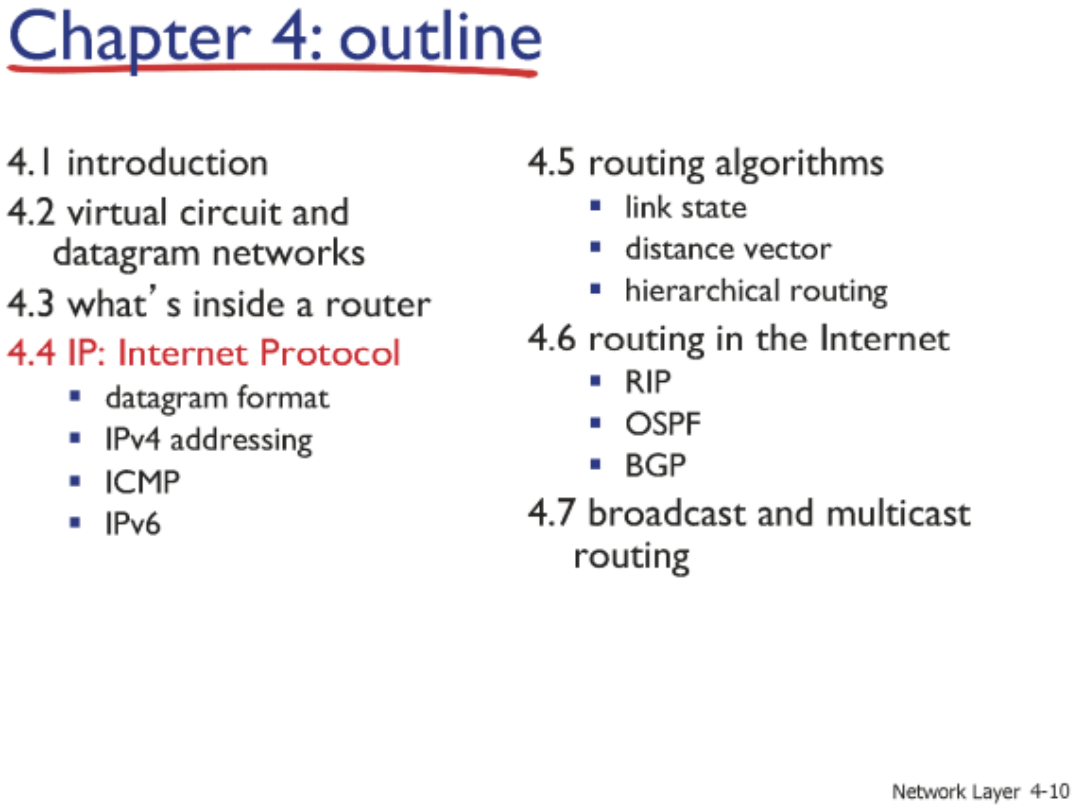
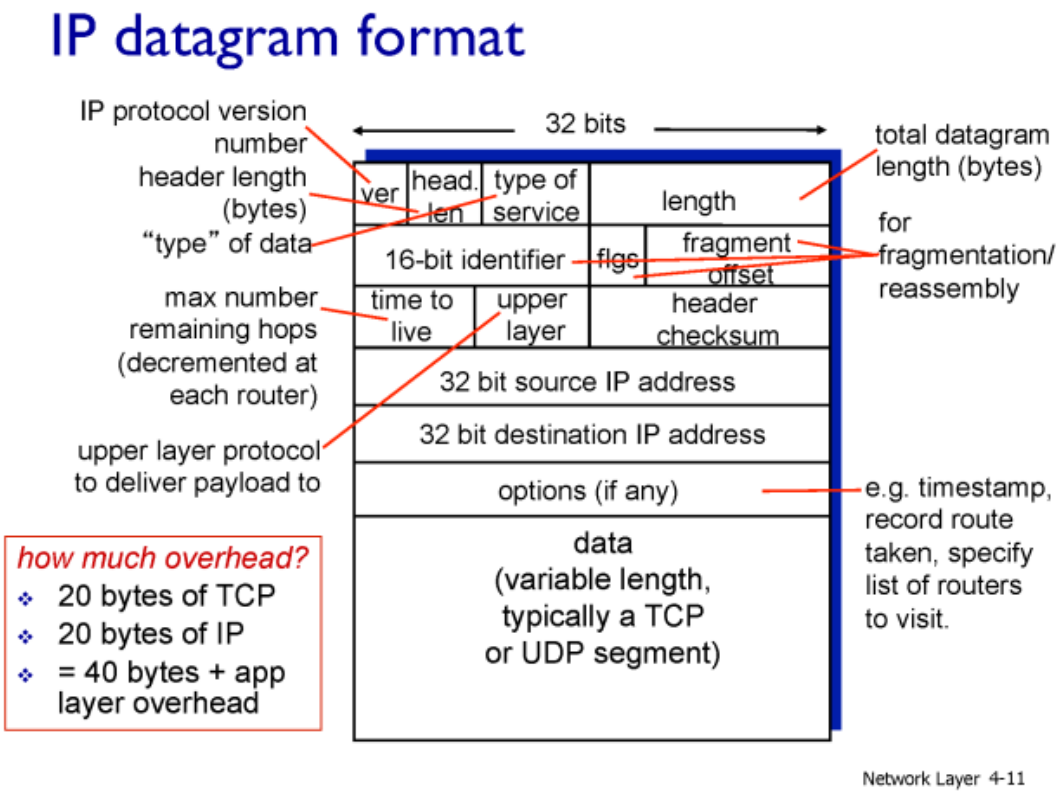
네트워크계층2

