BATCH : BATCH 85

LESSON : **Network -5**

DATE : 23.06.2022

SUBJECT : **IP Addressing**
IP Classification

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ZOOM GİRİŞLERİNİZİ LÜTFEN **LMS** SİSTEMİ ÜZERİNDEN YAPINIZ

Previous Session

Broadcast
Unicast
Multicast
MAC Address
IP v4
IP v6

İpconfig
Ping
Broadcast Domain
Collision Domain

RDP

Binary
Hexadecimal

Bit
Byte
Kilobyte
Megabyte
Gigabyte
Terabyte

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- IP Classes

İçerik

- IP Adresleme
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NETWORK Day 5

How Do IP Address Blocks Work?

- IPv4 addresses like **168.210.225.206** are really just decimal representations of four binary blocks.

- Each block is **8 bits**, and represents numbers from 0-255. Because the blocks are groups of 8 bits, each block is known as an **octet**. And since there are four blocks of 8 bits, **every IPv4 address is 32 bits**.

How Do IP Address Blocks Work?

Binary Base = 2

	Column 8	Column 7	Column 6	Column 5	Column 4	Column 3	Column 2	Column 1
Base^{exp}	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Weight	128	64	32	16	8	4	2	1

$2^0 = 1$

$2^1 = 2$

$2^2 = 2 * 2 = 4$

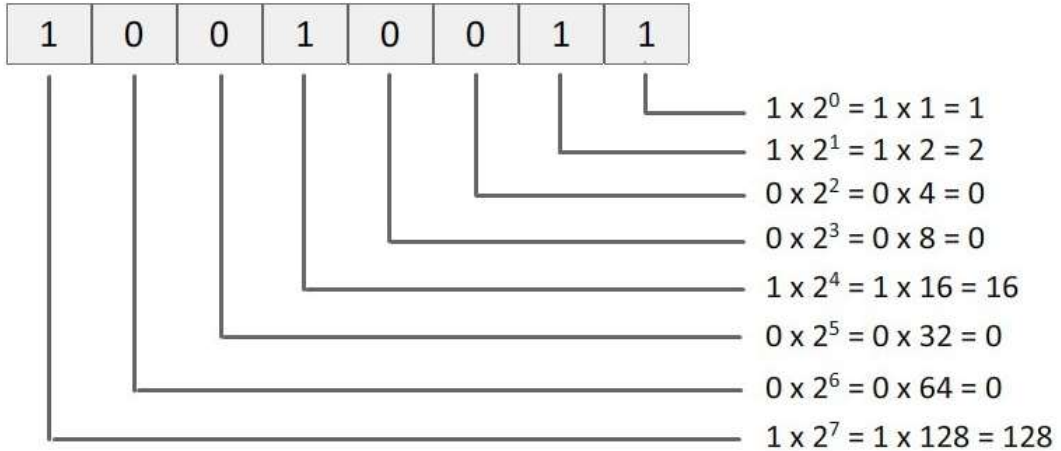
$2^3 = 2 * 2 * 2 = 8$

$2^4 = 2 * 2 * 2 * 2 = 16$

$2^5 = 2 * 2 * 2 * 2 * 2 = 32$

$2^6 = 2 * 2 * 2 * 2 * 2 * 2 = 64$

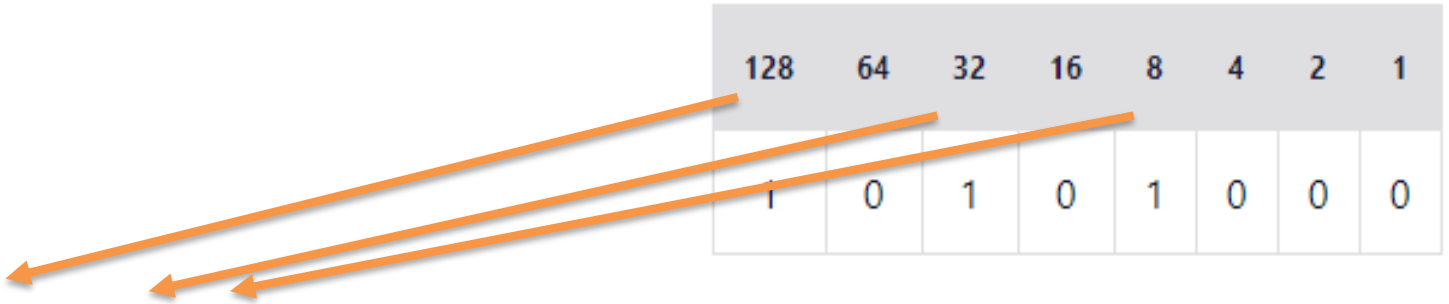
$2^7 = 2 * 2 * 2 * 2 * 2 * 2 * 2 = 128$



$(10010011)_2 = 1 + 2 + 0 + 0 + 16 + 0 + 0 + 128 = (147)_{10}$

How Do IP Address Blocks Work?

