SET 4573: Data Communication and Switching System

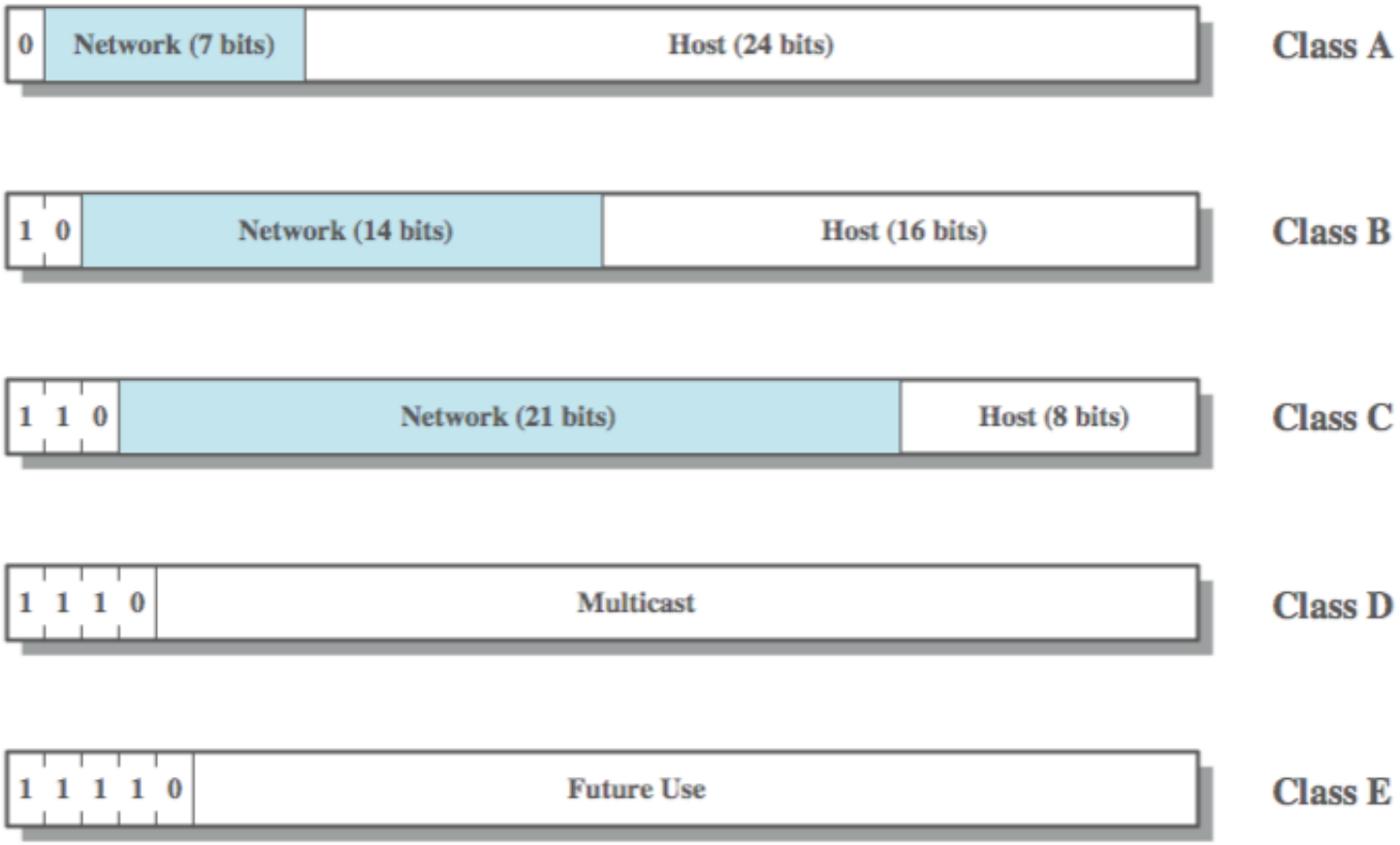
Chapter 8: Internet Protocol Standard

Lecturer:
Alias Mohd
Telecommunications Department
Faculty of Electrical Engineering
UTM