강의날짜	@2022/10/17
작성일시	@2022년 10월 17일 오후 11:50
편집일시	@2022년 10월 18일 오전 12:26
분야	네트워크
공부유형	스터디 그룹
복습	☐
태그	



- APP - HTTP - message

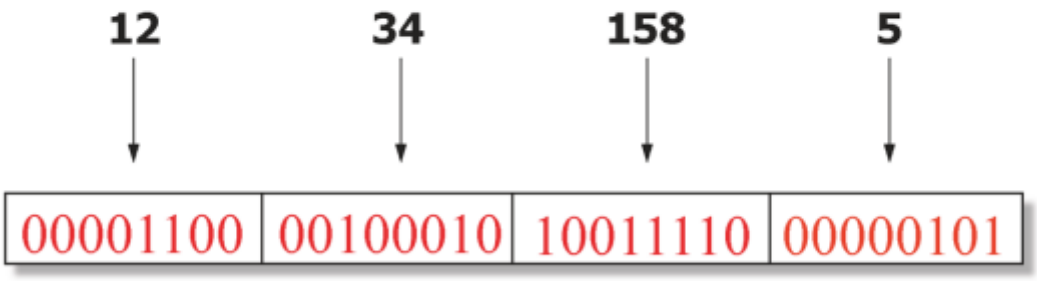
- Transport - TCP - segment
- Network - IP - packet



- 프로토콜 버전 4 ip packet header 20bytes
- 패킷에 length
- source ip address : message 생성해서 보내는 사람 ip주소
- destination IP address : 최종 목적지 post의 ip주소
- ttl : time to live 첫 라우터 20- 19- 18 - … 0이 되면 버려짐
  - 한정시간만큼만 네트워크 상에 돌다가 사라져라
- upper layer : tcp 인지 udp인지 작성
- ack만 담긴 파일 - 40 bytes

IP Address (IPv4)

- A unique 32-bit number
- Identifies an interface (on a host, on a router, …)
- Represented in dotted-quad notation



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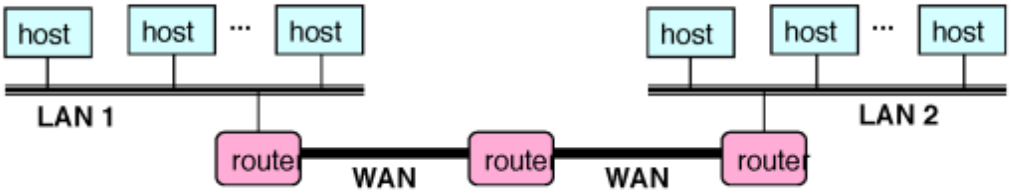
- 32bit 주소 체계를 가짐
- 이론 상 2의 32승의 ip주소를 가질 수 있음
- 8비트 씩 끊어서 10진수씩 바꾸기
- ip 주소 : 네트워크 인터페이스를 지칭하는 주소
- 네트워크 인터페이스를 여러 동시에 가질 수 있는 컴퓨터 : 라우터

Grouping Related Hosts

- The Internet is an "inter-network"
  - Used to connect networks together, not hosts
  - Need to address a network (i.e., group of hosts)

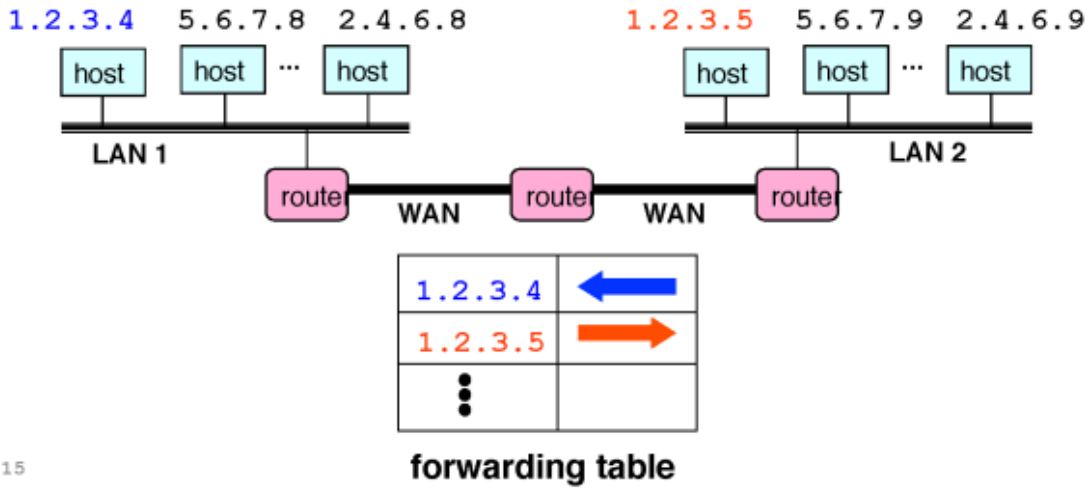


LAN = Local Area Network
WAN = Wide Area Network

- 네트워크는 라우터로 연결

Scalability Challenge

- Suppose hosts had arbitrary addresses
  - Then every router would need a lot of information
  - ...to know how to direct packets toward every host



