W7 3

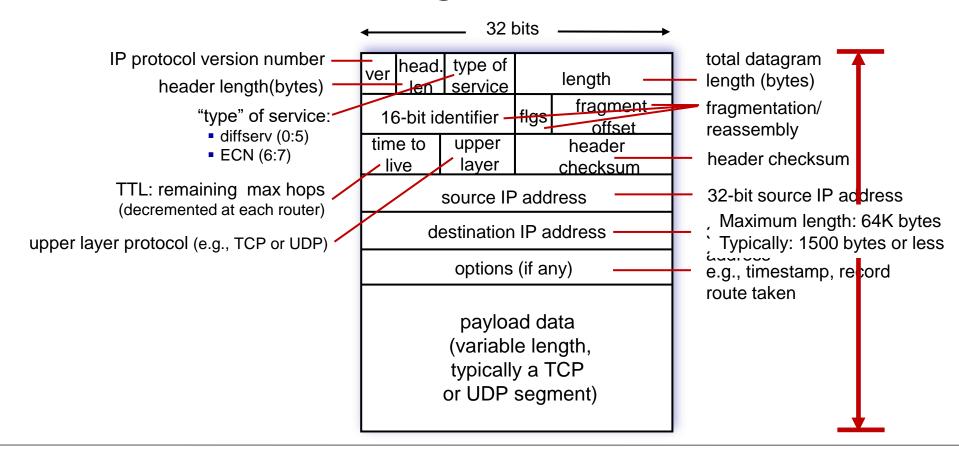
#### Computer Networks I

IPv4 Datagram Format and Addressing

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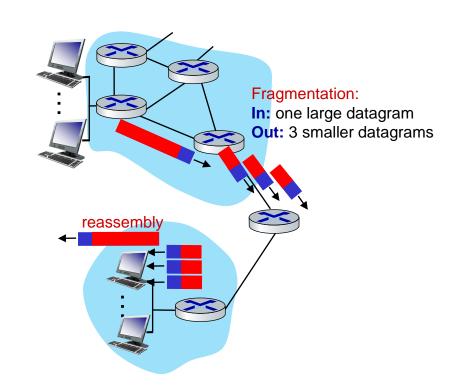
# IPv4 Datagram Format

### IP Datagram format

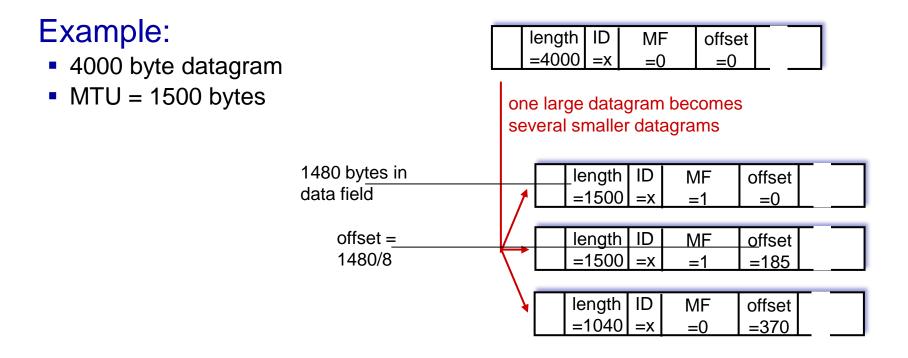


## IP Fragmentation/Reassembly

- Network links have MTU (max. transfer size) - largest possible link-level frame
  - Different link types, different MTUs
  - Ethernet 1.5 KB, WiFi 2.3 KB
- Large IP datagram divided ("fragmented") within net
  - One datagram becomes several datagrams
  - Reassembled only at destination
  - IP header bits used to identify, order related fragments