Internet Protocol (IP) v4

- IP version 4 (32 bit address)
- part of TCP/IP suite
- Several class of IP
  - Class A
  - Class B
  - Class C
  - Class D
- will (eventually) be replaced by IPv6 (128 bit address)

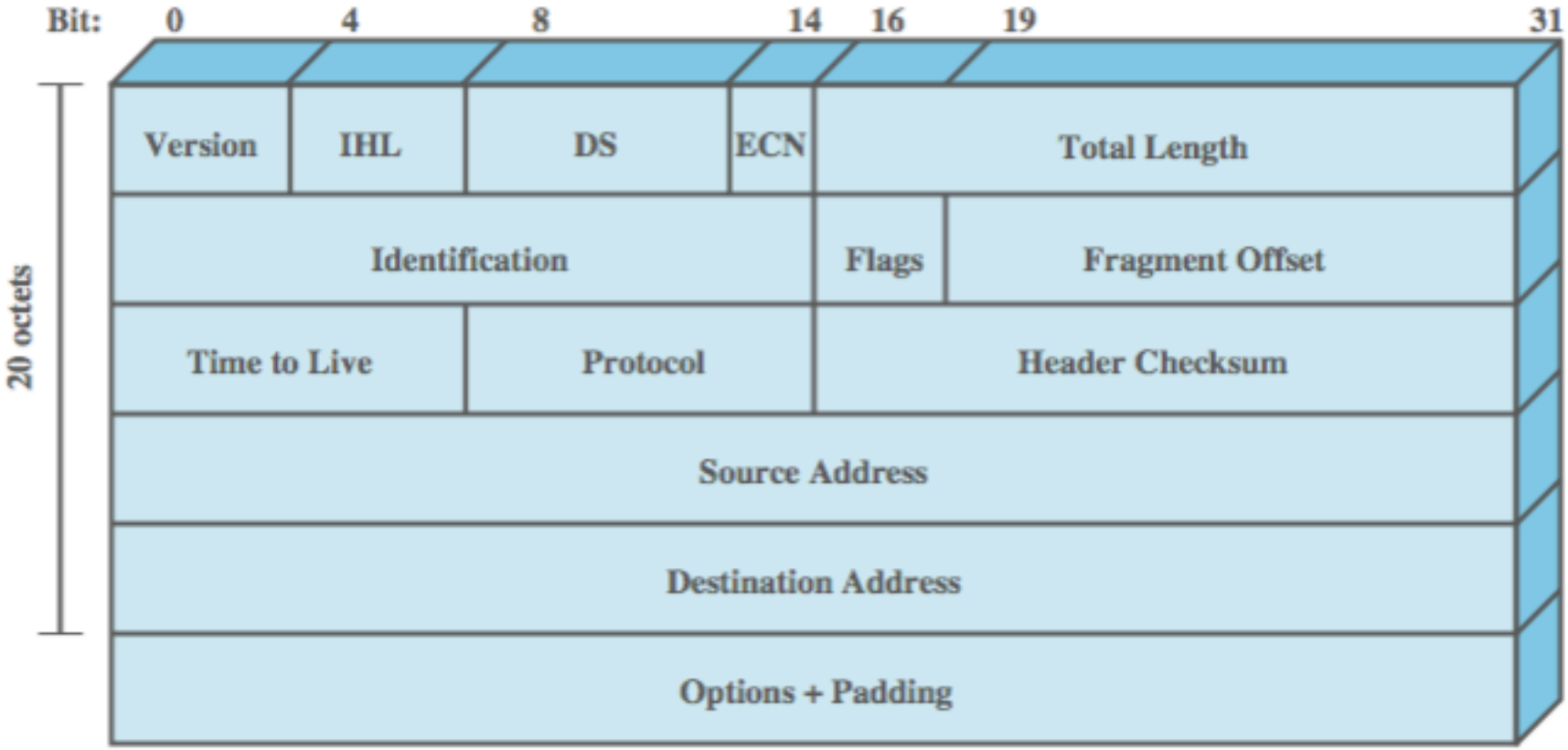
IPv4 Address Formats



IP Parameters

- Source & destination IP addresses
- Protocol
- Type of service
- Identification
- Fragmentation indicator
- Time to live (TTL)
- Data length
- User data

IPv4 Header


Bit:
0
4
8
14
16
19
31
20 octets
Version
IHL
DS
ECN
Total Length
Identification
Flags
Fragment Offset
Time to Live
Protocol
Header Checksum