IP address **168**.210.225.206



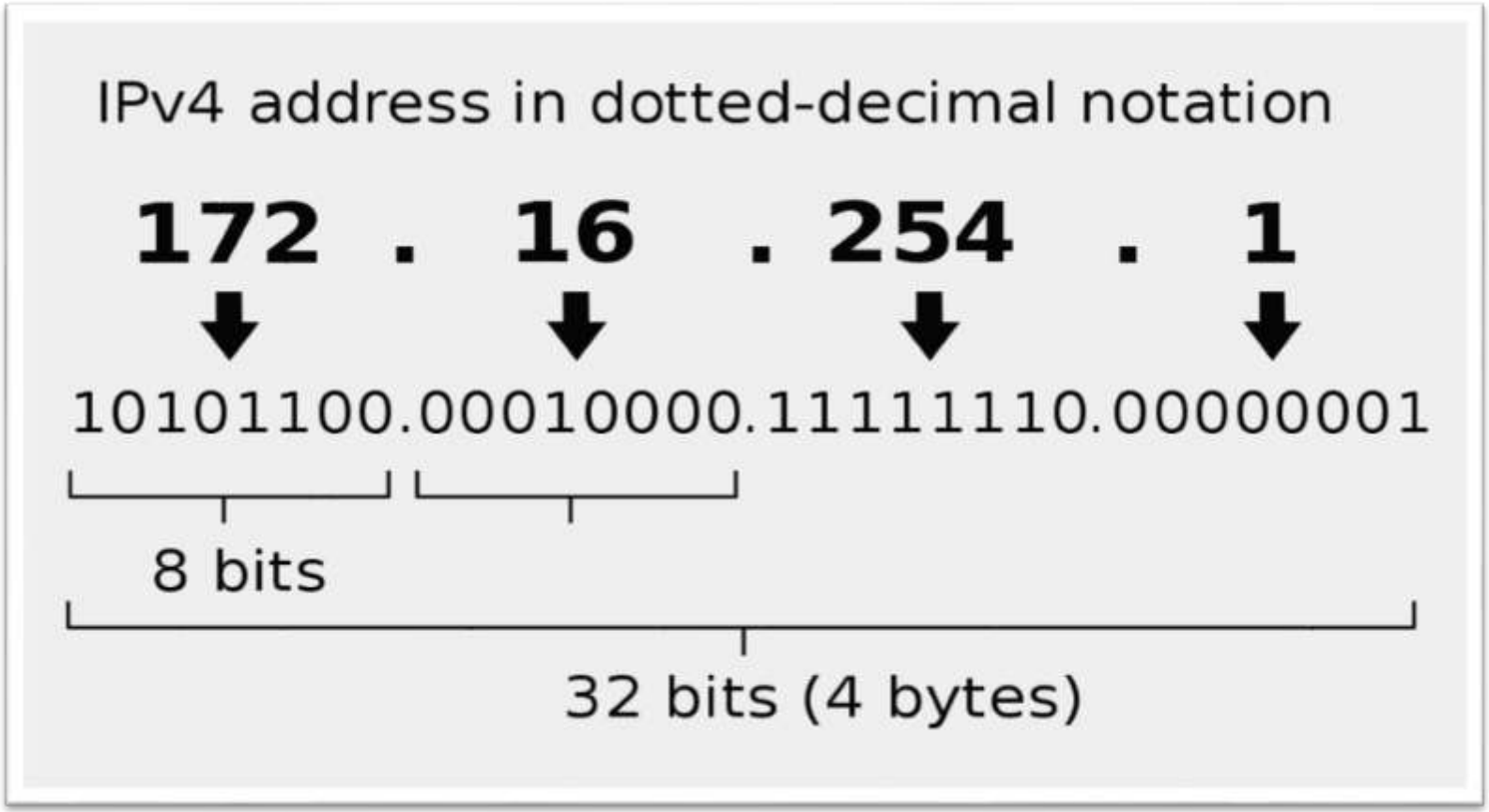
128	64	32	16	8	4	2	1
1	0	1	0	1	0	0	0

128 + 32 + 8 = 168, which in binary is `10101000`.

If you do this for the rest of the blocks, you'd get `10101000.11010010.11100001.11001110`.

How Do IP Address Blocks Work?

IP address **172.16.254.1** looks like in binary



Public and Private IP

Private IP address of a system is the IP address that is used to communicate within the same network. Using private IP data or information can be sent or received within the same network.

Public IP address of a system is the IP address that is used to communicate outside the network. A public IP address is basically assigned by the ISP (Internet Service Provider).

Public IP	Private IP
Used over the Public WAN, Internet	Used over the local network
Recognized over the Internet	Recognized over the local network
Unique over the Globe	Can be unique over the local network
Paid	Free
Assigned by IANA, ISP	Assigned by Network Administrator or DHCP
Open to attack	Closed to attacks
Does not require NAT	Requires NAT to access wider networks
Find out by typing “what is my ip”	Find out by typing "ipconfig or ifconfig" CLI or network device properties

Private Networks

Public and Private IP Addresses

- No two machines that connect to a public network can have the same IP address because public IP addresses are global and standardized.
- However, private networks that are not connected to the Internet may use any host addresses, as long as each host within the private network is unique.
- RFC 1918 sets aside three blocks of IP addresses for private, internal use.
- Connecting a network using private addresses to the Internet requires translation of the private addresses to public addresses using Network Address Translation (NAT).

Class	RFC 1918 internal address range
A	10.0.0.0 to 10.255.255.255
B	172.16.0.0 to 172.31.255.255
C	192.168.0.0 to 192.168.255.255

