



Lecture Outlines

- IPv4
- IPv6
- Subnetting
- Supernetting
- Routing



IP Hierarchical Addressing

IP Version 4; Address: 32 bits

4,294,967,296

Possible Addresses = 2^{32}

IP Version 6; Address: 128 bits

340282366920938463463374607431768211456

Possible Addresses = 2^{128}

Hierarchical addressing

2 Parts: Network, Host



determined by

Subnet Mask



IP version 4 (IPv4)

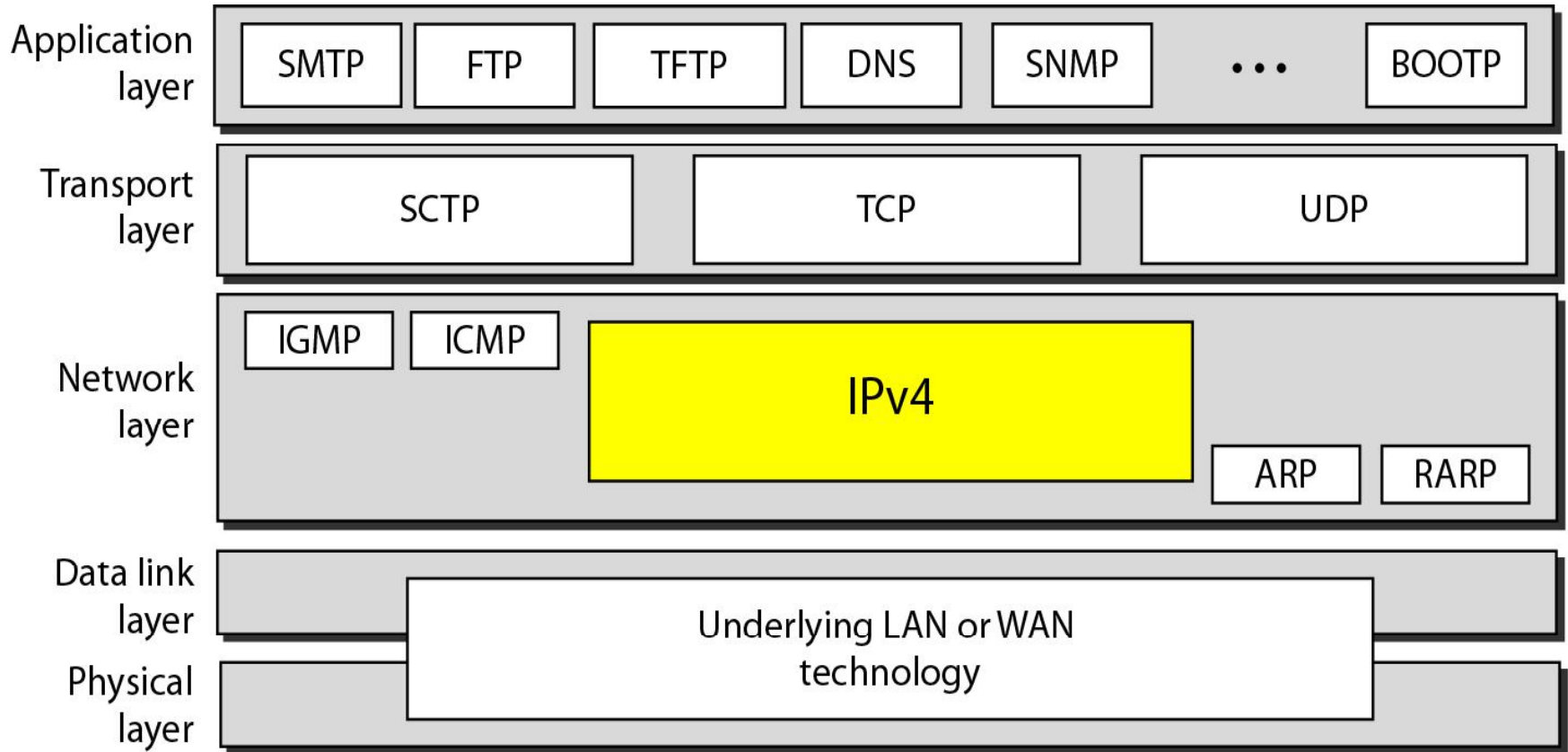
- The Internet Protocol version 4 (IPv4) is the delivery mechanism used by the TCP/IP protocols.
- ***IPv4 address length is 32 bits (4 byte), written in dotted-decimal notation***
- Hierarchical: consisting of two parts, network part and host part

