Chapter 3
IP v4

Prof. Dr. Md. Samsuzzaman
Professor
Dept. Computer and Communication Engineering
Patuakhali Science and Technology University

Co-funded by
the European Union

Course Content :

- **Review of Previous Class**
- **Background About Addressing**
  - IP Addresses/ Logical Addressing
  - Types of IP Address
- IPv4 Address
  - Address space
  - IP address Notation
  - Logical Operation of IP address

Types of IPv4 Address

- Classful Addressing

Classless Addressing

- **Classful Address in details**

Classes, level of addressing, subnet, network

- **Classless Address in details**

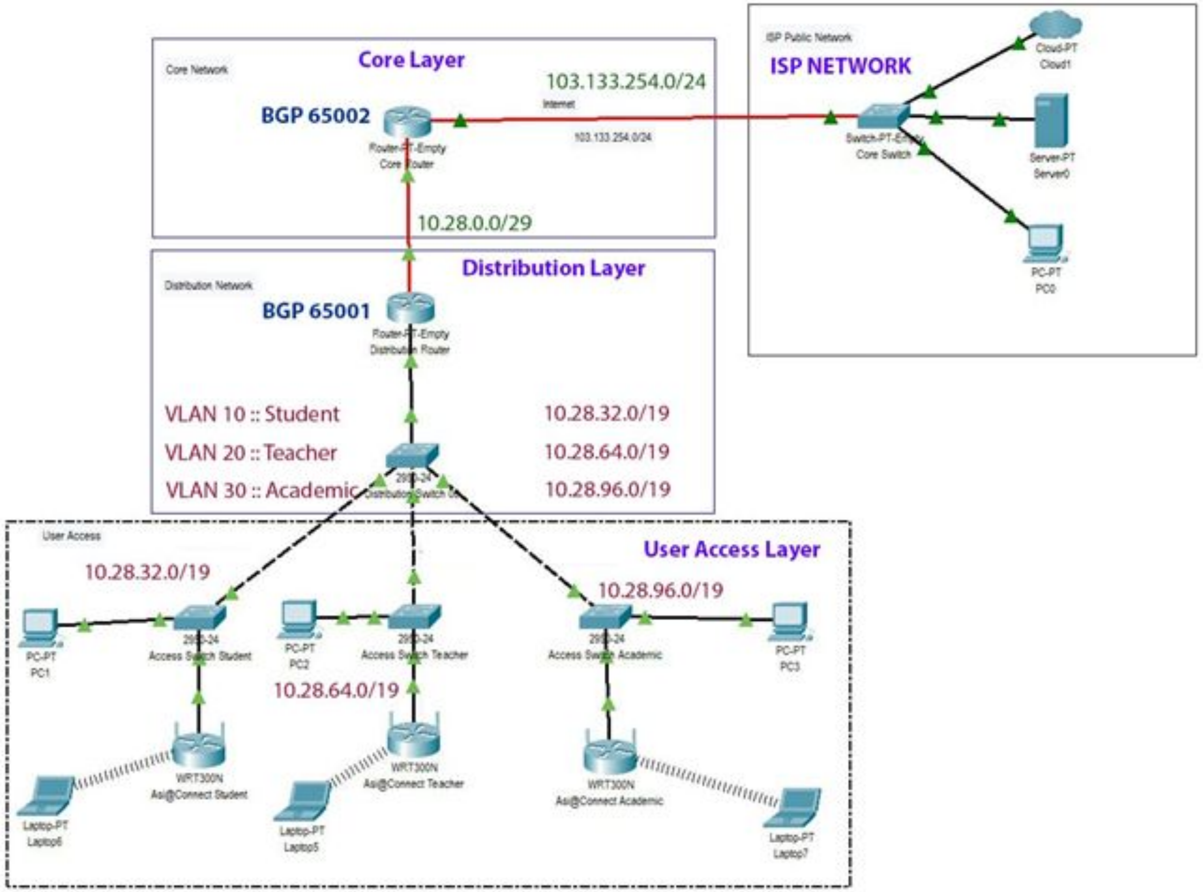
Variable length block, Address allocation, subnet, network,

- **Special Address**

- IPv6 Address
  - IPv4 Issues
  - IPv6 Address Representation
  - IPv6 Types

Co-funded by the European Union

Campus Network IP Address



Addressing Table 1:

Device/Endpoints	IP Address	Subnet Mask	Default Gateway	Network
ISP Public Network			103.133.254.1	103.133.254.0/24
Public DNS/HTTP Server	103.133.254.2	255.255.255.0	103.133.254.1	103.133.254.0/24
Remote PC	103.133.254.4	255.255.255.0	103.133.254.1	103.133.254.0/24
Core Router:				
Interface 1	103.133.254.1	255.255.255.0		103.133.254.0/24
Interface 2	10.28.0.1	255.255.255.248		10.28.0.0/29
Dist Router:				
Interface 1	10.28.0.2	255.255.255.248		10.28.0.0/29
Interface 2:				
Sub-interface 10	10.28.32.1	255.255.224.0		10.28.32.0/19
Sub-interface 20	10.28.64.1	255.255.224.0		10.28.64.0/19
Sub-interface 30	10.28.96.1	255.255.224.0		10.28.96.0/19

Addressing Table 2 (VLANs):

VLAN-ID & Name	DHCP Pool		Default Gateway	Network
	DHCP From	DHCP To		
VLAN-10 Student	10.28.32.2	10.28.63.254	10.28.32.1	10.28.32.0/19
VLAN-10 Student	10.28.64.2	10.28.95.254	10.28.64.1	10.28.64.0/19
VLAN-10 Student	10.28.96.2	10.28.127.254	10.28.96.1	10.28.96.0/19

Co-funded by the European Union

TEIN CC COOPERATION CENTER

Asi@Connect

OSI Model (7)/ TCP IP Layer (5)

7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

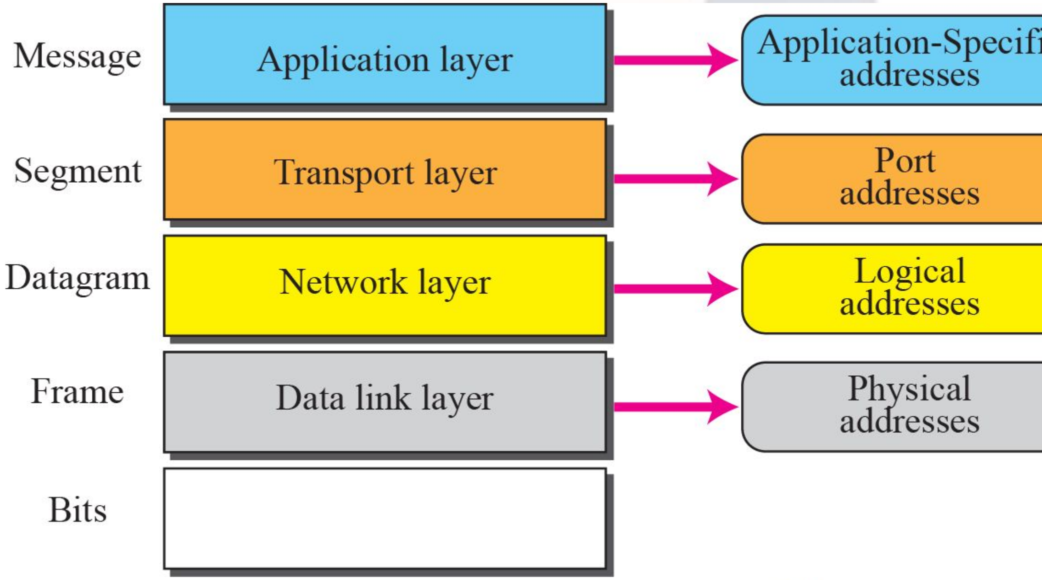
- Provides connectivity between end hosts on different networks (ie. outside of the LAN).
- Provides logical addressing (IP addresses).
- Provides path selection between source and destination.
- Routers operate at Layer 3.

Co-funded by the European Union

Addressing

Four levels of addresses are used in an internet employing the TCP/IP protocols: physical address, logical address, port address, and application-specific address. Each address is related to a one layer in the TCP/IP architecture, as shown in Figure.

- ✔ Physical Addresses 07:01:02:01:2C:4B
- ✔ Logical Addresses/IP Address 10.28.32.1
- ✔ 103.133.254.0/22
- ✔ Port Addresses HTTP 80
- ✔ Application-Specific Addresses



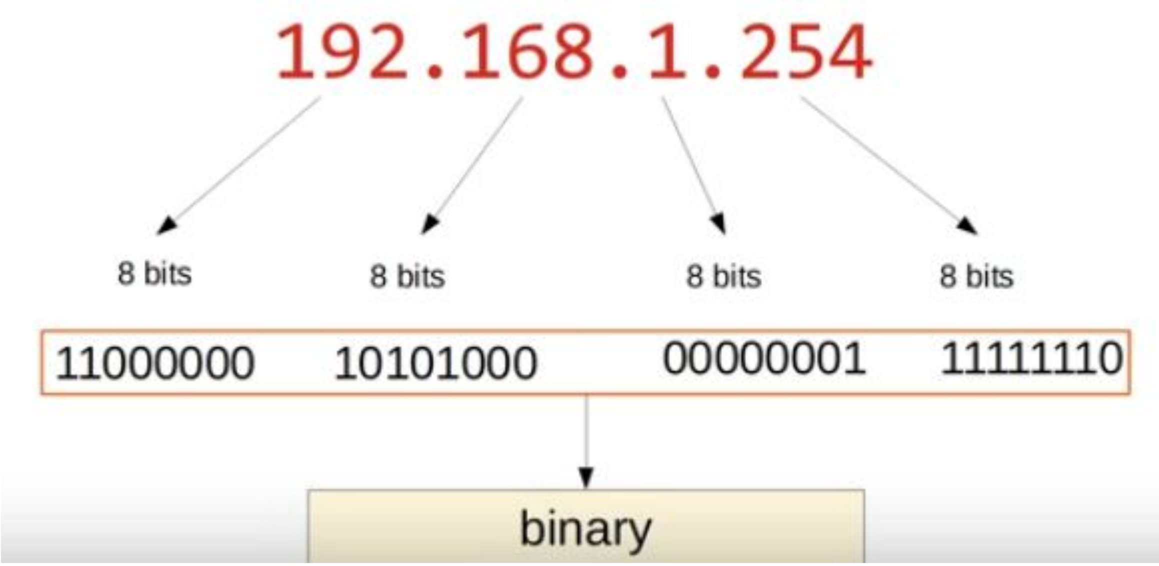
techgirl@cse.pstu.ac.bd

Co-funded by the European Union
TEIN*CC COOPERATION CENTER
Asi@Connect

IP Addresses/ Logical Addressing

The identifier used in the IP layer of the TCP/IP protocol suite to identify each device connected to the Internet is called the Internet address or IP address.

An IP address is the address of the interface/NIC.

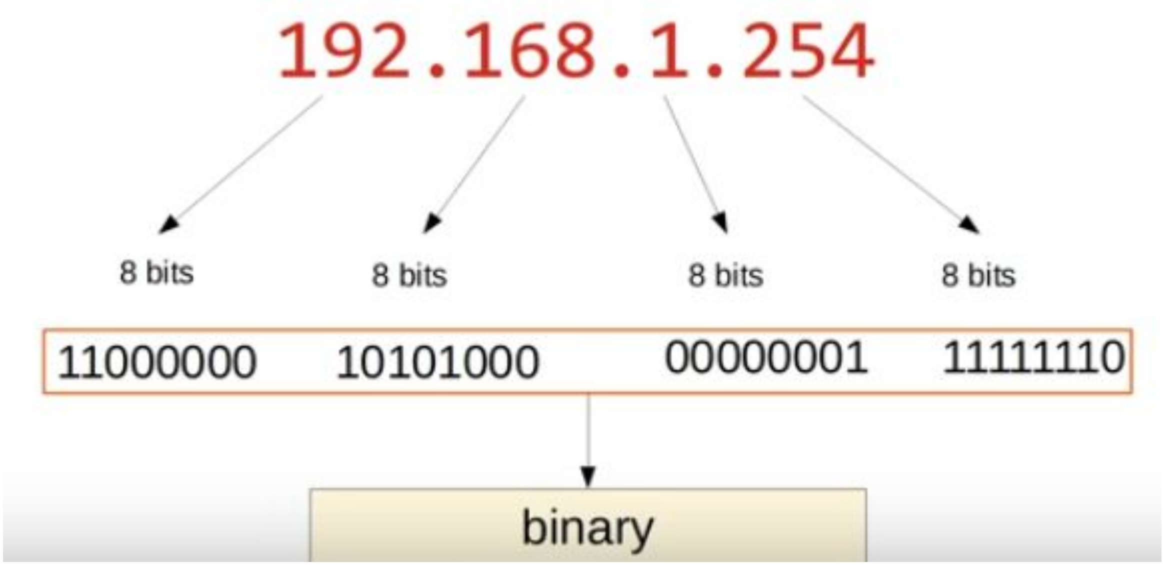


Types of IP Addresses/ Logical Addressing

Internet connected networks use two types of IP Addressing

– IPv4 – legacy Internet protocol

– IPv6 – new Internet protocol



IPv4 Address Representation

```
2001:0DB8:0000:1111:0000:0000:0000:0200
FE80:0000:0000:0000:0123:4567:89AB:CDEF
```

IPv6 Address Representation

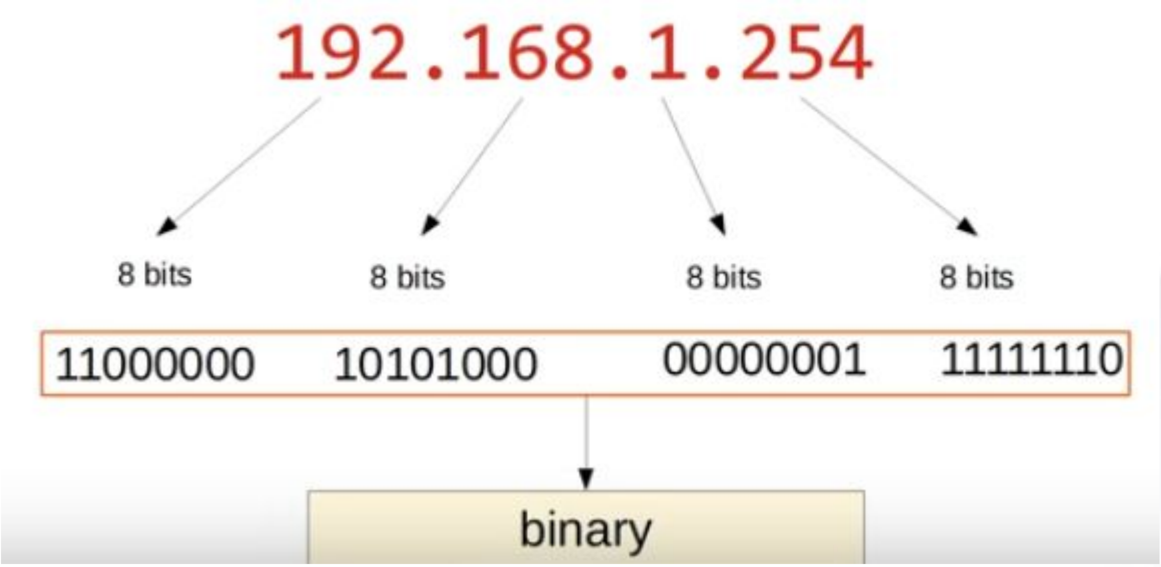
Co-funded by the European Union

IPv4 Addresses

An IPv4 address is a 32-bit address that uniquely and universally defines the connection of a host or a router to the Internet

An IPv4 address consists of four bytes (32 bits). These bytes are also known as octets.