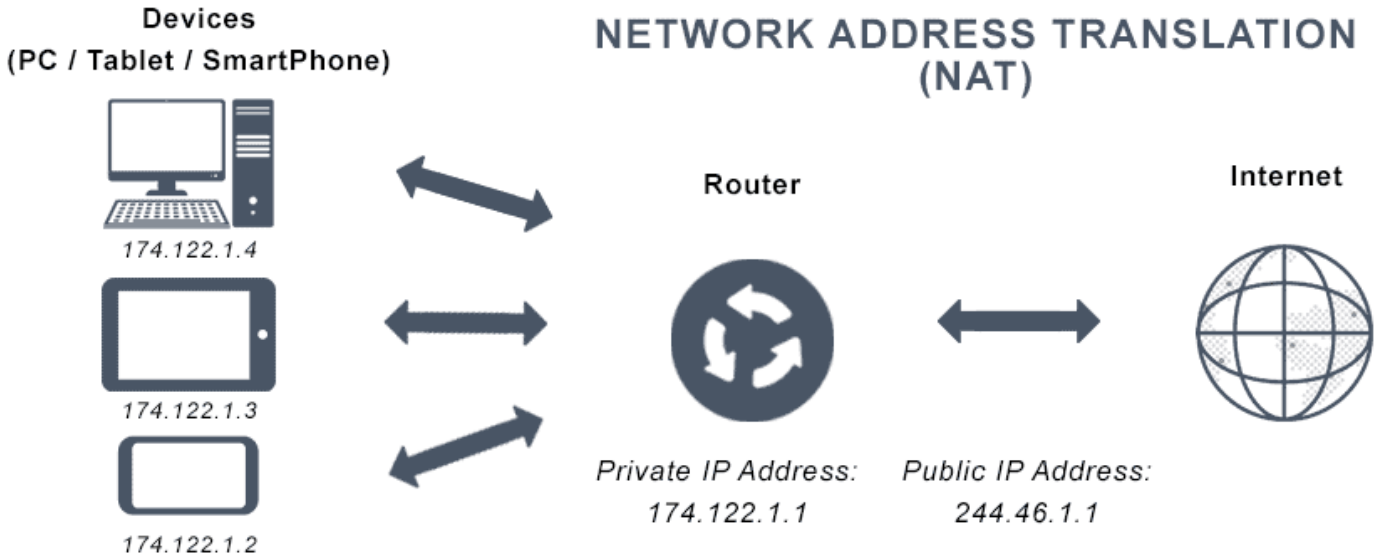
Private Networks

IANA reserved private IPv4 network ranges	START	END	NUMBER OF ADRESSES
24-bit block(/8prefix, 1xA)	10.0.0.0	10.255.255.255	16,777,216
20-bit block(/12prefix, 16xB)	172.16.0.0	172.31.255.255	1,048,576
16-bit block(/16prefix, 256xC)	192. 168.0.0	192. 168.255.255	65,536

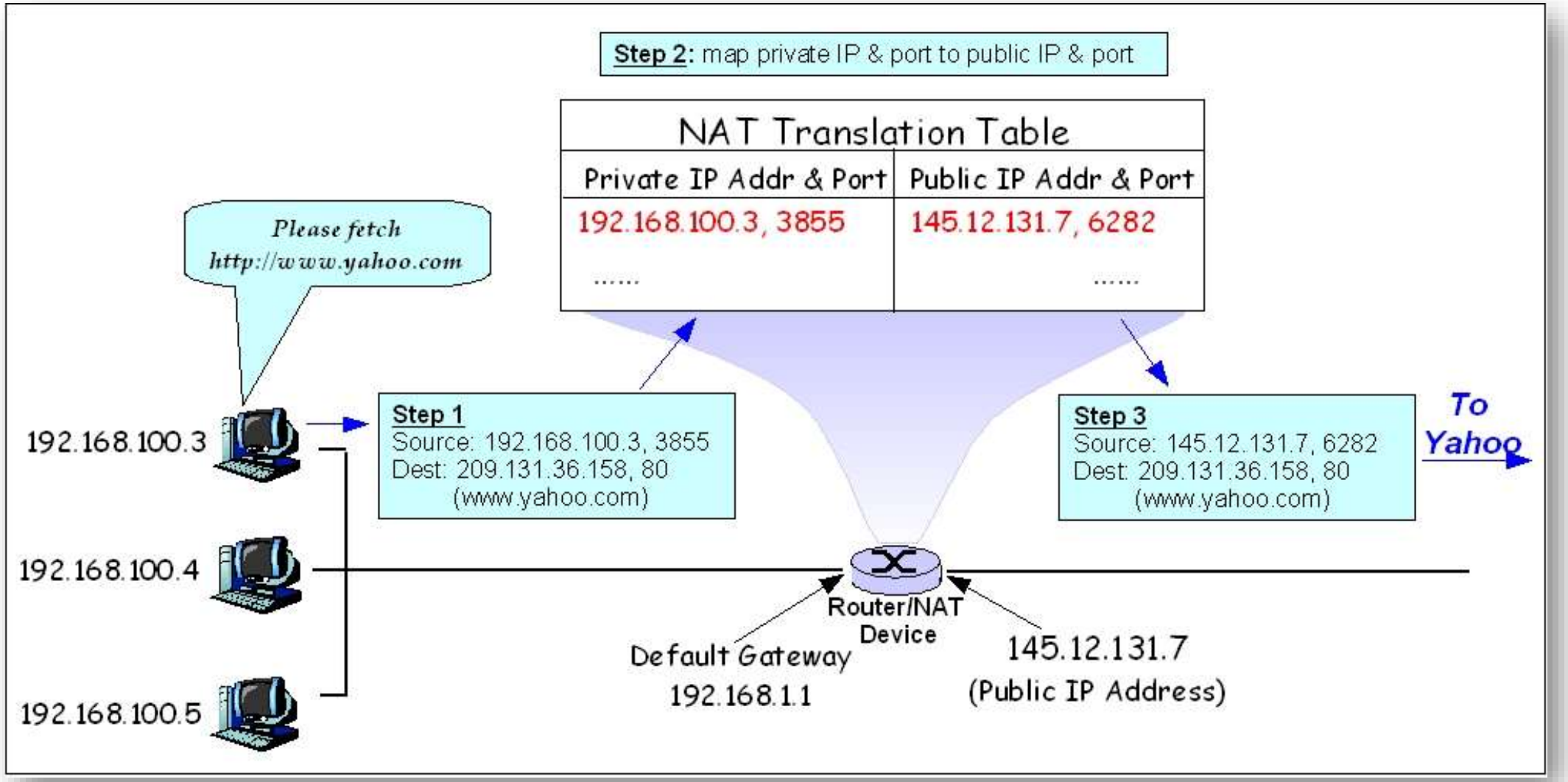
- Computers not connected to the Internet, such as factory machines that communicate only each other via TCP/IP, need not to have globally unique IP address. Three ranges of IPv4 addresses for private networks were reserved. These addresses are not routed on the Internet and thus their use need not be coordinated with IP address registry.