10000000 00001011 00000011 00011111

128.11.3.31

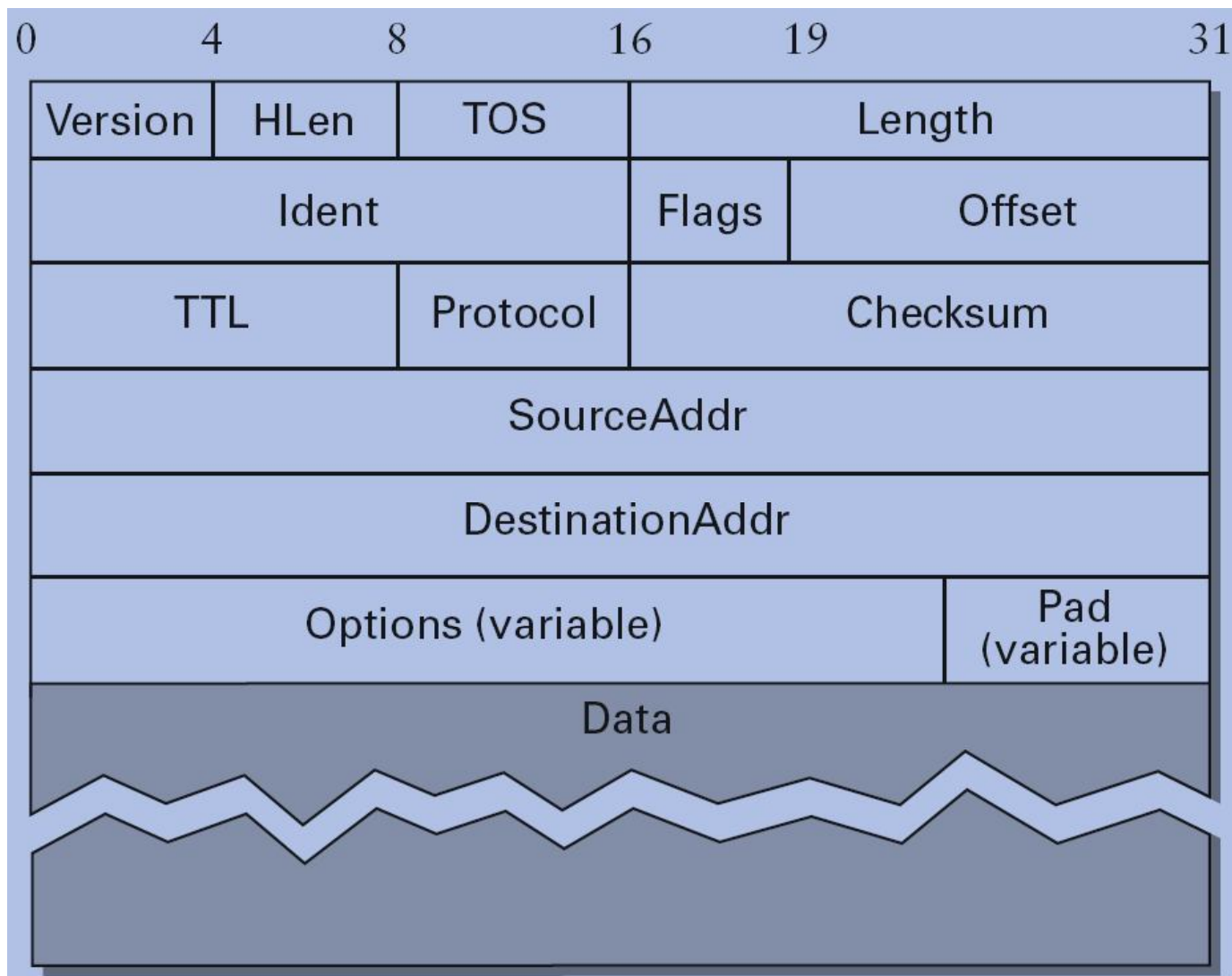


Position of IPv4 in TCP/IP protocol suite



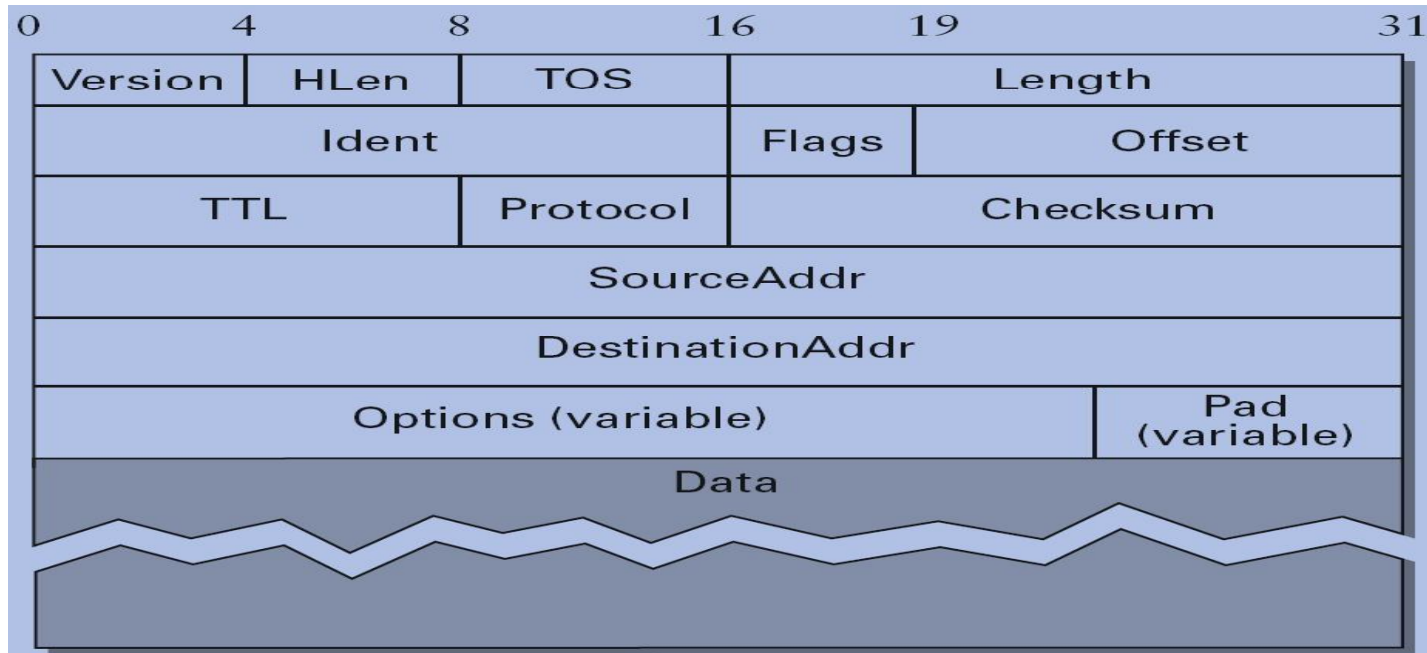


IP Packet Format





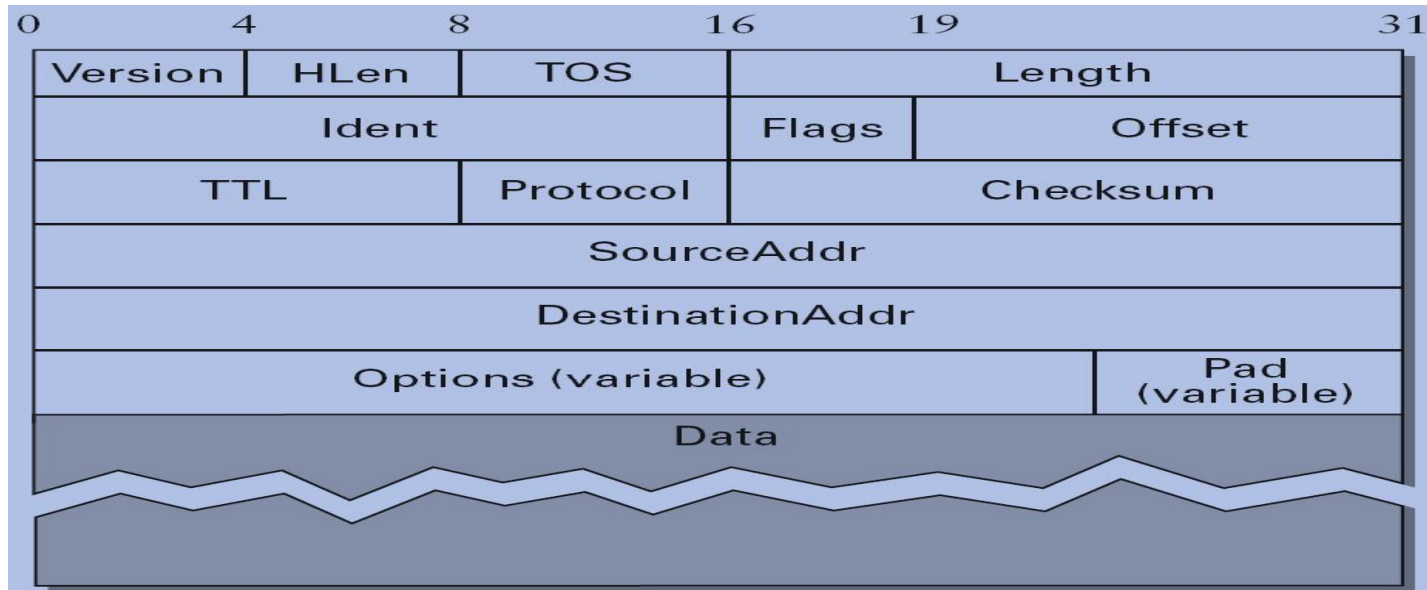
Datagram Format



- 4-bit version (4 for IPv4, 6 for IPv6)
- 4-bit header length (in words, minimum of 5)
- 8-bit type of service (TOS); more or less unused
- 16-bit datagram length (in bytes)
- 8-bit protocol (e.g., TCP=6 or UDP=17)