Source Address
Destination Address
Options + Padding

Header Fields

- Version (IPv4 or IPv6)
- Internet header length (in 32-bit words)
- Total length of packet or datagram (in octets)
- Identification (sequence number, identify datagram)
- Flags (for fragmentation process)
- Fragmentation offset
- Time to live ('lifetime' of a datagram)
- Protocol (next higher layer to receive data field at destination)
- Header checksum (to ensure the integrity of header)
- Source & Destination IP address

Data Field

- Carries user data from next layer up
- Integer multiple of 8-bit long (octet)
- Maximum length of datagram (header plus data) is 65,535 octets

Subnets and Subnet Masks

- Allows ease of management for internetworked LANs within organization
- Insulate overall internet from growth of network numbers and routing complexity
- Assigned subnet number fro each LAN
- Host portion of address partitioned
  - into subnet number and host number
- Subnet mask indicates
  - which bits are subnet number and
  - which are host number

Level of Addressesing

- www.fke.utm.my

DNS (domain name system)

- 161.139.114.5

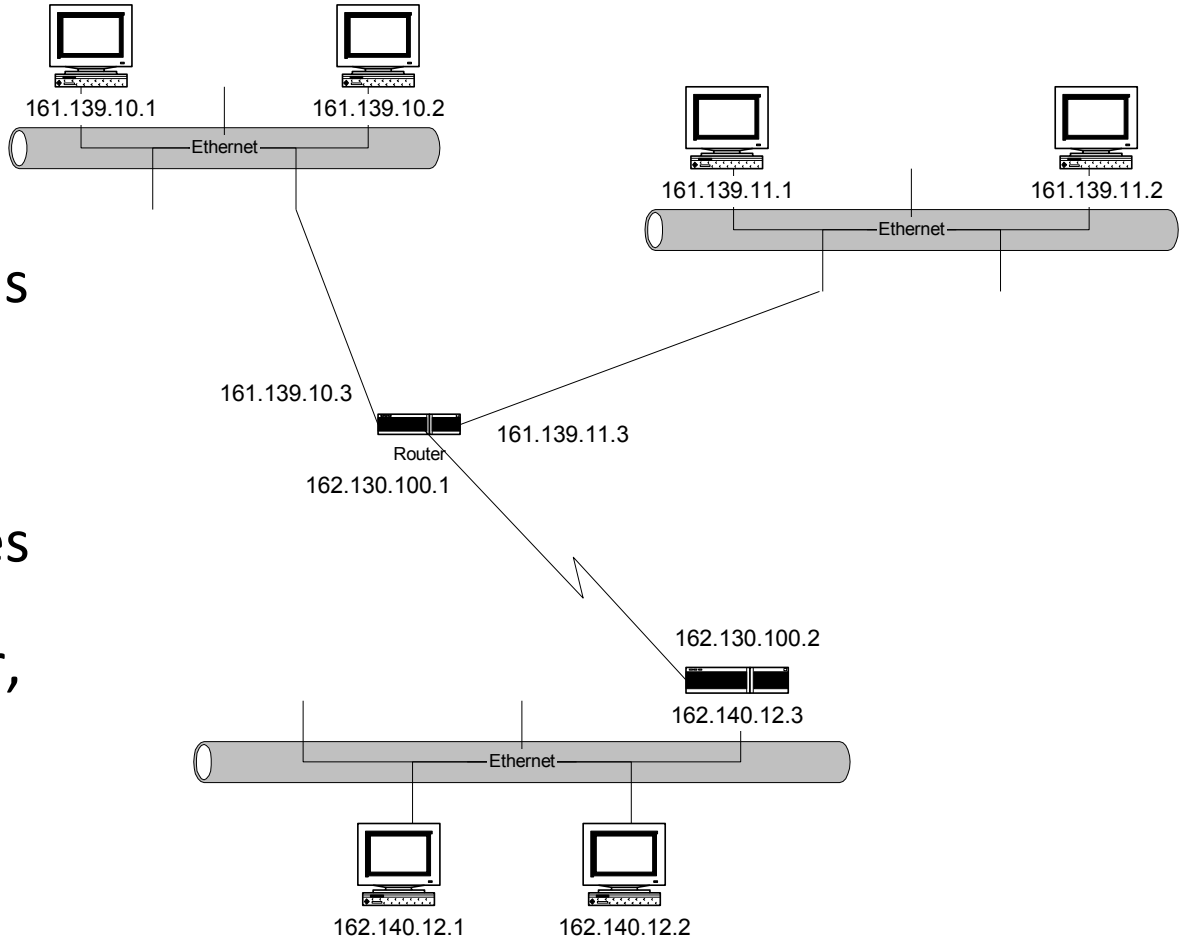
Address Resolution Protocol (ARP)