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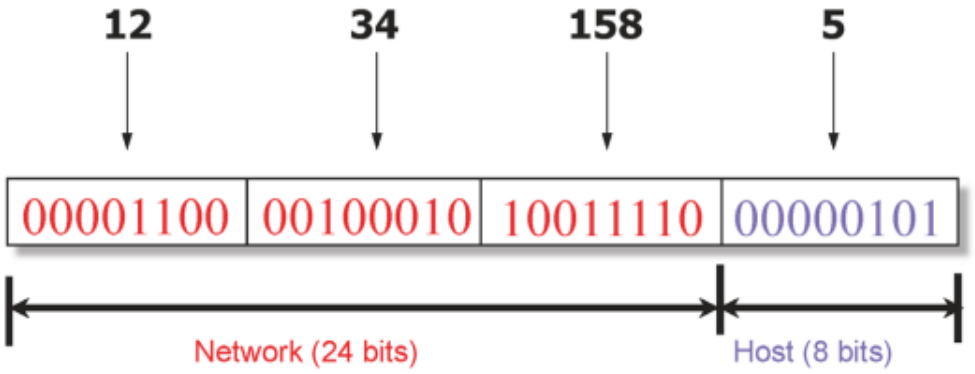
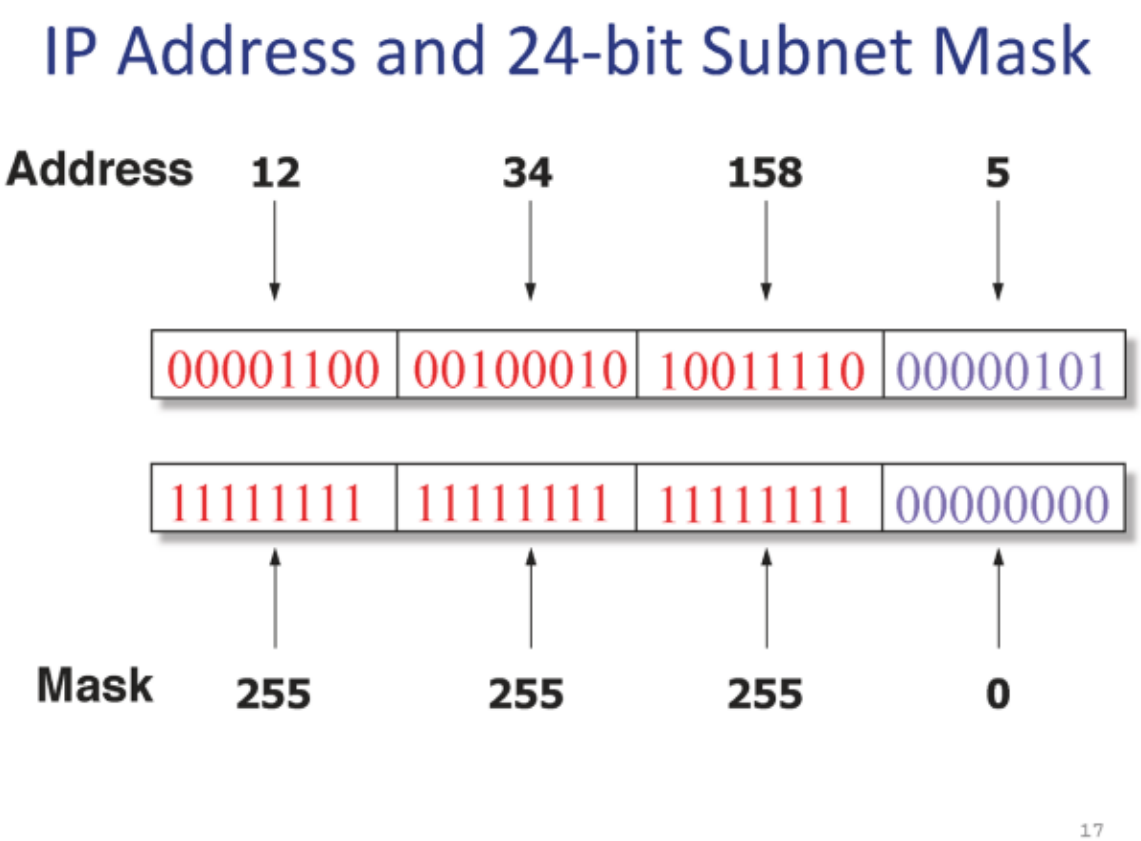
- 마음대로 배정하지 말아야함
  - 라우터안에 들어있는 forwaridng table이 엄청나게 커짐
    - 호스트 별로 방향이 다 다를테니까

Hierarchical Addressing: IP Prefixes

- Network and host portions (left and right)
- 12.34.158.0/24 is a 24-bit **prefix** with 2^8 addresses



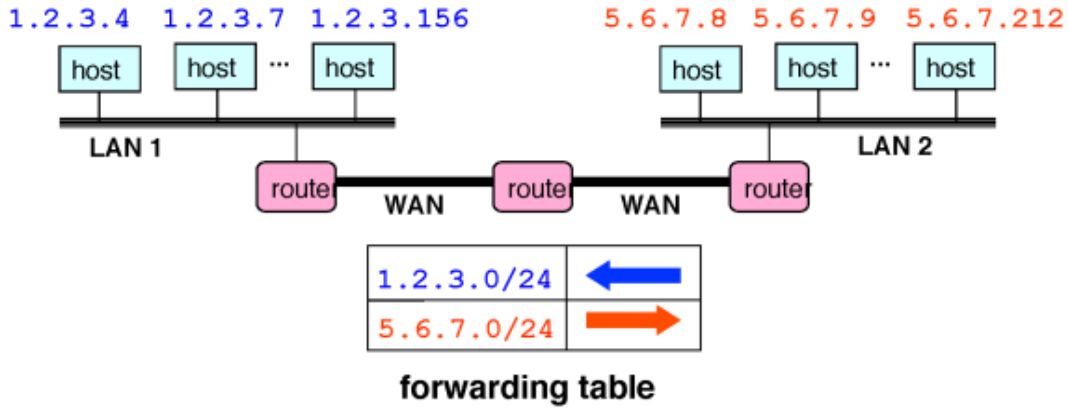
- 앞부분은 network id 뒷부분은 네트워크에 속한 host id
- 같은 네트워크 해당하는 호스트들은 같은 id를 가지도록