Network Address Translation-(NAT)

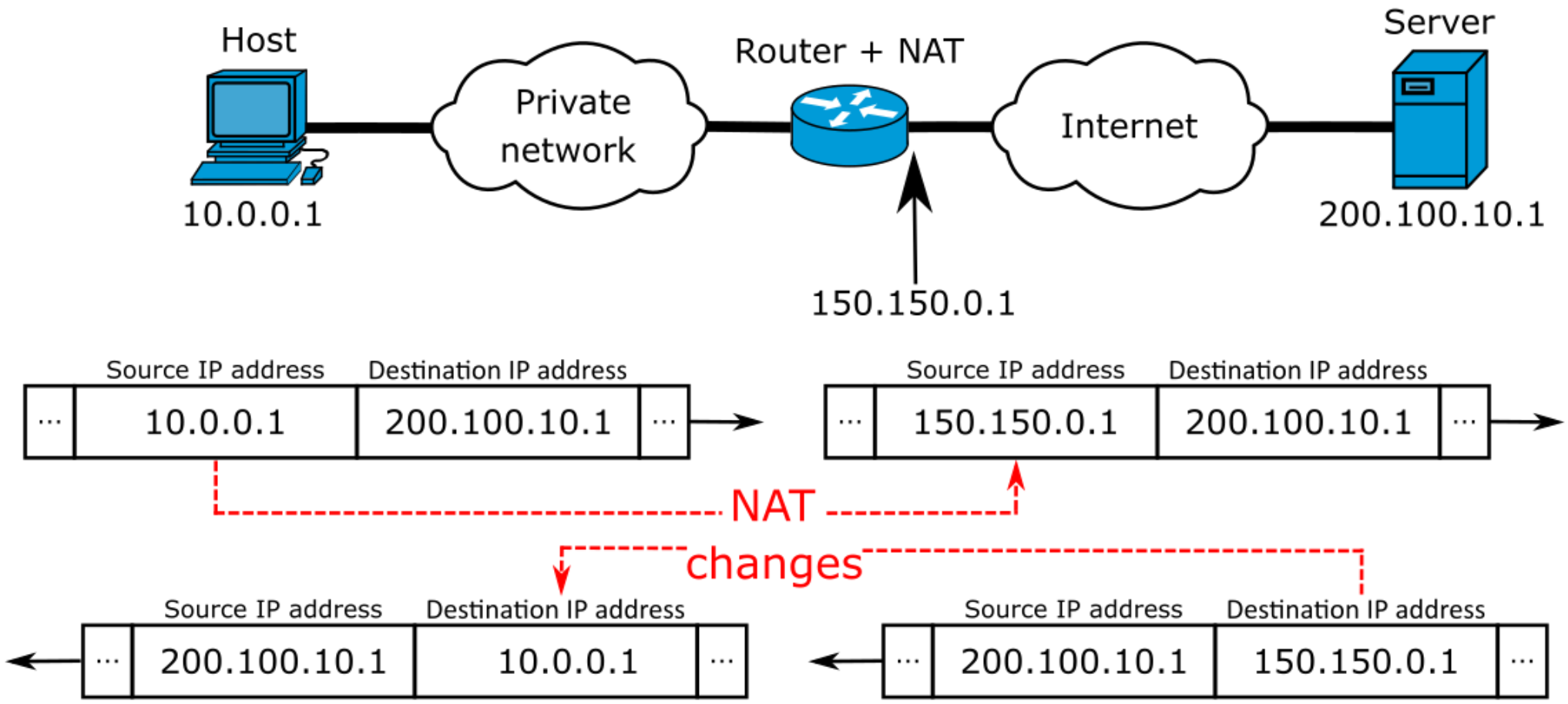
Network Address Translation (NAT) is a process that enables one, unique IP address to represent an entire group of computers. In network address translation, a network device, often a router or NAT firewall, assigns a computer or computers inside a private network a public address.



Network Address Translation-(NAT)



Network Address Translation-(NAT)



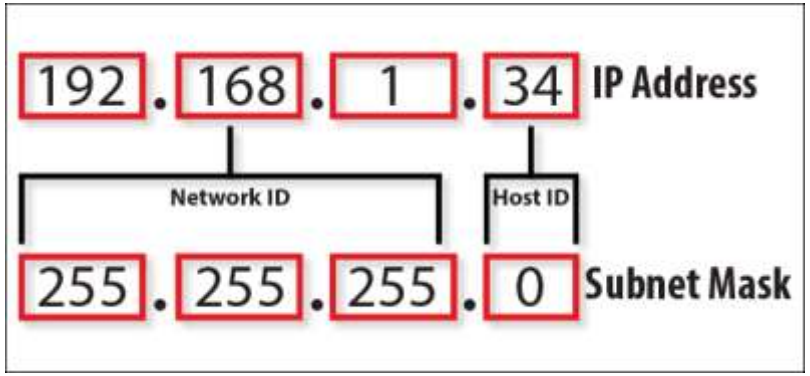
How Do IP Address Blocks Work?

Hierarchical Addressing Scheme

IPv4 uses hierarchical addressing scheme. An IP address, which is 32-bits in length, is divided into two or three parts as depicted –

A single IP address can contain information about the network and its sub-network and ultimately the host. This scheme enables the IP Address to be hierarchical where a network can have many sub-networks which in turn can have many hosts.