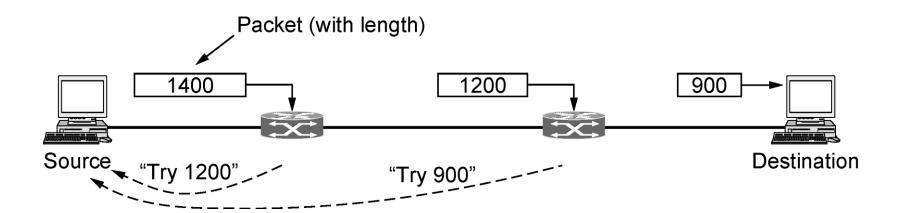
### IP Fragmentation/Reassembly



## IP Fragmentation/Reassembly

#### However fragmentation is undesirable

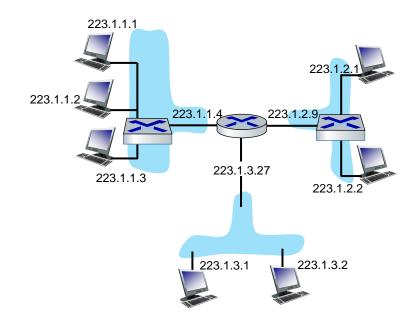
- More overhead for the routers
- Solution: discover the MTU that will fit for all the links
  - Implemented using ICMP → DF bit is set to 1



# IP Addressing

### IP addressing: introduction

- IP address: 32-bit identifier associated with each host or 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)

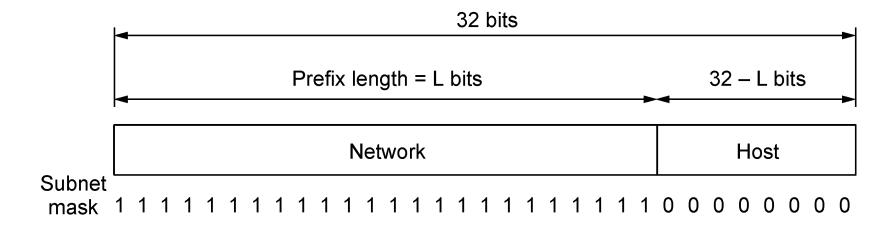


#### Dotted-decimal IP address notation:

223.1.1.1 = 110111111 00000001 00000001 00000001

223 1 1

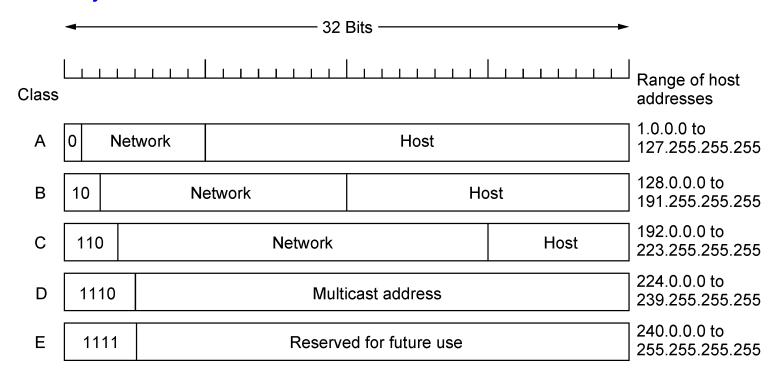
- IP addresses have structure:
  - Network part: devices in same network have common high order bits
  - Host part: remaining low order bits



### IP addressing: Classful Addressing

Classful Addressing: Fixed number of bits for network and host address

Used in old days



### IP addressing: Classful Addressing

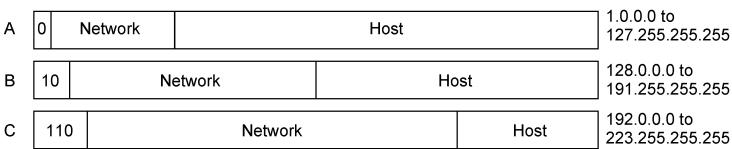
Classful Addressing: Fixed number of bits for network and host address

- Used in old days
- Network address: All 0's in the host address part
  - Class-A: 01111111.00000000.000000000.00000000 or 127.0.0.0
  - Class-B: 10101000.10101100.00000000.00000000 or 168.172.0.0
  - Class-C: 11011000.01111011.10010001.00000000 or 216.123.145.0
- Broadcast address: All 1's in the host address part
  - Class-A: 01111111.11111111.11111111.1111111 or 127.255.255.255
  - Class-B: 10101000.10101100.11111111111111111 or 168.172.255.255
  - Class-C: 11011000.01111011.10010001.11111111 or 216.123.145.255

## IP addressing: Classful Addressing

How many hosts can a Class A, Class B and Class C address accommodate?

- Class-A:
- Class-B:
- Class-C:



#### Limitation of Classful Addressing

Suppose you have 300 hosts. Which IP address you will go for?

