Ping

⇒ A network utility that is used to test reachability.
Ex → to test if two computers can reach each other.
⇒ Measures round-trip time (PC1 to PC3 and then reply request from PC3 to PC1)
⇒ Uses two messages :
ICMP echo request
ICMP echo reply

⇒ Command to use ping : ping (ip-address)

Cisco packet tracer CLI

ping 192.168.1.3 → (it will send 5 request, 1 will be failed bcoz of finding destination mac address)

show arp (cmd in cisco packet tracer)

⇒ Learn wireshark.

MAC-Address table

show mac address-table

vlan	Mac address	Type	Ports
1	0c2f.b011.9d00	Dynamic	Gi0/0
1	0c2f.b06a.3900	Dynamic	Gi0/0

Total Mac addresses for this criterion : 2.

clear mac-address-table dynamic
(all the data of mac-address with dynamic type will be cleared).

clear mac address-table dynamic address 0c2f.b011.9d00
(PC with this mac address will be cleared from table.)

(can also remove using interfaces)

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Ethernet frame review

PC1 # ping 192.168.1.3 size 36

Quiz

1. You send a 36 byte ping to another computer and perform a packet capture to analyze the network traffic. You notice a long series of bytes of 00000000 at the end of the ethernet payload. How can you explain these zeroes?

Ans They are padding bytes.

2 Which of these messages is sent to all hosts on the local network?

Ans ARP request

3. Which fields are present in the output of the ~~show~~ show mac address-table cmd of a Cisco Switch?

Ans VLAN, MAC address, type, ports.

4. Which types of frames does a switch send out of all interfaces, except the one of the frames was recieved on?

Ans Broadcast, Unknown Unicast.

5. Which cmd is used on a Cisco switch to clear all dynamic MAC addresses on a specific interface from the mac address table?

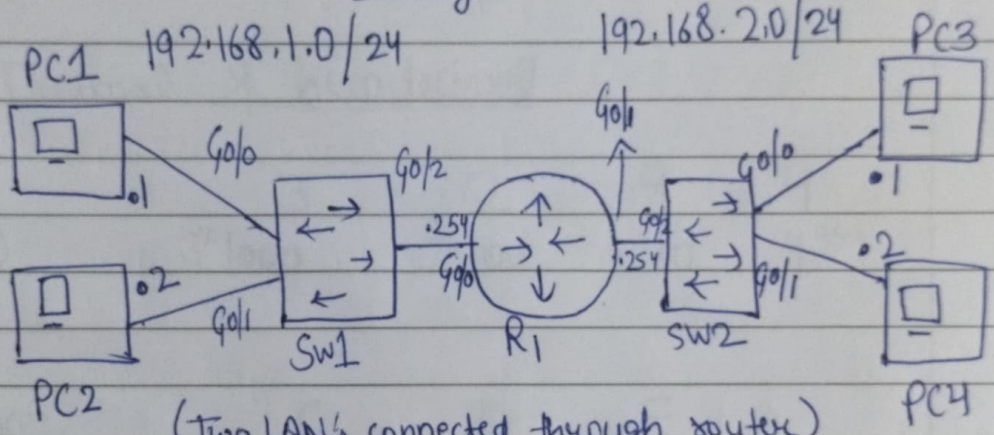
Ans clear mac address-table dynamic interface ('interface-id')

IPv4 addressing

Based on Layer 3 (network layer)

Network layer ⇒ • provides connectivity b/w end hosts on different networks (i.e. outside of the LAN).
• provides Logical addressing (IP addresses)
• provides Path selection b/w source and destination.
• Routers operate at Layer 3.

Routing



(Two LAN's connected through router)

192.168.1.0 /24

192.168.1 → represents a particular network
.0 → represents n hosts on a network n = 0, 1, 2, 3 — n
/24 → they are used to tell what part of address represents the network, and which part represents the end hosts.