--- . --- . --- . ---



Address Space

A protocol like IPv4 that defines addresses has an address space.

The address space of IPv4 is 2^{32} or 4,294,967,296.

0.0.0.0 through **255.255.255.255**

00000000 00000000 00000000 00000000

.

.

11111111 11111111 11111111 11111111

Total of 32 bits

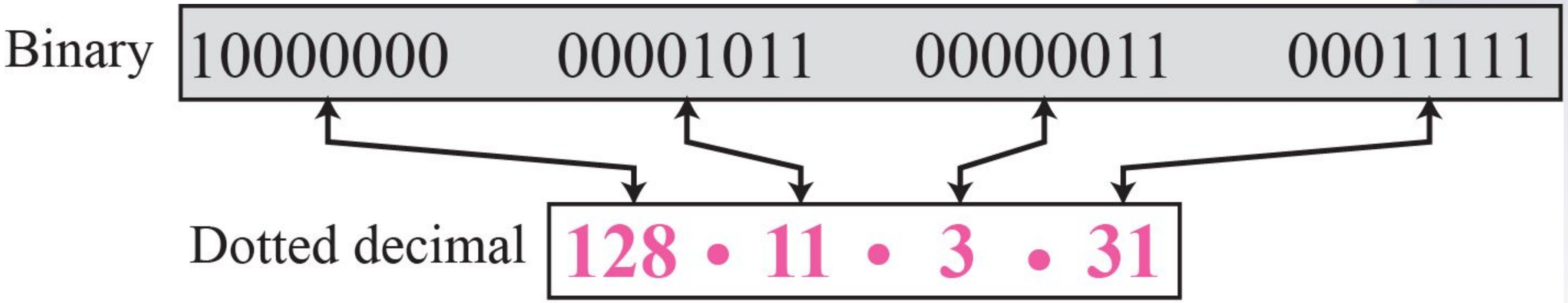
2 power 32 (2^{32}) 4 billion addresses

IP address Notation

a) Binary Notation: Base 2

01110101 10010101 00011101 11101010

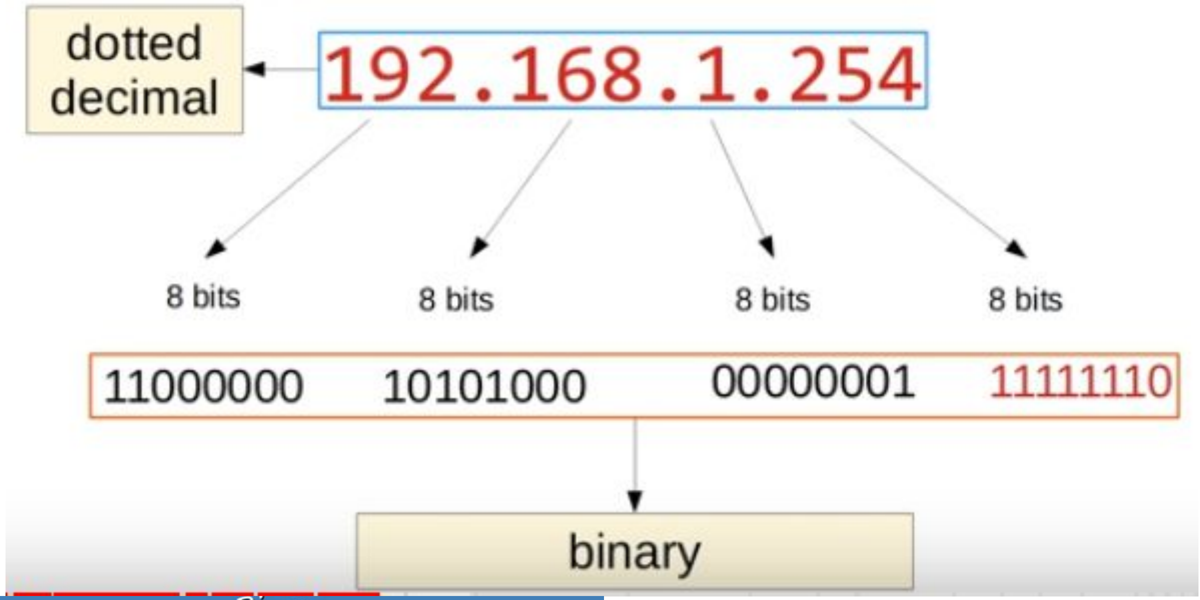
b) Dotted-Decimal Notation: Base 256

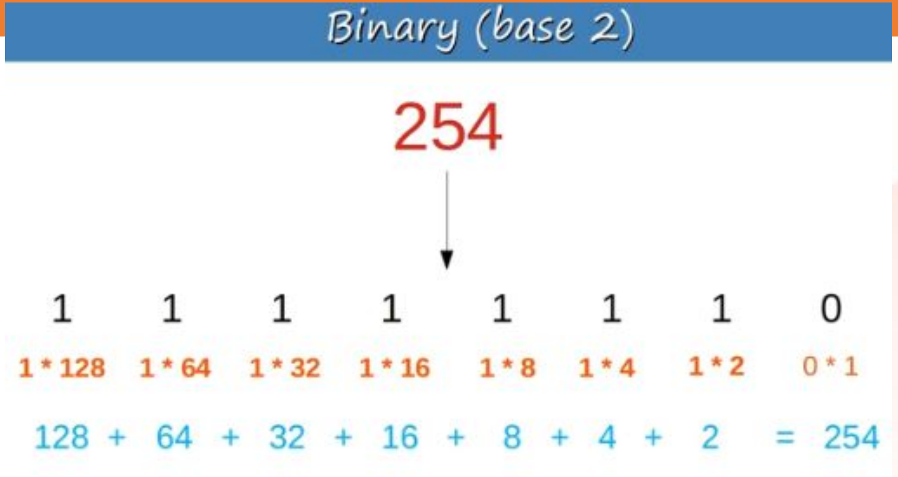


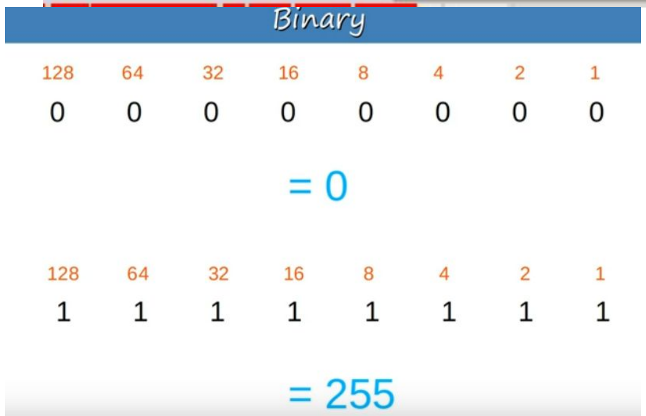
c) Hexadecimal Notation: Base 16

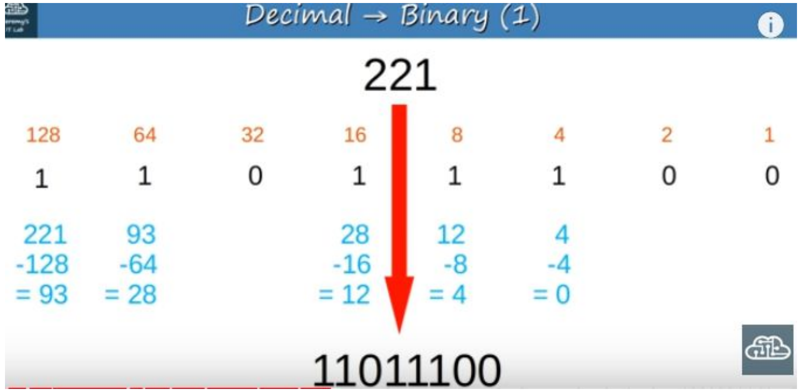
0X810B0BEF or $810B0BEF_{16}$

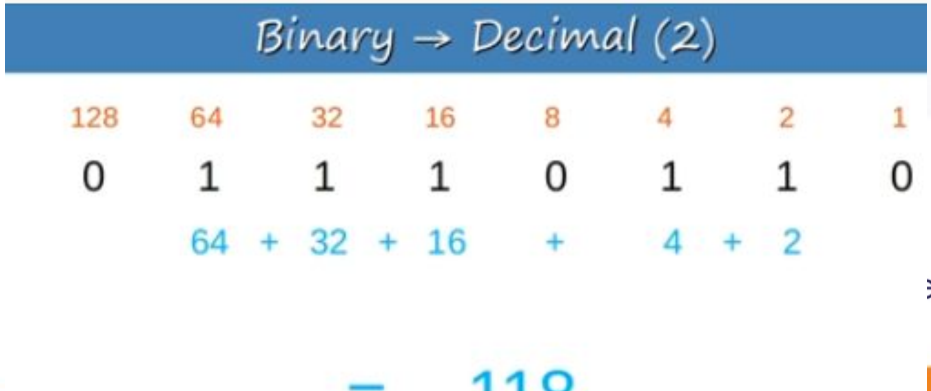
Address Notation





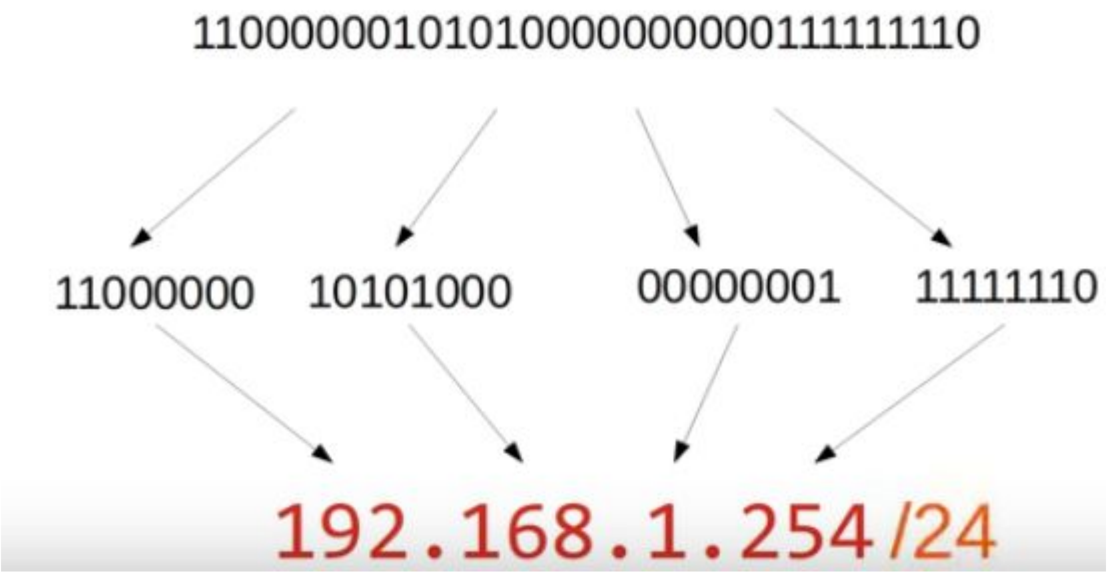


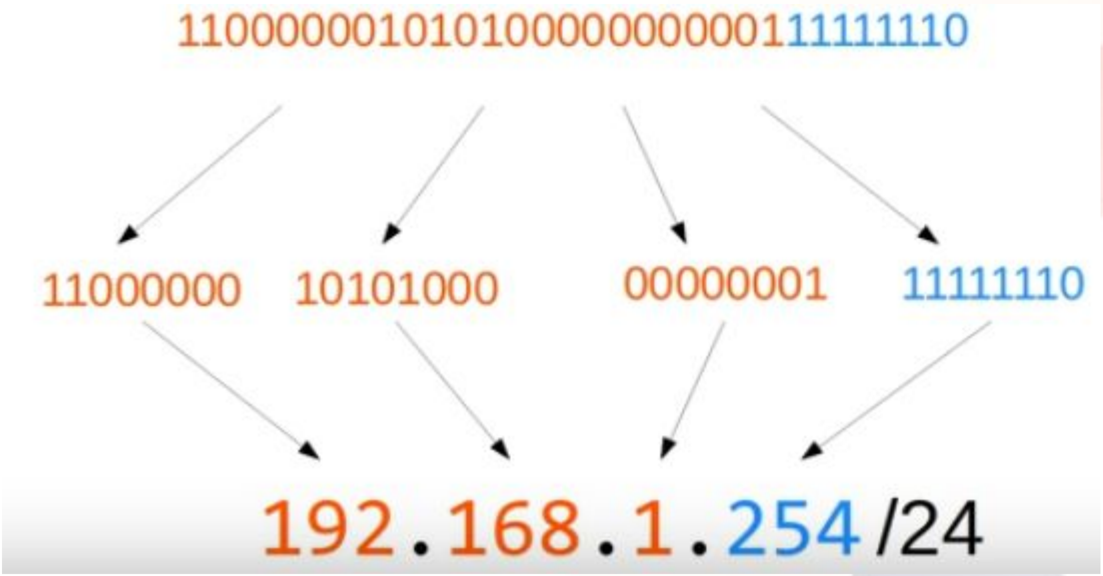




Co-funded by the European Union

Address Notation





Co-funded by
the European Union

IPv4 Addresses

Change the following IPv4 addresses from binary notation to dotted-decimal notation.

a. 10000001 00001011 00001011 11101111

b. 11000001 10000011 00011011 11111111

c. 11100111 11011011 10001011 01101111

d. 11111001 10011011 11111011 00001111

Solution

We replace each group of 8 bits with its equivalent decimal number and add dots for separation:

a. 129.11.11.239

b. 193.131.27.255

c. 231.219.139.111

d. 249.155.251.15

Co-funded by the European Union

TEIN CC COOPERATION CENTER

Asi@Connect

IPv4 Addresses

Change the following IPv4 addresses from dotted-decimal notation to binary notation.
a. **111.56.45.78**
b. **221.34.7.82**
c. ***241.8.56.12***
d. ***75.45.34.78***

Solution
We replace each decimal number with its binary equivalent:
a. 01101111 00111000 00101101 01001110
b. 11011101 00100010 00000111 01010010
c. 11110001 00001000 00111000 00001100
d. 01001011 00101101 00100010 01001110

IPv4 Addresses

Find the error, if any, in the following IPv4 addresses:

a. 111.56.045.78

b. 221.34.7.8.20

c. 75.45.301.14

d. 11100010.23.14.67

Solution

a. There should be no leading zeroes (045).

