LECTURE 4

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Content:

1. Network Address
2. Types of network address
    - Physical address
    - Logical address
3. Different Classes of Logical address
4. IP address Representation

Network Address:

- A network address is the unique code or number which is given to each node or device in the network.

- Each device has its own unique address and it make easy for the users to communicate within a network

- Examples of network addresses are:
  - A telephone no. in the public switched telephone (PSTN) network
  - An IP address in the Internet
  - MAC address in an Ethernet network etc

Types of Network Address:

Physical address:

- The MAC (Media Access Control) address is a physical address.
- MAC address is 48 bits in length.
- This unique code is given by manufacturer which is encoded in NIC card.
- It is associated with Data Link Layer of OSI model.

Logical Address:

- The IP (Internet Protocol) address is a Logical Address.
- IP address is 32 bits in length.
- IP address are assigned by ISP (Internet service provider) to the device.
- It is associated with network layer of OSI model

Types of Network Address:

Physical address:

- It is also known as Hardware address.
- The format of address is Hexadecimal.
- Example of MAC address 00-23-4E-47-21-01
- MAC address are used by many different Layer 2 devices some are Ethernet and Fiber Channel.

Logical Address:

- It is also known as virtual address.
- Format of address is Decimal ranges from 0 to 255.
- Example of IP address 209.161.122.70.
- The IP address is used to identify the different computers and websites on the internet.

The Hierarchical IP Addressing Scheme

- This scheme is comparable to a telephone number.
  - The first section, the area code, designates a very large area.
  - The second section, the prefix, narrows the scope to a local calling area.
  - The final segment, the customer number.
- IP addresses use the same type of layered structure.
- Rather than all 32 bits being treated as a unique identifier, a part of the address is designated as the network address and the other part is designated as either the subnet and host or just the node address.

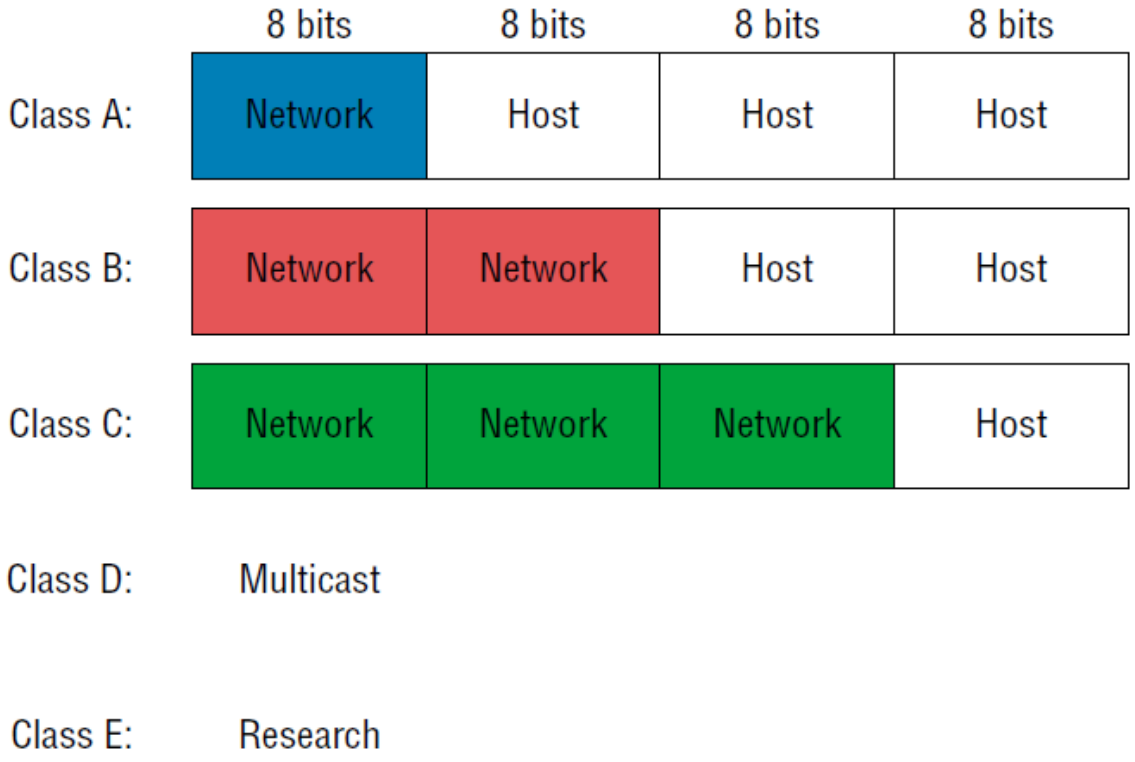
The Hierarchical IP Addressing Scheme

Network address This is the designation used in routing to send packets to a remote network—for example, 10.0.0.0, 172.16.0.0, and 192.168.10.0.

