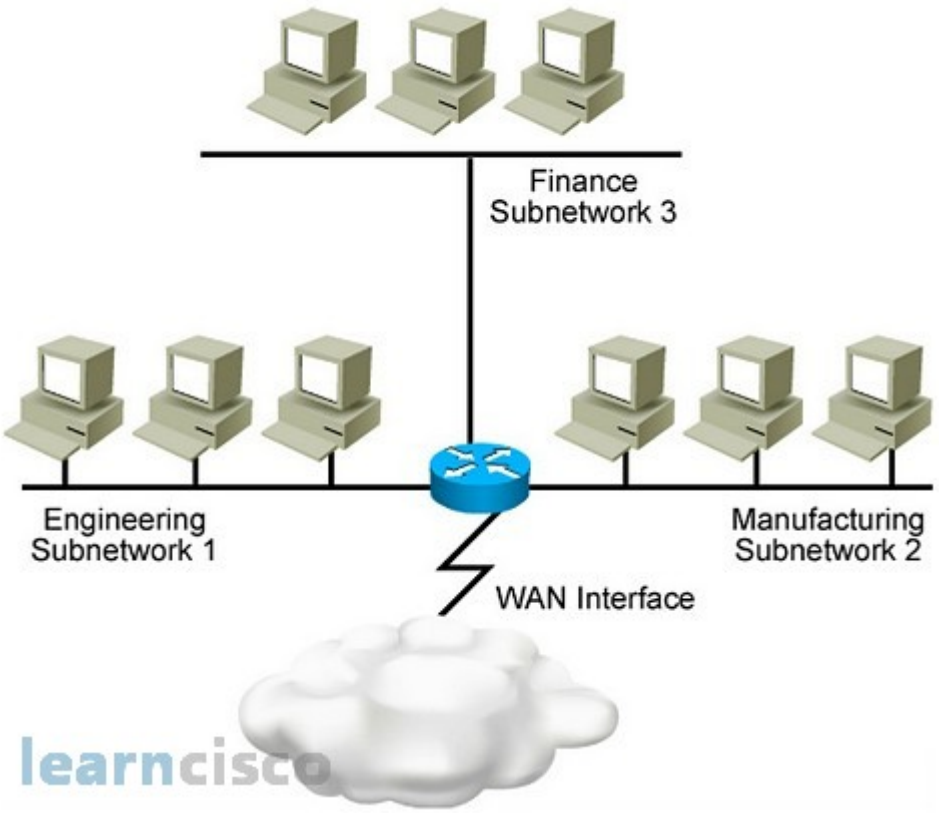
현행 인터넷 주소 바닥났다

NRO, IPv4 주소 잔여 공간 고갈 선언…IPv6로 전환 불가피

입력 : 2011.02.05. 토 09:55 댓글 (0)

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"

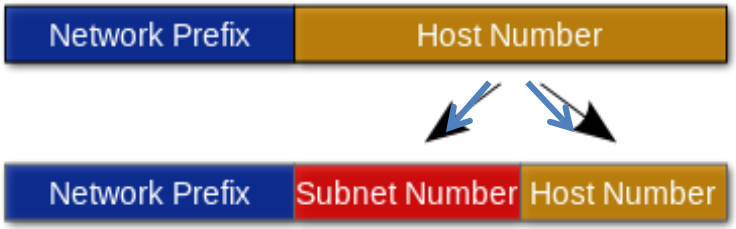


출처 -
https://www.google.co.kr/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjWr4q3s4TcAhXGFogKHTNuC2gQjRx6BAgBEAU&url=http%3A%2F%2Fwww.learncisco.net%2Fcourses%2Ficnd-1%2Flan-connections%2Fnetwork-addressing-scheme.html&psig=AOvVaw24-bw_TTDQV85Eh-H39Ipq&ust=1530757596051182