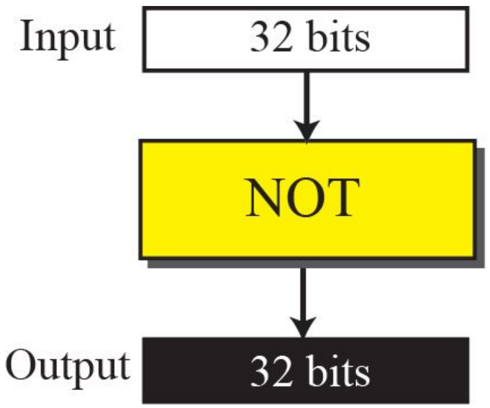
b. We may not have more than 4 bytes in an IPv4 address.

c. Each byte should be less than or equal to 255.

d. A mixture of binary notation and dotted-decimal notation.

Logical Operation of IPv4 Addresses

Bitwise NOT operation



NOT operation

Input	Output
0	1
1	0

Operation for each bit

The following shows how we can apply the NOT operation on a 32-bit number in binary.

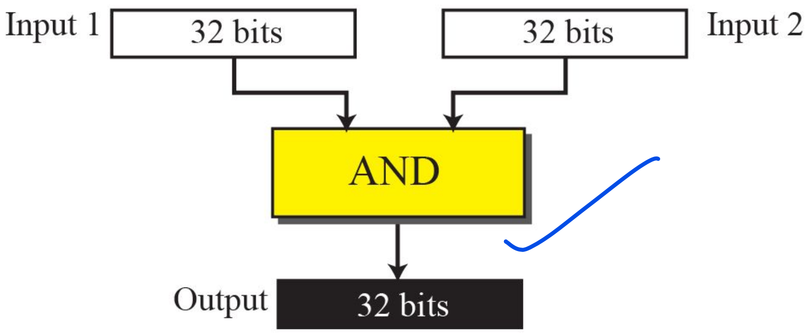
Original number:	00010001	01111001	00001110	00100011
Complement:	11101110	10000110	11110001	11011100

We can use the same operation using the dotted-decimal representation and the short cut.

Original number:	17 .	121 .	14 .	35
Complement:	238 .	134 .	241 .	220

Logical Operation of IPv4 Addresses

Bitwise AND operation



AND

Input 1	Input 2	Output
0	0	0
0	1	0
1	0	0
1	1	1

Operation for each bit

First number:	00010001	01111001	00001110	00100011
Second number:	11111111	11111111	10001100	00000000
Result	00010001	01111001	00001100	00000000

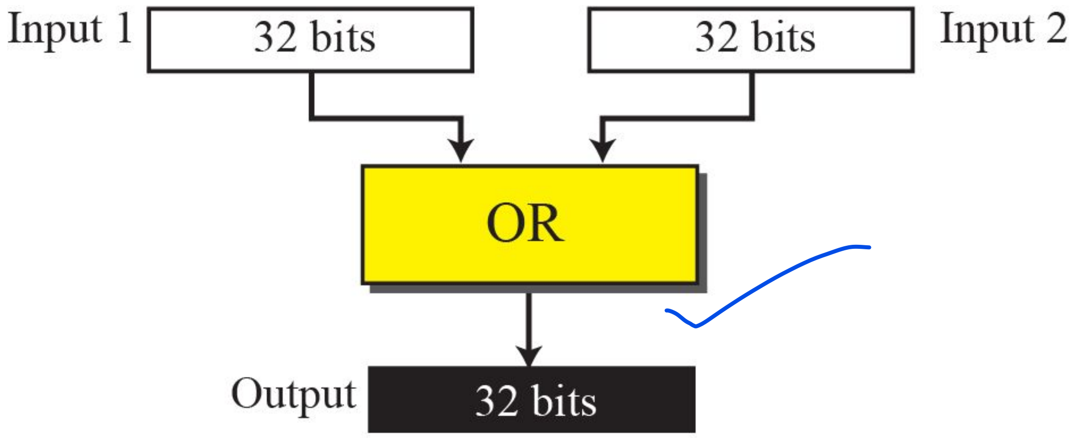
We can use the same operation using the dotted-decimal representation and the short cut.

First number:	17	.	121	.	14	.	35
Second number:	255	.	255	.	140	.	0
Result:	17	.	121	.	12	.	0

We have applied the first short cut on the first, second, and the fourth byte; we have applied the second short cut on the third byte. We have written 14 and 140 as the sum of terms and selected the smaller term in each pair as shown below.

Powers	2^7		2^6		2^5		2^4		2^3		2^2		2^1		2^0
Byte (14)	0	+	0	+	0	+	0	+	8	+	4	+	2	+	0
Byte (140)	128	+	0	+	0	+	0	+	8	+	4	+	0	+	0
Result (12)	0	+	0	+	0	+	0	+	8	+	4	+	0	+	0

Logical Operation of IPv4 Addresses



OR

Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	1

Operation for each bit

The following shows how we can apply the OR operation on two 32-bit numbers in binary.

First number:	00010001	01111001	00001110	00100011
Second number:	11111111	11111111	10001100	00000000
Result	11111111	11111111	10001110	00100011

We can use the same operation using the dotted-decimal representation and the short cut.

First number:	17	.	121	.	14	.	35
Second number:	255	.	255	.	140	.	0
Result:	255	.	255	.	142	.	35

We have used the first short cut for the first and second bytes and the second short cut for the third byte.

Co-funded by the European Union

Types of IPV4 Address

CLASSFUL ADDRESSING

IP addresses, when started a few decades ago, used the concept of classes. This architecture is called Classful addressing.

CLASSLESS ADDRESSING

In the mid-1990s, a new architecture, called classless addressing, was introduced that supersedes the original architecture.

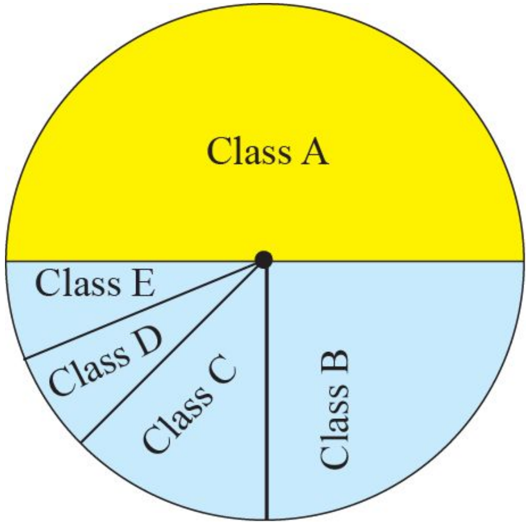
Co-funded by the European Union

TEIN*CC COOPERATION CENTER

Asi@Connect

CLASSFUL ADDRESSING

- In classful addressing, the IP address space is divided into five classes: A, B, C, D, and E.
- Each class occupies some part of the whole address space.



Occupation of address space

Class A: 2^{31} = 2,147,483,648 addresses, 50%
Class B: 2^{30} = 1,073,741,824 addresses, 25%
Class C: 2^{29} = 536,870,912 addresses, 12.5%
Class D: 2^{28} = 268,435,456 addresses, 6.25%
Class E: 2^{28} = 268,435,456 addresses, 6.25%

CLASSFUL ADDRESSING

Finding the class of address

	Octet 1	Octet 2	Octet 3	Octet 4
Class A	0........			
Class B	10......			
Class C	110.....			
Class D	1110....			
Class E	1111....			

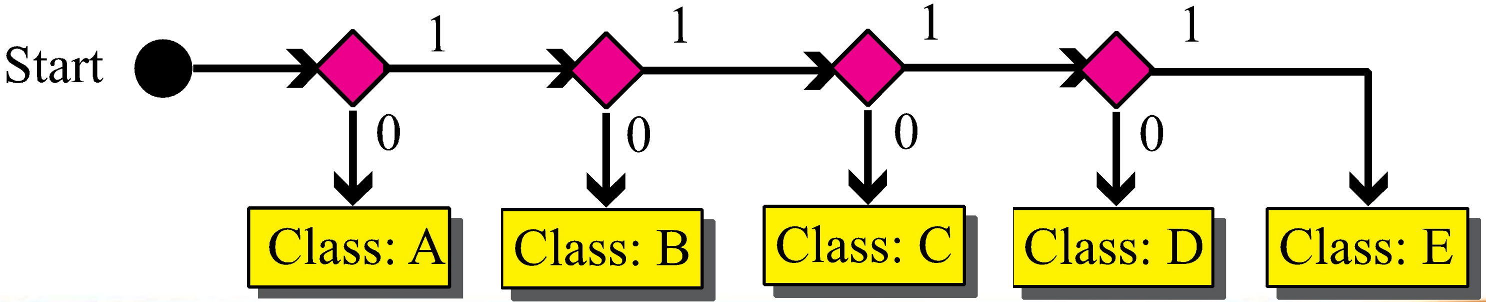
Binary notation

	Byte 1	Byte 2	Byte 3	Byte 4
Class A	0–127			
Class B	128–191			
Class C	192–223			
Class D	224–239			
Class E	240–255			

Dotted-decimal notation

Legend

- Check next bit
- Address class



Co-funded by the European Union

Classful Addressing

Find the class of each address:

a. 227.12.14.87

b. 193.14.56.22

c. 14.23.120.8

d. 252.5.15.111

Solution

a. The first byte is 227 (between 224 and 239); the class is D.

b. The first byte is 193 (between 192 and 223); the class is C.

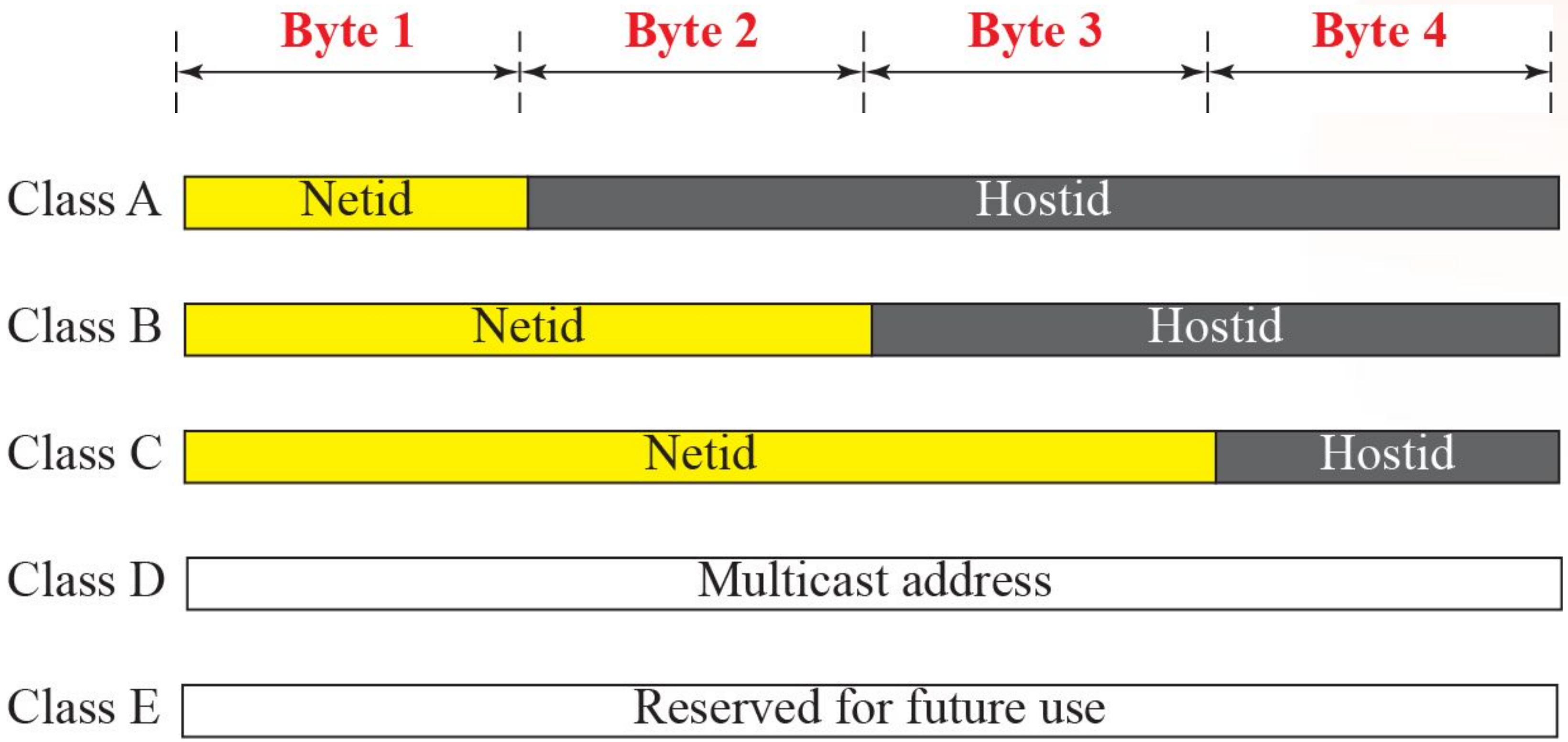
c. The first byte is 14 (between 0 and 127); the class is A.

d. The first byte is 252 (between 240 and 255); the class is E.