Broadcast address The address used by applications and hosts to send information to all nodes on a network is called the *broadcast address*. Examples include 255.255.255.255, which is all networks, all nodes; 172.16.255.255, which is all subnets and hosts on network 172.16.0.0; and 10.255.255.255, which broadcasts to all subnets and hosts on network 10.0.0.0.

Different Classes of Logical address:

The designers of the Internet decided to create classes of networks based on network size. For the small number of networks possessing a very large number of nodes, they created the rank *Class A network*. At the other extreme is the *Class C network*, which is reserved for the numerous networks with a small number of nodes. The class distinction for networks between very large and very small is predictably called the *Class B network*.



Different Classes of Logical address:

Class	Address	No. of Network	No. of Host
Class A	0-126	126	16777214
Class B	128-191	16384	65534
Class C	192-223	2097152	254
Class D	224-239	Multicasting addresses	
Class E	240-255	Reserved for future use	

Reserved IP Addresses

Address	Function
Network address of all 0s	Interpreted to mean "this network or segment."
Network address of all 1s	Interpreted to mean "all networks."
Network 127.0.0.1	Reserved for loopback tests. Designates the local node and allows that node to send a test packet to itself without generating network traffic.
Node address of all 0s	Interpreted to mean "network address" or any host on specified network.
Node address of all 1s	Interpreted to mean "all nodes" on the specified network; for example, 128.2.255.255 means "all nodes" on network 128.2 (Class B address).
Entire IP address set to all 0s	Used by Cisco routers to designate the default route. Could also mean "any network."
Entire IP address set to all 1s (same as 255.255.255.255)	Broadcast to all nodes on the current network; sometimes called an "all 1s broadcast" or limited broadcast.