Subnet Mask

❖ Division of IP address

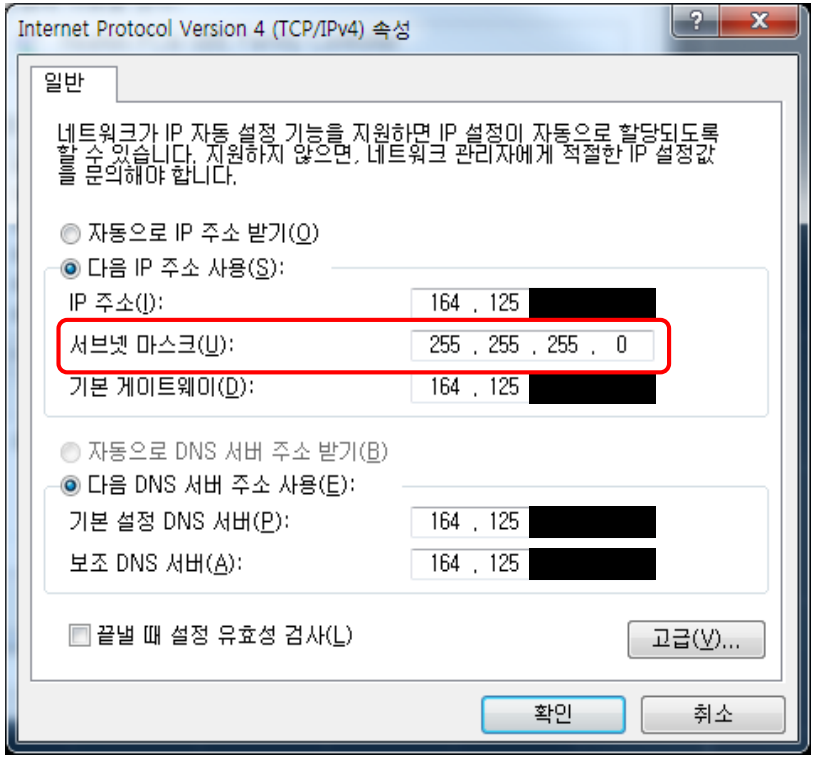
- subnet part: high order bits of host id
- host part: low order bits of host id



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

❖ How to decide the size of subnet number?

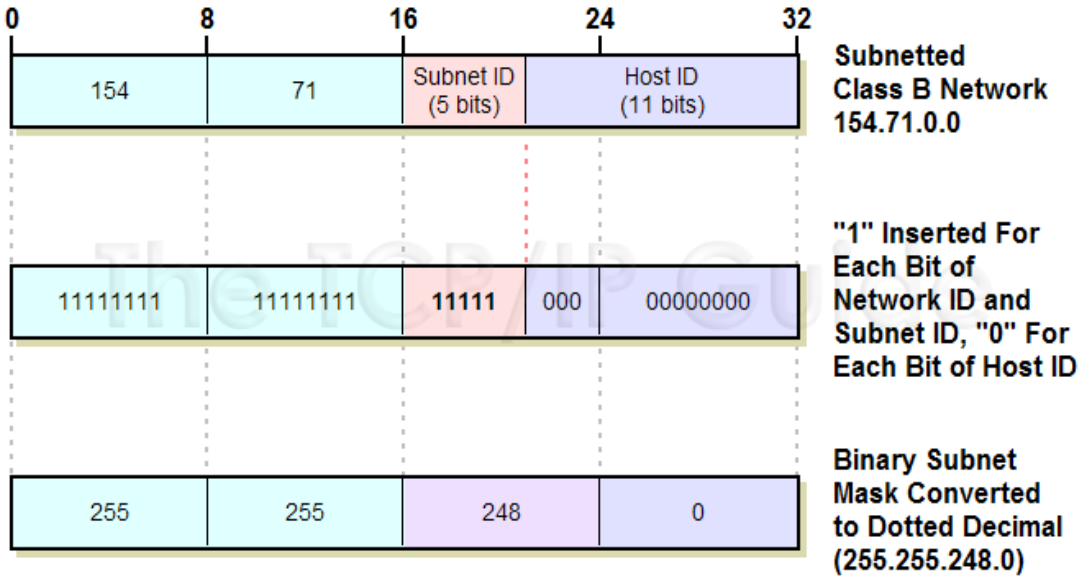
- subnet mask: indicating the bits that will be used as the network number
- e.g., 255.255.255.0 => 24 bits are used as the network number