Class-C: Less addresses

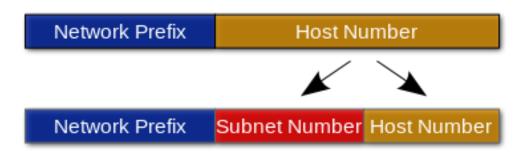
Class-B: Huge wastage of IP addresses

Α	0	Network		Host	1.0.0.0 to 127.255.255.255	
В	10	Ne	etwork	Host		128.0.0.0 to 191.255.255.255
С	110	Network			Host	192.0.0.0 to 223.255.255

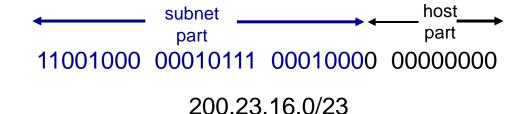
### IP addressing: CIDR

CIDR: Classless InterDomain Routing (pronounced "cider")

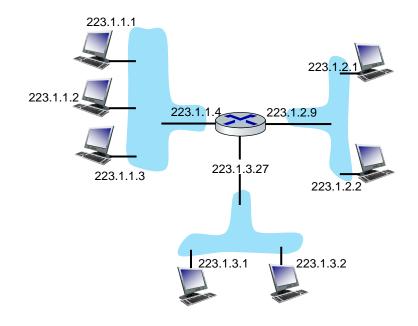
- Network or subnet portion of address of arbitrary length
- Address format: a.b.c.d/x, where x is # bits in network or subnet portion of address



Src: https://commons.wikimedia.org/wiki/File:Subnetting\_operation.svg



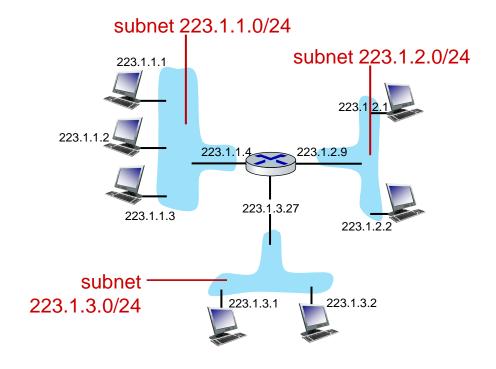
- What's a subnet ?
  - Device interfaces that can physically reach each other without passing through an intervening router



Network consisting of 3 subnets

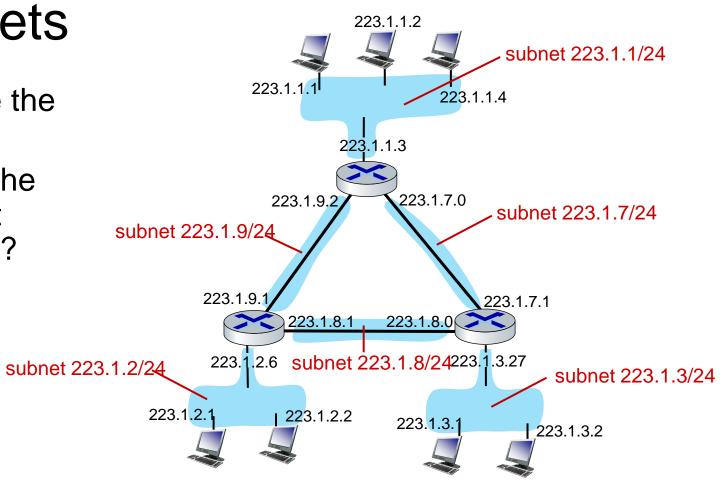
#### Recipe for defining subnets:

- Detach each interface from its host or router, creating "islands" of isolated networks
- Each isolated network is called a subnet



subnet mask: /24 (high-order 24 bits: subnet part of IP address)

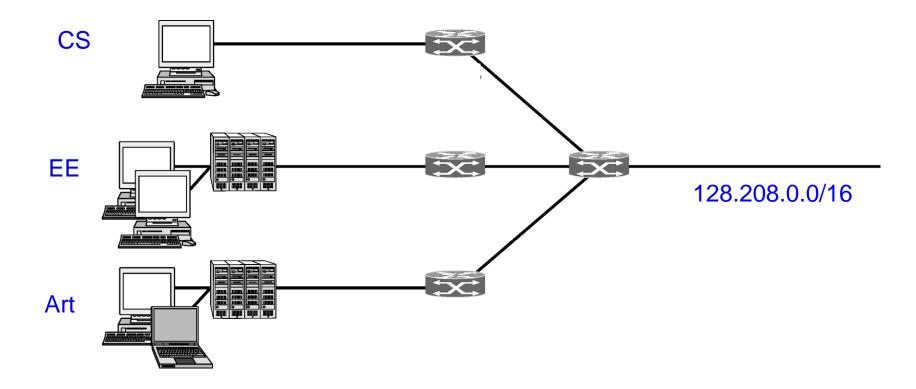
- Where are the subnets?
- What are the /24 subnet addresses?