Co-funded by
the European Union

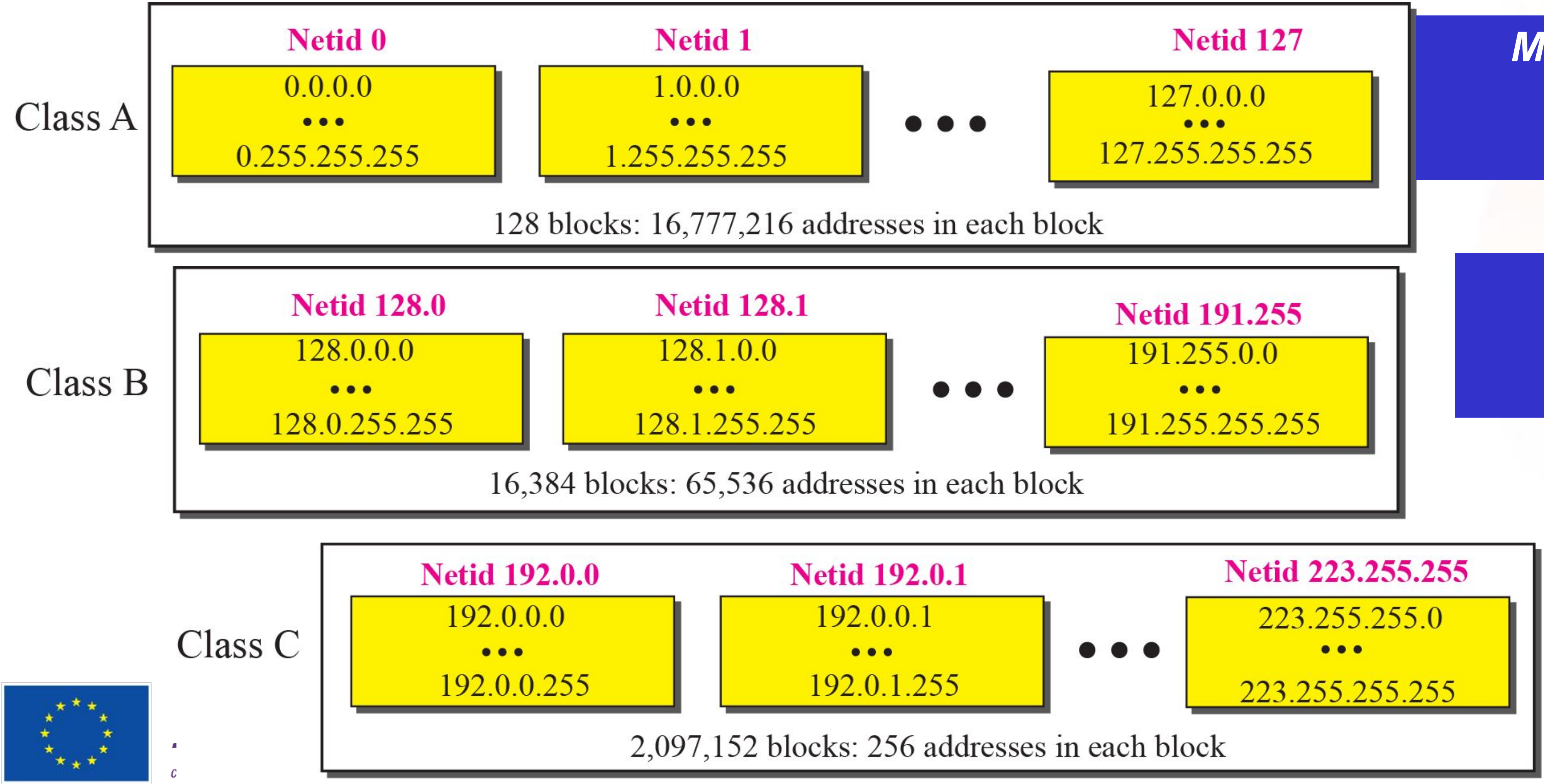
Classful Addressing

Netid and Hostid



Classful Addressing

Classes and Blocks



Millions of class A addresses are wasted.

Many class B addresses are wasted.

Not so many organizations are so small to have a class C block.

Co-funded by the European Union

Classful Addressing

Classes and Blocks

Class D

224.0.0.0 ••• 239.255.255.255

One block: 268,435,456 addresses

Class E

240.0.0.0 ••• 255.255.255.255

One block: 268,435,456 addresses

Class D addresses are made of one block, used for multicasting.

The only block of class E addresses was reserved for future purposes.

The range of addresses allocated to an organization in classful addressing was a block of addresses in Class A, B, or C.

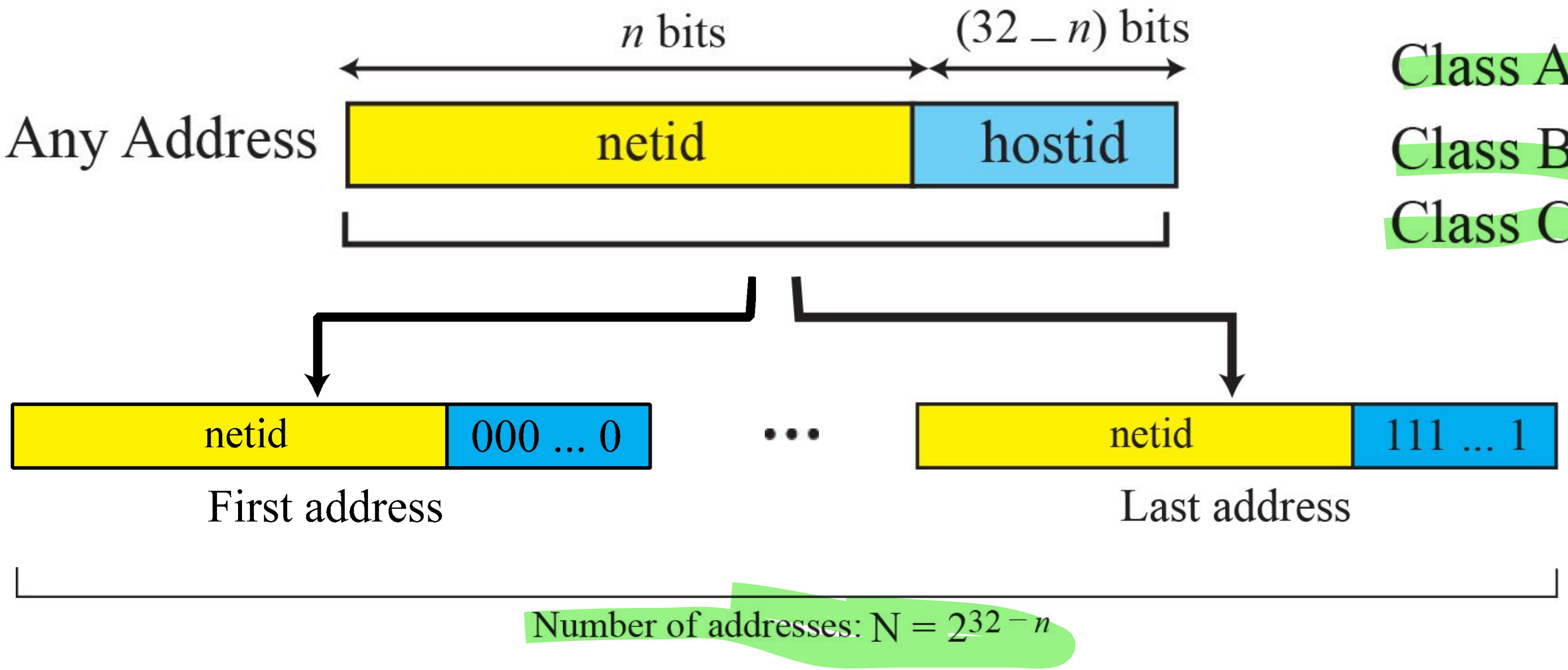
Co-funded by the European Union

TEIN*CC COOPERATION CENTER

Asi@Connect

Classful Addressing

Two-Level Addressing



Class A: $n = 8$

Class B: $n = 16$

Class C: $n = 24$

Classful Addressing

An address in a block is given as 73.22.17.25. Find the number of addresses in the block, the first address, and the last address.

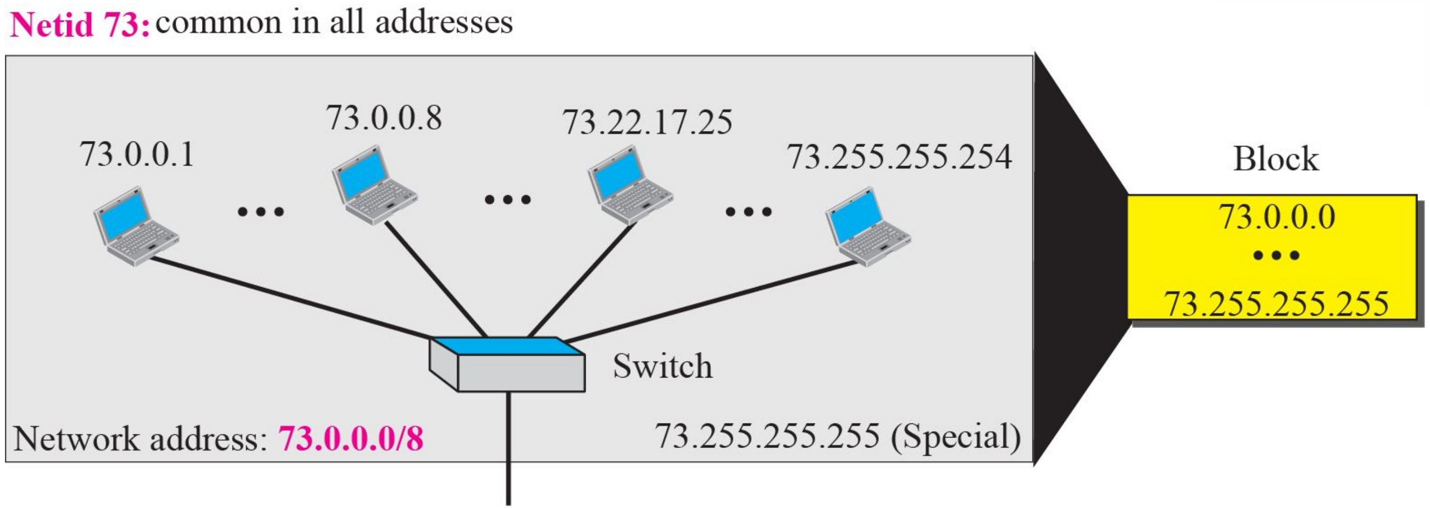
Solution

Figure shows a possible configuration of the network that uses this block.

1. The number of addresses in this block is N = 2^{32-n} = 16,777,216.

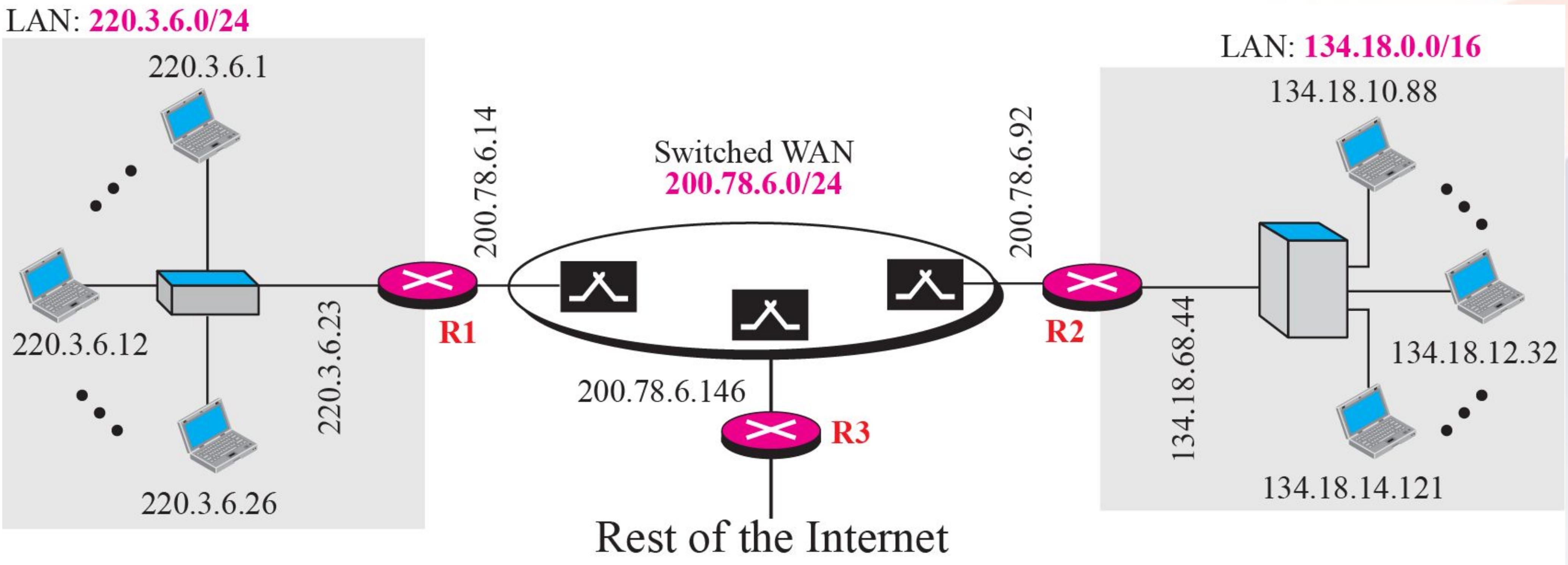
2. To find the first address, we keep the leftmost 8 bits and set the rightmost 24 bits all to 0s. The first address is 73.0.0.0/8, in which 8 is the value of *n*.

3. To find the last address, we keep the leftmost 8 bits and set the rightmost 24 bits all to 1s. The last address is 73.255.255.255.



Co-funded by the European Union
TEIN CC COOPERATION CENTER
Asi@Connect

Classful Addressing (*Sample Internet*)



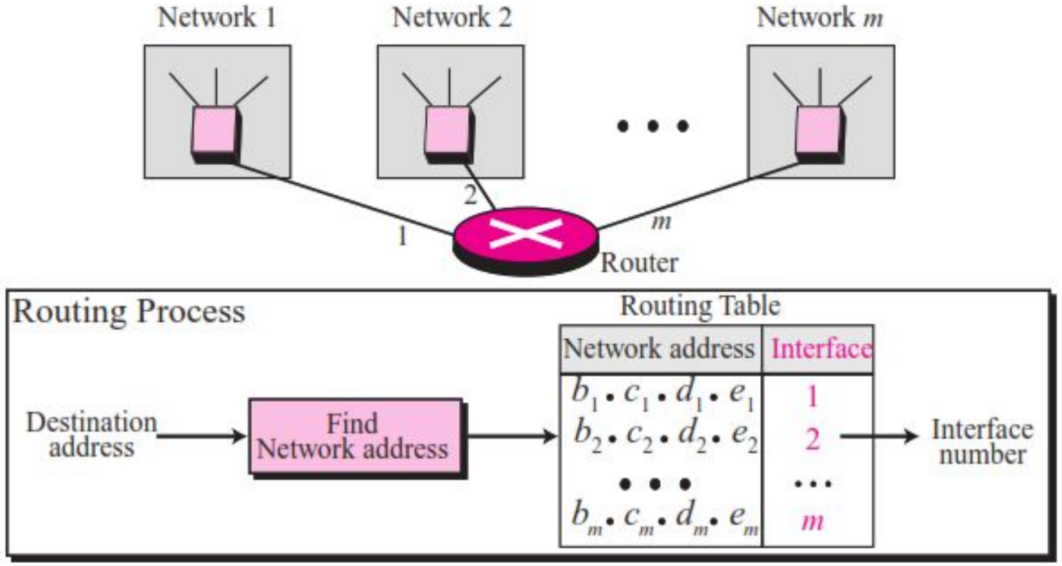
Co-funded by
the European Union

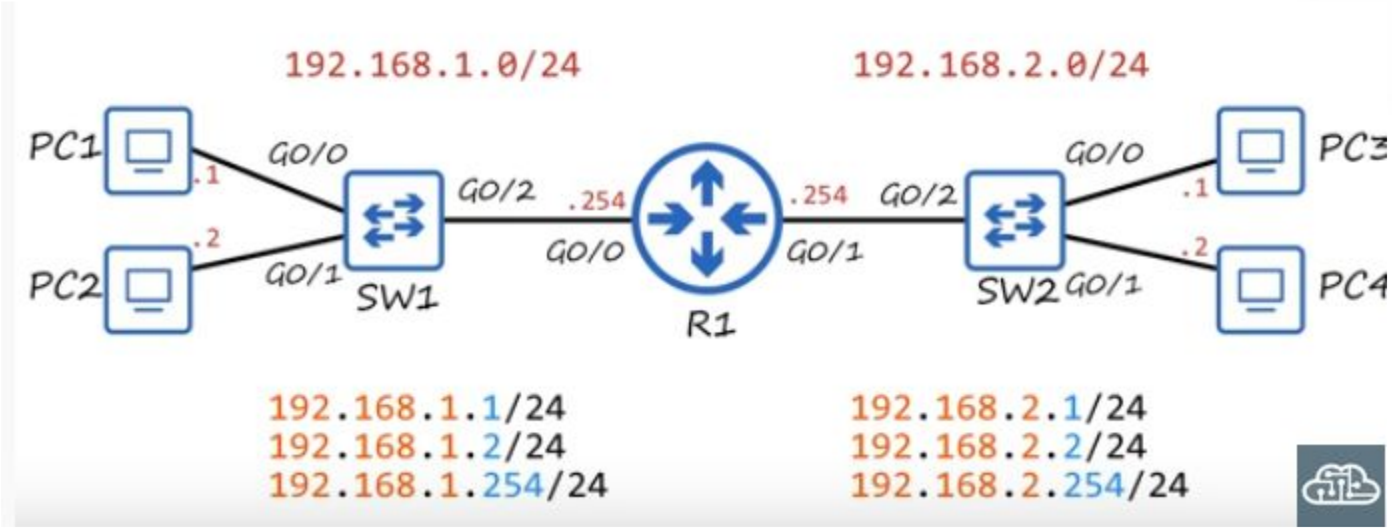
TEIN CC
COOPERATION CENTER

Asi@Connect

Network Address

The network address is the identifier of a network.