- 서브넷 마스크 : 어디까진가 네트워크 id인지 / 현재 속한 네트워크 크기를 알 수 있음
- 항상 ip address와 같이 다님

Scalability Improved

- Number related hosts from a common subnet
  - 1.2.3.0/24 on the left LAN
  - 5.6.7.0/24 on the right LAN



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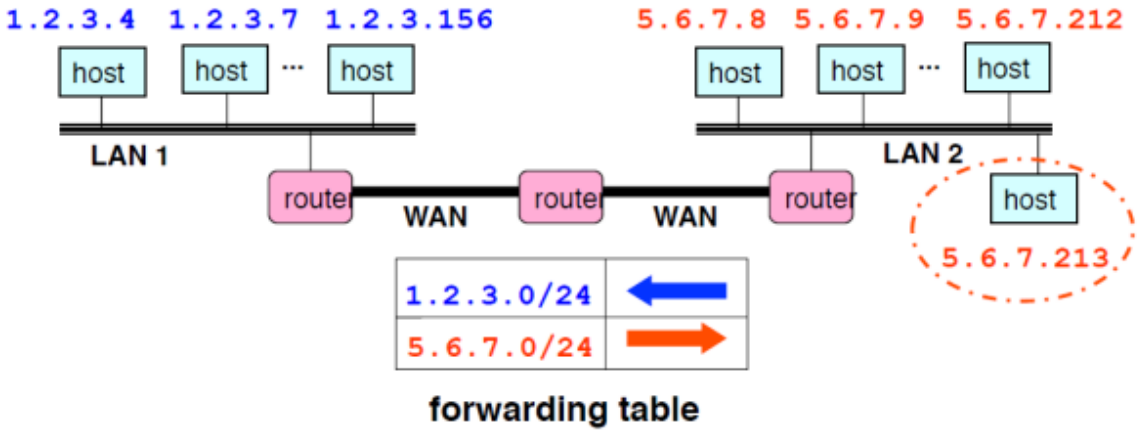
Easy to Add New Hosts

- No need to update the routers
  - E.g., adding a new host 5.6.7.213 on the right
  - Doesn't require adding a new forwarding-table entry



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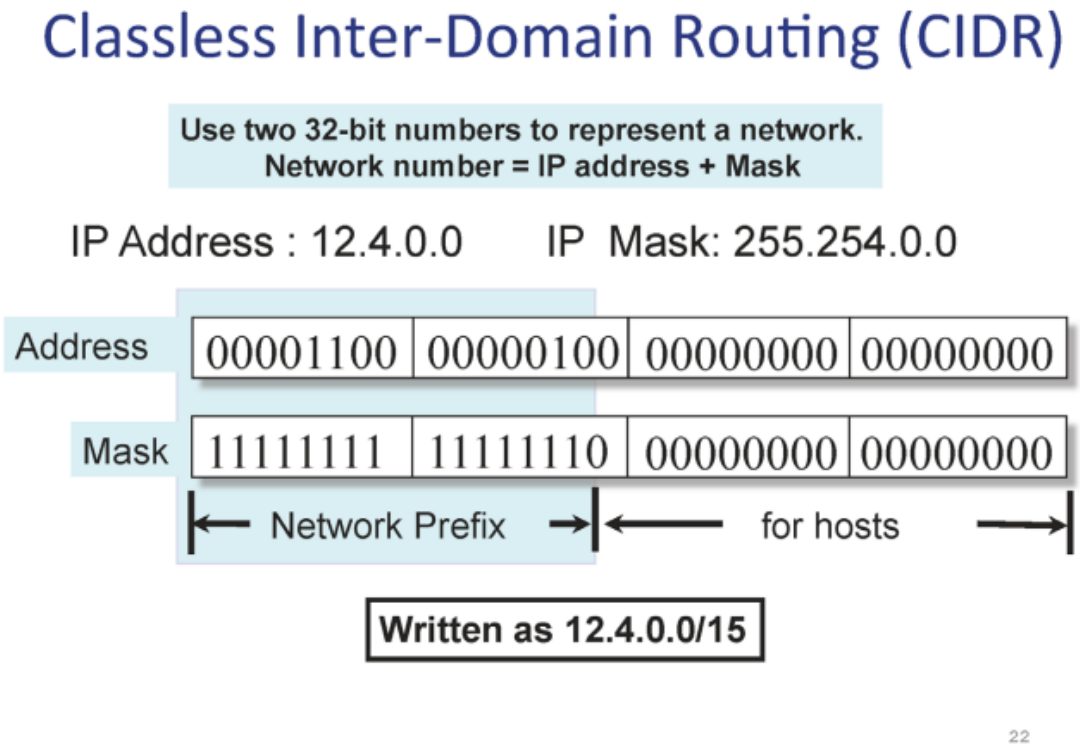
Classful Addressing

- In the old days, only fixed allocation sizes
  - Class A: 0*
    - Very large /8 blocks (e.g., MIT has 18.0.0.0/8)
  - Class B: 10*
    - Large /16 blocks (e.g,. Princeton has 128.112.0.0/16)
  - Class C: 110*
    - Small /24 blocks (e.g., AT&T Labs has 192.20.225.0/24)
  - Class D: 1110* for multicast groups
  - Class E: 11110* reserved for future use
- This is why folks use dotted-quad notation!