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

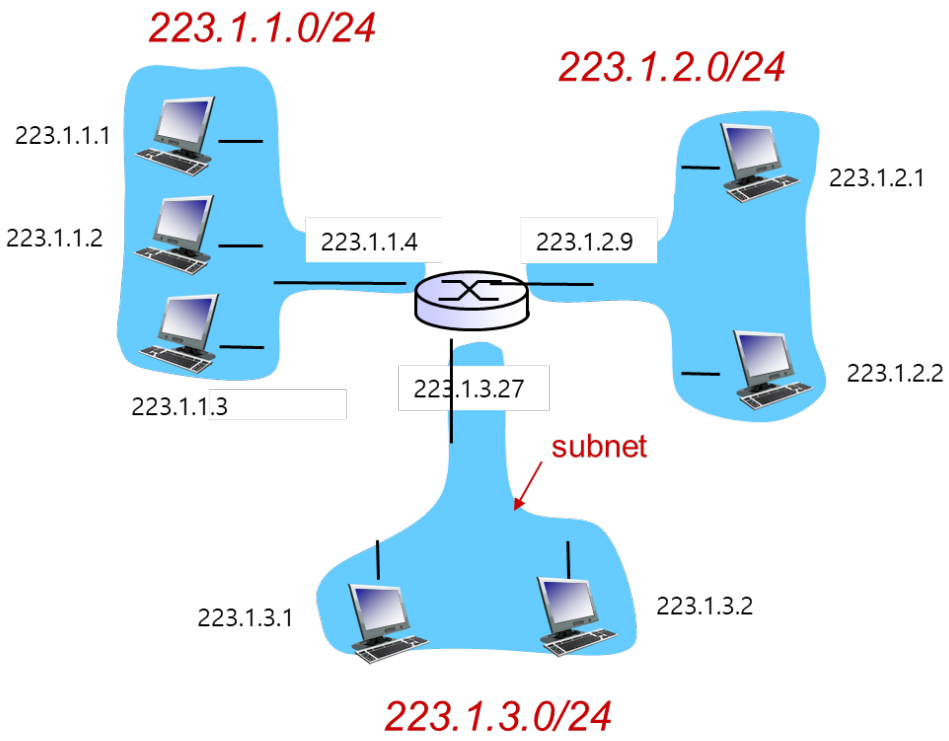


출처 -
https://www.google.co.kr/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwjut7mQroTcAhVCdt4KHcrgD1AQjRx6BAgBEAU&url=http%3A%2F%2Fwww.tcpipguide.com%2Ffree%2Ft_IPSubnetMasksNotationandSubnetCalculations-2.htm&psig=AOvVaw2fWClcQMJzIPoe3PYzjlZn&ust=1530756208997926

Subnetworking Example

❖ An IP network can be a subnet by itself

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



subnet mask: /24

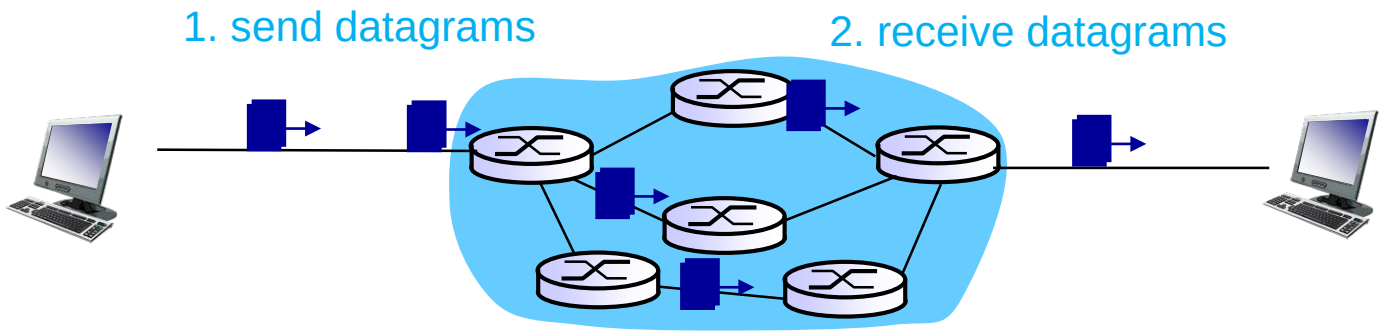
11111111 11111111 11111111 00000000

02. DATAGRAM FORWARDING

IP Network = Datagram Network

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

- no network-level concept of "connection"