⇒ In this above network, routers also need ipaddresses no. of ip addresses = no. of networks connected to routers. In above case, two ip addresses assigned to router i.e. 192.168.1.254
192.168.2.254

⇒ Now, if we send packet from PC1 (broadcasts) then it will go to PC2 and SW1 and then router,

but it will not go further the router bcoz these messages are limited to local network.

IPv4 header

IPv4 address

Dotted decimal — 192.168.1.254

8 bits 8 bits 8 bits 8 bits

octet → 11000000 10101000 00000001 11111110

↓

Binary Representation

Decimal & hexadecimal

Decimal (base 10)

3 2 9 4

3*1000 2*100 9*10 4*1

Hexadecimal (base 16)

C D E

C*256 D*16 E*1

C=12 (D=13) (E=14)

3072 + 208 + 14 = 3294

binary (base 2)

192 → 1 1 0 0 0 0 0 0

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

128 + 64 = 192

168 → 1 0 1 0 1 0 0 0

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

128 + 32 + 8 = 168

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254 → 1 1 1 1 1 1 1 0

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

128+64+32+16+8+4+2 = 254

Decimal ← binary

1 0 0 0 1 1 1 1

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

128+8+4+2+1 = 143

Decimal → Binary

221 → 11011100

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

221	93	28	28	12	4
-128	-64	32	-16	-8	-4
93	28		12	4	0

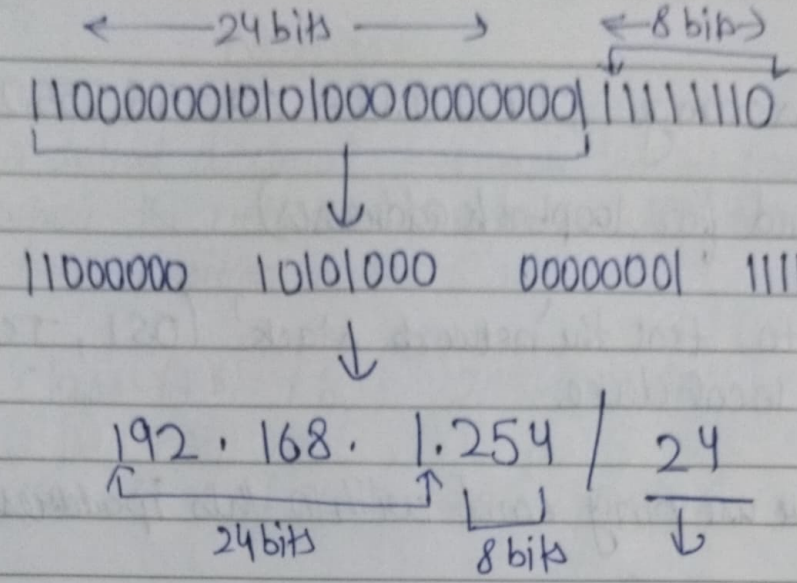
127 → 01111111

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

127	63	31	15	7	3	1
-64	-32	-16	-8	-4	-2	-1
63	31	15	7	3	1	0

Note ⇒ Range → 0 — 255

00000000 — 11111111



it means the first 24 bits of this ip address represents the network portion of the address and the remaining 8 represents the end hosts.

IPv4 Address Classes

Class	first Octet	first Octet numeric range
A	0xxxxxxx	0-127
B	10xxxxxx	128-191
C	110xxxxx	192-223
D	1110xxxx	224-239
E	1111xxxx	240-255

main focus ↑ (A, B, C)

Multicast addresses → D

D → multicast address different from unicast & broadcast.

E → reserved for experimental purposes

Loopback address

⇒ Address range 127.0.0.0 – 127.255.255.255.
(reserved for loopback addresses)

⇒ used to test the network stack (OSI, TCP/IP model) on the local device.

when we use ping cmd within this ipaddress range
ie.
ping 127.0.0.1
our pc will send and recieve request to itself within 0 time.