How Do IP Address Blocks Work?

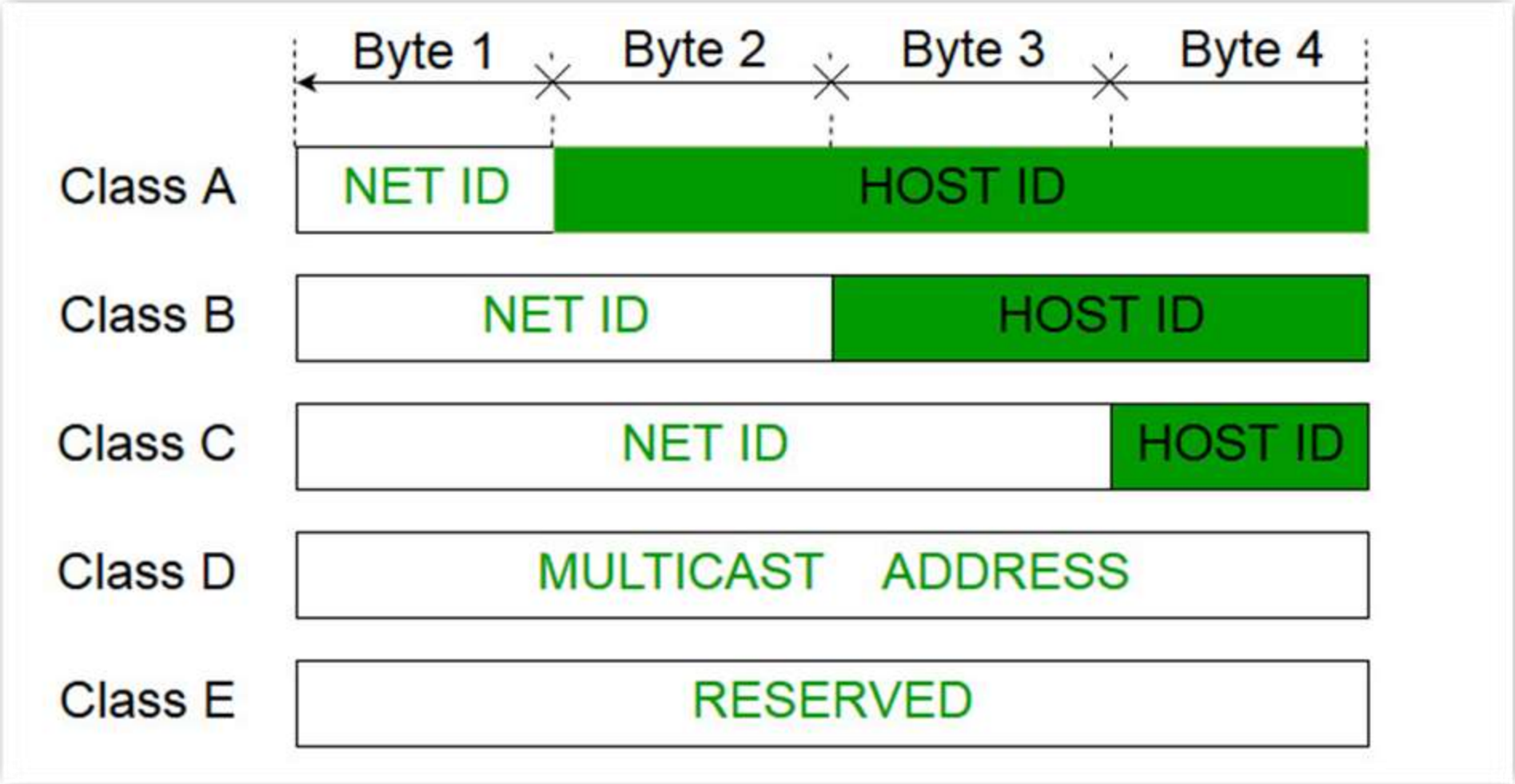


Network Part
This part specifies the unique number assigned to your network. It also identifies the class of network assigned.

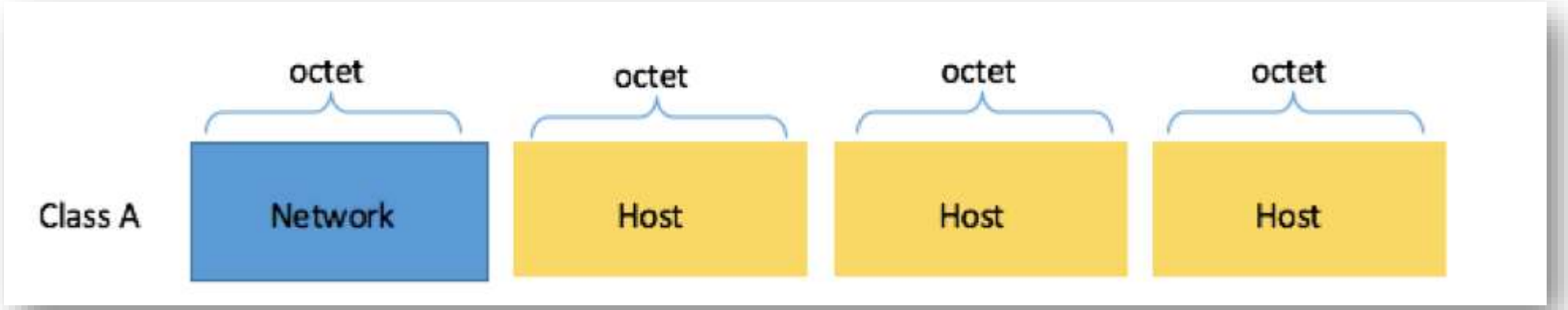
Host Part
This is the part of the IP address that you assign to each host. Host is any node connected to a network. It uniquely identifies this machine on your network. Note that for each host on your network, the network part of the address will be the same, but the host part must be different.

