Network Layer

COMP90007 Internet Technologies

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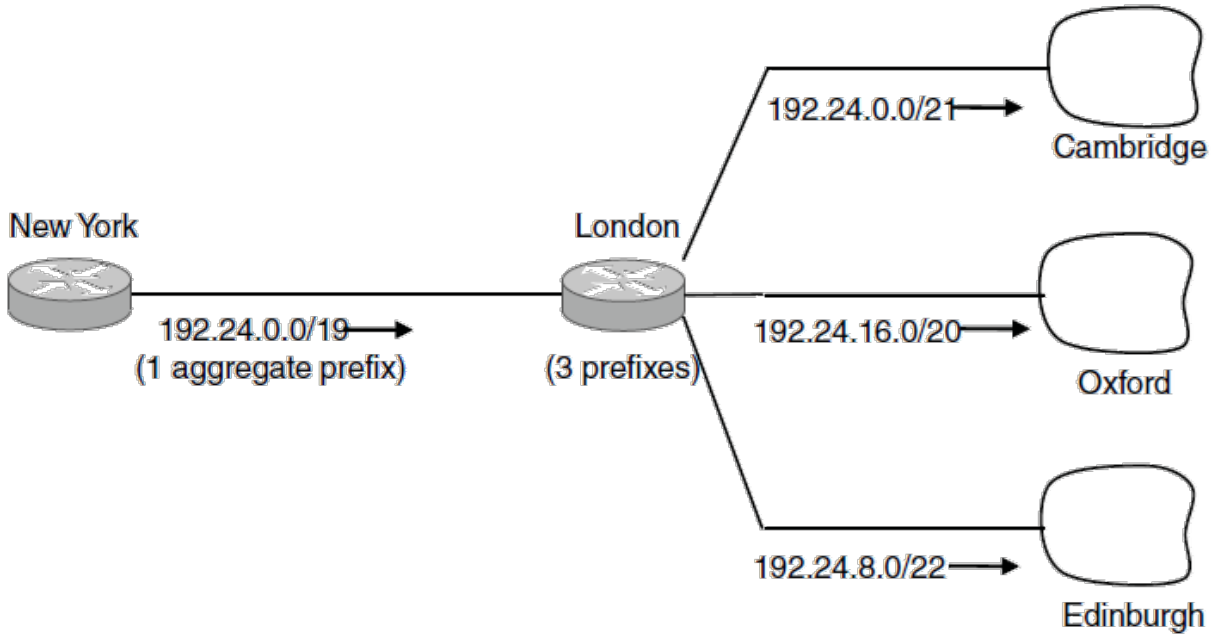
Classless Inter-Domain Routing (1)

- Routing table explosion? Backbone router connecting networks around the world → 300k networks
- Aggregation: process of joining multiple IP prefixes into a single larger prefix to reduce size of routing table