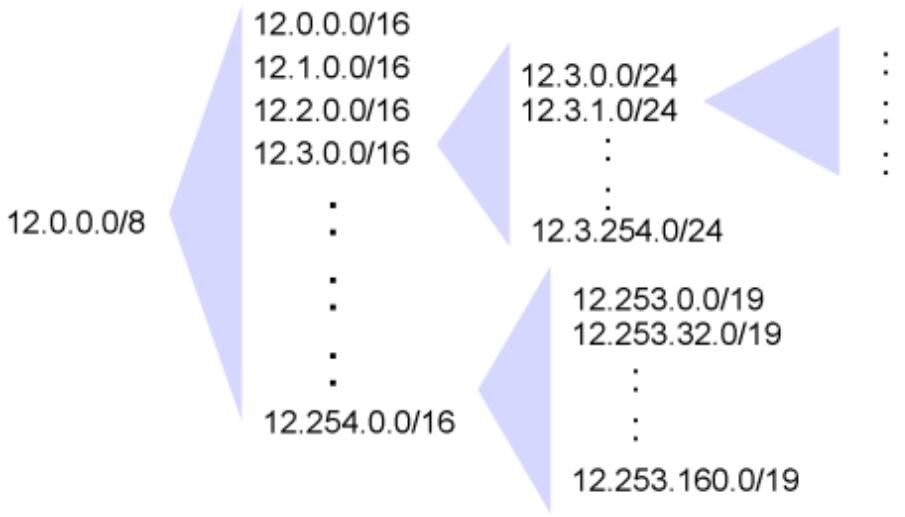
- 자기만의 프리픽스를 가져야함
- 예전에는 프리픽스 자체를 클래스를 나누어놨음
- 클래스 A 가 2의 8승개면 host는 2의 24승 개 : 이걸 가질 수 있는 기관은 전세계에 128개(2의8승)
- 클래스 B 가 2의 16승개면 host는 2의 16승개
- 클래스는 비효율적임



- 클래스가 없는 개념(classless)
- 8비트 단위로 떨어지는게 아니라 자유롭게 떨어지게 됨
- 프레픽스를 사용

Hierarchical Address Allocation

- Hierarchy is key to scalability
  - Address allocated in contiguous chunks (prefixes)
  - Today, the Internet has about 400,000 prefixes



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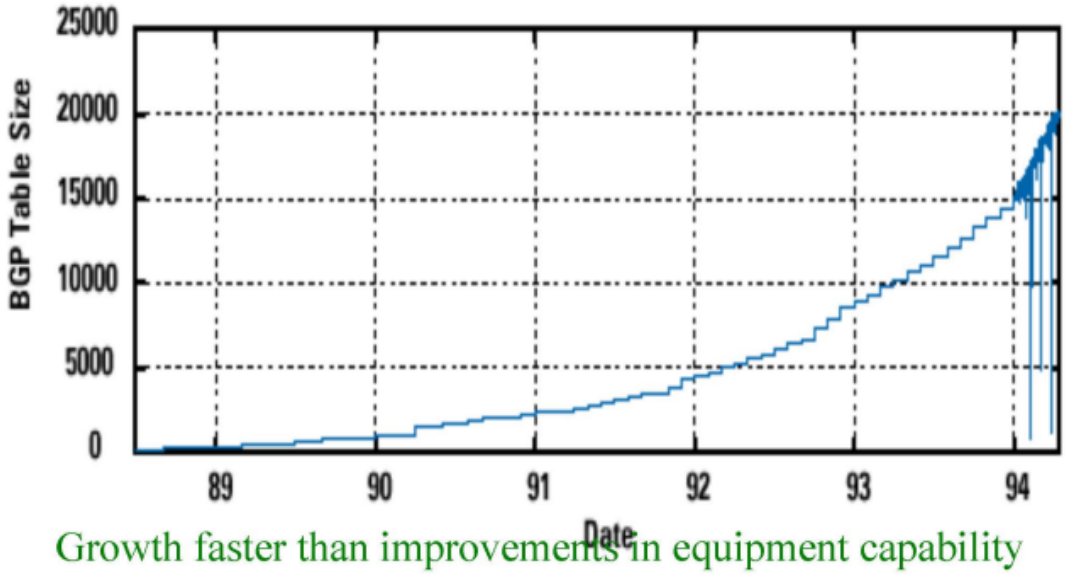
Obtaining a Block of Addresses

- Internet Corporation for Assigned Names and Numbers (ICANN)
  - Allocates large blocks to Regional Internet Registries
- Regional Internet Registries (RIRs)
  - E.g., ARIN (American Registry for Internet Numbers)
  - Allocates to ISPs and large institutions
- Internet Service Providers (ISPs)
  - Allocate address blocks to their customers
  - Who may, in turn, allocate to their customers…

Pre-CIDR (1988-1994): Steep Growth



Growth faster than improvements in equipment capability

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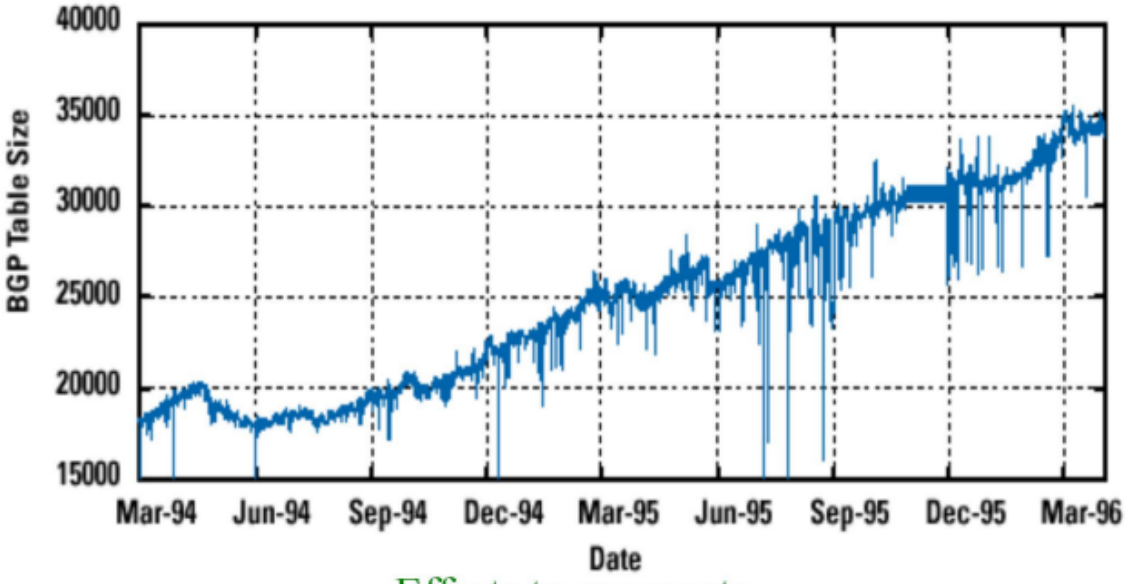
CIDR (1994-1996): Much Flatter