Datagram Format

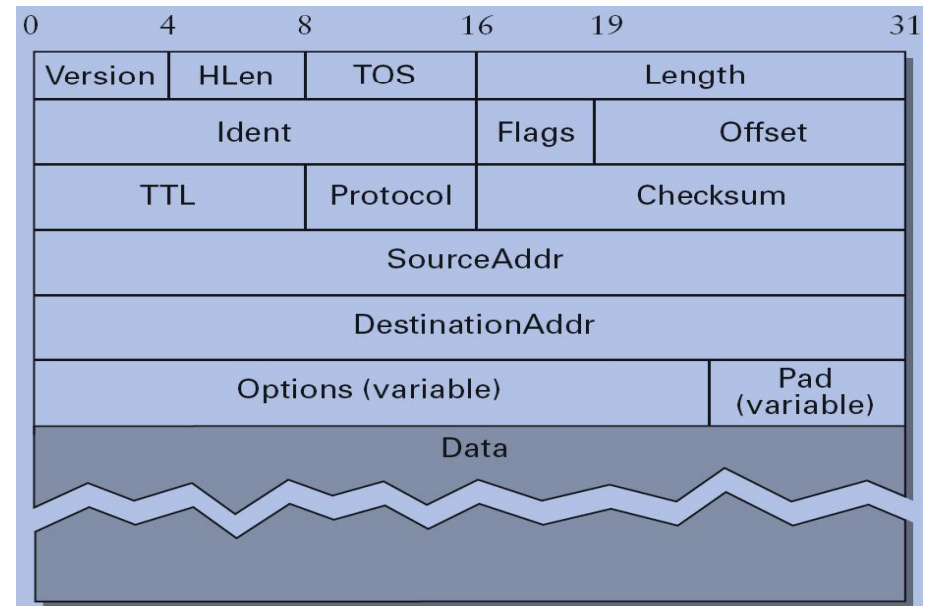


- Fragmentation support
 - ❑ 16-bit packet ID (identifies packet fragments)
 - ❑ 3-bit flags; one bit marks last fragment
 - ❑ 13-bit fragment offset into packet (in 8-byte words)
- 8-bit “time-to-live” (TTL); a hop count until forced destruction of packet



Datagram Format

- 16-bit IP checksum on header
- 32-bit source IP address
- 32-bit destination IP address
- Options and padding (variable length)
 - ❑ Source-based routing (typically disabled)
 - ❑ Record route
 - ❑ Several others





Class-based and Classless Addressing



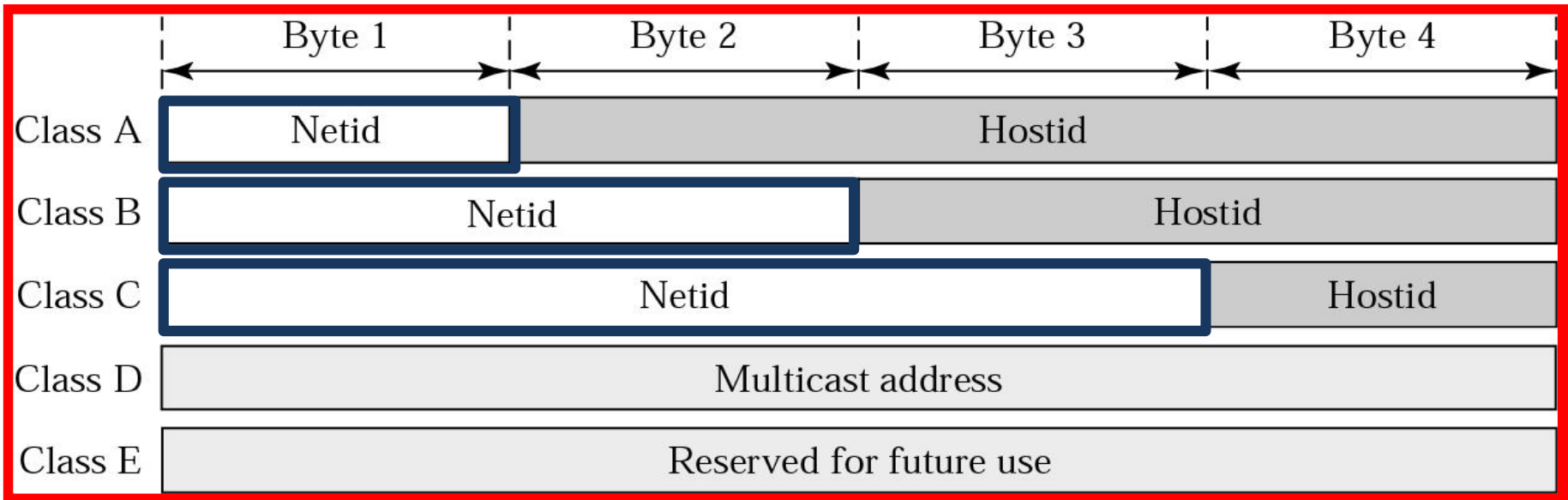
Class-based IP Addresses

	First byte	Second byte	Third byte	Fourth byte
Class A	0			
Class B	10			
Class C	110			
Class D	1110			
Class E	1111			

	First byte	Second byte	Third byte	Fourth byte
Class A	0 to 127			
Class B	128 to 191			
Class C	192 to 223			
Class D	224 to 239			
Class E	240 to 255			



Class-based IP Addresses





How to get IP Address



Internet Assigned Numbers Authority



RIRs





How to know IP Address

<http://www.ipligence.com/geolocation>



IP Geolocator

Find the city and country location of IP Addresses, hostnames or web addresses.

IP Address Database Lookup



Your IP address is 202.114.0.245
City: Wuhan
Country: China
Continent: Asia
Time Zone: GMT+8 [more demo?](#)

Enter IP Address / Hostname / URL:

202.114.0.245

Find

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Data obtained from IPelligence Max
[Learn more...](#)