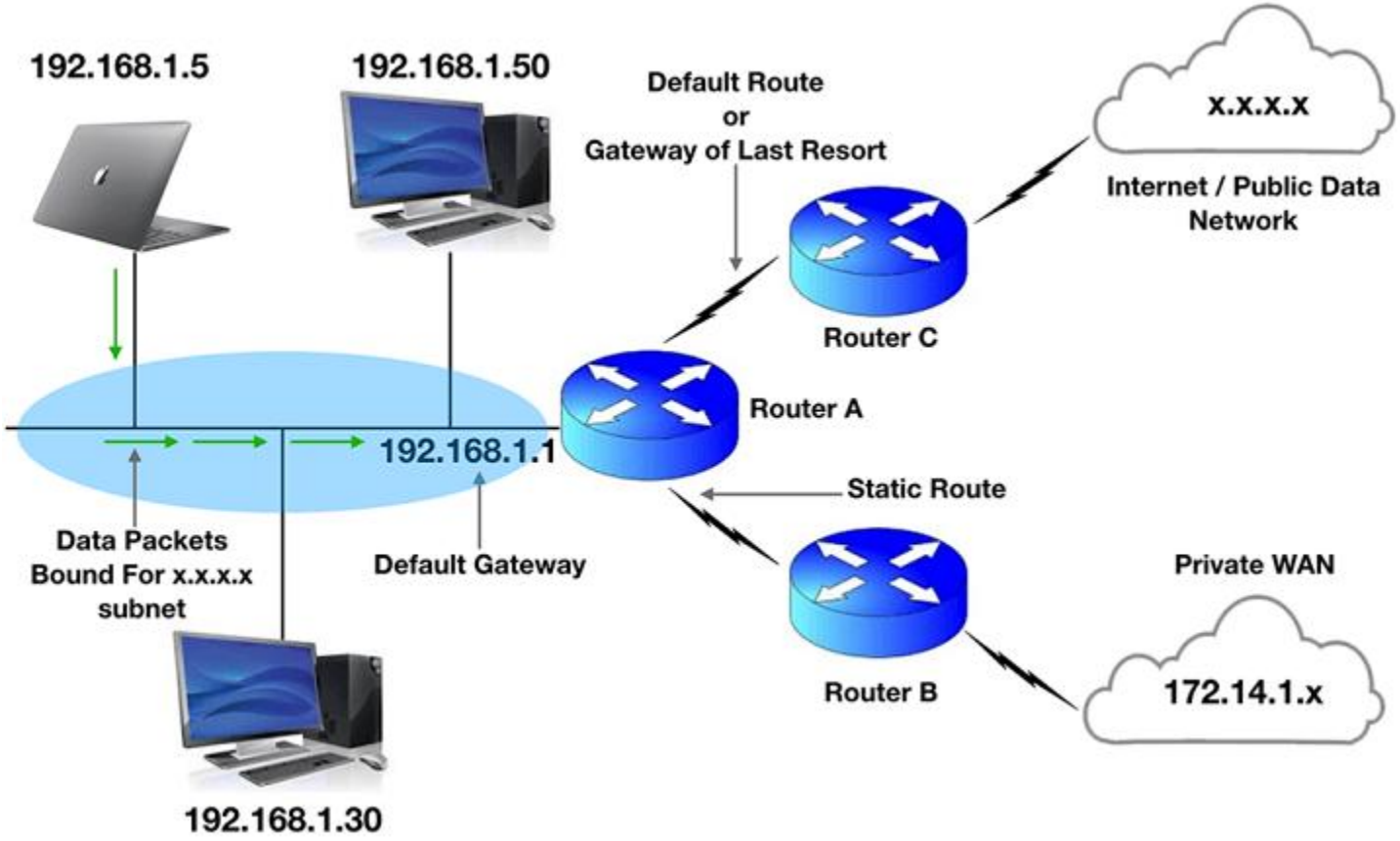
IP address Representation:

- Every IP address is broken down into four sets of octets and translated into binary to represent the actual IP address.
- For an example, IP address :192.168.5.2

Binary Representation	128	64	32	16	8	4	2	1
192	1	1	0	0	0	0	0	0
168	1	0	1	0	1	0	0	0
5	0	0	0	0	0	1	0	1
2	0	0	0	0	0	0	1	0

Automatically Assigned IP address:

- There are IP addresses that are automatically assigned (dynamic allocation) when you set up a home network.
  - 192.168.1.0 0 is automatically assigned network address.
  - 192.168.1.255 255 is commonly used as Broadcast address.
  - 192.168.1.1 1 is commonly used as Gateway Address.



Types of Logical address

Type Of Logical Address:

- Logical Network Is divided into two parts:
    1. Private IP address
    2. Public IP address