Efforts to aggregate

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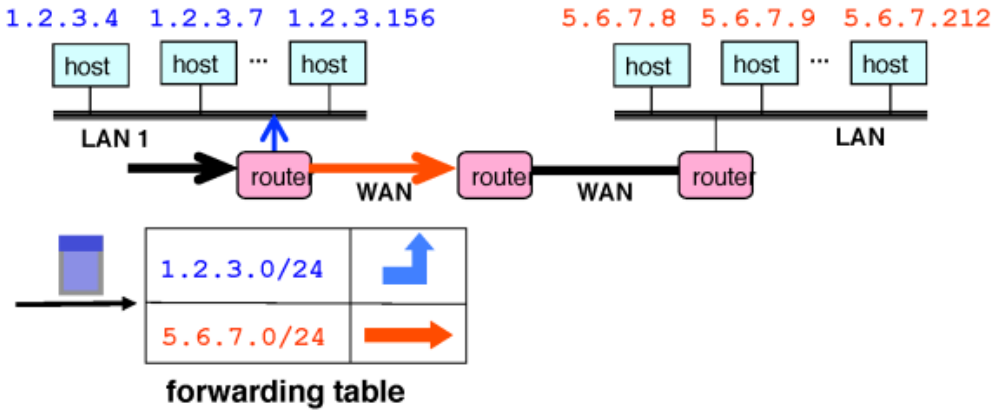
Separate Forwarding Entry Per Prefix

- Prefix-based forwarding
  - Map the destination address to matching prefix
  - Forward to the outgoing interface



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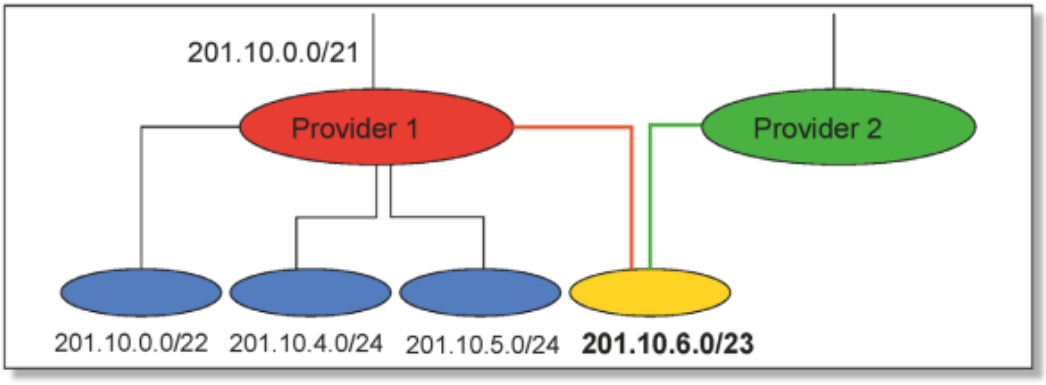
CIDR Makes Packet Forwarding Harder

- Forwarding table may have many matches
  - E.g., entries for 201.10.0.0/21 and 201.10.6.0/23
  - The IP address 201.10.6.17 would match both!



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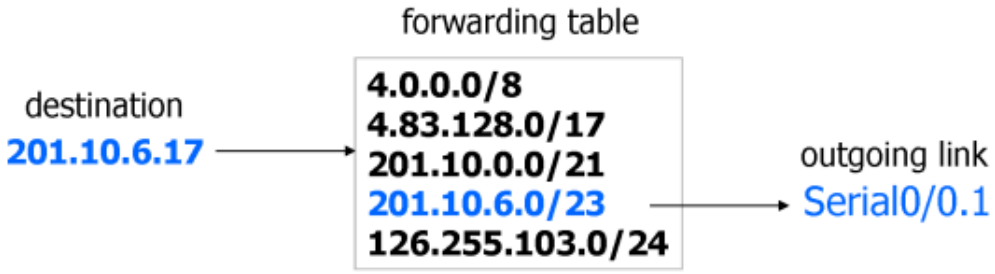
Longest Prefix Match Forwarding

- Destination-based forwarding
  - Packet has a destination address
  - Router identifies longest-matching prefix
  - Cute algorithmic problem: very fast lookups



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- 프레픽스가 가장 긴 것을 찾아 매칭 시켜주면 된다
- 라우터가 하는 일
- 포워딩 테이블의 엔트리는 누가 채우냐? 라우팅 알고리즘

Creating a Forwarding Table

- Entries can be statically configured
  - E.g., "map 12.34.158.0/24 to Serial0/0.1"
- But, this doesn't adapt
  - To failures
  - To new equipment
  - To the need to balance load
- That is where the *control plane* comes in
  - Routing protocols