Subnetting and Supernetting



Subnetting

202.125.138.0/24

202.125.138.0 – 202.125.138.255

202.125.138.0/25

202.125.138.0 – 202.125.138.127

202.125.138.128/25

202.125.138.128 – 202.125.138.255

Borrowing one host bit provides two subnetworks



Subnetting

202.125.138.0/24

202.125.138.0 – 202.125.138.255

202.125.138.0/26

202.125.138.0 – 202.125.138.63

202.125.138.192/26

202.125.138.192 – 202.125.138.255

202.125.138.64/26

202.125.138.64 – 202.125.138.127

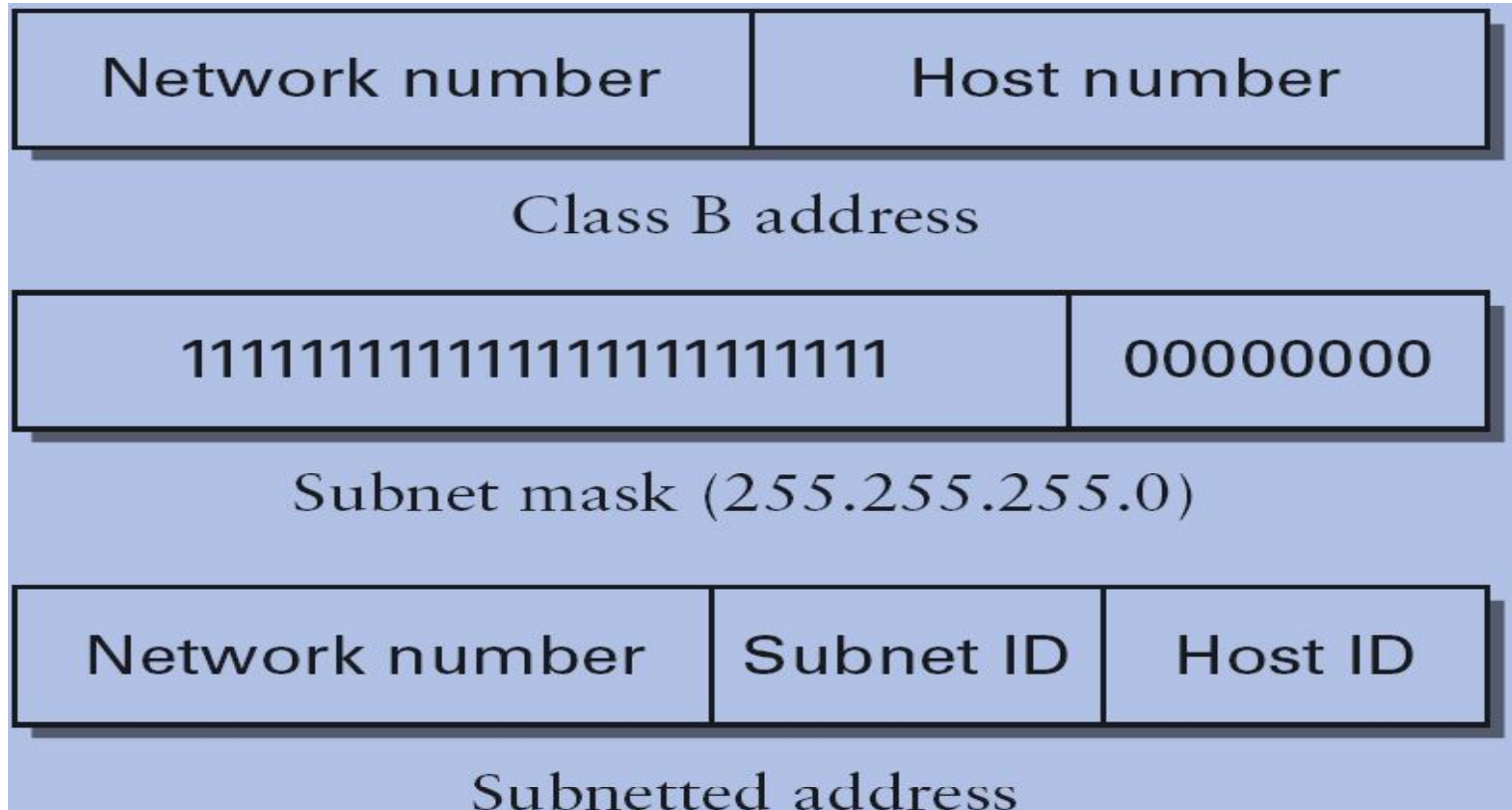
202.125.138.128/26

202.125.138.128 – 202.125.138.191

Borrowing two host bits provide four subnetworks



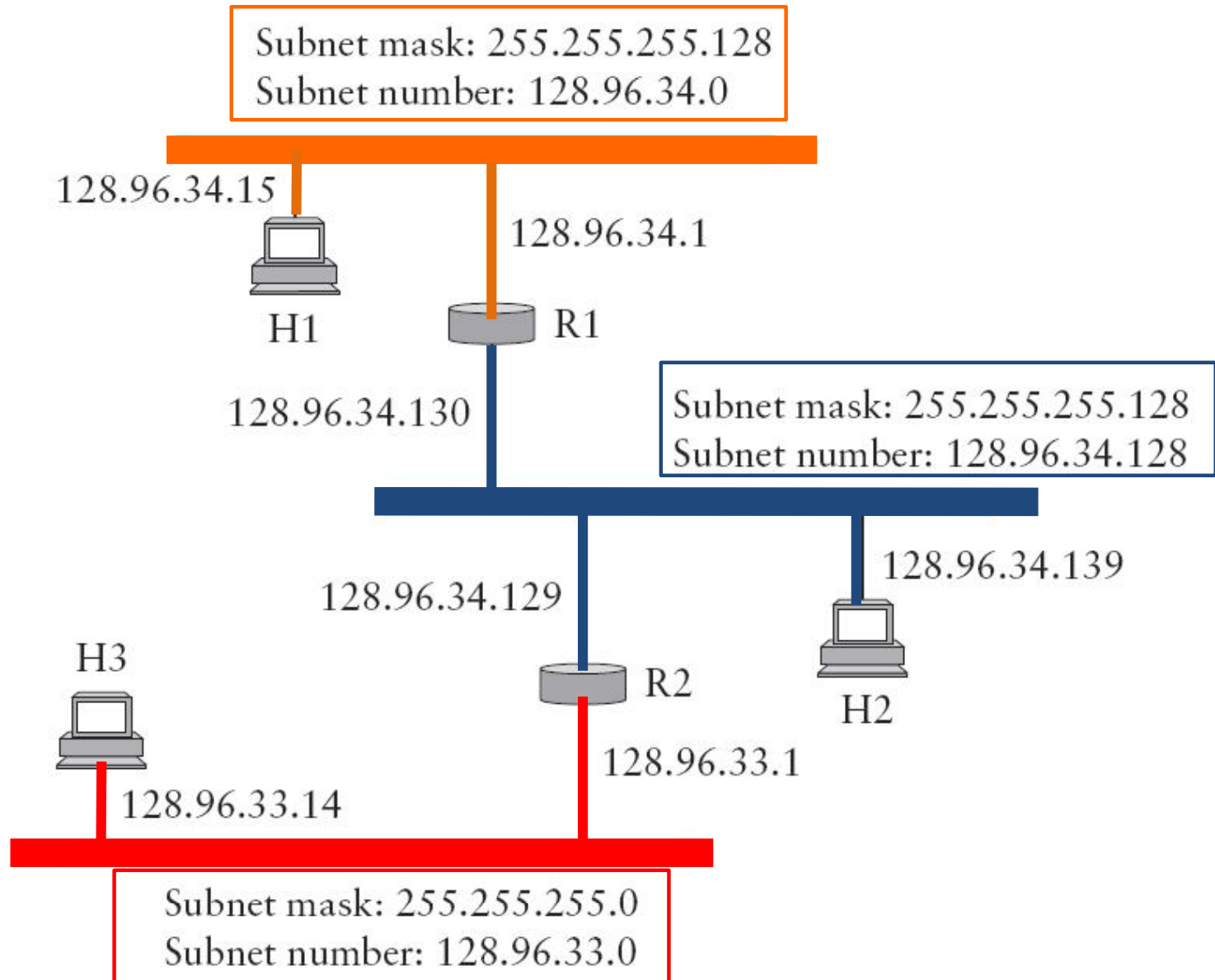
Subnetting – General Definition



In general, for a network with m possible hosts, borrowing n bits provides 2^n subnetworks of m/n hosts