RARP

- 00:02:a5:b7:66:ec

IP addresses in a network

- IP addresses are associated with interface
  - Each interface has its own address
  - A station can has more IP addresses
  - e.g router, server, etc.



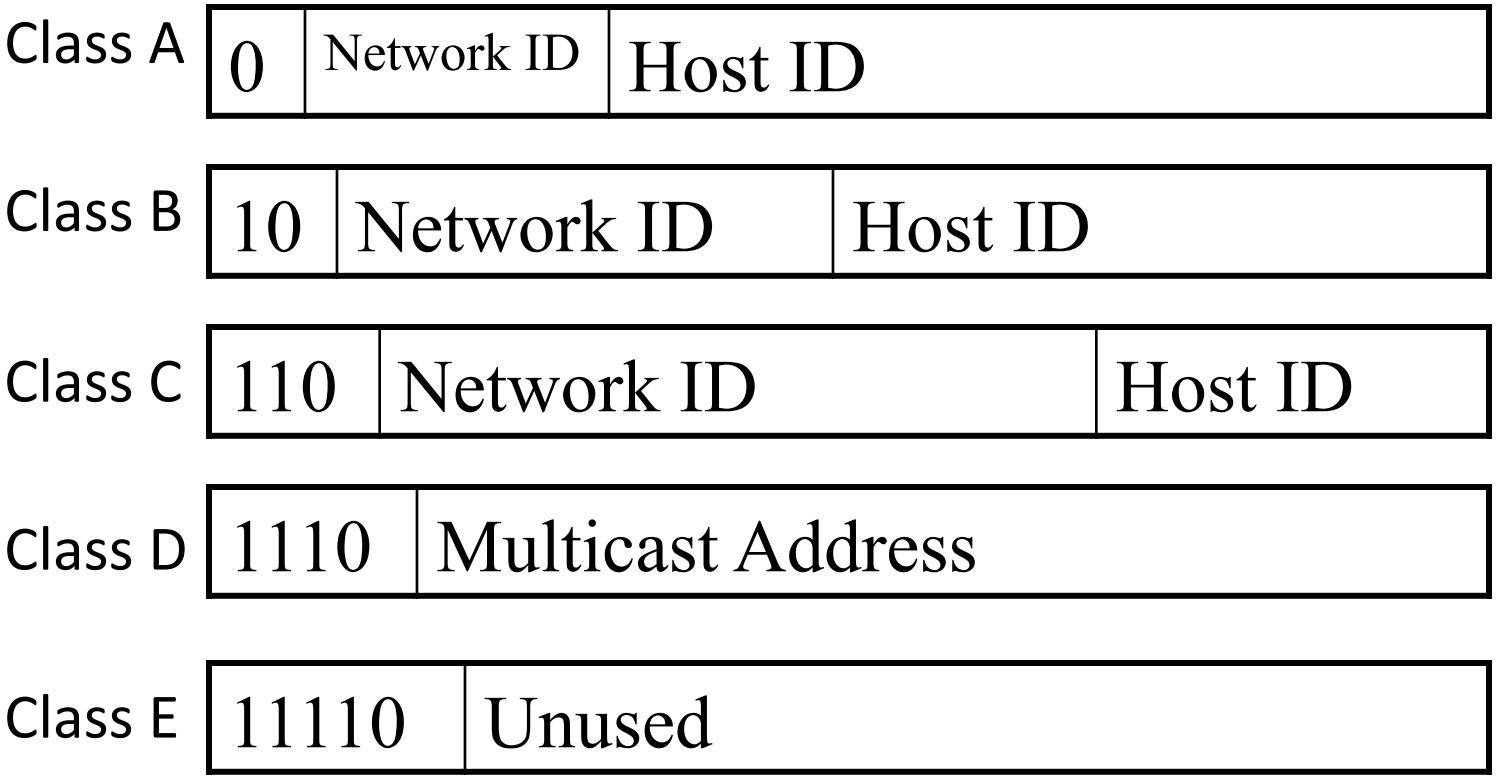
IP addressing concept

- Partitioned into 2 parts
  - Network address
  - Node address

Network	Node
161.139.10	1,2,3
161.139.11	1,2,3
162.130.100	1,2

IP address class

- 32 bits
  - Network identifier
  - Node identifier



IP Address Table

class	Initial bits	# bits for net	# bits for host	range	Address spaces	usable
A	0	7	24	0.0.0.0 – 127.255.255.255	2^24 =1667216	166777 214
B	10	14	16	128.0.0.0 – 191.255.255.255	2^16 =65536	65534
C	110	21	8	192.0.0.0 – 223.255.255.255	2^8=256	254
D	1110	28	-	224.0.0.0 – 239.255.255.255		
E	11110	27	-	240.0.0.0 – 247.255.255.255		

Special Address

- Host ID with all 0s is referred to a network number
  - 161.139.0.0, 162.11.210.0
- Host ID with all 1 is reserved to broadcast address
  - 161.139.255.255, 161.11.210.255
- 0.0.0.0 is reserved and means ‘this host on this network”
  - Used to boot diskless WS
- 255.255.255.255 is reserved to broadcast to every host in the local network
- 127.x.x.x means ‘this node’ (local loopback).