Subnet Number (Optional)
Local networks with large numbers of hosts are sometimes divided into subnets. If you choose to divide your network into subnets, you need to assign a subnet number for the subnet. You can maximize the efficiency of the IP address space by using some of the bits from the host number part of the IP address as a network identifier. When used as a network identifier, the specified part of the address becomes the subnet number. You create a subnet number by using a netmask, which is a bit mask that selects the network and subnet parts of an IP address.

IP Classification



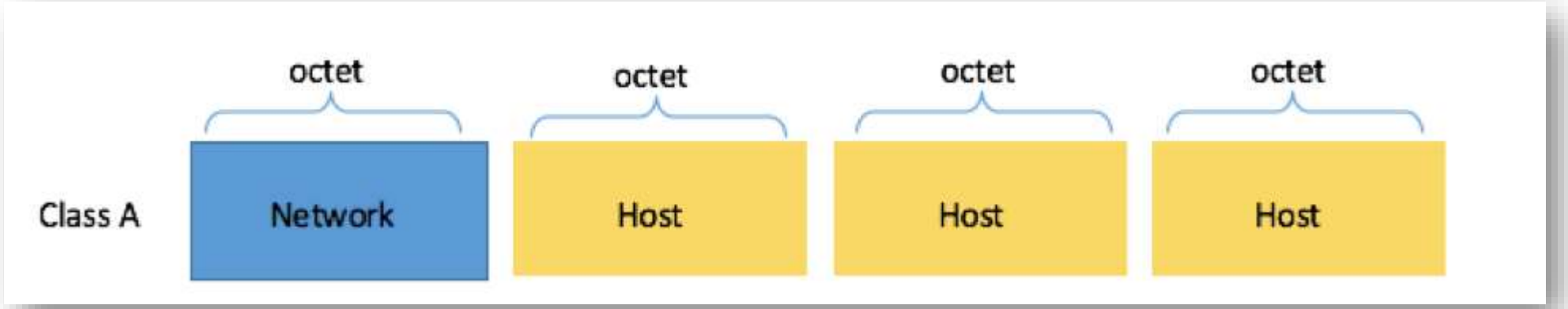
Class A



- Leading bit = **0**
  Maximum 2^7 = **128 Network**
- Maximum 2^24 = **16,777,214 hosts**(except broadcast / network id)
- 0000 0000 = **0 and** 0111 1111 = **127** networks are for other purposes

Class A Range
Starts : 1.0.0.0 – Ends:126.0.0.0

Class A



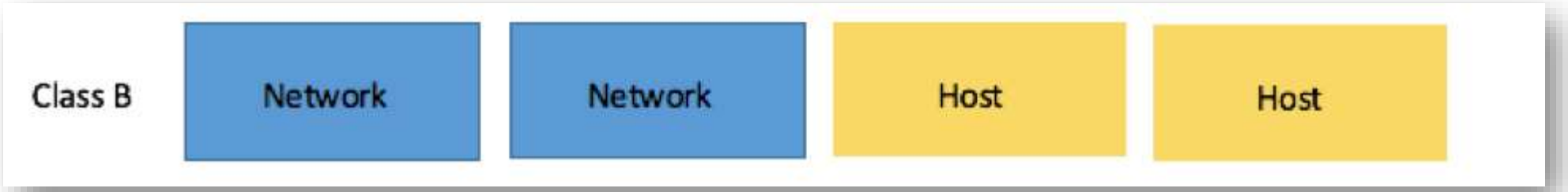
Example for a Class A IP - address:

2.134.213.2

Class A Range

Starts : 1.0.0.0 – Ends:126.0.0.0

Class B

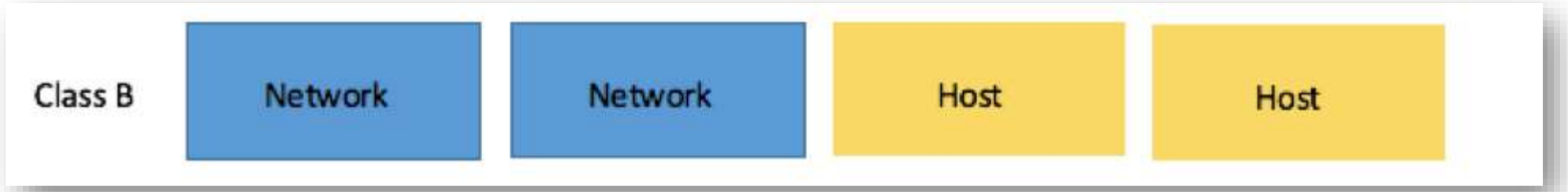


- Leading bits = **10**
  Maximum 2^14 = 16,384 Network
- Maximum 2^16 = 65,534 hosts(broadcast / network id)

Class B Range **Mask:255.255.0.0**

Starts : 128.0.0.0 – Ends:191.255.0.0

Class B



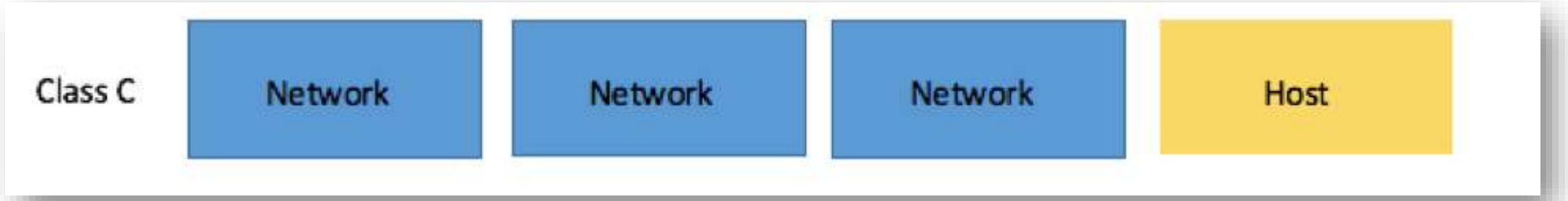
Example for a Class B IP - address:

135.58.24.17

Class B Range

Starts : **128.0.0.0** – **Ends:191.255.0.0**

Class C



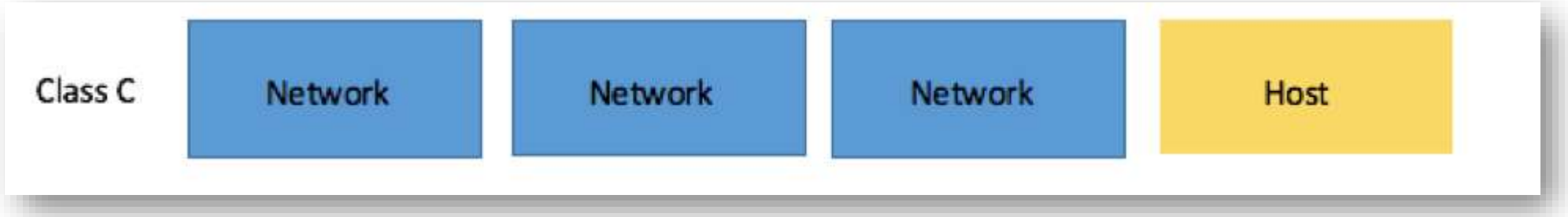
- Leading bits = **110**
  Maximum 2^21 = 2,097,152 Network
- Maximum 2^8 = 256 hosts(broadcast / network id)

Mask:255.255.255.0

Class C Range

Starts : 192.0.1.0 – Ends:223.255.255.0

Class C



Example for a Class C IP - address:

192.168.178.1

Class D

- Special category of IPs, which are used for **Multicasting purposes**
- **Leading bits = 1110**

Note: There are no host addresses within the Class D address space, since all the hosts within a group share the group's IP address for receiver purposes.

Example for a Class C IP - address:

227.21.6.173

Class D Range

Starts : 224.0.0.0 – Ends:239.0.0.0

Class E

- Special ctaegory of IPs, which are reserved for future use.
  Leading bits = 1111

Example for a Class C IP - address:

243.164.89.28

Class E Range
Starts : 240.0.0.0 – Ends:254.0.0.0

IP Classification

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network	Total addresses in class	Start address	End address
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})	2,147,483,648 (2^{31})	0.0.0.0	127.255.255.255
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})	1,073,741,824 (2^{30})	128.0.0.0	191.255.255.255
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)	536,870,912 (2^{29})	192.0.0.0	223.255.255.255
Class D (multicast)	1110	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	224.0.0.0	239.255.255.255
Class E (reserved)	1111	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	240.0.0.0	255.255.255.255

IP Classification

IPv4 Address Classes and Ranges						
Address Class	**Type**	**Range**	**Default Subnet Mask**	**Number of Networks**	**No of Hosts Per Network**	**Use**
A	Public	1.0.0.0 to 127.0.0.0	255.0.0.0	126	16,777,214	Governments and Large Number of Hosts
	Private	10.0.0.0 to 10.255.255.255				
B	Public	128.0.0.0 to 191.255.255.255	255.255.0.0	16,382	65,534	Medium Companies
	Private	172.16.0.0 to 172.31.255.255				
C	Public	192.0.0.0 to 223.255.255.255	255.255.255.0	2,097,150	254	Small Companies and LANs
	Private	192.168.0.0 to 192.168.255.255				
D	N/A	224.0.0.0 to 239.255.255.255	Not Applicable	N/A	N/A	Reserved for Multicasting
E	N/A	240.0.0.0 to 254.255.255.255	Not Applicable	N/A	N/A	Expermential
Special	Special	127.0.0.1 to 127.255.255.255	N/A	N/A	N/A	Loopback Testing

Note:

- Addesses 127.0.0.1 to 127.255.255.255 cannot be used and are reserved for loopback testing

- APIPA address range is 169.254.0.1 to 169.254.255.254 and has 65, 534 usable IP addresses, with the subnet mask of 255.255.0.0.