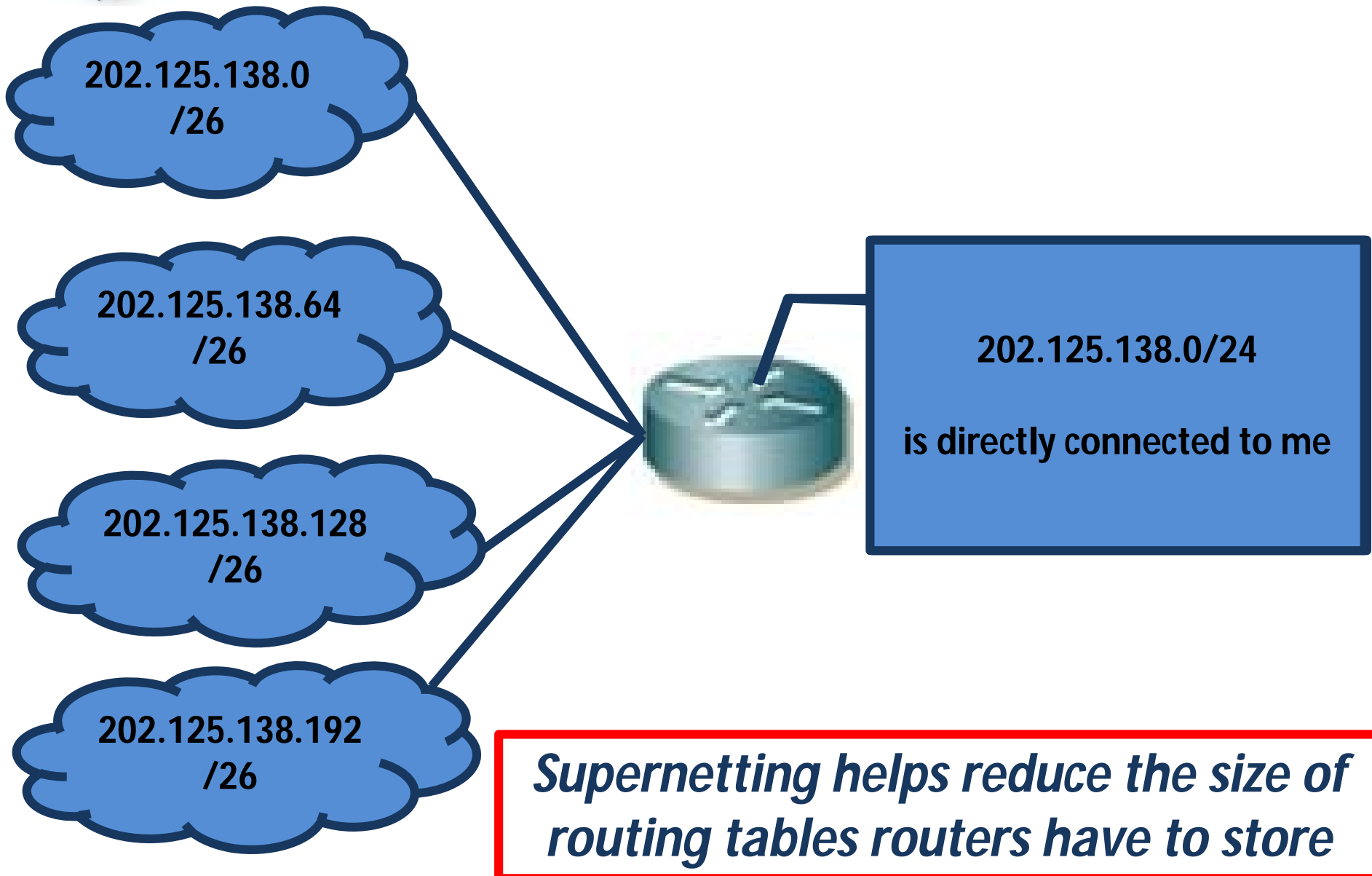


Subnetting – Example





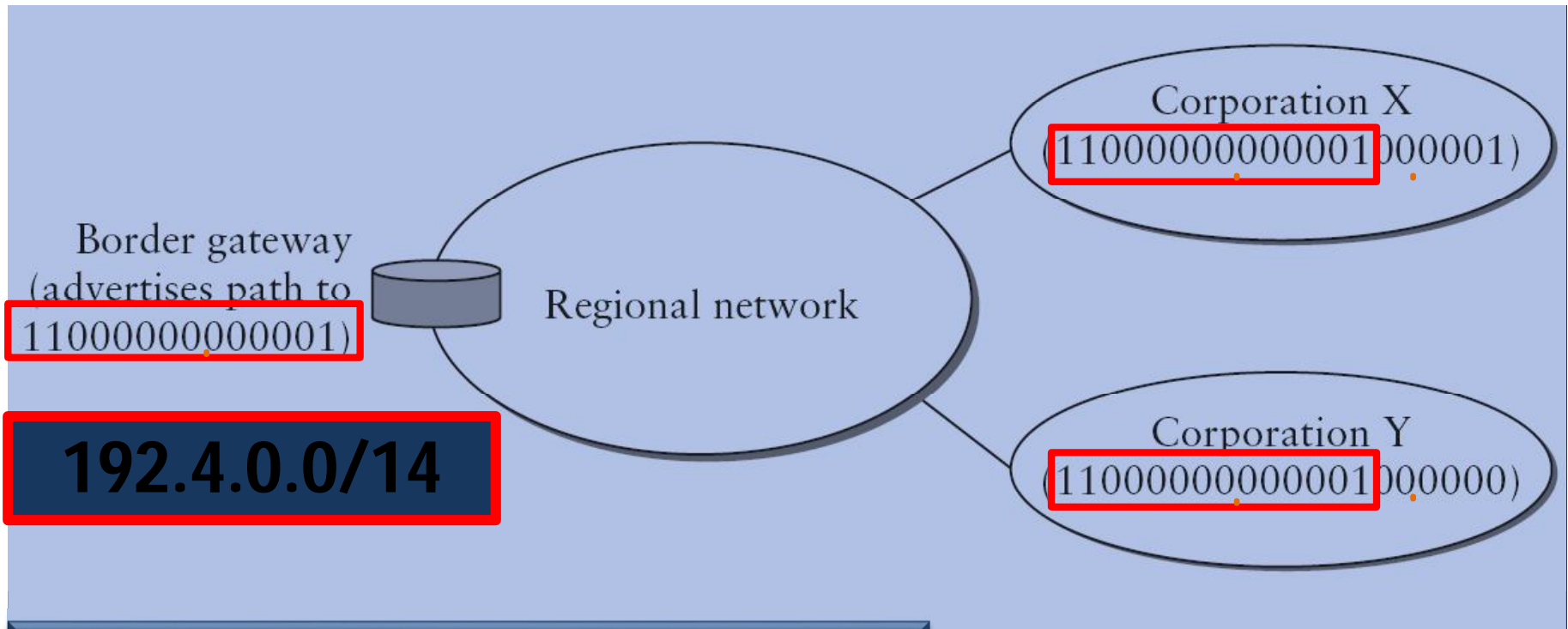
Supernetting – Route Aggregation





CIDR

192.4.16.0/20



192.4.0.0/14

Contains 2^6 (20 bit: /20) prefixes including the two prefixes on RHS

To only advertise the two /20 prefixes on RHS, use 192.4.0.0/19

192.4.0.0/20

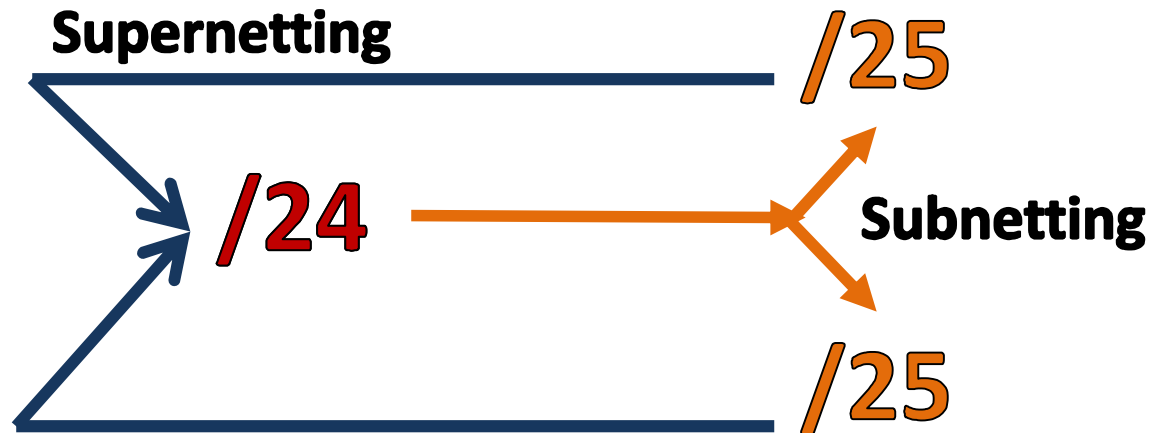


CIDR

CIDR uses both subnetting and supernetting

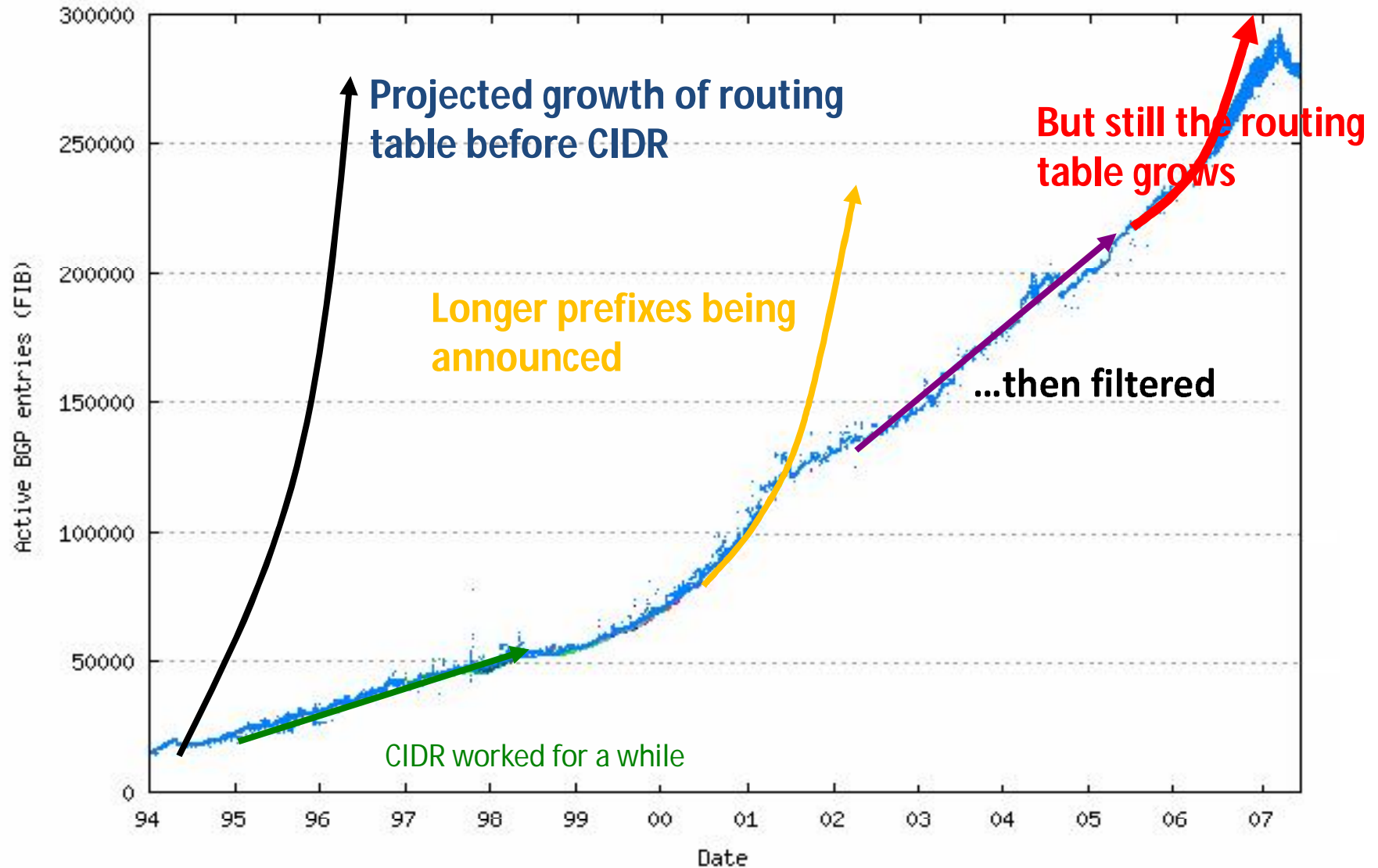
Subnetting – efficient usage of IP addresses

Supernetting – allows more efficient routing





