Identifying Network Addresses

Name ..... Date .....

01 Logical Address and Physical Address

Feature	IP Address (Logical Address)	MAC Address (Physical Address)
Purpose	Used to route packets between networks.	Used to deliver frames to the next device on the same network link.
OSI Layer	Network Layer (Layer 3)	Data Link Layer (Layer 2)
Assignment	IPv4 address may be assigned by DHCP or configured by an administrator.	Usually assigned by the network interface manufacturer.
Permanence	A dynamic IP address can change over time.	Normally fixed by the manufacturer, but may be changed using software.
Example	192.168.1.10	00:1A:2B:3C:4D:5E

When sending data to a server on another network, the destination IP address identifies the server. The first frame uses the default gateway router's MAC address.

02 IPv4 and IPv6

Feature	IPv4	IPv6
Length	32 bits; 4 octets	128 bits; 8 groups of 16 bits
Notation	Decimal numbers separated by dots.	Hexadecimal values separated by colons.
Addresses	2^32 (approximately 4.3 billion)	2^128 (approximately 3.4 x 10^38)

IPv6 provides a much larger address space than IPv4. Leading zeros in an IPv6 group may be omitted, and one continuous sequence of zero groups may be shortened to ::.

2001:0db8:0000:0000:0000:0000:0000:0001 -> 2001:db8::1

IPv4 Structure and Address Classes

03 Decimal and Binary Representation

An IPv4 address contains 32 bits divided into four octets. Each octet has a decimal value from 0 to 255 and is represented by 8 binary bits.

Dotted Decimal Notation	Binary Notation
192.168.1.10	11000000.10101000.00000001.00001010
10.0.0.1	00001010.00000000.00000000.00000001

04 Address Classes and Default Subnet Masks (DSM)

Class	First Octet	DSM / Prefix	Network / Host	Usage
A	1-126*	255.0.0.0 /8	8 / 24	Large networks
B	128-191	255.255.0.0 /16	16 / 16	Medium networks
C	192-223	255.255.255.0 /24	24 / 8	Small networks
D	224-239	-	-	Multicast
E	240-255	-	-	Reserved range

* In classful addressing, first-octet values 0 and 127 have special uses (Section 08).

05 Separating Network ID and Host ID

IP bits corresponding to 1s in the subnet mask belong to the network portion; bits corresponding to 0s belong to the host portion. Set all host bits to 0 to obtain the network address.

IP / Prefix	Network Portion	Host Portion	Network Address
10.20.30.40/8	10	20.30.40	10.0.0.0
172.16.5.25/16	172.16	5.25	172.16.0.0
192.168.1.10/24	192.168.1	10	192.168.1.0

Subnet Bits and Address Identification

06 Borrowing Subnet Bits from Host ID

To create subnets, borrow bits from the original host portion. The remaining bits identify hosts within each subnet.

192.168.1.70	Network Bits	Subnet Bits	Remaining Host Bits
Original /24	24	0	8
New /26	24	2	6

70 = 01000110. Split the last octet as 01 | 000110. Keeping the subnet bits 01 and setting all six host bits to 0 gives 01000000 = 64. Subnet address: 192.168.1.64/26.

07 Steps to Identify Class and Divide an IP Address

1. Check the first octet: 1-126 = A, 128-191 = B, 192-223 = C.
2. Select the default mask: Class A /8, Class B /16, Class C /24.
3. For /n, the first n bits form the network part; the rest form the host part.
4. Set host bits to 0 for Network ID; identify the remaining host portion.

Example: 172.16.5.25 -> Class B -> /16 -> 172.16 | 5.25 -> 172.16.0.0

08 Special Cases: First Octet 0 or 127

0.0.0.0/8 is reserved for "this network". A device without an IPv4 address may use 0.0.0.0 as the source address in an initial DHCP request.

127.0.0.0/8 is the loopback range. ping 127.0.0.1 can test the TCP/IP stack of the same computer.

09 Exercise - Identify Class and Address Parts

Using the DSM, write the class, complete network address and host portion.