❖ 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

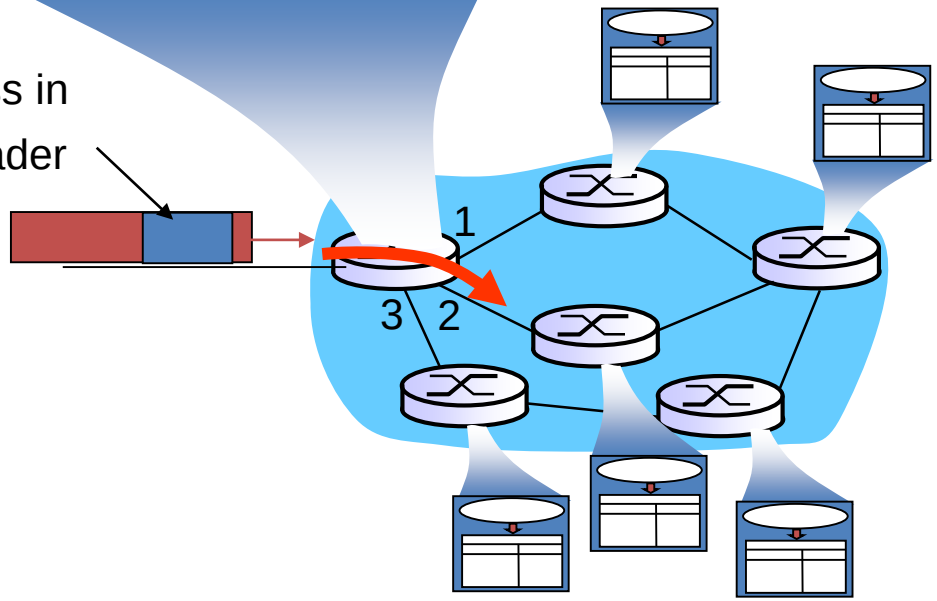
dest address	output link
address-range 1	3
address-range 2	2
address-range 3	2
address-range 4	1

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



Destination-based Forwarding

forwarding table

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?

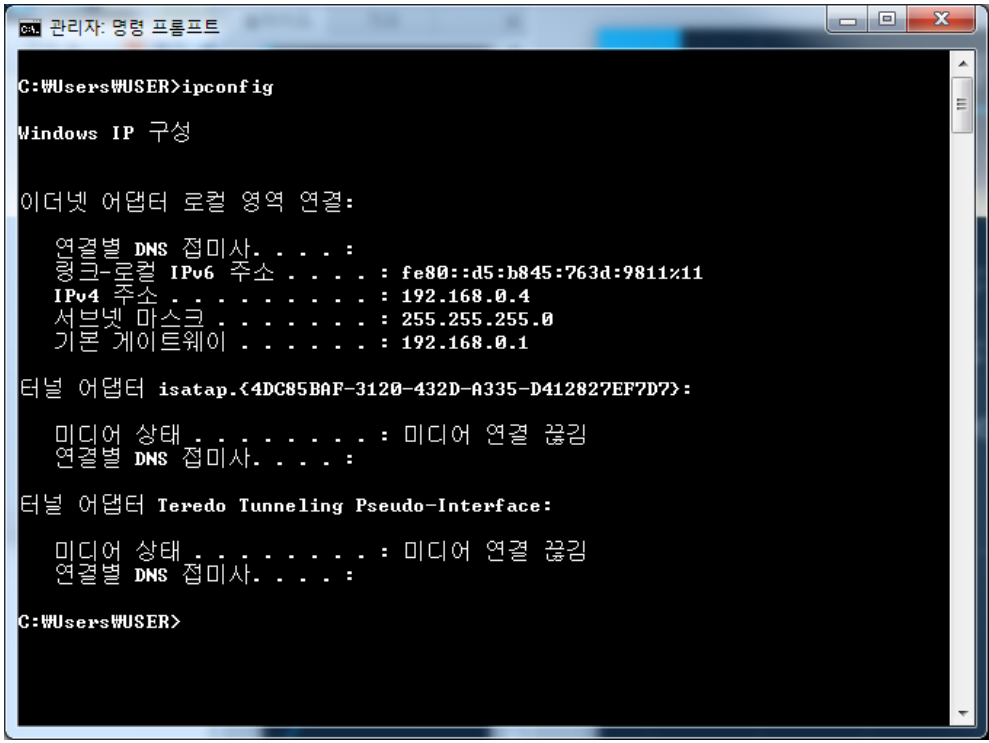
DA: 11001000 00010111 00011000 10101010 which interface?