Growth of Routing Table



Source: <http://potaroo.net>



CIDR

CIDR Calculator

IP Address	CIDR Netmask
202 . 125 . 38 . 0	255.255.255.0
Mask Bits	Wildcard Mask
24	0.0.0.255
Maximum Subnets	Maximum Addresses
256	254
CIDR Network (Route)	Net: CIDR Notation
202.125.38.0	202.125.38.0/24
CIDR Address Range	
202.125.38.0 - 202.125.38.255	

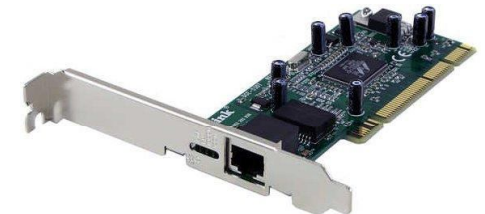
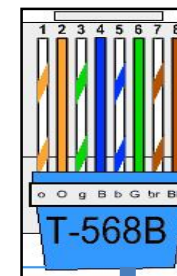
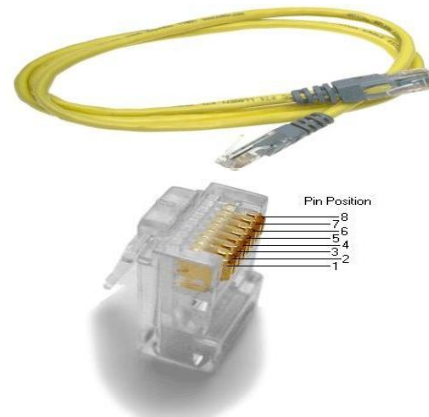
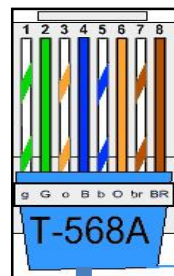
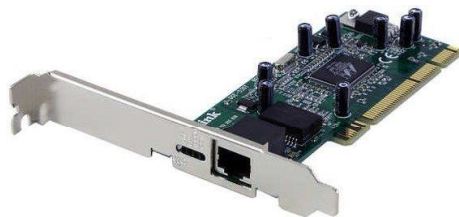
<http://www.subnet-calculator.com/cidr.php>