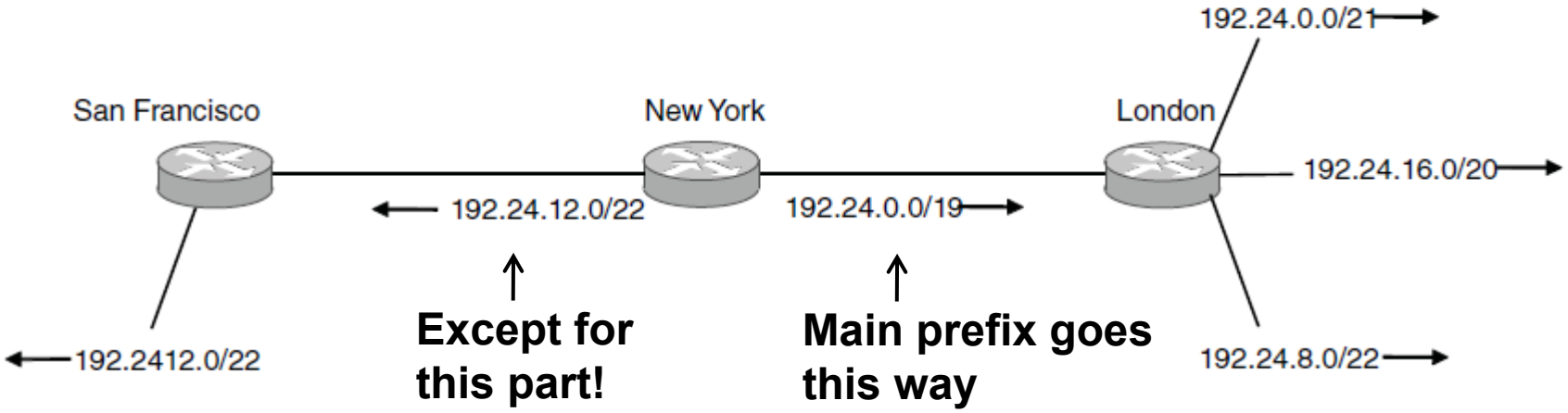


Classless Inter-Domain Routing (2)

- Packets are forwarded to the entry with the **longest matching prefix** (i.e. smallest address block)
- Complicates forwarding process but adds flexibility

  1) Check address whether matches the longest prefix → /22

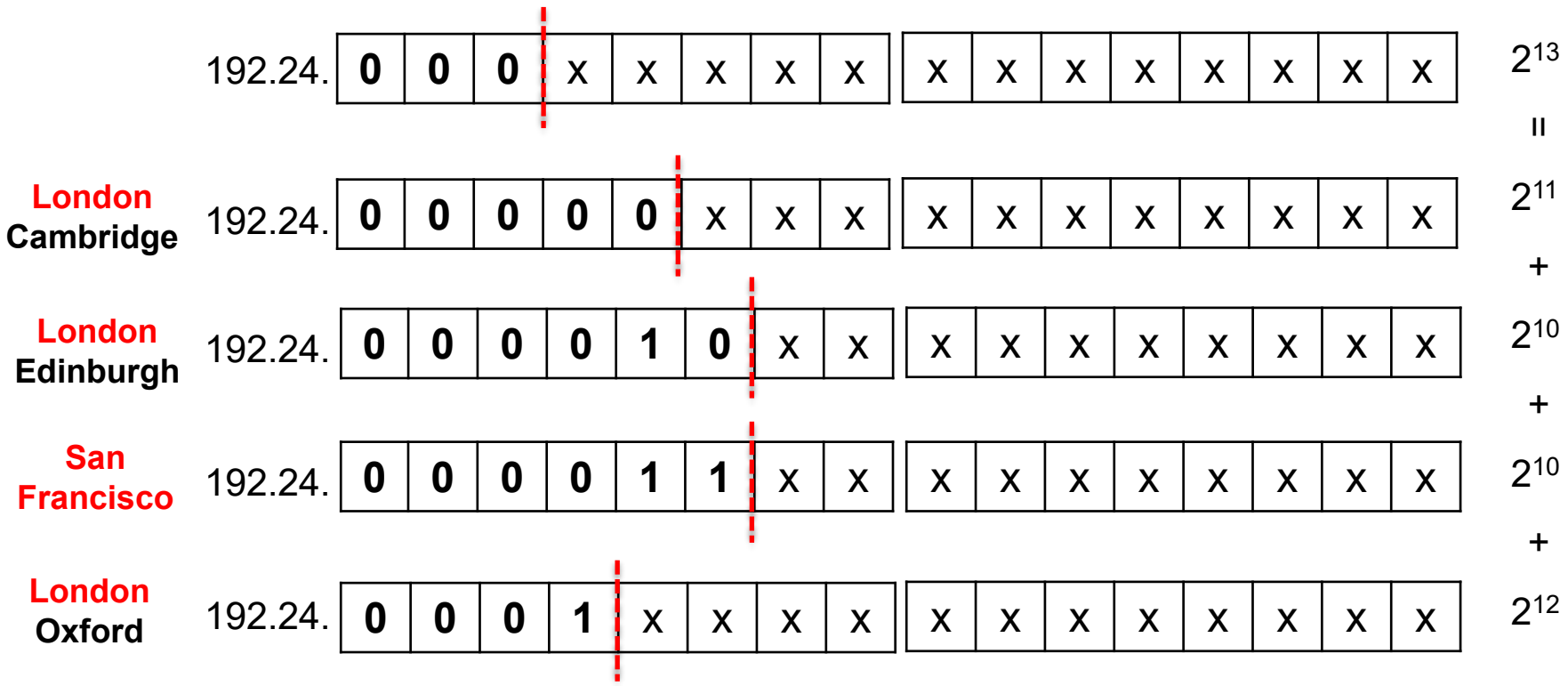
  2) If not, then see if it matches /19



Prefix Address	Subnet Mask	Interface
192.24.12.0/22	255.255.252.0	Eth 0 (to SF)
192.24.0.0/19	255.255.224.0	Eth 1 (to London)