Class	first Octet	first Octet numeric range	Prefix length
A	0xxxxxxx	0-127	/8
B	10xxxxxx	128-191	/16
C	110xxxxx	192-223	/24

Class A : 12.128.251.23 /8

Class B : 154.78.111.32/16

Class C : 192.168.1.254/24

	No. of networks	Addresses per network
Class A	128 (2^7)	16,777,216 (2^{24}) -2
B	16384 (2^{14})	65,536 (2^{16}) -2
C	2097,152 (2^{21})	256 (2^8) -2 = 254

First ~~network~~ address is network address and last address is broadcast address. 2 IP address will not be counted.

Netmask

A dotted decimal netmask looks like an ip address where the network portion is all one's 1's and the host position is all 0's.

Class A : /8 255.0.0.0

Class B : /16 255.255.0.0

Class C : /24 255.255.255.0

Note ⇒ ∘ host portion of the address is all 0's = Network Address
⇒ network address cannot be assigned to a host. (1st address)

⇒ Host portion of the address in all 1's
= broadcast address.

Quiz ⇒

1. Convert the following IPv4 address to dotted decimal

00111111 00111000 11100111 00010011

63.56.231.19

00111111 → 0 0 1 1 1 1 1 1
32+16+8+4+1*2+1*1
= 63

00111000 → 0 0 1 1 1 0 0 0
32+16+8+0+0+0 = 56

11100111 → 1 1 1 0 0 1 1 1
128+64+32 → 4+2+1 = 231

00010011 → 1+2+16 = 19

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IPv4 to Binary notation:

88. 46. 90. 91

128 10110000.

88

40 128 01011000. 00101110. 01011010. 01011011

-64 88

40 64 46 90 91

32 24 32 64 64

8 32 14 26 27

16 24 8 16 16

8 16 6 10 11

8 8 4 8 8

0 8 2 2 3

0 2 2

0 0

128

64

32

16

8

4

2

1

221. 234. 246. 163

110|1101. 1110|1010. 1111|0110. 1010|0011

221 234 246 163

128 128 128 128

93 106 118 35

64 64 64 32

29 42 54 3

16 32 32 2

13 10 22 1

8 8 16

5 2 6

4 4

1 2

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IPv4 addressing Part-2

⇒ Maximum hosts per network (Class C)

Class C network → 192.168.1.0/24 (represent Class C)

192.168.1.0/24 ⟶ 192.168.1.255/24

Host portion = 8 bits = 2^8 = 256

Host portion all 0's = network address (network id)

Host portion all 1's = broadcast address

Max hosts per network = $2^8 - 2 = 254$ for Class C

⇒ Class B

172.16.0.0/16 ⟶ 172.16.255.255/16

Host portion = 16 bits = 2^{16} = 65,536 addresses

Host portion all 0's = network address (network id)

Host portion all 1's = broadcast address

Max hosts per network = $2^{16} - 2 = 65,534$

⇒ Class A

10.0.0.0/8 ⟶ 10.255.255.255/8

↓ Host portion = 24 bits = 2^{24} = 16,777,216

Host portion all 0's = network address (id)

Host portion all 1's = Broadcast address

Max hosts per network = $2^{24}-2$ = 16,777,214

⇒ first and last usuable address

Class C ⇒

192.168.1.0/24 ⟶ 192.168.1.255/24

↓

Host portion all 0's = network address (id)

00000000

↓ +1

00000001

192.168.1.1/24

= first usuable address

Host portion all 1's = broadcast address

11111111

↓ -1

11111110

192.168.1.254/24

= last usuable address

Class B ⇒

172.16.0.0 /16 ⟶ 172.16.255.255 /16

Host portion all 0's = network address (id)