Practical Networking Overview



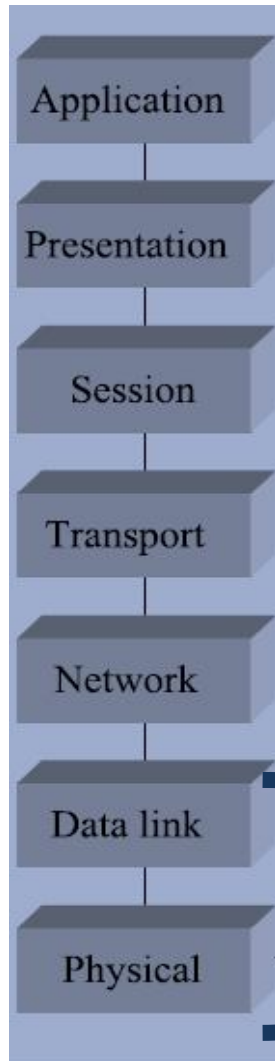
Point – to – Point Network



Crossover Cable

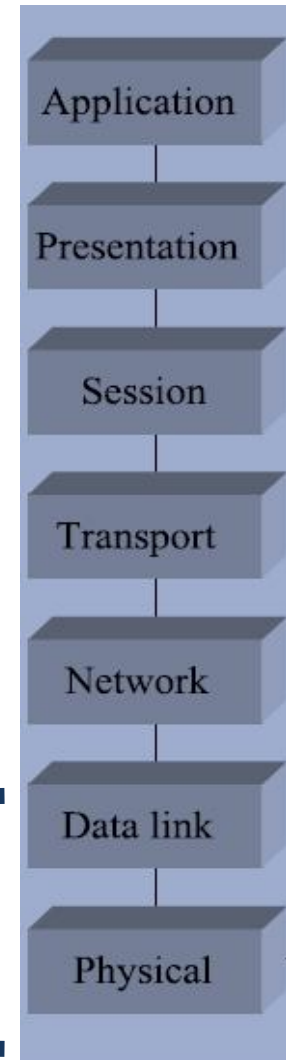


Point – to – Point Network



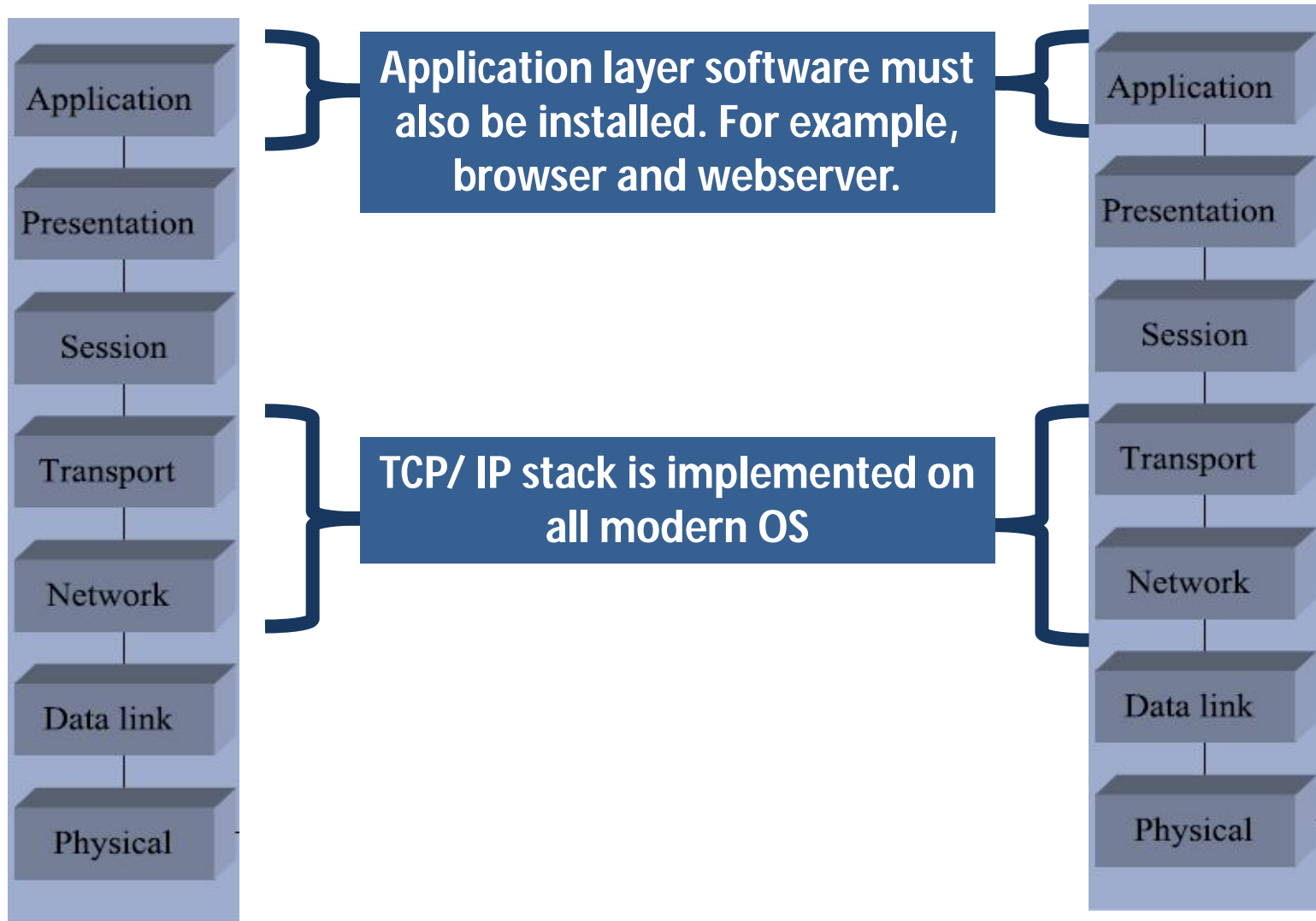
In back-to-back connected computers, the data-link technology should be same.