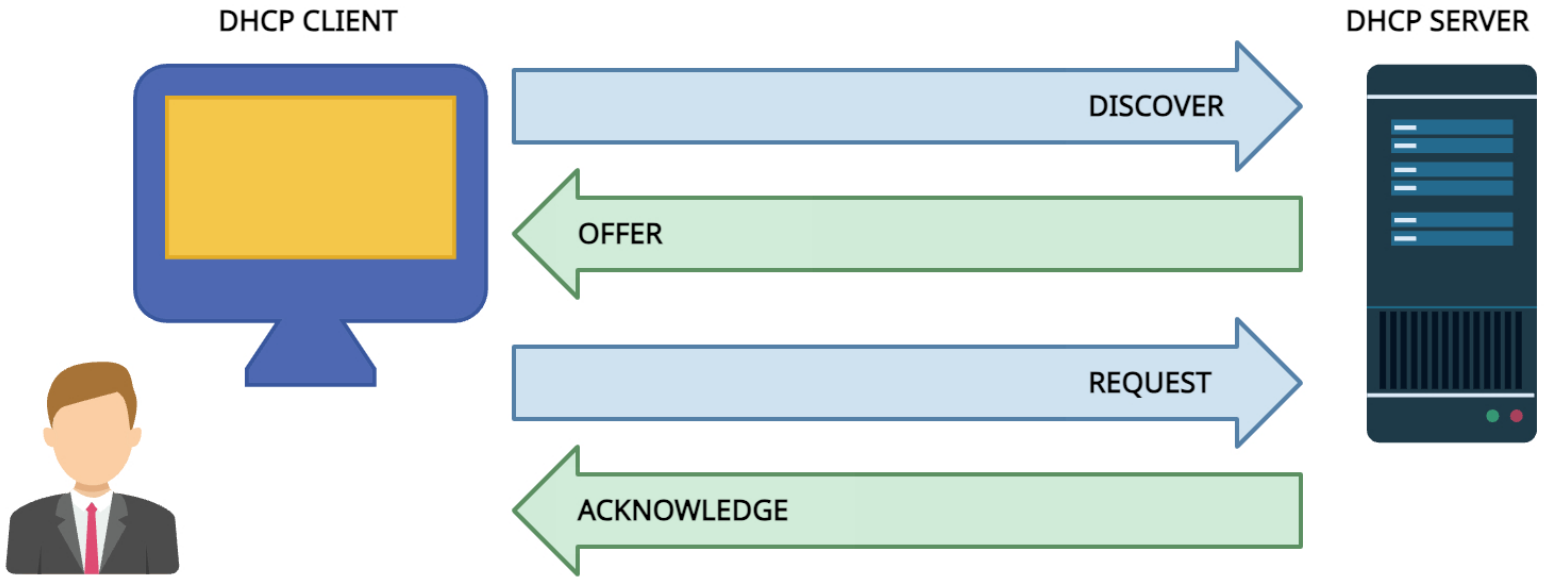
- Subnet Mask

Public IP Address:

- The public IP address is assigned to the computer by the Internet Service Provider when it is connected to the Internet Service.
- It can be reached via the Internet from any computer in the world.
- A public IP address can be assigned as **static** or **dynamic**.
- **A static public** IP address remain unchanged and is used for hosting web pages or services on the Internet.
- **A dynamic public** IP address is chosen from a pool of available addresses and it changes each time as a device connects to the Internet by using DHCP.

What is DHCP?

- **Dynamic Host Configuration Protocol (DHCP)** is the network protocol which assigns IP addresses through the DHCP server to hosts.
- The DHCP client broadcasted for an IP address; a router then forwarded this as a unicast packet to the DHCP server.



Private IP Address:

- An Private IP address is an IP number which falls within one of the IP address ranges reserved for private networks such as a Local Area Network (LAN).
- Private means the IP address can only be reached by other devices on the same network.

- The Internet Assigned Numbers Authority (IANA) has reserved the following 3 blocks of the IP address as private networks :

Address Class	Reserved Address Space
Class A	10.0.0.0 through 10.255.255.255
Class B	172.16.0.0 through 172.31.255.255
Class C	192.168.0.0 through 192.168.255.255

Private IP Address:

- If every host on every network had to have real routable IP addresses, we would have run out of available IP addresses to hand out years ago.
- To accomplish this task, the ISP and the end users, need to use something called network address translation (NAT), which basically takes a private IP address and converts it for use on the Internet.
- Devices with private IP addresses cannot connect directly to the Internet.
- Computers outside the local network cannot connect directly to a device having private IP address or device within Private network.

Subnet Mask:

- A Subnet mask is a 32-bit number that divides the IP address into network address and host address.

- It is used to determine to what subnet an IP address belongs to.

- Subnet Mask is made by setting network bits to all "1"s and host bits to all "0"s.

- Subnet Mask Of different classes are:

  Class A 255.0.0.0 /8
  Class B 255.255.0.0 /16
  Class C 255.255.255.0 /24

Network Layer Protocol

Network Layer Protocol:

- There are two type of network Protocol:

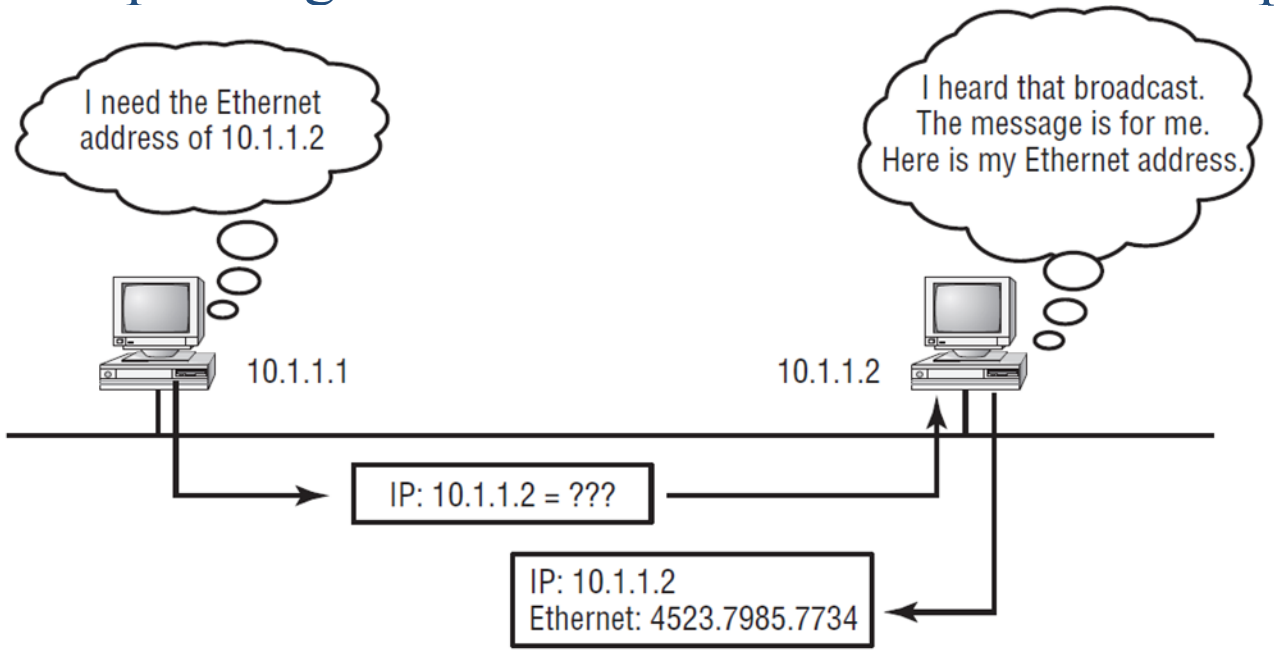
    1. ARP Address Resolution Protocol
    2. RARP Reverse Address Resolution Protocol

- These Protocols are used for mapping physical address into logical address or vice-versa.

- A table called the ARP cache, is used to maintain a relation between each MAC address and its corresponding IP address.