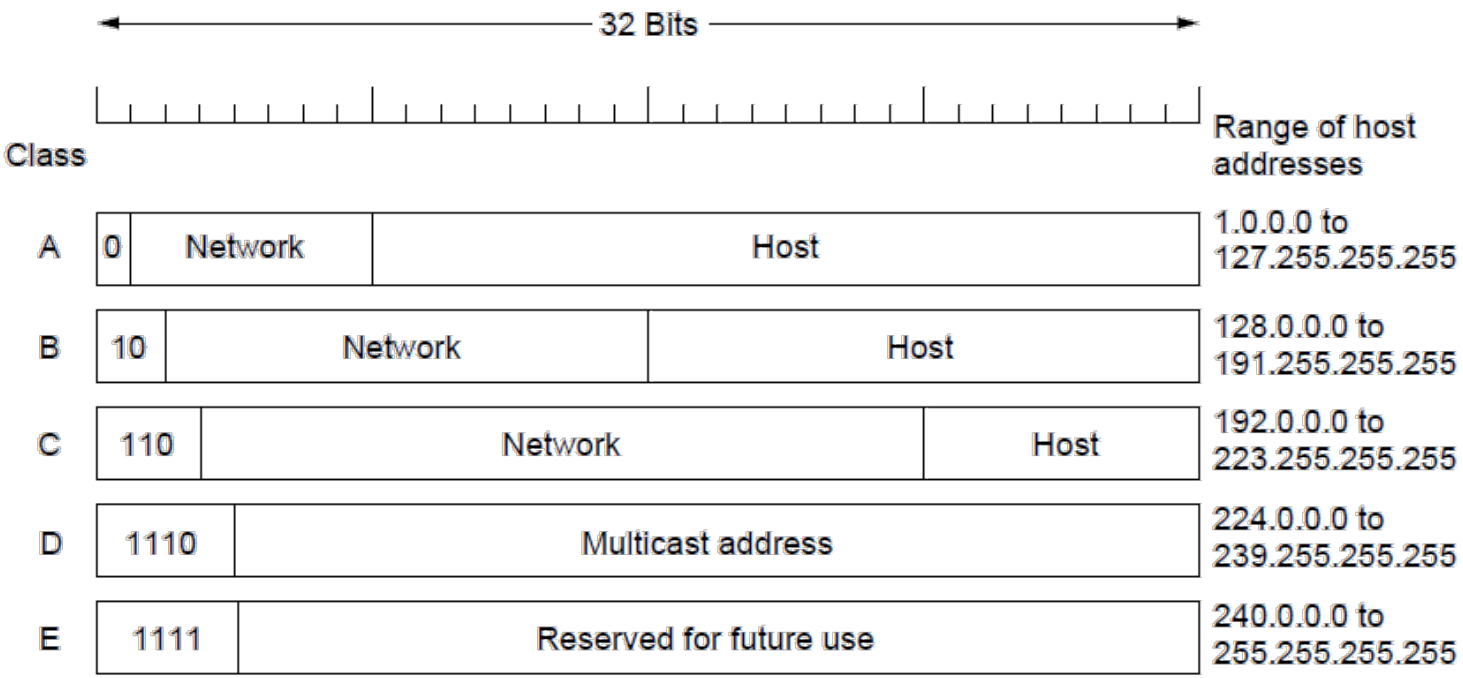
Classless Inter-Domain Routing (3)

192.24.0.0/19 → number of addresses 2^{13} (8192)



Classful Addressing

- Old design: addresses came in blocks of fixed size (Class A, B, C, D, E)
  - Carries size as part of address, but lacks flexibility