Also, both machines should be on same network





Point – to – Point Network





Point – to – Point Network



Let's allocate an IP address to A

Assume, we choose an address **192.168.0.1/16**

**Typically, private addressing class is used:
10.0.0.0/8; 172.16.0.0/12; 192.168.0.0/16**



Point – to – Point Network



For communication, B has to be given IP belonging to the same network class (i.e., 192.168.0.0/16)

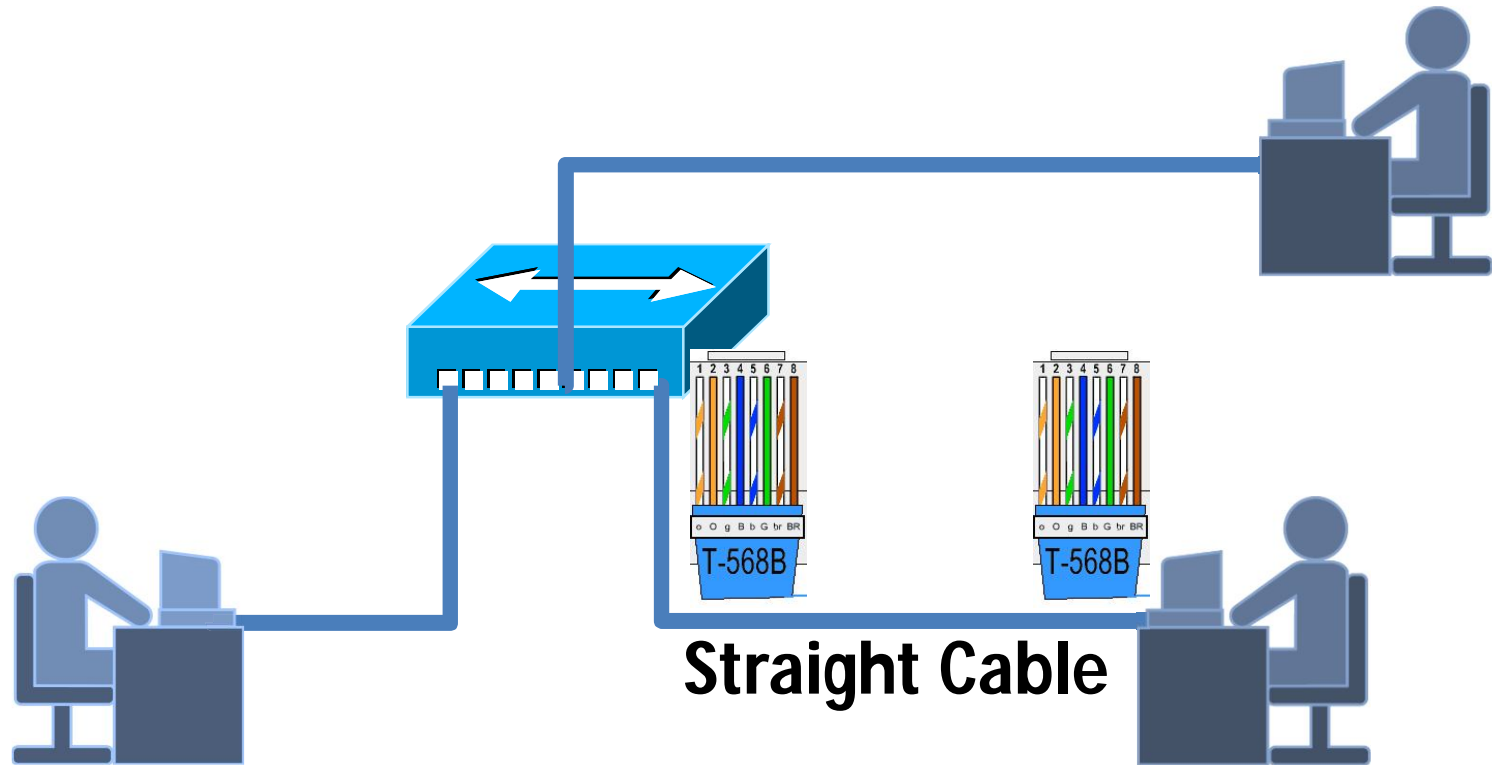
An example IP address that will allow communication is:

192.168.15.2/16

Only the first two octets have to be same since the network bits are the first 16 bits (/16)



Connect for more than two Computers

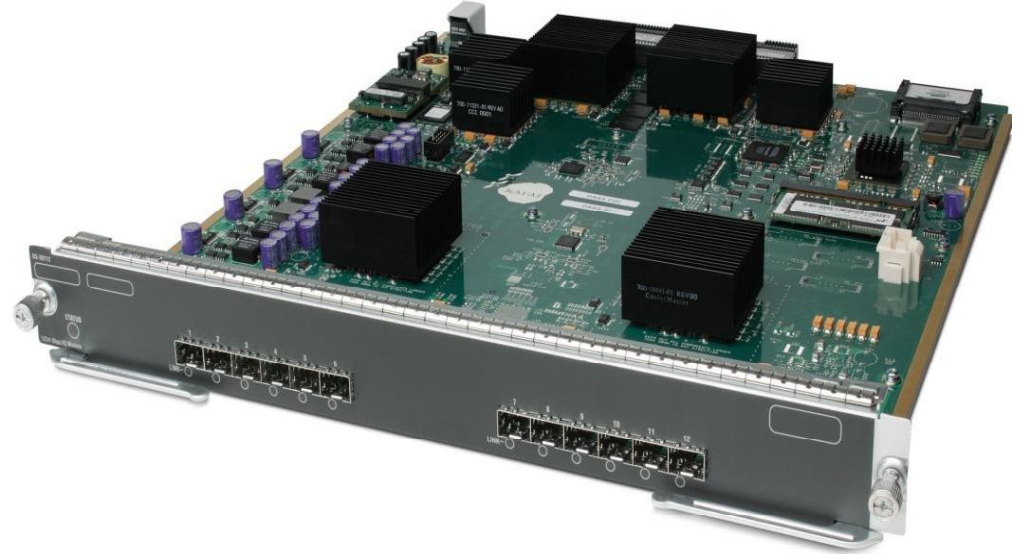




Intermediate Devices



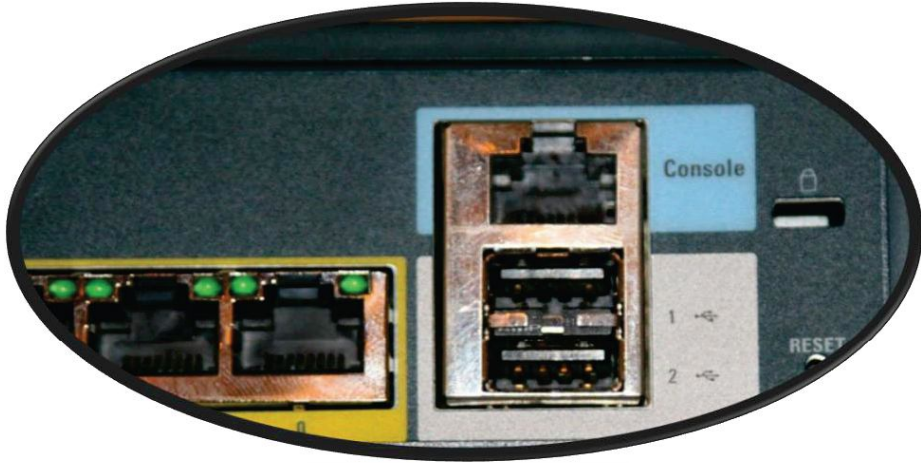
SOHO Router – Cisco 1721



Gigabit Ethernet Router Module



Intermediate Devices



Console Port in Router



Switch – Cisco Catalyst 3560