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connect to a Network:
    - An IP Address
    - Subnet Mask
    - Default Gateway
   An IPv4 Address:
     - Is a 32-Bit Logical Address that identifies your computer on the Network
     - Logical means it's not fixed to the Computer/Device like the MAC Address
      which means if you change your Network your IP Address will change
     - is represented with the Dotted Decimal Notation to increase readibility for Humans
     - Four Numbers between 0 and 255 separated by a dot '.'
     - Each number from 0-255 is a Sequence of 8 Bits or Octet and each bit can be a 0 or a 1
     - Octet = A Group of 8 and 0's and 1's means Binary Values or Bits
    - IPv4 Addresses are 32-Bits in Length so Max. Possible IP Address Values =
     2^32 or approximately 4.3 Billion IP Addresses
                                         IPv4 Address Classes
                               Number
   CI IP
                                         Number
                                                   Max
                                                              Default
   as Address IP Address End
                                         of Host
                                                  Number
                                                                               Use-cases
                                                           Subnet Mask
                               Network
                                        ID Octets of Hosts
      Start
                               ID Octets
    A 0.0.0.0
               127.255.255.255
                                                 16 Million
                                                            255.0.0.0
                                                                       ISP's and MNC's
    B | 128.0.0.0 | 191.255.255.255
                                                           255.255.0.0 SMB's
                                                          255.255.255.0 General Public Use
   C 192.0.0.0 223.255.255.255
    D 224.0.0.0 239.255.255.255
                                                                        Used for Multicast
    E 240.0.0.0 255.255.255.255
                                                                        Experiments/Testing
    Why were the IP Addresses divided into these five Classes:
    Let's look at the first Octet in Binary Form
    Class A - Starts with all Zero:
                                         0000 0000
    Class B - 1st 2 Bits are One Zero:
                                         1000 0000
    Class C - 1st 3 Bits are One One Zero:
                                         1100 0000
    Class D - 1st 4 Bits are One One One Zero: 1110 0000
    Class E - 1st 4 Bits are One One One One: 1111 0000
    - Class A,B and C are used for Unicast Transmissions
    - Class D is used for Multicast Transmissions
    - Class E is used for research and experimentation purposes
    Unicast: An Single Origin Point going towards a Single Destination
    Multicast : An Single Origin Point to multiple destinations
    The most fundamental unit of the data in a Computer is Bits, i.e. 0's and 1's, we use 8-Bit Binary Numbers
     2^7
                  2^6
                                2^5
                                             2^4
                                                           2^3
                                                                                     2^1
                                                                                                   2^0
                                                                        2^2
                                              16
     128
                   64
                                 32
                                                            8
    A Subnet Mask:
    - tells your computer what other Computers are present on the same network that it is on
    - Splits the IP Address into 2 Sections - Network Section and Host Section
    - It is represented in two ways: Dotted Decimal or CIDR
    Possible Values for Subnet Masks according to Dotted Decimal Values:
     Number Binary Octet
                 0000 0000
         0
        128
                 1000 0000
        192
                 1100 0000
        224
                 1110 0000
                 1111 0000
        240
                 1111 1000
        248
                 1111 1100
        252
                 1111 1110
        254
        255
                 1111 1111
     For a subnet mask Only 1 Octet can be a value other than 0 or 255
     A Subnet Mask splits the IP addresses into a Series of 1's followed
     by a series of 0's where:
      - Network Portion is represented by a sequence of 1's
      - Host Portion is represented by a sequence of 0's
       Classful
                                             Binary Form
   Subnet Masks
      255.0.0.0
                        11111111.00000000.00000000.00000000
                        11111111111111111.00000000.00000000
    255.255.0.0
   255.255.255.0 111111111111111111111111111100000000
 Subnets with Non
                                                Binary Form
                                                                                         The more Zeros which get added to the Subnet Mask the Larger the Host
    0/255 Values
                                                                                         Portion of the IP Address but larger number of Hosts
   255.255.240.0
                            1111111111111111111110000.00000000
                                                                                         The more Ones which get added to the Subnet Mask the Larger
     255.254.0.0
                            1111111111111110.00000000.00000000
                                                                                         the Network Portion of the IP Address so smaller number of Hosts
  255.255.255.248 | 111111111111111111111111111111000
                                          Subnet Mask: 255.255.0.0
IP Address:
                   172.16.15.25
IP Address:
                    1010 1100
                                            0001 0000
                                                                                     0000 1111
                                                                                                          0001 1001
                                                                                                          0000 0000
Subnet Mask:
                                            1111 1111
                                                                                     0000 0000
                    1111 1111
                                                                                               Host Portion
                             Network Portion
                          If we want to reduce the number of IP's we add 1's to the Host Bits
                                                                                    0000
                                                                           1111
Subnet Mask:
                                           1111 1111 .
                                                                                                          0000 0000
                    1111 1111
                                            Network Portion
                                                                                               Host Portion
New Subnet Mask
                                                        255.255.240.0
             172.16.15.25
                                  Subnet Mask:
Source IP:
Destination IP: 172.16.17.3
                                   255.255.0.0
     It will use the Subnet Mask to determine if the IP Address resides on the same Network
           So it will check if the Bits in the Network Portion matches for Both the IP's
Source IP:
              1010 1100
                                    0001 0000
                                                          0000 1111
                                                                            0001 1001
                                                          0000 0000
                                                                            0000 0000
Subnet Mask:
             1111 1111
                                   1111 1111
                       Network Portion
                                                                  Host Portion
Destination IP: 1010 1100
                                   0001 0000
                                                         0001 0001
                                                                            0000 0011
Yes the Bits in the Network Portion Matches so Destination is in it's own Network so send the Packet to it directly
              172.16.15.25
Source IP:
                                   Changed Subnet
                                        Mask:
Destination IP: 172.16.17.3
                                    255.255.240.0
    It will use the Subnet Mask to determine if the IP Address resides on the same Network
           So it will check if the Bits in the Network Portion matches for Both the IP's
                                                               0000
              1010 1100
Source IP:
                                     0001 0000
                                                                         1111
                                                                                         0001 1001
Subnet Mask: 1111 1111
                                                                         0000
                                     1111 1111
                                                               1111
                                                                                         0000 0000
                                   Network Portion
                                                                               Host Portion
Destination IP: 1010 1100
                                     0001 0000
                                                               0001
                                                                         0001
                                                                                         0000 0011
  Here the last Bit in the Network Portion is different in the Source and Destination IP Addresses so the IP
 address resides in a different Network so we send it to the Default Gateway which then transfers it to the
                                       appropriate Network
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IP Addresses and Subnetting:

Device Requirements to

65534 2^16 65536 255.255.0.0 of Hosts Subnet Mask: 1111 1111 1111 1111 0000 0000 0000 0000 **Network Portion Host Portion**

If the Values in the Network portion don't Match - Different Network - Add Gateway Device IP to Packet

3. Remove 2 from each calculated Values received to remove the Network IP and Broadcast IP Address

So if the Values in Network portion match - Same Network - Add Destination IP to Packet

Calculating the Number of IP's in a Subnet:

Number

Subnet Mask

Subnet Mask

255.255.240.0

IP Address:

IP Address:

Broadcast IP

IP Address

IP Address

255.255.240.0

255.254.0.0

№ Laptop0

-IP Configuration

O DHCP

IPv4 Address

Binary Values:

1. Find the number of Zeros in a Subnet Mask

2. Raise 2 to the Power of the number from Step 1

172.16.15.25

1010 1100

1010 1100

172.16.17.1

1010 1100

Number of IP's in a Subnet = 2 ^ (Number of Zeros in a Subnet Mask)

Number of IP's in a Subnet = 2 ^ (Number of Zeros in a Subnet Mask) - 2

Subnet Mask: 1111 1111 1111 1111 0000 1111 0000 0000 **Network Portion Host Portion Subnet Mask** Number 2^12 4096 4094 255.255.0.0 of Hosts Network and Broadcast IP Addresses: Define the Boundary of the Subnet For Every Subnet we have two reserved IP's One for the Network IP (1st IP) and One for the Broadcast IP (Last IP)

0001 0000

0001 0000

0001 0000

/20

/15

/29

/8

/16

DHCP failed. APIPA is being used.