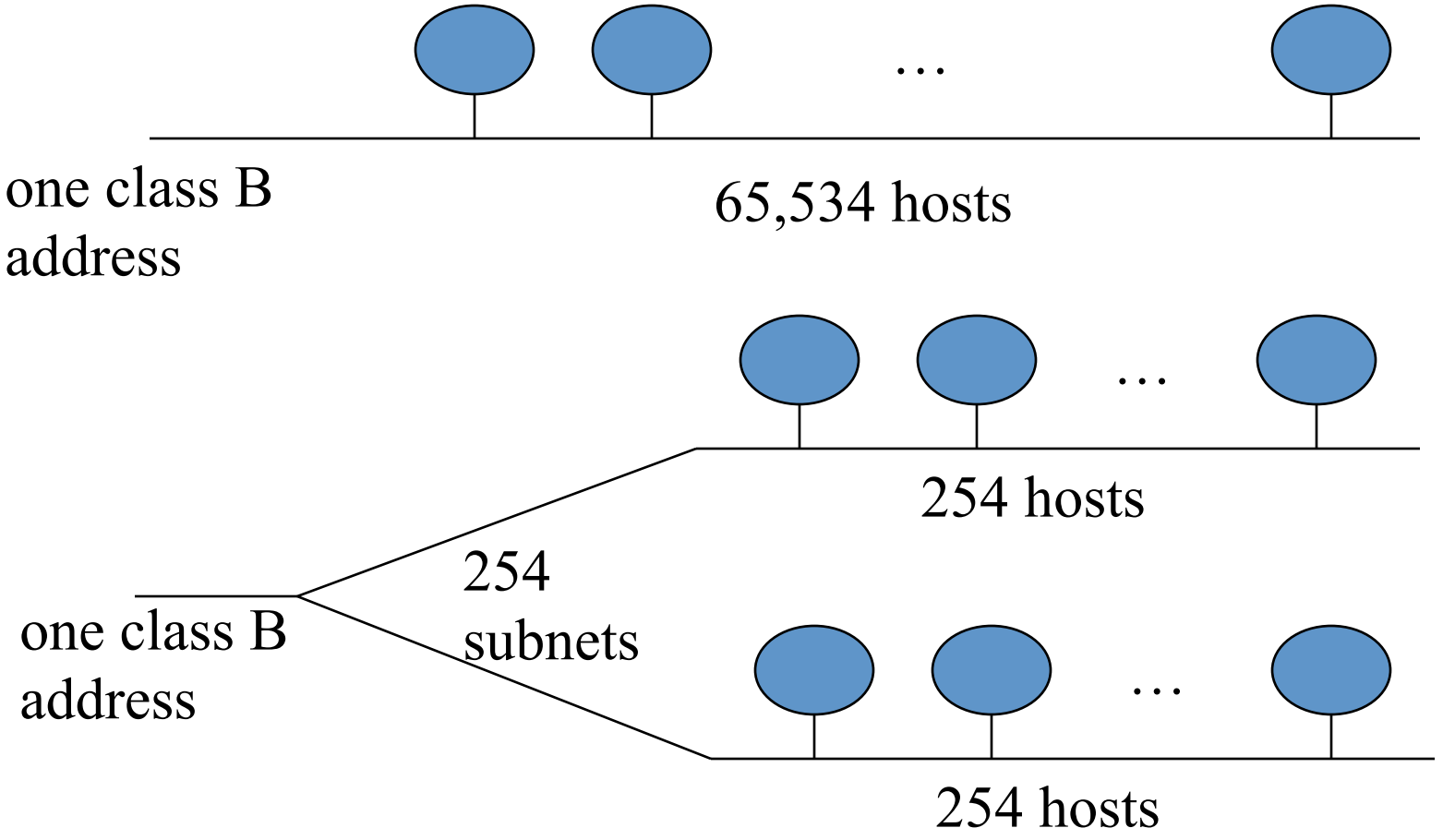
Problem with large network

- Class B flat network will have more than 60 000 hosts
  - How to manage?
  - Performance?
- Subdivide class B network into smaller group (subnetwork) with router