1. Address Resolution Protocol (ARP):

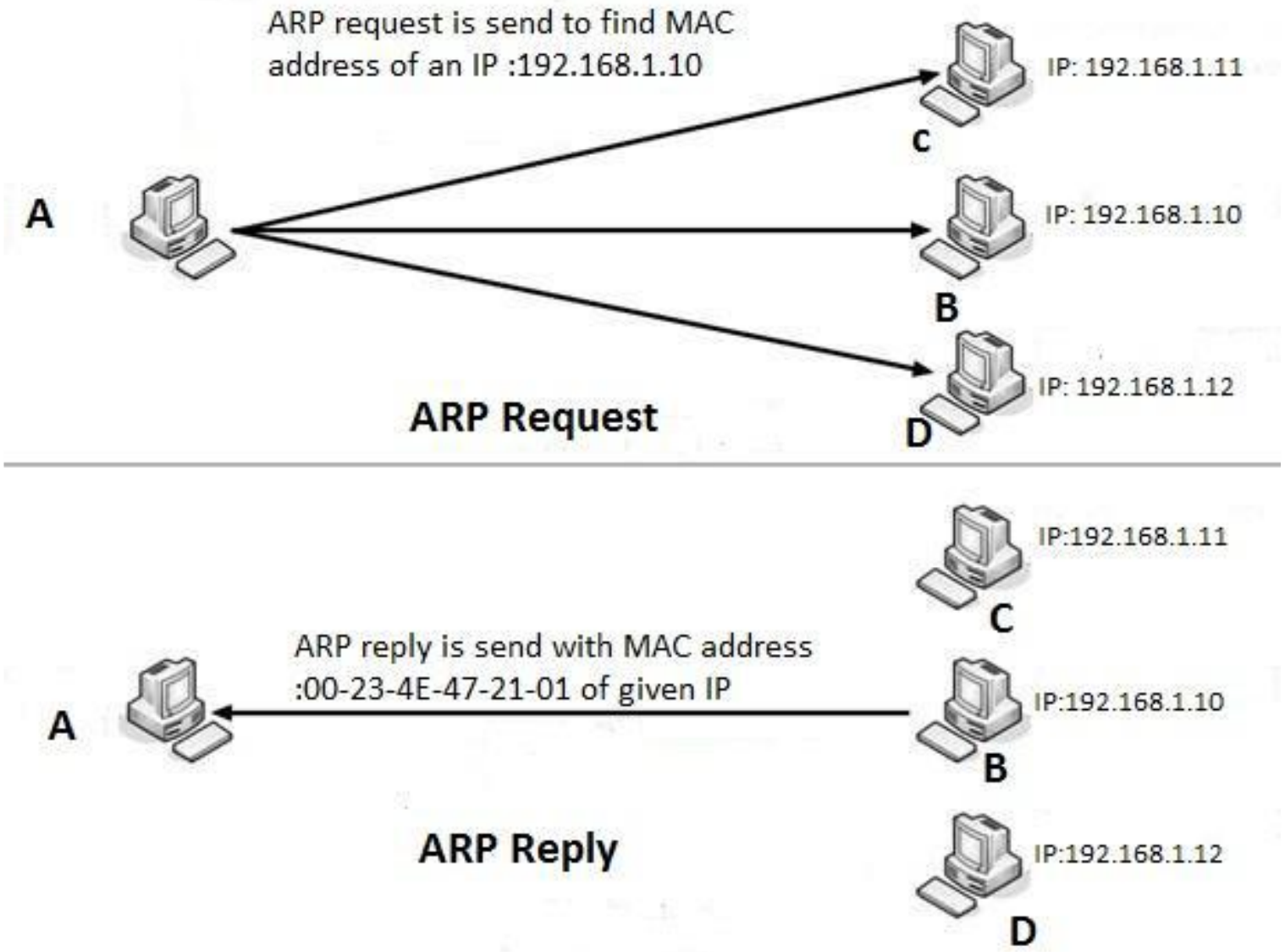
- For example: Computer A wants to send packet to computer B but Computer A only knows the IP address of Computer B but don't know its MAC address.
- So, to get MAC address. First of all Computer A checks the ARP cache table to find corresponding MAC address to IP address of Computer B.