03. DOMAIN NAME SYSTEM

IP Address

- `ipconfig` command

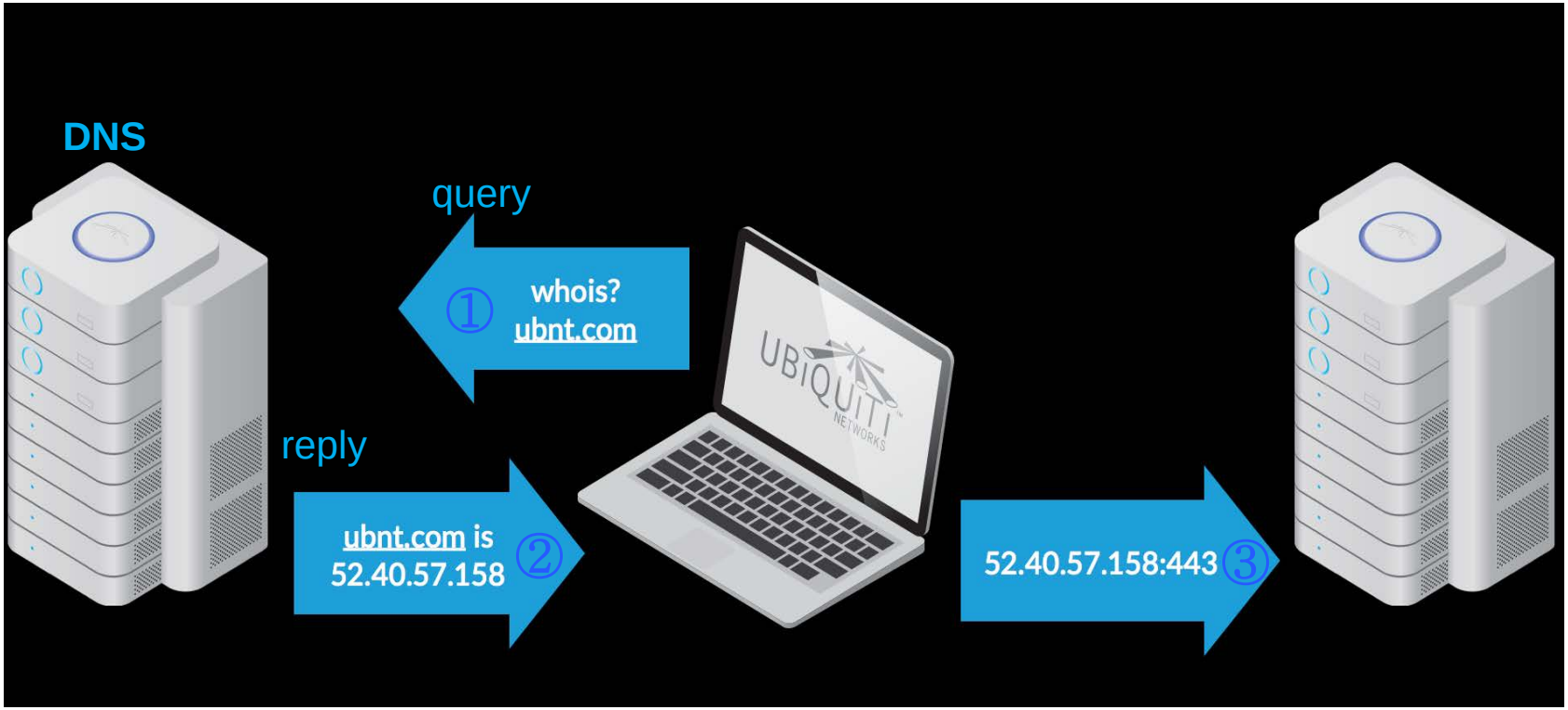
- IP address is 32-bit long, represented by 4 numbers between 0~255
- Hard to remember the IP address of a server by the numbers
- Instead, people use the name of servers such as www.pusan.ac.kr