Subnetwork benefits

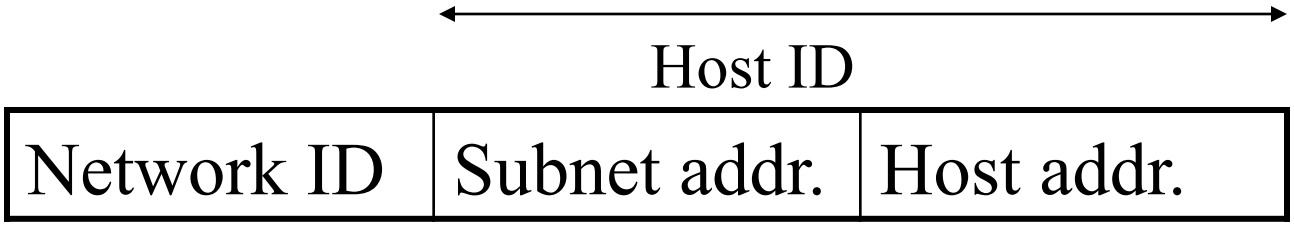
- Ease the network manager control over the address space
- Easy to allocate the addresses
- Better network performance
- Hide routing structure from remote routers, thus reducing routes in their routing tables

Subnets


one class B address
65,534 hosts
254 hosts
254 subnets
one class B address
254 hosts

Assigning Subnetwork (Subnet)

- Divide host ID into 2
  - Subnet address & host address



- Class B address (161.139) can use its 3rd byte to identify subnet
  - Subnet #1 – 161.139.1.x
  - Subnet #2 – 161.139.2.x
  - x is host ID from 1-254

Subnet Mask (1/2)

- 32 bit number
  - Tells router to recognize the subnet field
- The bits covering network and subnet part of an address are set to '1'
  - E.g. class B with 24 bit mask
  - Subnet mask = 255.255.255.255.0

1111 1111	1111 1111	1111 1111	0000 0000

Zero bits are used to mask ot the host number resulting only the network address

Subnet Mask (2/2)

- Subnet mask of 255.255.255.0 for a class B tells:
  - Network has been partition to 254 subnets
    - e.g. 161.139.1.x to 161.139.254.x
  - Logical AND between IP address with mask yields network address

161.139.2.71 AND 255.255.255.0 = 161.139.2.0 (network address)

158.100.70.51 AND 255.255.255.0=158.100.70.0 (network address)

Subnet Mask bits

128	64	32	16	8	4	2	1	#
1	0	0	0	0	0	0	0	128
1	1	0	0	0	0	0	0	192
1	1	1	0	0	0	0	0	224
1	1	1	1	0	0	0	0	240
1	1	1	1	1	0	0	0	248
1	1	1	1	1	1	0	0	252
1	1	1	1	1	1	1	0	254
1	1	1	1	1	1	1	1	255

Network prefix

- The class ID plus network ID portions of the IP address are known as the network prefix
  - class A: an 8-bit network prefix (/8)
  - class B: a 16-bit network prefix (/16)
  - class C: a 24-bit network prefix (/24)