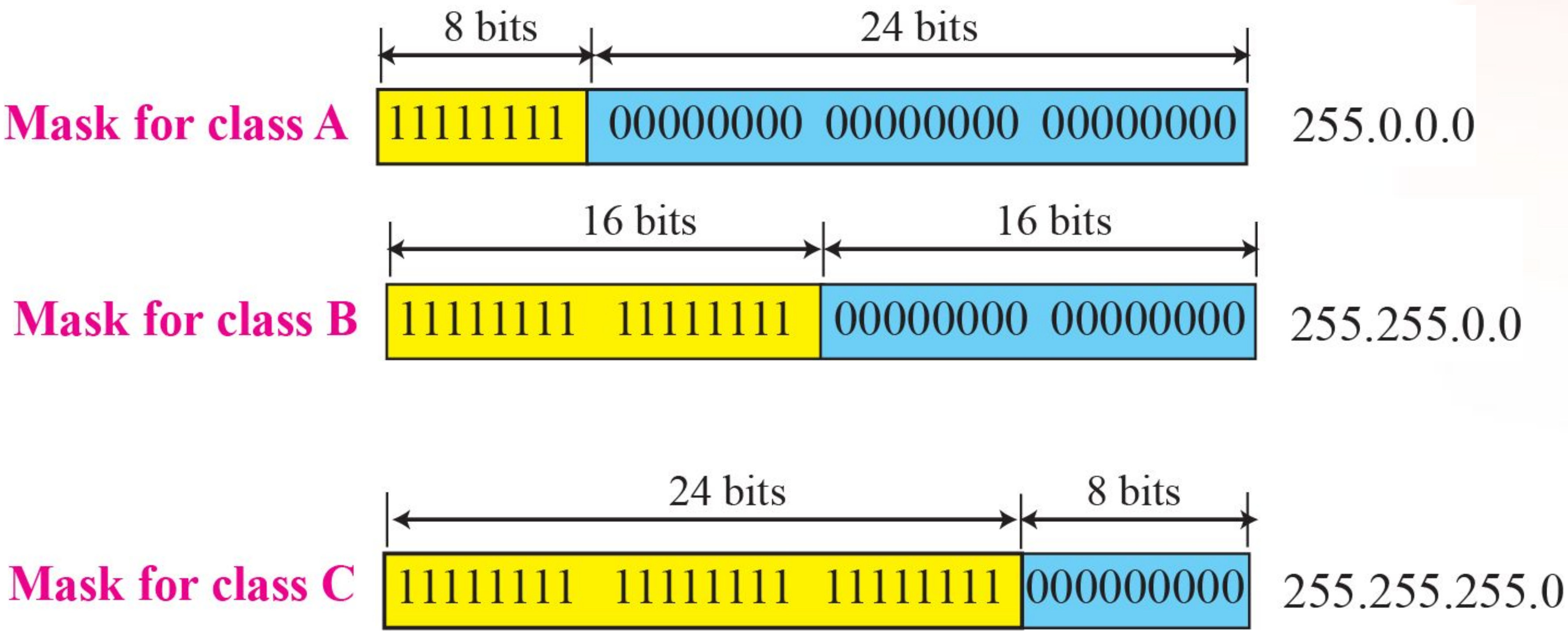




Co-funded by the European Union

Network Mask (Default Mask)

- It is called a subnet mask because it is used to identify network address of an IP address by perfoming a bitwise AND operation on the netmask.
- A Subnet mask is a 32-bit number that masks an IP address, and divides the IP address into network address and host address.



Co-funded by the European Union

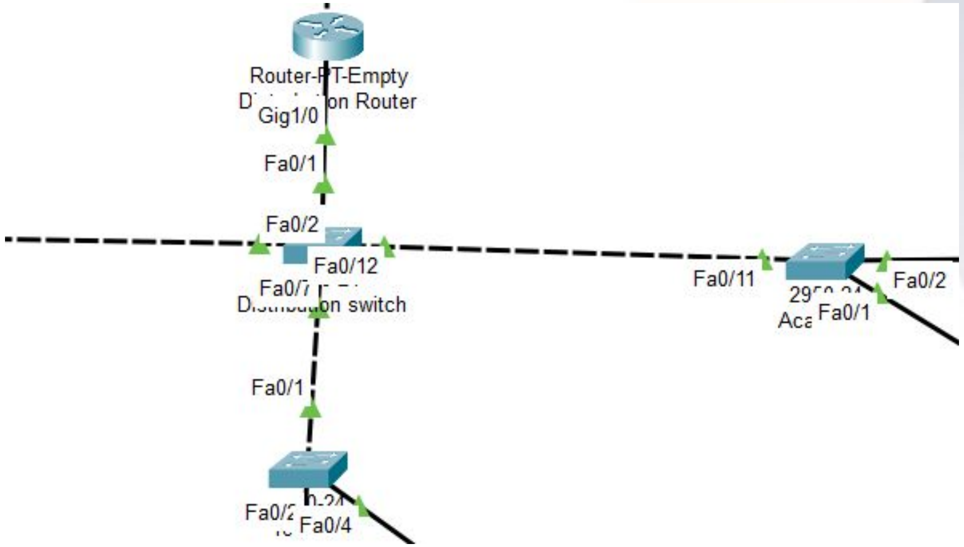
Classful Addressing

A router receives a packet with the destination address 201.24.67.32. Show how the router finds the network address of the packet.

Solution

Since the class of the address is C, we assume that the router applies the default mask for class C, 255.255.255.0 to find the network address.

Destination address	→	201	.	24	.	67	.	32
Default mask	→	255	.	255	.	0	.	0
Network address	→	201	.	24	.	0	.	0

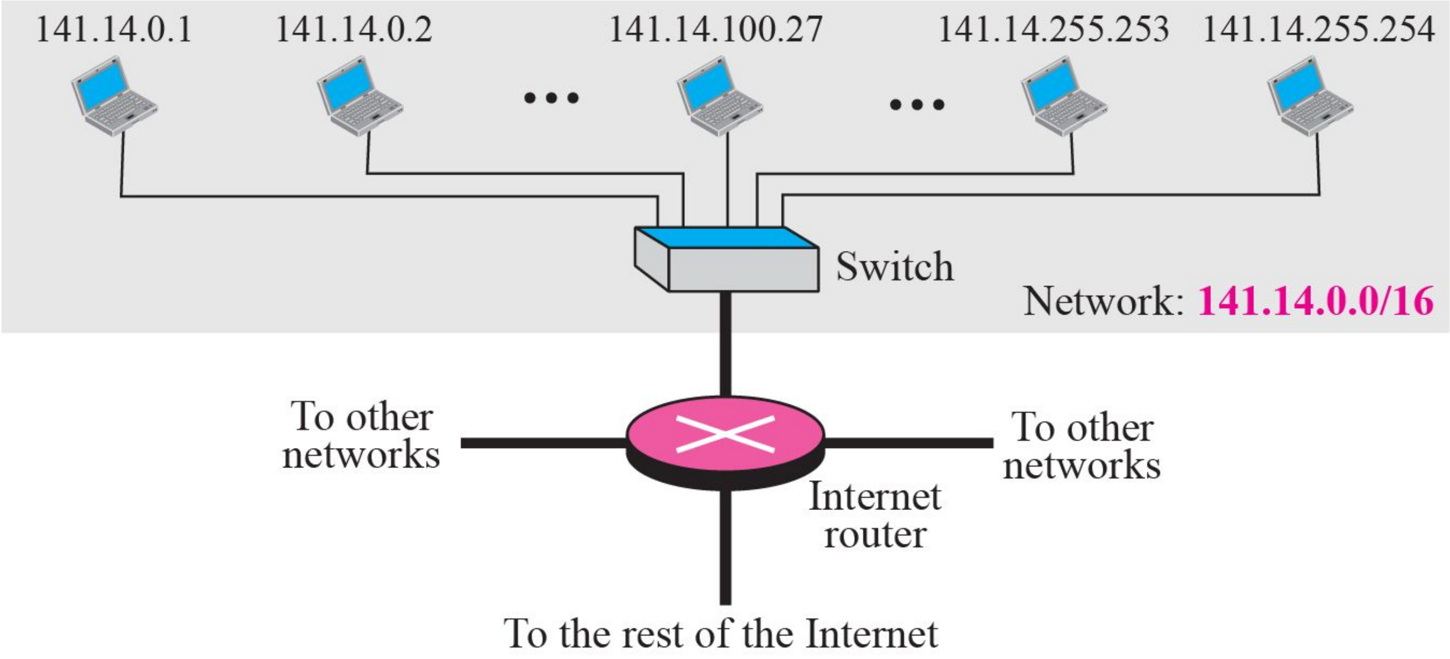


Co-funded by the European Union

Classful Addressing

Three-Level Addressing: Subnetting

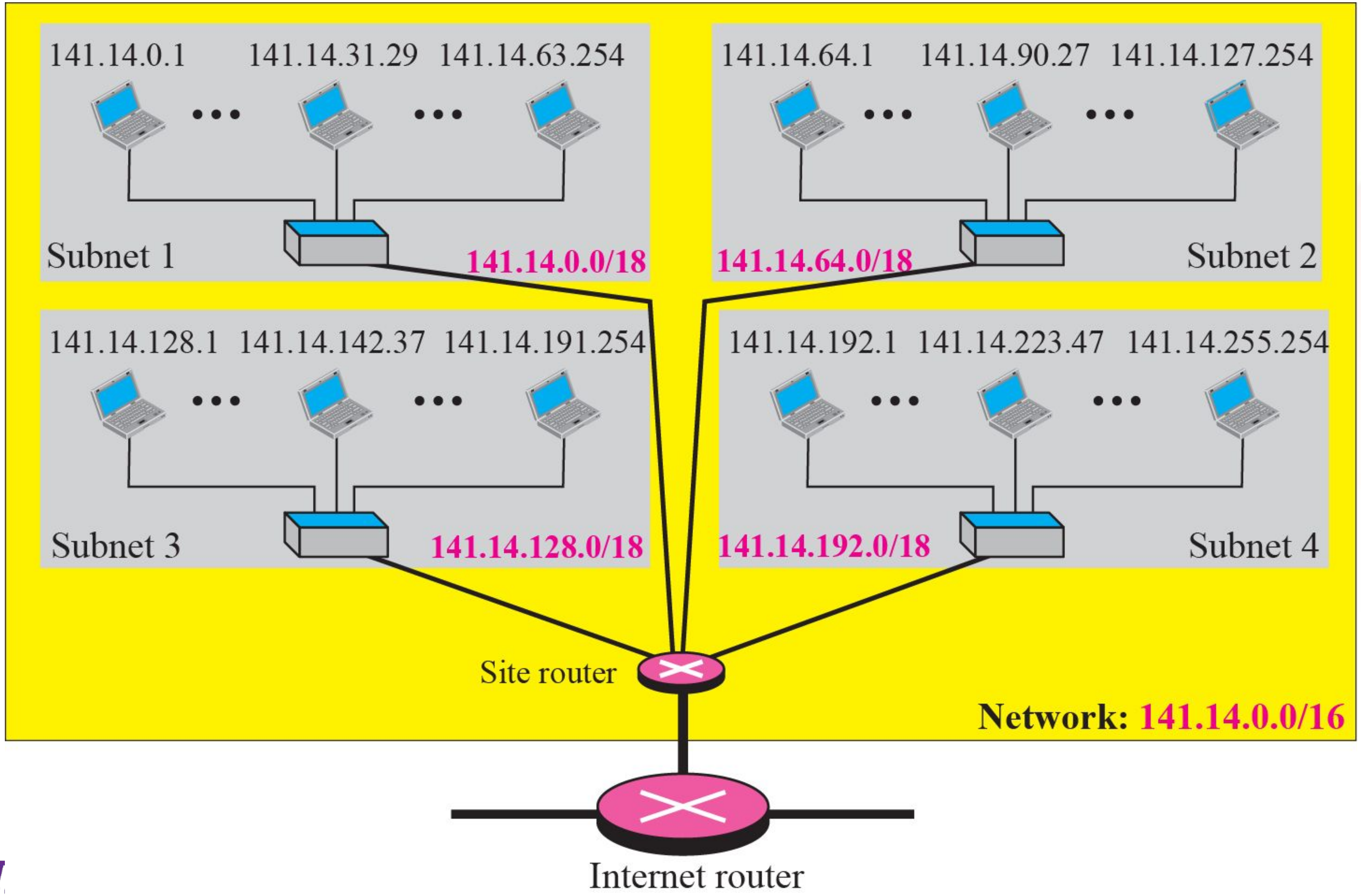
- The idea of splitting a block to smaller blocks is referred to as subnetting.
- In subnetting, a network is divided into several smaller subnetworks (subnets) with each subnetwork having its own subnetwork address.



A network using class B addresses before subnetting.