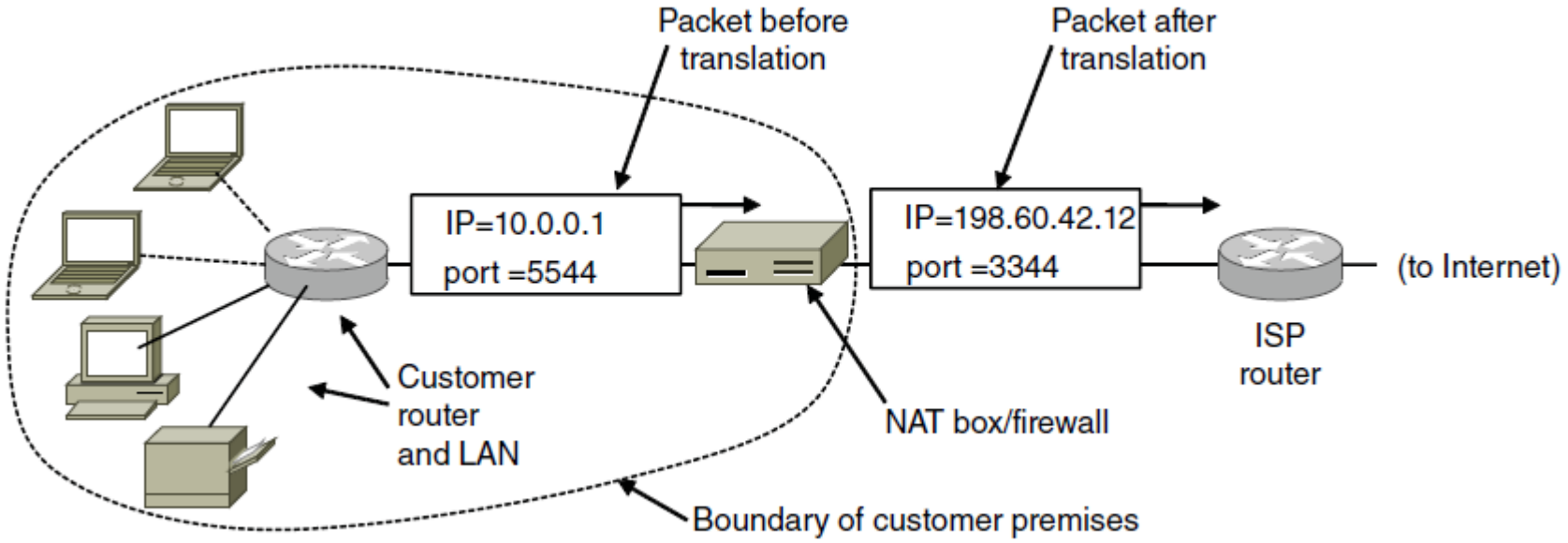


Private IP Ranges

- Range of IP addresses that CANNOT appear in the Internet
- Reserved only for private networks
  - 10.0.0.0/8 (2^{24} = 16,777,216 hosts)
  - 172.16.0.0/12 (2^{20} = 1,048,576 hosts)
  - 192.168.0.0 /16 (2^{16} = 65,536 hosts)

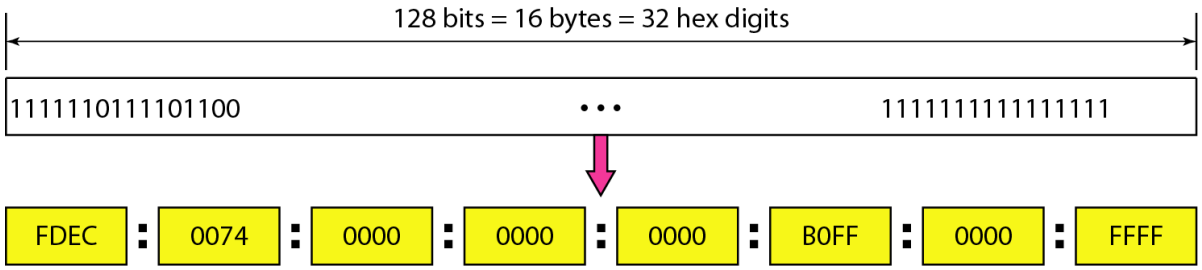
Network Address Translation (NAT)

- NAT box maps one external IP address to many internal IP addresses
  - Uses TCP/UDP port to distinguish connections
  - Violates layering; popular tool in conserving global address space



IPv6 (1)