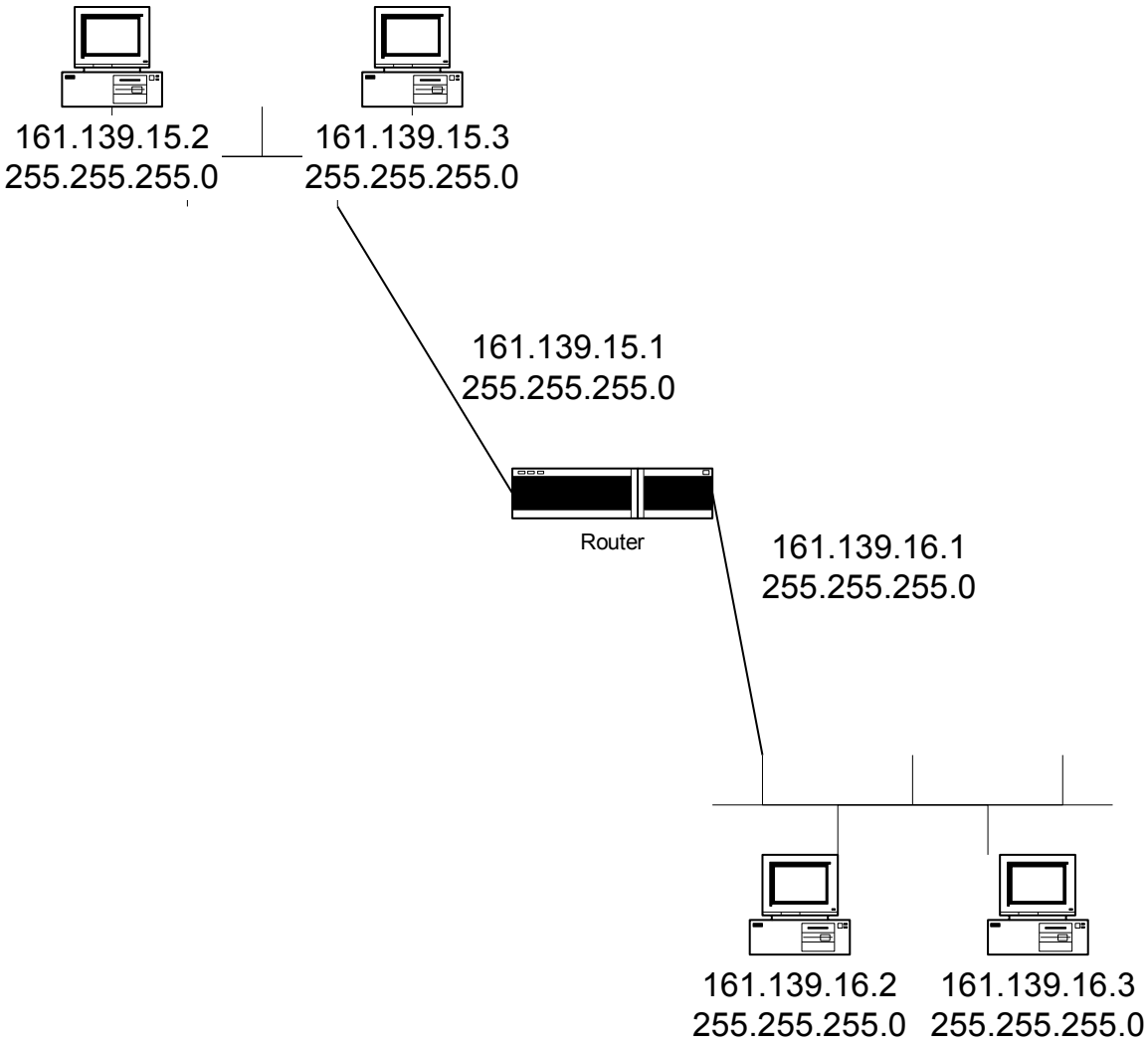
Subnetting Class B

- 255.255.0.0 (0000 0000 0000 0000)
  - 0 subnet with 65534 hosts (default subnet)
- 255.255.192.0 (1100 0000 0000 0000)
  - 4 subnets with 16382 hosts each
- 255.255.252.0 (1111 1100 0000 0000)
  - 64 subnets with 1022 hosts each
- 255.255.254.0 (1111 1111 0000 0000)
  - 256 subnets with 254 hosts each
- 255.255.255.252 (1111 1111 1111 1100)
  - 16384 subnets with 2 hosts each

Subnetting Class C

- 255.255.255.0 (0000 0000)
  - 0 subnet with 254 hosts (default subnet)
- 255.255.255.192 (1100 0000)
  - 4 subnets with 62 hosts each
- 255.255.255.224 (1110 0000)
  - 8 subnets with 30 hosts each
- 255.255.255.240 (1111 0000)
  - 16 subnets with 14 hosts each

Class B Subnet with router



Subnet Results

IP address	Subnet mask	Result
161.139.2.71	255.255.255.0	host 71 on subnet 161.139.2.0
130.139.34.3	255.255.255.192	host 3 on subnet 130.139.34.0
130.139.34.132	255.255.255.192	host 4 on subnet 130.139.34.128
200.190.155.66	255.255.255.192	host 2 on subnet 200.190.155.64