IP addressing: CIDR

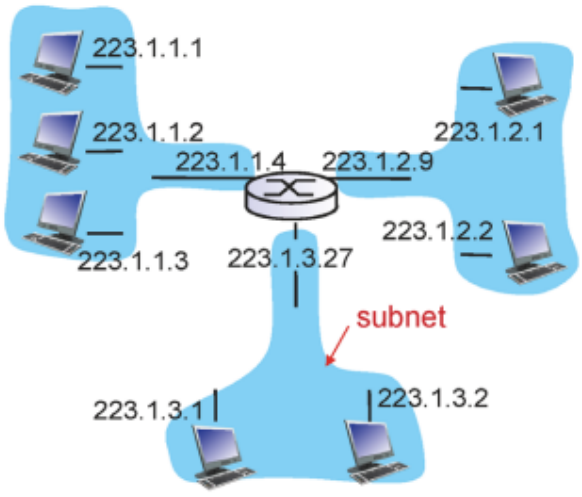
CIDR: Classless InterDomain Routing

- subnet portion of address of arbitrary length
- address format: a.b.c.d/x, where x is # bits in subnet portion of address

200.23.16.0/23

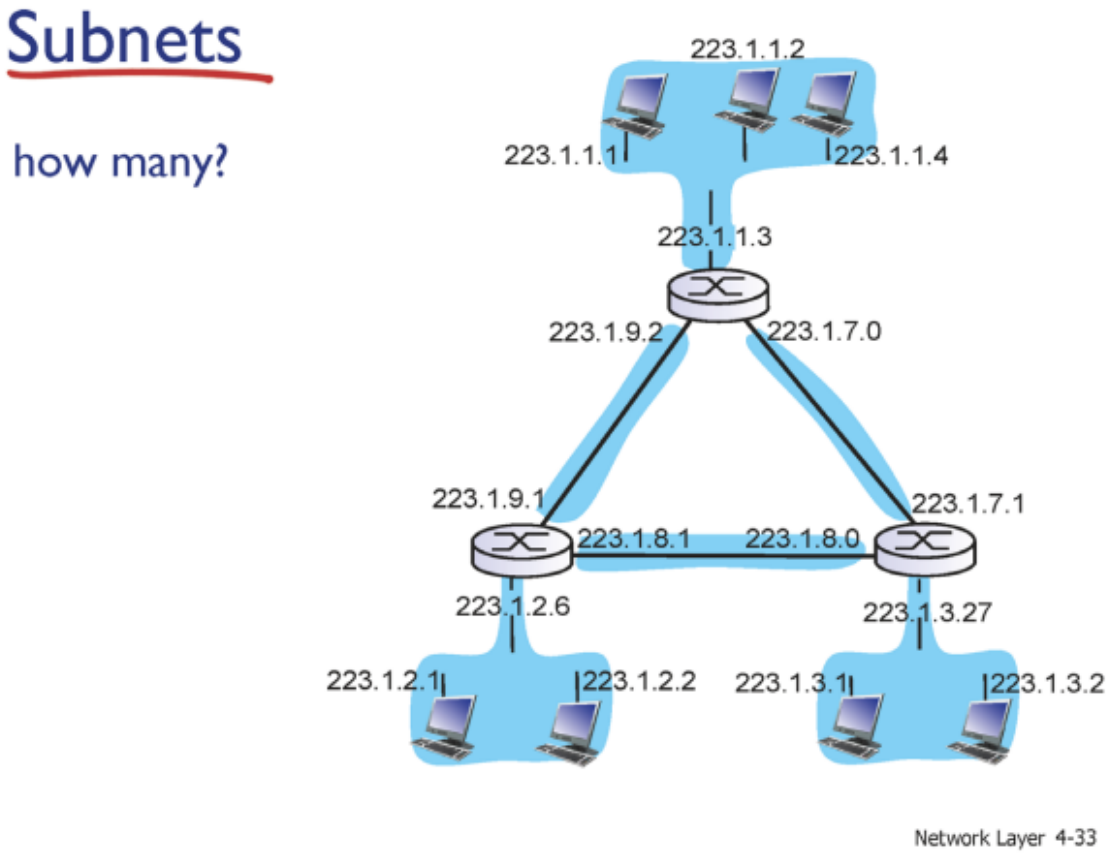
Subnets

- IP address:
  - subnet part - high order bits
  - host part - low order bits
- *what's a subnet ?*
  - device interfaces with same subnet part of IP address
  - can physically reach each other *without intervening router*



network consisting of 3 subnets

- 라우터를 거치지 않고도 접근이 가능
- 라우터는 여러개의 서브넷이 속한



- 서브넷 개수 : 6개
- 서브넷 : 같은 프레픽스를 가지는 애들의 집합

Network Address Translation (NAT)

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History of NATs

- IP address space depletion
  - Clear in early 90s that 2^{32} addresses not enough
  - Work began on a successor to IPv4
- In the meantime…
  - Share addresses among numerous devices
  - … without requiring changes to existing hosts
- Meant as a short-term remedy
  - Now: NAT is widely deployed, much more than IPv6