**CS**: 550

■ EE: 550

• Art: 400



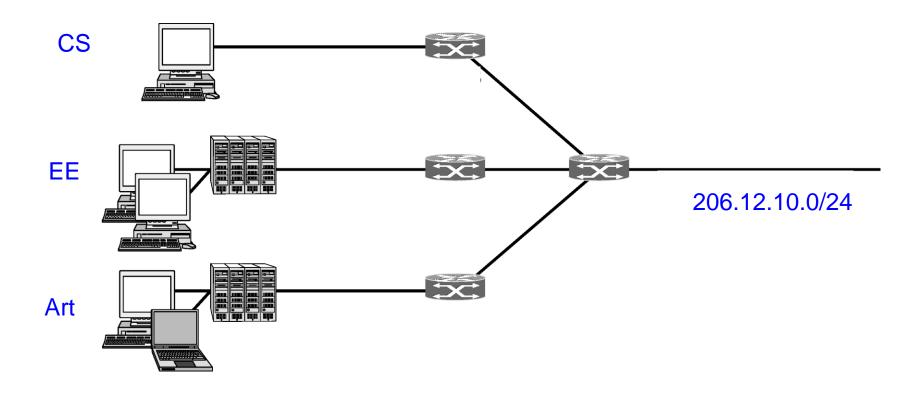
Useful Link: https://www.cisco.com/c/en/us/support/docs/ip/dynamic-address-allocation-resolution/13711-40.html

## Subnets: Fixed Length Subnetting

**CS**: 60

■ EE: 10

• Art: 10

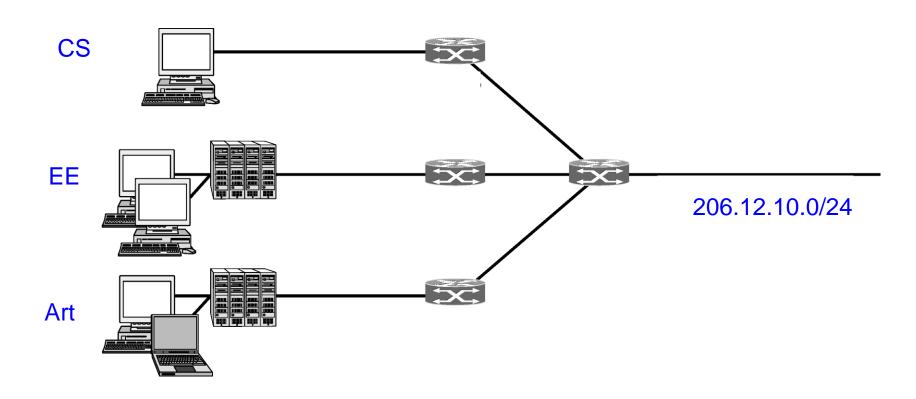


## Subnets: Variable Length Subnetting

**CS**: 60

■ EE: 10

• Art: 10



## Aggregation of IP Prefixes

University	First address	Last address	How many	Prefix		
Cambridge	194.24.0.0	194.24.7.255	2048	194.24.0.0/21		
Edinburgh	194.24.8.0	194.24.11.255	1024	194.24.8.0/22		
(Available)	194.24.12.0	194.24.15.255	1024	194.24.12.0/22	192.24.0.0/21	
Oxford	194.24.16.0	194.24.31.255	4096	194.24.16.0/20		Cambridg
	New York  192.24.0.0/19  (1 aggregate prefix)  Londo  (3 prefixes					Oxford
					192.24.8.0/22	

Edinburgh

#### Summary

#### □Internet Protocols:

- IPv4 datagram format
- Fragmentation and Reassembly
- IP addressing
  - · Classful addressing
  - Classless InterDomain Routing