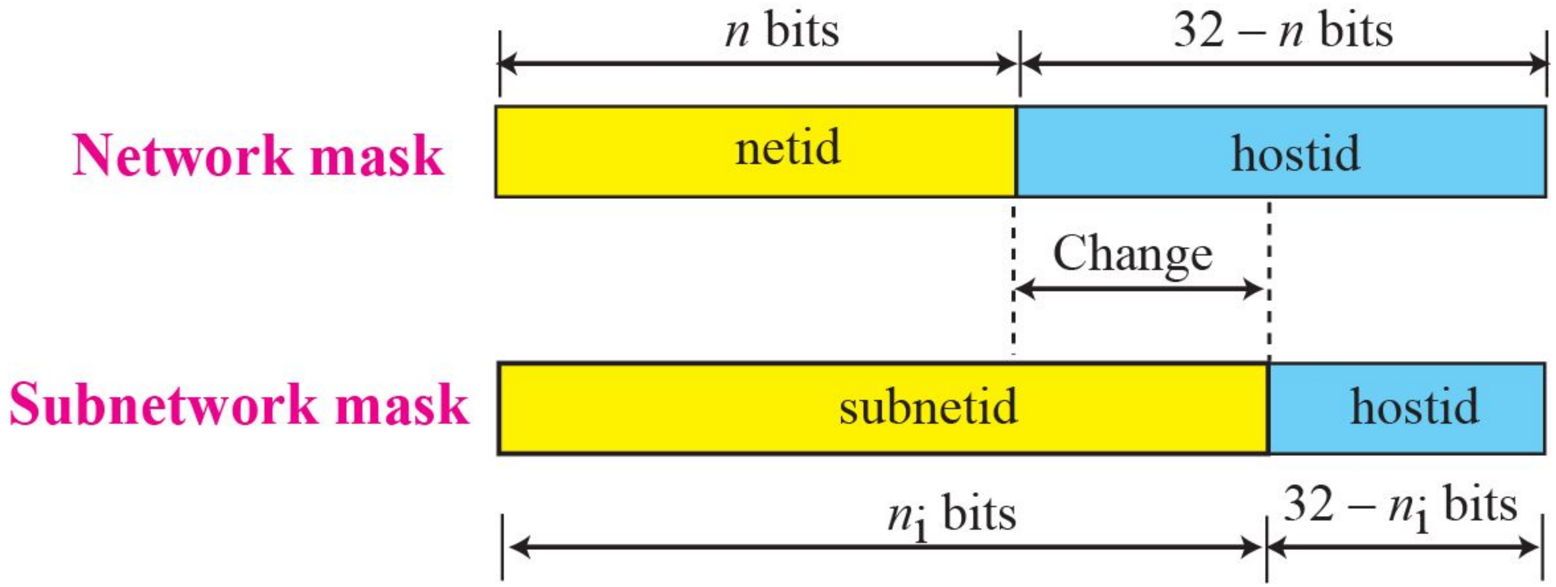
Co-funded by the European Union
TEIN CC COOPERATION CENTER
Asi@Connect

Classful Addressing (**Subnetting**)



Classfull Addressing (**Subnetting**)

- The network mask is used when a network is not subnetted.
- When we divide a network to several subnetworks, we need to create a subnetwork mask (or subnet mask) for each subnetwork.
- A subnetwork has subnetid and hostid



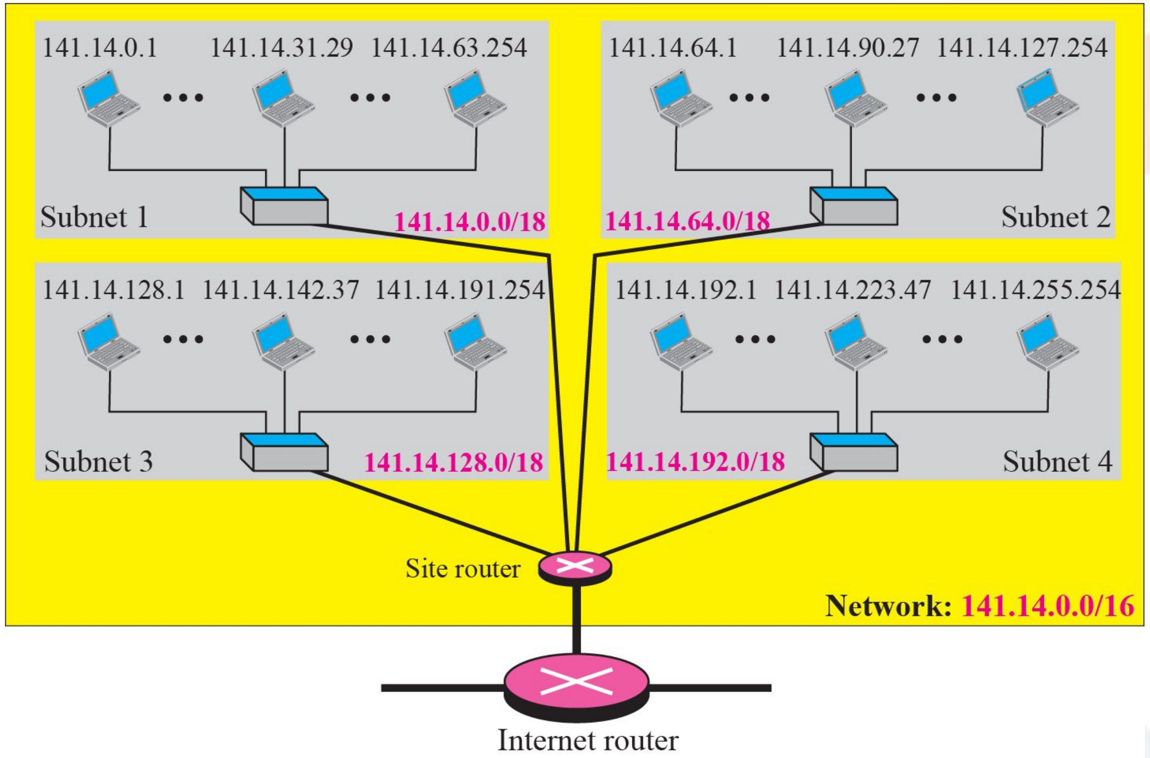
$$n_{sub} = n + \log_2 s$$

Classfull Addressing (Subnetting)

In previous example we divided a class B network into four subnetworks. The value of n = 16 and the value of

$$n_1 = n_2 = n_3 = n_4 = 16 + \log_2 4 = 18.$$

This means that the subnet mask has eighteen 1s and fourteen 0s. In other words, the subnet mask is 255.255.192.0 which is different from the network mask for class B (255.255.0.0).



Classfull Addressing

In Previous Example , we show that a network is divided into four subnets. Since one of the addresses in subnet 2 is 141.14.120.77, we can find the subnet address as:

Address	→	141	.	14	.	120	.	77
Mask	→	255	.	255	.	192	.	0
Subnet Address	→	141	.	14	.	64	.	0

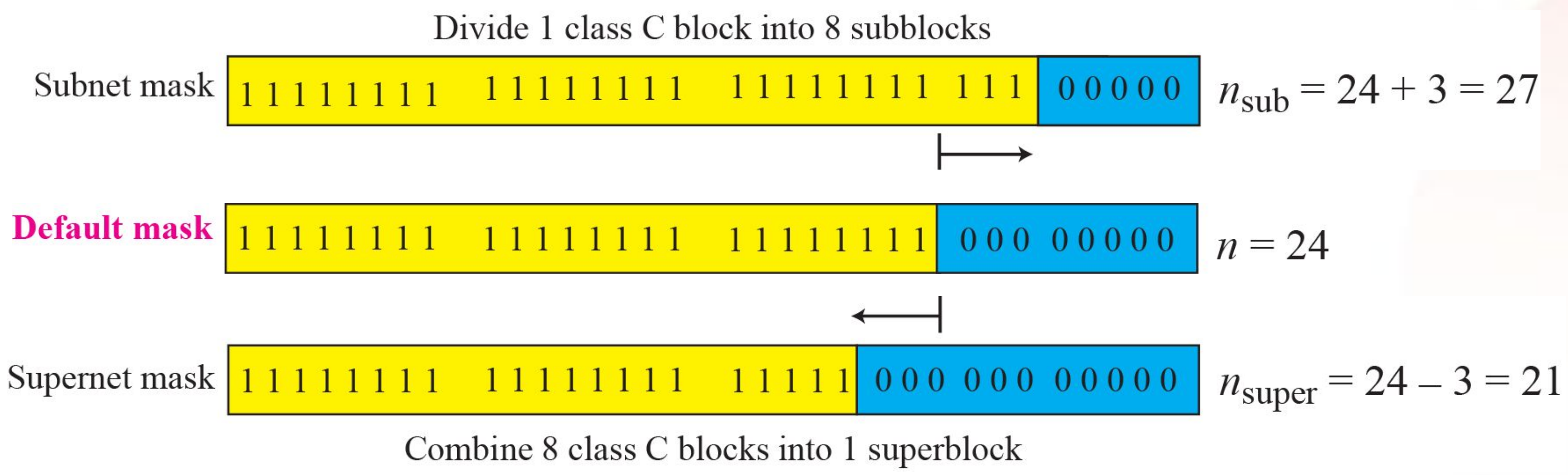
The values of the first, second, and fourth bytes are calculated using the first short cut for AND operation. The value of the third byte is calculated using the second short cut for the AND operation.

Address (120)	0	+	64	+	32	+	16	+	8	+	0	+	0	+	0
Mask (192)	128	+	64	+	0	+	0	+	0	+	0	+	0	+	0
Result (64)	0	+	64	+	0	+	0	+	0	+	0	+	0	+	0

Co-funded by the European Union

Classful Addressing

Comparison of subnet, default, and supernet mask

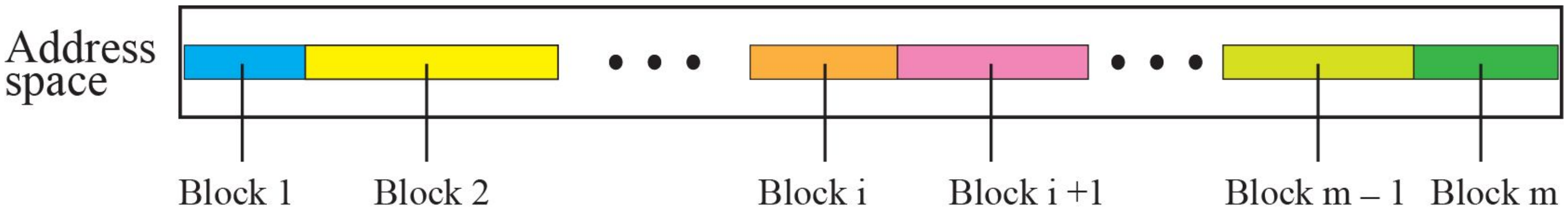


Classless Addressing

- **Subnetting and supernetting in classful addressing did not really solve the address depletion problem.**
- **With the growth of the Internet, it was clear that a larger address space was needed as a long-term solution.**
- **The short-term solution still uses IPv4 addresses, but it is called *classless addressing*.**

Co-funded by the European Union

Variable-Length Blocks

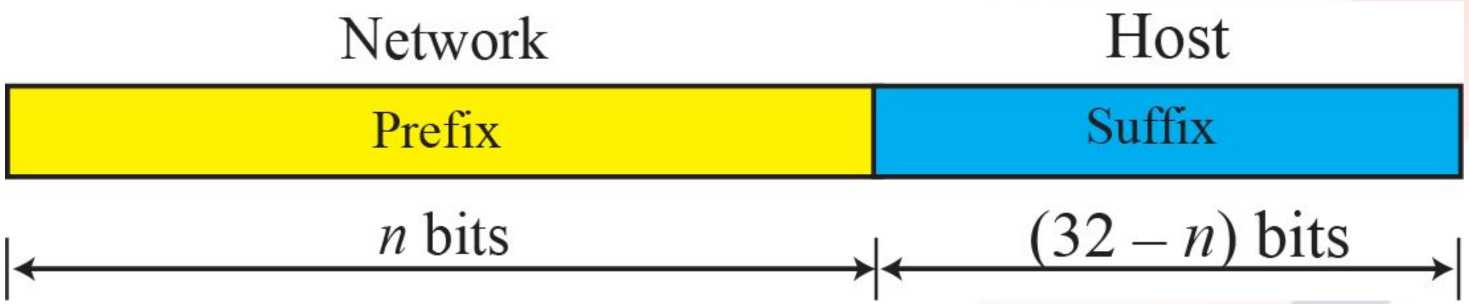


- In classless addressing, the whole address space is divided into variable length blocks.
- Theoretically, we can have a block of 2 addresses.
- The only restrictionis that the number of addresses in a block needs to be a power of 2.
- An organization can be granted one block of addresses.

Co-funded by the European Union
TEIN CC COOPERATION CENTER
Asi@Connect

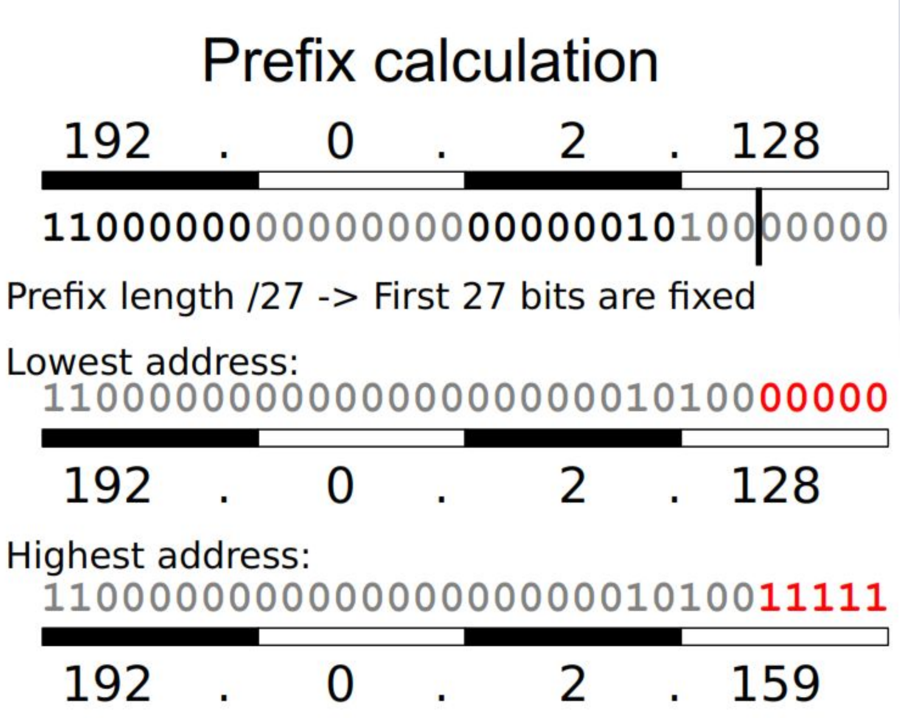
Classless Addressing

Two-Level Addressing



In classless addressing, the prefix defines the network and the suffix defines the host.

All addresses in the block have the same prefix; each address has a different suffix.



The prefix length in classless addressing can be 1 to 32.