Host portion all 1's = network broadcast address

00000000 00000000 ⟶ 11111111 11111111

↓ +1 ↓ -1

00000000 00000001 ⟶ 11111111 11111110

172.16.0.1 /16 ⟶ 172.16.255.254 /16

= first usable address = Last usable address

Class A ⇒ 10.0.0.0 /8 ⟶ 10.255.255.255 /8

00000000 00000000 00000000 ⟶ 11111111 11111111 11111111

↓ +1 ↓ -1

00000000 00000000 00000001 ⟶ 11111111 11111111 11111110

10.0.0.1 /8 ⟶ 10.255.255.254 /8

= first usable address = Last usable address

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Assigning / Configuring IP addresses

R1 > en ← privilaged exec mode
R1 > show ip interface brief.
↓
used to confirm status of each interface on the device, as well as their IP addresses.

Interface	IP-address	OK?	Method	status	protocol
GigabitEthernet 0/0	Unassigned	Yes	Unset	administratively	down
Gigabit Ethernet 0/1	〃	〃	〃	〃	〃
〃 0/2	〃	〃	〃	〃	〃
〃 0/3	〃	〃	〃	〃	〃

↑

R1 # (Before setting up IP addresses)

- administratively down: Interface has been disabled with the 'shut down' command.
- this is the default status of Cisco router interfaces.
- Cisco "Switch" interfaces are not admin. down by default.

⇒ Configuring interface gigbitethernet 0/0.

R1 # Conf t

R1(Config)# interface gigabitethernet 0/0.

R1(Config-if)#

R1(config)# i?
in?

R1(config)# in g?

R1(config)# in g0/0
R1(config-if)#

Configuring g0/0

R1(config-if)# ip address 10.255.255.254 ?
A.B.C.D IP subnet Mask

R1(config-if)# ip address 10.255.255.254 255.0.0.0
R1(config-if)# no shutdown

R1(config-if)#
Some msg will appear for changed state to up

Now, check the configuration

R1(config-if)# do sh int br

Interface	IP-add	OK?	Method	Status	protocol
g0/0	10.255.255.254	yes	Manual	up	up
g0/1	unassigned	yes	unset	down	down
g0/2	"	yes	"	"	"
g0/3	"	yes	"	"	"

Configuring g0/1

R1(config-if)# int g0/1 ⇒ for entering g0/1 interface
ip add 172.16.255.254 255.255.0.0
no shut
do sh ip int br

g0/1 is activated.

Configuring g0/2

R1(config-if)# int g0/2
R1(config-if)# ip add 192.168.0.254 255.255.255.0
no shut
do sh ip int br

Commands to check out interfaces

⇒ Show interfaces g0/0.

⇒ show interfaces description

Configuring description on each of the interfaces

R1(config)# int g0/0
R1(config-if)# description ## to SW1 ##

int g0/1
desc ## to SW2

int g0/2
desc ## to SW3

do sh int desc

Quiz

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1. PC1 has an ip address of 43.109.23.12/8 find the following:

⇒ Network address: 43.0.0.0
⇒ Max. no. of hosts in network: $2^{24}-2 = 16,777,214$
⇒ Network broadcast address: 43.255.255.255
⇒ first usable address: 43.0.0.1
⇒ last usable address: 43.255.255.254

2. PC4 has an ip address of 129.221.23.13/16 find the following:

Net address ⇒ 129.221.0.0
max no. of hosts ⇒ $2^{16}-2 = 65,534$
net broadcast addr. ⇒ 129.221.255.255
first usable address ⇒ 129.221.0.1
last ⇒ 129.221.255.254

3. PC8 has an ip address of 209.211.3.22/24 find following

Net address: 209.211.3.0
max no. of hosts ⇒ $2^8-2 = 254$
net broadcast addr. ⇒ 209.211.3.255
first ⇒ 209.211.3.1
last ⇒ 209.211.3.254.

4. PC5 has IP address of 2.71.209.233/8
⇒ 2.0.0.0
⇒ $2^{24}-2 = 16,777,214$
⇒ 2.255.255.255
⇒ 2.0.0.1
⇒ 2.255.255.254