IP Address	Class	Network ID	Host ID
192.168.12.45			
10.25.6.14			
172.20.8.35			
126.4.0.9			
128.16.0.25			

Subnet Masks and Host Calculations

10 Comparing SM and DSM

For 192.168.1.70	DSM /24	New SM /26
Subnet Mask	255.255.255.0	255.255.255.192
Last Octet in Binary	00000000	11000000
Network / Subnet / Host Bits	24 / 0 / 8	24 / 2 / 6
Network / Subnet Address	192.168.1.0	192.168.1.64

11 Exercise - Calculate Subnets and Hosts

Use the class default subnet mask (DSM) as the original mask. s = borrowed subnet bits; h = remaining host bits.

Number of subnets = 2^s | Addresses per subnet = 2^h | Usable hosts = 2^h - 2

IP Address	Subnet Mask	Class	No. of Subnets	Addresses / Subnet	Usable Hosts
10.24.8.15	255.255.0.0				
172.16.40.25	255.255.255.0				
192.168.1.70	255.255.255.192				
10.80.12.30	255.192.0.0				
172.20.50.10	255.255.240.0				
192.168.5.210	255.255.255.240				

Space for Calculations

Choosing a Subnet Mask for Requirements

12 Exercise - Suggest the Suitable Subnet Mask

Create equal-sized subnets in each question. The requested host count refers to usable host addresses.

01 192.168.10.0/24

Create at least 4 subnets using the minimum number of borrowed subnet bits.

SM ..... CIDR / .....

02 192.168.20.0/24

Create the maximum number of subnets while allowing at least 25 usable hosts in each.

SM ..... CIDR / .....

03 172.16.0.0/16

Create at least 10 subnets while retaining the maximum possible hosts per subnet.

SM ..... CIDR / .....

04 172.20.0.0/16

Create the maximum number of subnets with at least 500 usable hosts per subnet.

SM ..... CIDR / .....

05 10.0.0.0/8

Create at least 50 subnets and allow at least 200,000 usable hosts in each.

SM ..... CIDR / .....

13 Class C - Dividing IP Address Ranges into Subnets

Use the default prefix /24. For each question, list the subnet ranges and identify the subnet containing the given IP address.

01 192.168.10.150 | 255.255.255.128 /25

Number of subnets ..... Addresses per subnet .....

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				

02 192.168.20.70 | 255.255.255.192 /26

Number of subnets ..... Addresses per subnet .....

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				

03 192.168.30.210 | 255.255.255.224 /27

Number of subnets ..... Addresses per subnet .....

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				
5				
6				
7				
8				

14 Class B - Dividing IP Address Ranges into Subnets

Use the default prefix /16. For each question, list the subnet ranges and identify the subnet containing the given IP address.

01 172.16.150.25 | 255.255.128.0 /17

Number of subnets ..... Addresses per subnet .....

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				

02 172.20.70.45 | 255.255.192.0 /18

Number of subnets ..... Addresses per subnet .....

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				

03 172.24.210.10 | 255.255.224.0 /19

Number of subnets ..... Addresses per subnet .....

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				
5				
6				
7				
8				

15 Class A - Dividing IP Address Ranges into Subnets

Exercise 01 10.12.150.25 | 255.255.128.0 /17

Use 10.0.0.0/8 as the original network. Starting from the subnet containing the given IP address, write the address ranges of five consecutive subnets in the table below.

Number of subnets ..... Addresses per subnet .....

Space for Calculations

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				
5				

15 Class A - Dividing IP Address Ranges into Subnets

Exercise 02 10.45.70.40 | 255.255.192.0 /18

Use 10.0.0.0/8 as the original network. Starting from the subnet containing the given IP address, write the address ranges of five consecutive subnets in the table below.

Number of subnets ..... Addresses per subnet .....

Space for Calculations

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				
5				

15 Class A - Dividing IP Address Ranges into Subnets

Exercise 03 10.80.210.15 | 255.255.240.0 /20

Use 10.0.0.0/8 as the original network. Starting from the subnet containing the given IP address, write the address ranges of five consecutive subnets in the table below.

Number of subnets ..... Addresses per subnet .....

Space for Calculations

No.	Subnet Address	First Host Address	Last Host Address	Broadcast Address
1				
2				
3				
4				
5				