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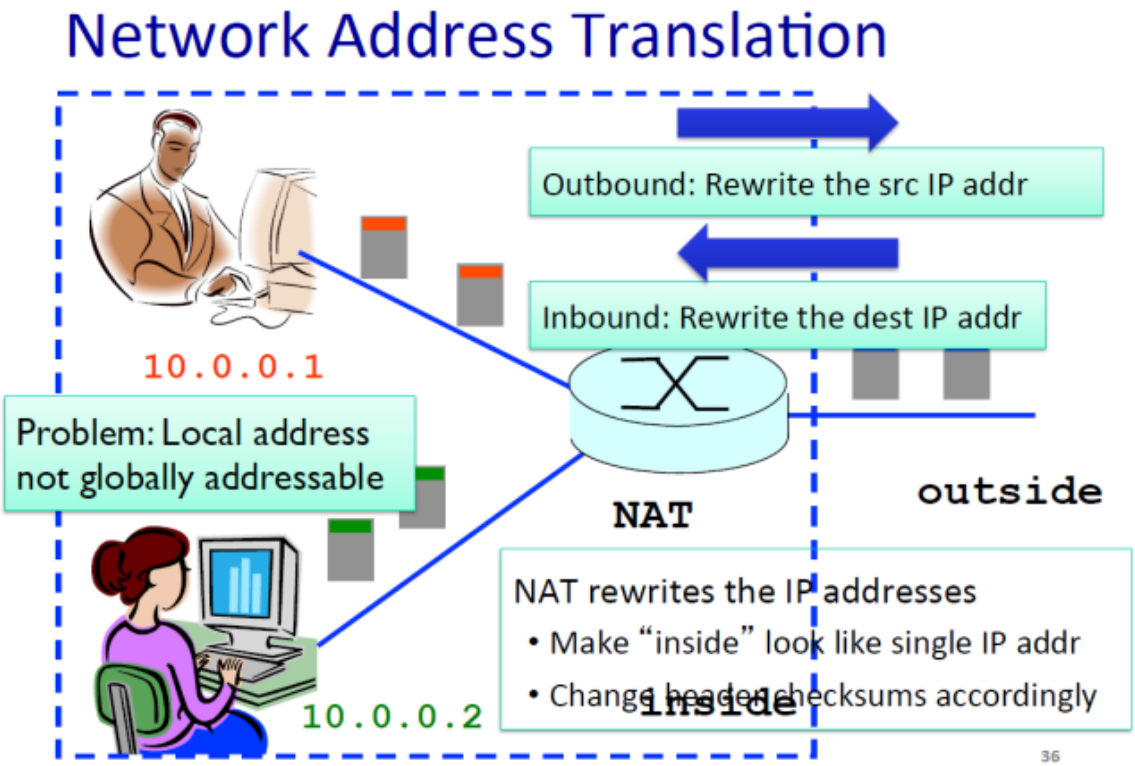
Network Address Translation
Outbound: Rewrite the src IP addr
Inbound: Rewrite the dest IP addr
10.0.0.1
Problem: Local address not globally addressable
NAT
outside
NAT rewrites the IP addresses
• Make "inside" look like single IP addr
• Change header checksums accordingly
10.0.0.2
inside
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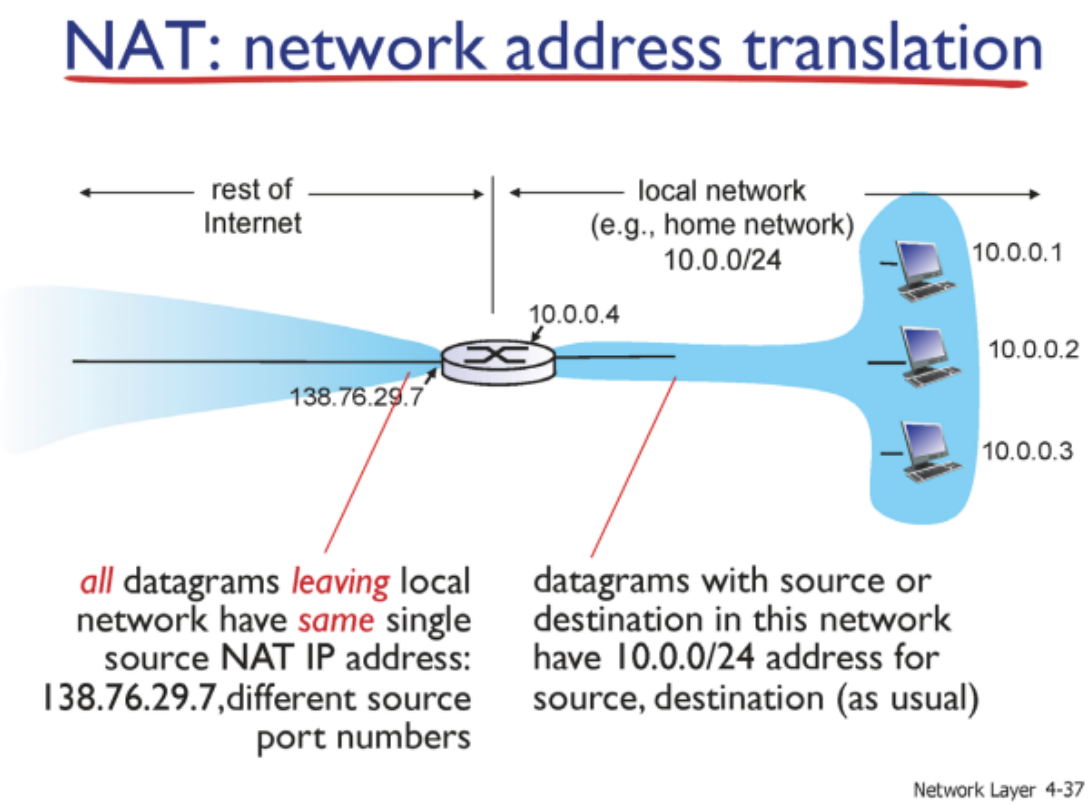
NAT: network address translation
rest of Internet
local network (e.g., home network) 10.0.0/24
10.0.0.1
10.0.0.4
10.0.0.2
138.76.29.7
10.0.0.3
all datagrams leaving local network have same single source NAT IP address: 138.76.29.7,different source port numbers
datagrams with source or destination in this network have 10.0.0/24 address for source, destination (as usual)
Network Layer 4-37

- ip 내부적으로만 유효

- ip와 포트넘버까지 바뀜