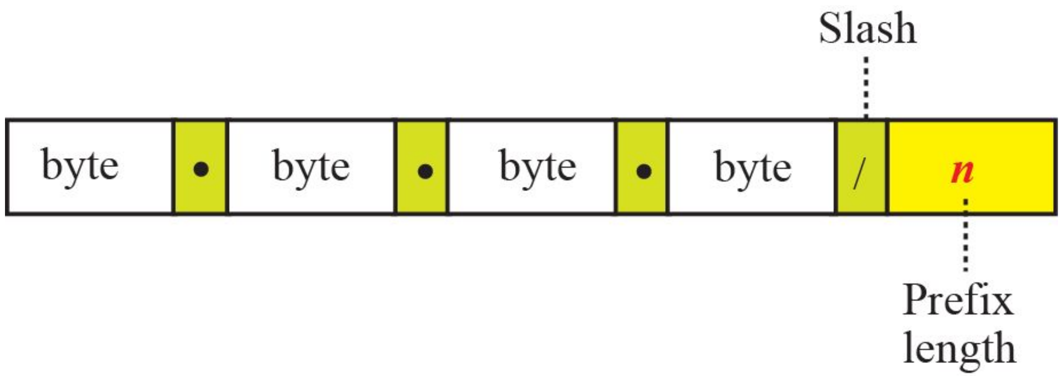
Co-funded by the European Union

Classless Addressing

Slash Notation

In classful addressing, the netid length is inherent in the address. Given an address, we know the class of the address that allows us to find the netid length (8, 16, or 24).

In classless addressing, the prefix length cannot be found if we are given only an address in the block. The given address can belong to a block with any prefix length.



10.28.0.0/29

In classless addressing, we need to know one of the addresses in the block and the prefix length to define the block.

The slash notation is formally referred to as classless interdomain routing or CIDR (pronounced cider) notation.

Co-funded by the European Union

Classless Addressing

Network Mask

- The idea of network mask in classless addressing is the same as the one in classful addressing.
- A network mask is a 32-bit number with the n leftmost bits all set to 1s and the rest of the bits all set to 0s.

Network address 10.28.0.0/29 n=29

Network Mask/Subnet Mask **255.255.255.248**

1111111 1111111 1111111 11111000

29 **32-29=3**

Co-funded by the European Union

Classless Addressing

The following addresses are defined using slash notations.

a. In the address 12.23.24.78/8, the network mask is 255.0.0.0. The mask has eight 1s and twenty-four 0s. The prefix length is 8; the suffix length is 24.

b. In the address 130.11.232.156/16, the network mask is 255.255.0.0. The mask has sixteen 1s and sixteen 0s.The prefix length is 16; the suffix length is 16.

c. In the address 167.199.170.82/27, the network mask is 255.255.255.224. The mask has twenty-seven 1s and five 0s. The prefix length is 27; the suffix length is 5.

Classless Addressing

One of the addresses in a block is 17.63.110.114/24. Find the number of addresses, the first address, and the last address in the block.

Solution

The network mask is 255.255.255.0.

a. The number of addresses in the network is $2^{32-24} = 256$.

b. To find the first address, we use the short cut methods discussed early in the chapter. The first address is 17.63.110.0/24.

Address:	17	63	110	114
Network mask:	255	255	255	0
First address (AND):	17	63	110	0

c. To find the last address, we use the complement of the network mask and the first short cut method we discussed before. The last address is 17.63.110.255/24.

Address in binary:	10100111	11000111	10101010	01010010
Complement of network mask:	00000000	00000000	00000000	00011111
Last address:	10100111	11000111	10101010	01011111

Co-funded by the European Union

TEIN*CC COOPERATION CENTER

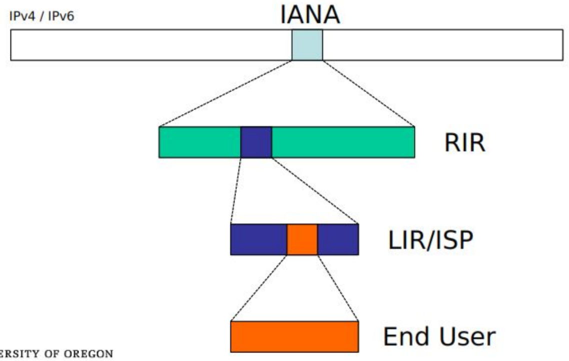
Asi@Connect

Internet Address Allocation

Who are part of the number registries?

IANA, RIRs, NIRs, and LIRs all comprise the number registries.

Hierarchical address allocation



UNIVERSITY OF OREGON

NSRC

REGISTRY	AREA COVERED
AFRINIC	Africa Region
APNIC	Asia/Pacific Region
ARIN	Canada, USA, and some Caribbean Islands
LACNIC	Latin America and some Caribbean Islands
RIPE NCC	Europe, the Middle East, and Central Asia

Co-funded by the European Union
TEIN CC COOPERATION CENTER
Asi@Connect

Classless Addressing

Block Allocation

The ultimate responsibility of block allocation is given to a global authority called ICANN

For the proper operation of the CIDR, three restrictions need to be applied to the allocated block.

1. The number of requested addresses, N, needs to be a power of 2. This is needed to provide an integer value for the prefix length, n (see the second restriction). The number of addresses can be 1, 2, 4, 8, 16, and so on.
2. The value of prefix length can be found from the number of addresses in the block. Since $N = 2^{32-n}$, then $n = \log_2 (2^{32}/N) = 32 - \log_2 N$. That is the reason why N needs to be a power of 2.
3. The requested block needs to be allocated where there are a contiguous number of unallocated addresses in the address space. However, there is a restriction on choosing the beginning addresses of the block. The beginning address needs to be divisible by the number of addresses in the block. To see this restriction, we can show that the beginning address can be calculated as $X \times 2^{n-32}$ in which X is the decimal value of the prefix. In other words, the beginning address is $X \times N$.

Co-funded by the European Union

Classless Addressing

An ISP has requested a block of 1000 addresses. The following block is granted.

a. **Since 1000 is not a power of 2, 1024 addresses are granted ($1024 = 2^{10}$).**

b. **The prefix length for the block is calculated as $n = 32 - \log_2^{1024} = 22$.**

c. **The beginning address is chosen as 18.14.12.0 (which is divisible by 1024).**

The granted block is 18.14.12.0/22. The first address is 18.14.12.0/22 and the last address is 18.14.15.255/22.

Classless Addressing (Subnetting)

An organization (or an ISP) that is granted a range of addresses may divide the range into several subranges and assign each subrange to a subnetwork (or subnet).

Following steps need to be carefully followed to guarantee the proper operation of the subnetworks.

The total number of addresses granted to the organization is N, the prefix length is n, the assigned number of addresses to each subnetwork is Nsub, the prefix length for each subnetwork is nsub, and the total number of subnetworks is s

1. The number of addresses in each subnetwork should be a power of 2.
2. The prefix length for each subnetwork should be found using the following formula:

$$n_{sub} = n + \log_2 (N/N_{sub})$$

3. The starting address in each subnetwork should be divisible by the number of addresses in that subnetwork. This can be achieved if we first assign addresses to larger networks.

Co-funded by the European Union

TEIN CC COOPERATION CENTER

Asi@Connect

Classless Addressing

Address Aggregation

One of the advantages of CIDR architecture is address aggregation. ICANN assigns a large block of addresses to an ISP. Each ISP in turn divides its assigned block into smaller subblocks and grants the subblocks to its customers; many blocks of addresses are aggregated in one block and granted to one ISP.

Example

An BTCL is granted a block of addresses starting with 190.100.0.0/16 (65,536 addresses).

The ISP needs to distribute these addresses to three groups of customers as follows:

- **The Dhaka group has 64 customers; each needs approximately 256 addresses.**
- **The Barishal group has 128 customers; each needs approximately 128 addresses.**
- **The Khulna group has 128 customers; each needs approximately 64 addresses.**

We design the subblocks and find out how many addresses are still available after these allocations.

Classless Addressing

Solution

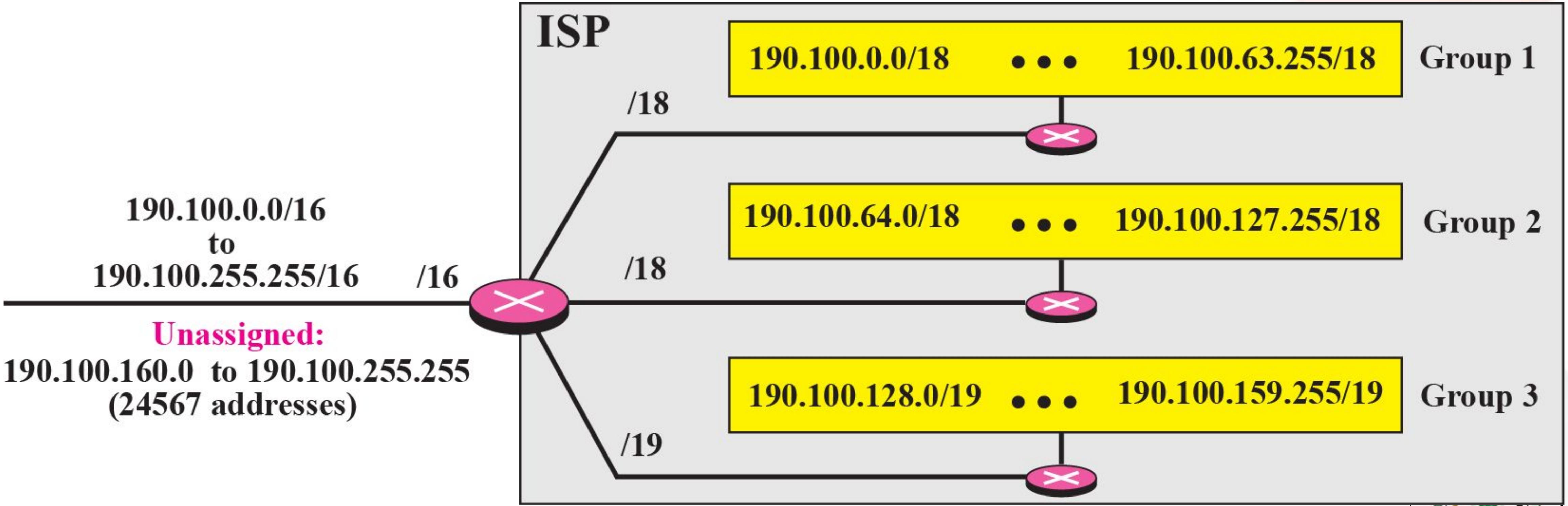
Let us solve the problem in two steps. In the first step, we allocate a subblock of addresses to each group. The total number of addresses allocated to each group and the prefix length for each subblock can found as

Group 1: $64 \times 256 = 16{,}384$	$n_1 = 16 + \log_2 (65536/16384) = 18$
Group 2: $128 \times 128 = 16{,}384$	$n_2 = 16 + \log_2 (65536/16384) = 18$
Group 3: $128 \times 64 = 8192$	$n_3 = 16 + \log_2 (65536/8192) = 19$

Figure 1 shows the design for the first hierarchical level. Figure 2 shows the second level of the hierarchy. Note that we have used the first address for each customer as the subnet address and have reserved the last address as a special address.

Classless Addressing

Solution to Example first step



Co-funded by the European Union
TEIN CC COOPERATION CENTER
Asi@Connect

Classless Addressing

Group: $n = 18$

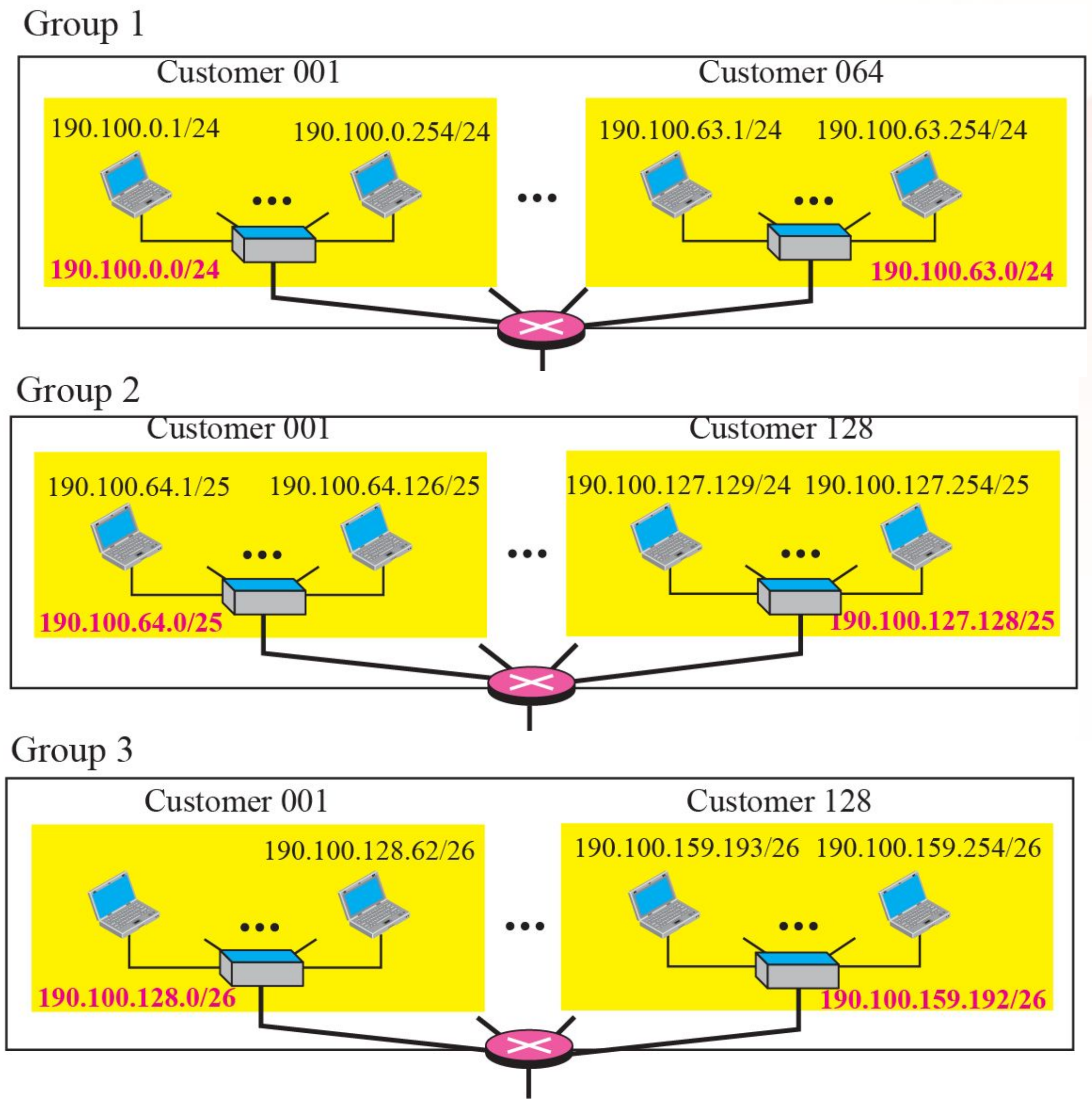
Subnet: $n = 18 + \log_2 (16385/256) = 24$

Group: $n = 18$

Subnet: $n = 18 + \log_2 (16385/128) = 25$

Group: $n = 19$

Subnet: $n = 19 + \log_2 (8192/64) = 26$



Co-funded by
the European Union

TEIN CC COOPERATION CENTER

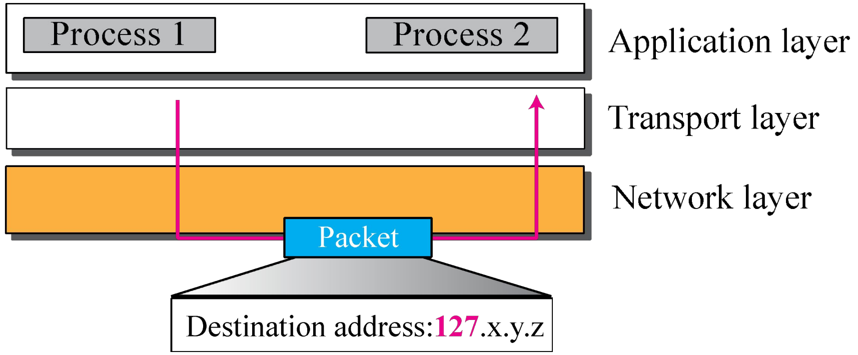
Asi@Connect

SPECIAL ADDRESSES

In classful addressing some addresses were reserved for special purposes. The classless addressing scheme inherits some of these special addresses from classful addressing.