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

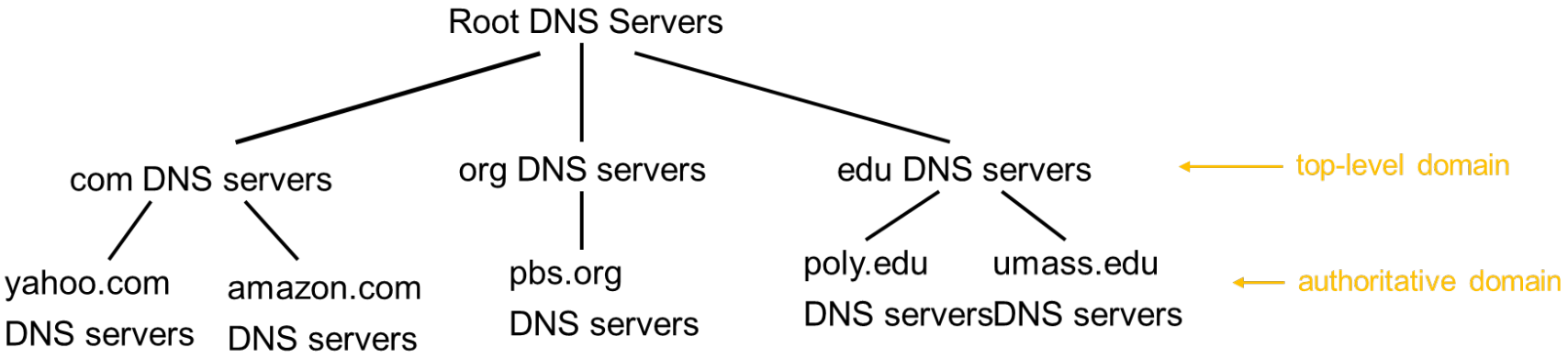
❖ Distributed database system

❖ 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 com DNS server
2. Client queries com DNS server to get amazon.com DNS server
3. Client queries amazon.com DNS server to get IP address for www.amazon.com

DNS: Root Name Servers

- ❖ **Contacted by local name server that can not resolve name**
- ❖ **Location of root name servers**

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/

DNS: Authoritative Servers & Local Servers

❖ Authoritative Servers

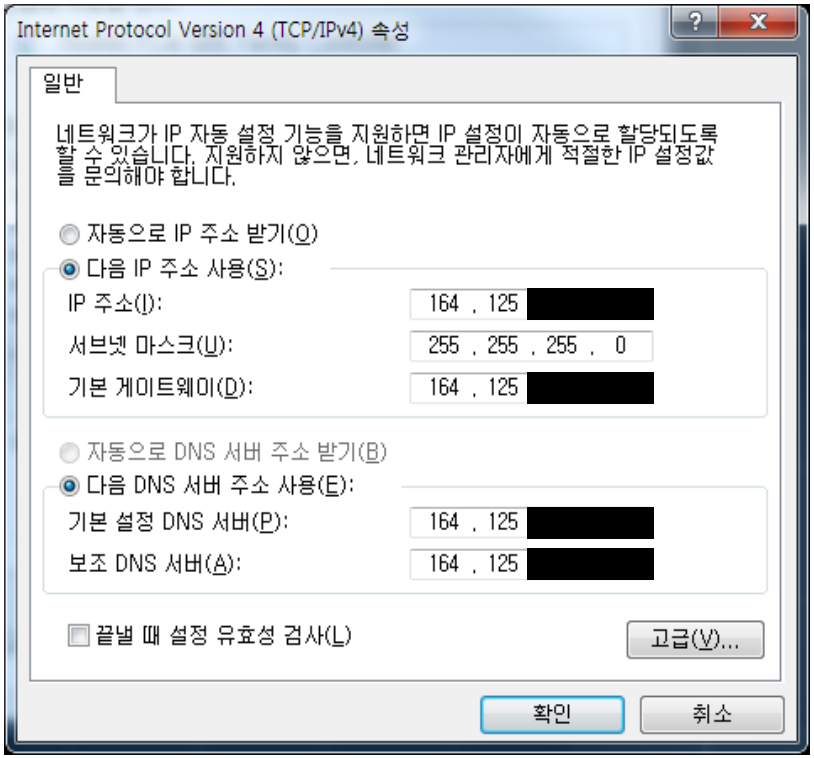
- organization's own DNS server(s), providing authoritative hostname to IP mappings for organization's named hosts
- can be maintained by organization or service provider

❖ 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

요 약

- IP address
- Subnet Mask
- DNS server



https://www.youtube.com/watch?v=5o8CwafCxnU&list=LLOvthjKPpJZN8bPHCM0xZXA&index=11&t=4s