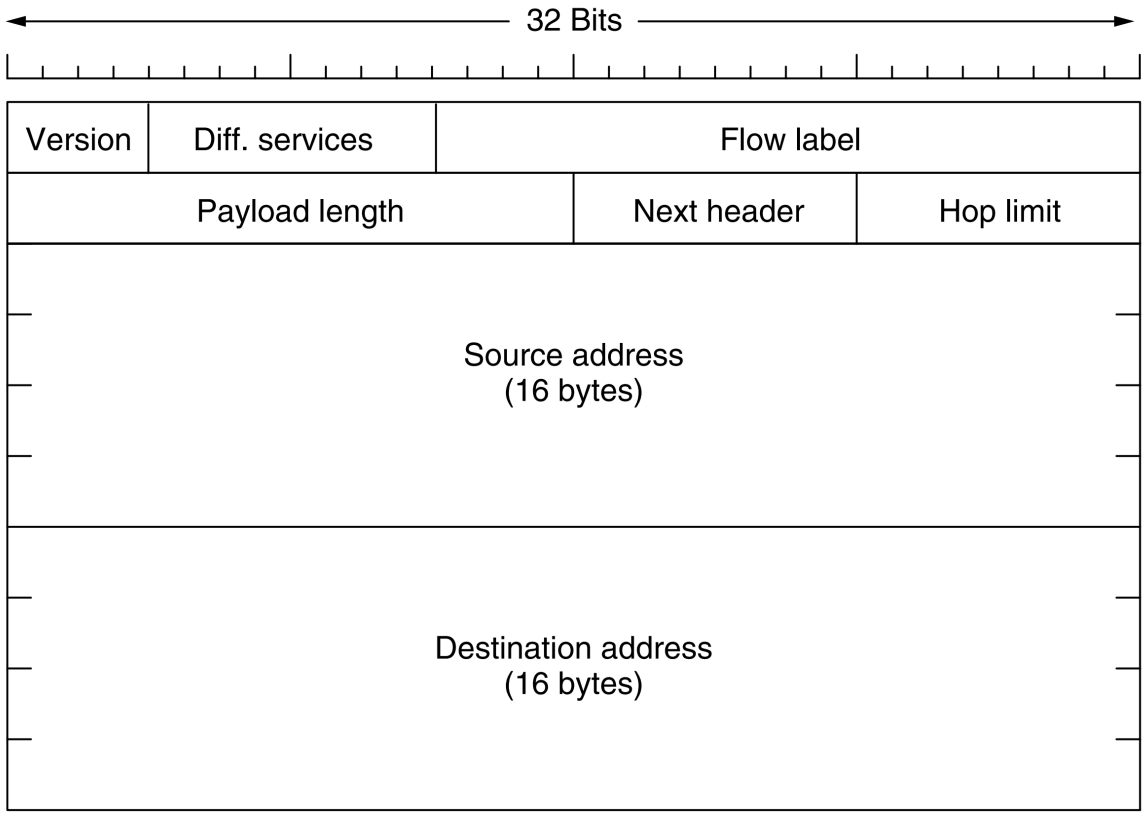
- Larger address space: 128-bit address
  use hexadecimal colon notation



- The format of header is simplified: required fields + options
- Support for more security: encryption and authentication
- Transition: dual stack, tunneling

IPv6 (2)

- Required fields in IPv6 header (40 bytes)



Internet Control Protocols

- IP works with the help of several control protocols:
  - ICMP (Internet Control Message Protocol) is a companion to IP that returns error info
    - Required, and used in many ways, e.g., traceroute, ping
  - ARP (Address Resolution Protocol) finds MAC address of a local IP address
    - Host queries an address and the owner replies
  - DHCP (Dynamic Host Control Protocol) assigns a local IP address to a host
    - Gets host started by automatically configuring it
    - Host sends request to server, which grants a lease

ICMP

- Used for testing and monitoring ambient conditions between hosts and routers

Message type	Description
Destination unreachable	Packet could not be delivered
Time exceeded	Time to live field hit 0
Parameter problem	Invalid header field
Source quench	Choke packet
Redirect	Teach a router about geography
Echo and Echo reply	Check if a machine is alive
Timestamp request/reply	Same as Echo, but with timestamp
Router advertisement/solicitation	Find a nearby router