All-Zeros Address : The block 0.0.0.0/32

All-Ones Address: Limited Broadcast Address
The block 255.255.255.255/32



Loopback Addresses

The block 127.0.0.0/8 is used for the loopback address, which is an address used to test the software on a machine

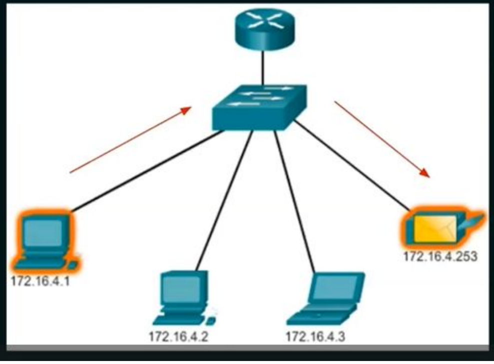
Co-funded by the European Union

Unicast Multicast and Broadcast

Unicast transmission

Unicast Transmission: The process of sending a packet from one host to an individual host.

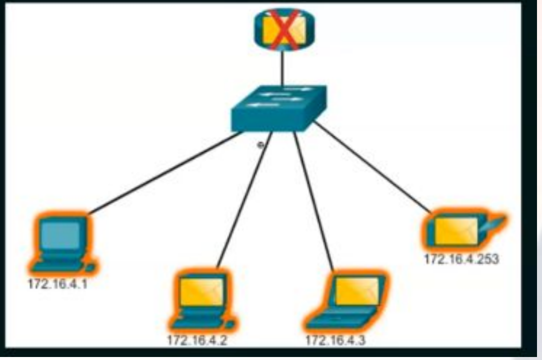
Source: 172.16.4.1
Destination: 172.16.4.253



Broadcast transmission

Broadcast Transmission: The process of sending a packet from one host to all hosts in the network.

Source: 172.16.4.1
Destination: 255.255.255.255



Limited Broadcast:

Destination: 255.255.255.255

Routers do not forward a limited broadcast!

Directed broadcast:

Destination: 172.16.4.255

Hosts within the 172.16.4.0/24 network!

Multicast transmission

Multicast Transmission: The process of sending a packet from one host to a selected group of hosts, possibly in different networks.

★ Multicast transmission reduces traffic

★ The Multicast Address range: 224.0.0.0 to 239.255.255.255

★ Link local – 224.0.0.0 to 224.0.0.255 (Example: routing information exchanged by routing protocols)

★ Globally scoped addresses – 224.0.1.0 to 238.255.255.255 (Example: 224.0.1.1 has been reserved for Network Time Protocol)

Co-funded by the European Union

SPECIAL ADDRESSES

Private Addresses/Local Address

A number of blocks are assigned for private use. They are not recognized globally.

Block	*Number of addresses*	*Block*	*Number of addresses*
10.0.0.0/8	16,777,216	192.168.0.0/16	65,536
172.16.0.0/12	1,047,584	169.254.0.0/16	65,536

Multicast communication

224.0.0.0/4 is reserved for multicast communication.

Co-funded by
the European Union

SPECIAL ADDRESSES

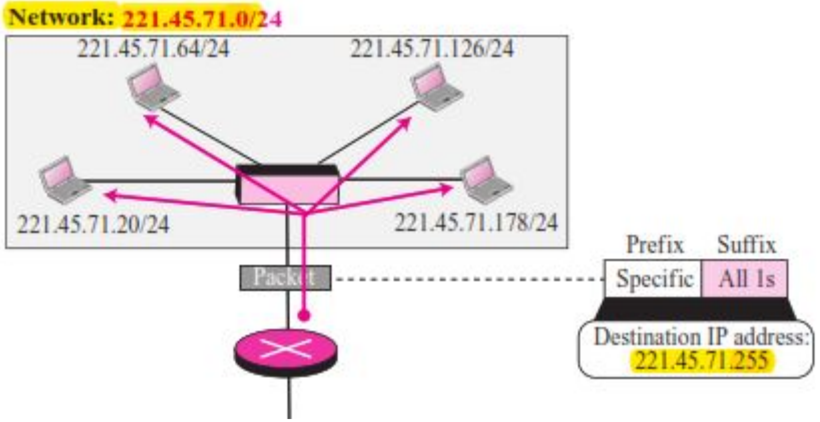
Special Addresses in Each block

Network Address

The have already discussed network addresses. The first address (with the suffix set all to 0s) in a block defines the network address. 10.28.0.0/29

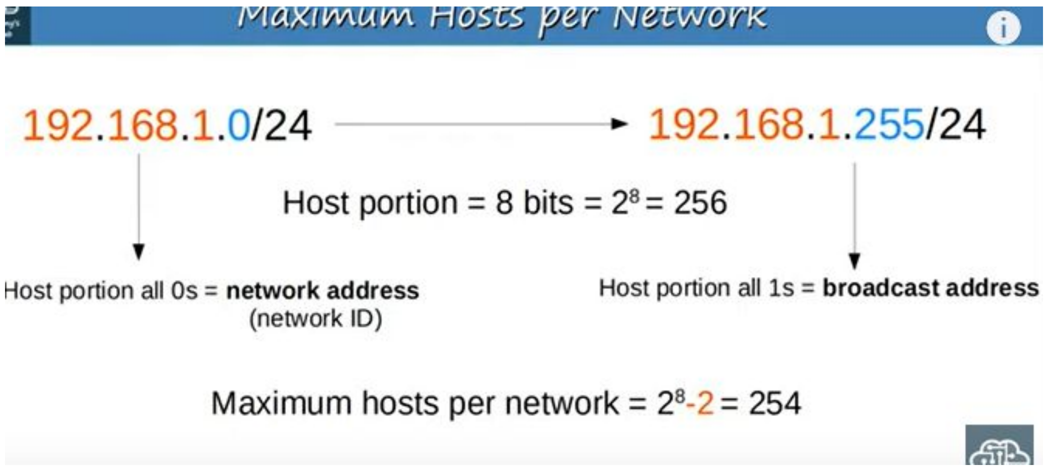
Direct Broadcast Address

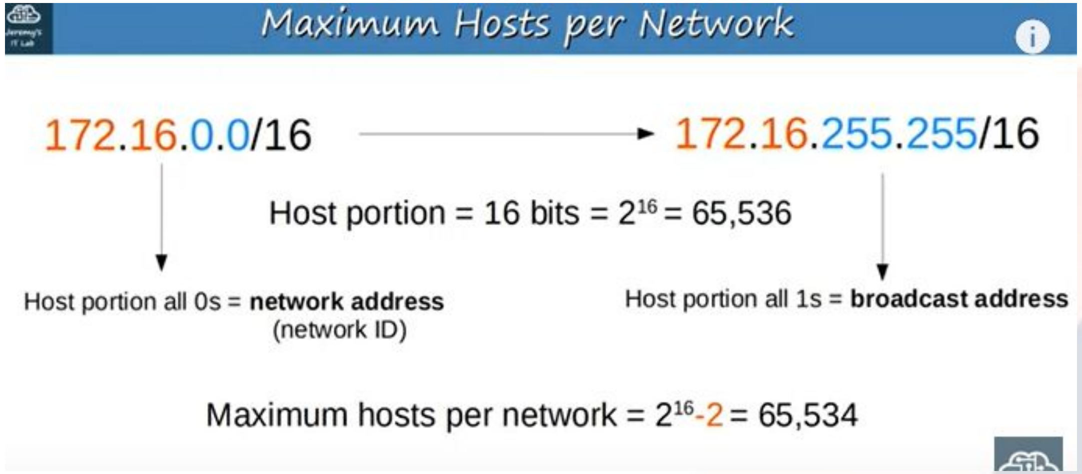
The last address in a block or subblock (with the suffix set all to 1s) can be used as a direct broadcast address. This address is usually used by a router to send a packet to all hosts in a specific network.

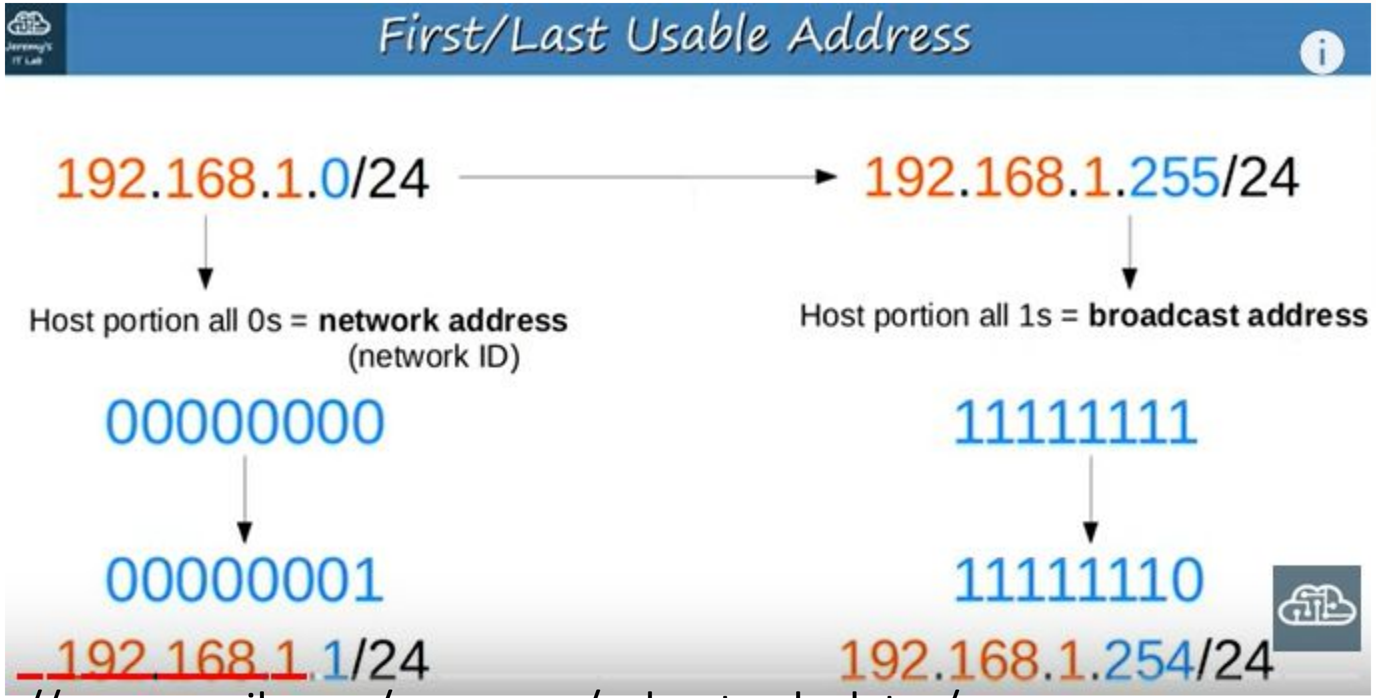


Co-funded by the European Union

Important Notes







https://www.auvik.com/resources/subnet-calculator/

Co-funded by the European Union

Quiz

PC1 has an IP address of 43.109.23.12/8

Find the following:

Network address:

Maximum number of hosts in the network:

Network broadcast address:

First usable address of the network:

~~Last usable address of the network:~~

PC1 has an IP address of 43.109.23.12/8

Find the following:

Network address: 43.0.0.0

Maximum number of hosts in the network: 16,777,214

Network broadcast address: 43.255.255.255

First usable address of the network: 43.0.0.1

~~Last usable address of the network: 43.255.255.254~~

PC4 has an IP address of 129.221.23.13/16

Find the following:

Network address:

Maximum number of hosts in the network:

Network broadcast address:

First usable address of the network:

~~Last usable address of the network:~~

PC4 has an IP address of 129.221.23.13/16

Find the following:

Network address: 129.221.0.0

Maximum number of hosts in the network: 65,534

Network broadcast address: 129.221.255.255

First usable address of the network: 129.221.0.1

~~Last usable address of the network: 129.221.255.254~~

Co-funded by
the European Union

Designing an Address Plan IPv4

The following table shows the host allocation for each part of that campus

The University has the following address space: – 172.16.0.0/16 IPv4 Address block

Network	Number of Devices
Border Router to Core Router	2
Server Network	23
Science Building	120
Arts Building	52
Engineering Building	200
Library	80
Administration Building	40
Languages Building	30
Staff & Student Hostel	60
Wireless Network	350

Co-funded by the European Union

Designing an Address Plan IPv4

add a column to show the subnet sizes for each function

Network	Number of Devices	IPv4 Subnet Size
Border Router to Core Router	2	/30
Server Network	23	/27
Science Building	120	/25
Arts Building	52	/26
Engineering Building	200	/24
Library	80	/25
Administration Building	40	/26
Languages Building	30	/26
Staff & Student Hostel	60	/25
Wireless Network	350	/23

Co-funded by
the European Union

TEIN*CC COOPERATION CENTER

Asi@Connect

Designing an Address Plan IPv4

assign address blocks accordingly

Network	Number of Devices	IPv4 Subnet Size	Allocation
Border Router to Core Router	2	/30	172.16.0.0/30
Server Network	23	/27	172.16.0.32/27
Science Building	120	/25	172.16.5.0/25
Arts Building	52	/26	172.16.5.128/26
Engineering Building	200	/24	172.16.1.0/24
Library	80	/25	172.16.4.0/25
Administration Building	40	/26	172.16.0.192/26
Languages Building	30	/26	172.16.5.192/26
Staff & Student Hostel	60	/25	172.16.4.128/25
Wireless Network	350	/23	172.16.2.0/23

Co-funded by the European Union