Broadcast IP - 172.16.255.255

Subnet Mask: 255.255.240.0

Subnet Mask: 255.255.0.0

Every Bit Added reduces

the number of IP's by

Half and the Every Bit

the Value

Removed increases the

Number of IP's by Double

Subnet Mask: 1111 1111 0000 0000 . 0000 0000 1111 1111 **Network Portion Host Portion** Network IP - All Zeroes in the Host portion

Network IP 1010 1100 0000 0000 . 0000 0000 0001 0000 Network IP - 172.16.0.0 Broadcast IP - All Ones in the Host Portion

0001

0001

0000 1111

0001 1001

. 0000 0001

1111 1111 . 1111 1111

Subnet Ma	ask 1111 1111 .	1111 1	111	. 1111	0000		0000 0000		
		Network P	ortion		Hos	t Po	rtion		
					Network	IP -	All Zeroes in	n the Host	portion
Network IF	1010 1100 .	0001 00	000	. 0001	0000		0000 0000		
		Network II	P - 172.16.16.	0					
					Broadca	st IP	- All Ones ir	the Host	Portion
Broadcast	IP 1010 1100 .	0001 00	000	. 0001	1111		1111 1111		
	В	roadcast IP	- 172.16.31.2	255					
	ts the Number of 1's present in the	Subnet Mask							
Classful Subnet Masks	Binary Form	CIDR Notation							
255.0.0.0	11111111.00000000.00000000.000000000000	/8							
255.255.0.0	11111111111111111100000000.000000000000	/16							
255.255.255.0	1111111111111111111111111111000000000	/24							
Subnets with Non 0/255 Values	Binary Form	CIDR Notation							

255.255.255.248 11111111111111111111111111111000 It is written as: IP Address / CIDR Notation

For eg. 172.15.16.25/20 OR 192.168.1.38/24 Calculate the Values of Zero's as 32 - CIDR Value For Eg. /20 = 32 - 20 = 12 Zeros OR /16 = 32 - 16 = 16 Zeros Then calculate the Number of Hosts = 2^(Number of Zeros) -2 For Eg. /20 = 32-20 = 12; 2^12 - 2 = 4094 OR /16 = 32-16 = 16; 2^16 - 2 = 65534 Classfull IP's Class 1st Octet Usable IP's Subnet Mask | CIDR 16,777,214 0-127 255.0.0.0 128-191 65,534 В 255.255.0.0 255.255.255.0 192-223 254

Private IP Addresses: Private IP Blocks allocated in each IP Class

They can only be routed in the Local Area Network (LAN) and cannot

11111111.11111111.11110000.00000000

1111111111111110.000000000.000000000

k	e Routed acc	ross the Internet (Not ro	outable accross WAN or Interne
	Class	Private IP	
	Α	10.0.0.0/8	
	В	172.16.0.0/12	
Ī			Most likely IP
			Address for Home
	С	192.168.0.0/16	Networks
			Then uses NAT to
			convert Private IP

into Public

Loopback Address - Class A IP Address Used by a Computer to identify itself - 127.0.0.0/8 All IP Addresses Ranging from 127.0.0.0/8 to 127.255.255.255/8 can be used as a Loopback Address For eg. ping 127.0.0.1 OR ping 127.240.131.42 **APIPA - Automatic Private IP Addressing - Class B IP Address** Given to your System if it cannot connect to a DHCP Server -IP Address: 169.254.0.0/16 IP address can be assigned Statically by giving IP Address manually or Dynamically using DHCP (Automatically leasing IP Addresses to it's connecting Hosts)

Static

169.254.138.166

Physical Config Desktop Programming Attributes

FastEthernet0

PC1				
Physical Config	Desktop	Programming	Attribute	
P Configuration				
nterface Fas IP Configuration	stEthernet0			
ODHCP		O St	atic	
IPv4 Address		172.10	68.1.1	
Subnet Mask		255.25	55.0.0	