SubnetMask

IP address **192.168.0.96 and** Mask **255.255.255.0**

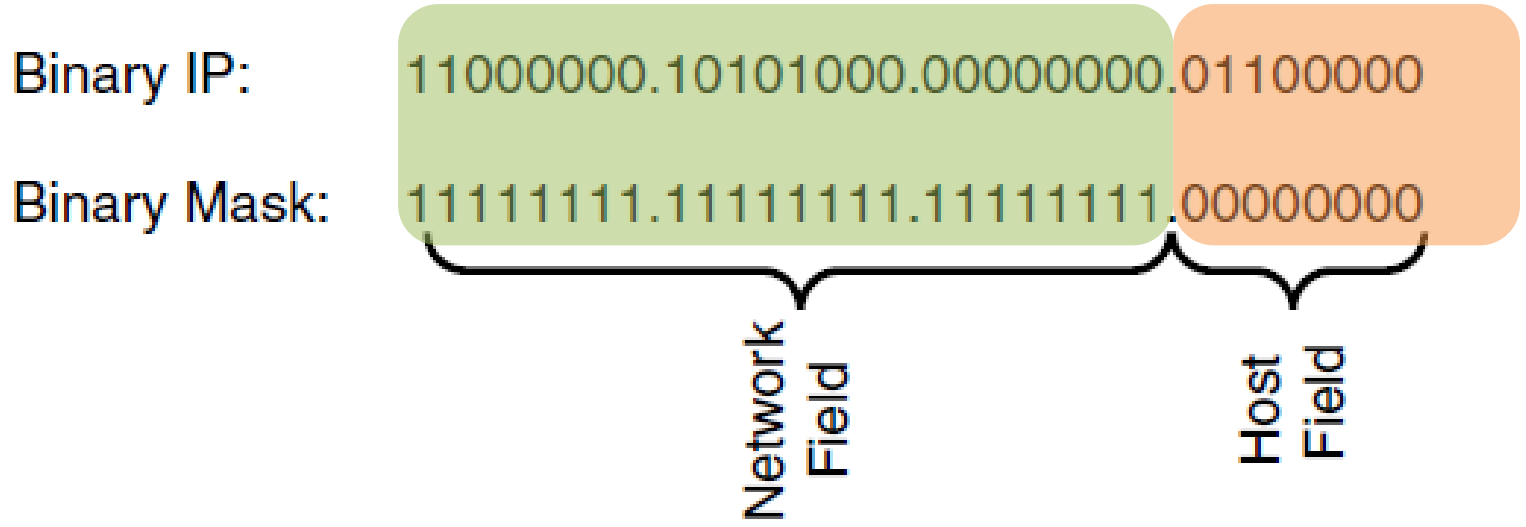


Figure 3.1 IP address and mask in binary, showing network and host fields.

SubnetMask

IP address **192.168.0.96 and** Mask **255.255.255.0**

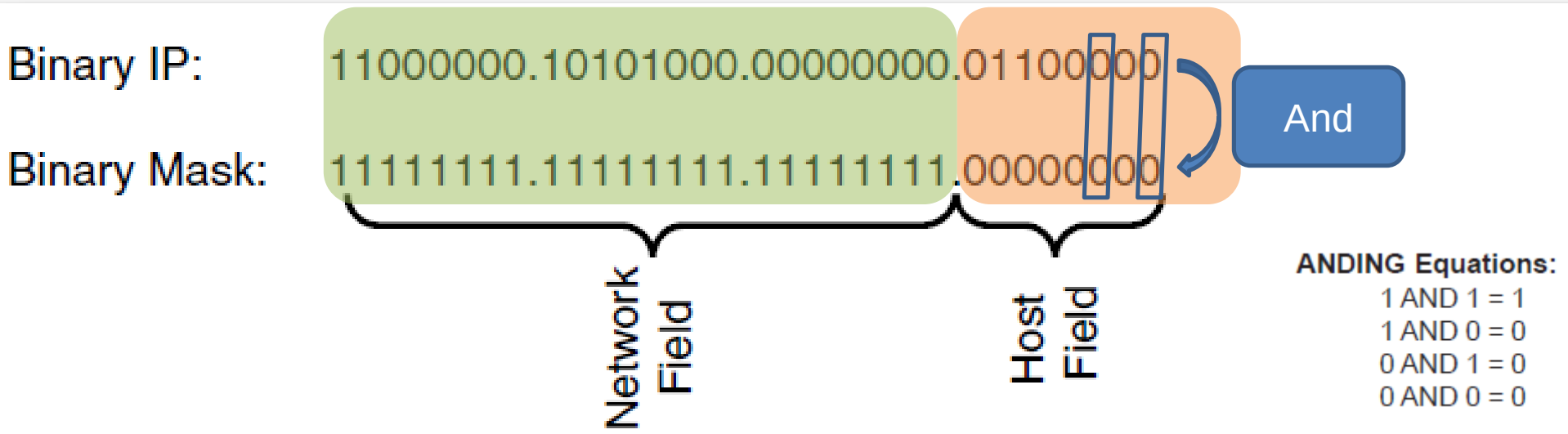


Figure 3.1 IP address and mask in binary, showing network and host fields.

SubnetMask

192.168.0.96 and Mask **255.255.255.0**

Broadcast address

➡ **192.168.0.255**

Host/ip address

➡ **192.168.0.96**

Definitions

Network address/id

➡ **192.168.0.0**

CIDR

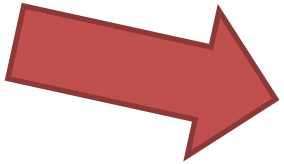
IP address **192.168.0.96 and** Mask **255.255.255.0**

Definitions

Classless Inter Domain Routing
(also called Subnet Mask)

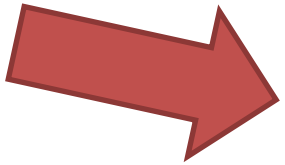
Guess CIDR values

IP address **172.16.0.12** and Mask **255.255. 0.0**



? **172.16.0.12/16**

IP address **10.1.1.1** and Mask **255.0. 0.0**

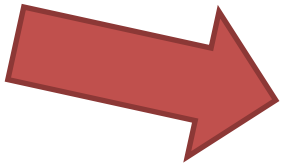


? **10.1.1.1/8**

CIDR Classless Inter Domain Routing (also called Subnet Mask)

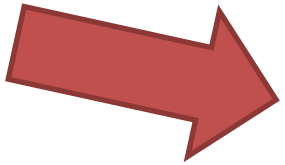
Guess CIDR values

IP address **172.16.0.12** and Mask **255.255. 0.0**



172.16.0.12 /16

IP address **10.1.1.1** and Mask **255.0. 0.0**



10.1.1.1 /8

CIDR Classless Inter Domain Routing (also called Subnet Mask)