1. Address Resolution Protocol (ARP):

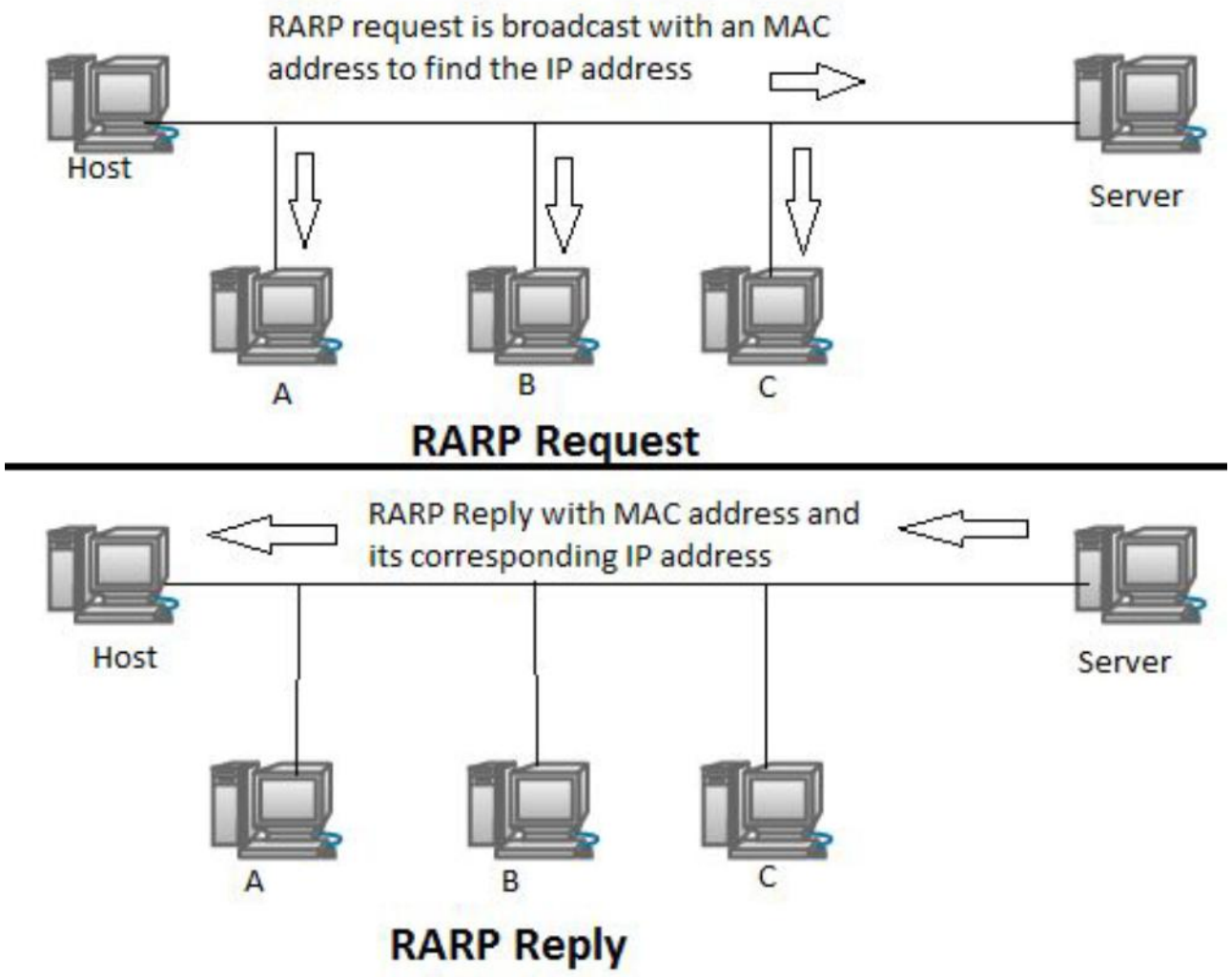
- if not found then, Computer A broadcast ARP request Message in the network.
- Each Computer in Network check the ARP request and match the given IP address.
- After matching IP address Computer B sends a unicast message to Computer A with its IP address and MAC address.
- This MAC address get stored in ARP cache for future use.
- Now Computer A can send packets to Computer B.

1. Address Resolution Protocol (ARP):



2. Reverse Address Resolution Protocol (RARP):

- The Reverse Address Resolution Protocol (RARP) is a computer networking protocol used by a client computer to request its Internet Protocol(IPv4) address from a computer network, using MAC address or hardware address.



Calculation of Network Addresses

Calculation of Network Addresses

- 1. Calculation of

    - Subnet mask
    - Broadcast ID
    - Network ID
    - Other IP's

Calculation:

- How to calculate the subnet mask, broadcast IP address, network IP address and other related IP address of given IP address.

  1. 192.168.1.5

- Here 192 in first octet represent the class of an IP address. Thus this IP address belongs to Class C.

- Then calculate the subnet mask, as this IP belongs to class C so the subnet mask of class C be : 255.255.255.0 or /24

- Thus, 192.168.1. 5
  Network bits Host bits

Calculation:

- We know Network IP address contain all zeros in host bits. So, to find n/w IP make all host bits equal to 0.

  11000000.10101000.00000001.00000000 = 192.168.1.0

- Thus Network IP address is 192.168.1.0

- We know Broadcast IP address contain all one's in host bits. So, to find Broadcast IP make all host bits equal to 1.

  11000000.10101000.00000001.11111111= 192.168.1.255

- Thus Broadcast IP address is 192.168.1.255

Calculation:

- So IP address ranges from 192.168.1.0 to 192.168.1.255
  - 192.168.1.0 - N/w address
  - 192.168.1.1
  - ……
  - …….
  - 192.168.1.254
  - 192.168.1.255 - Broadcast address
- Total IP address =256
- **1 Network IP** and **1 Broadcast IP** both are invalid IP addresses.
- So, there are **total 254 IP addresses** which are **valid** and can be used in network.
- We can also calculate as
  - No. of Host bits =8
  - 2^8= 256 -total IP addresses
  - 2^8-2 = 254 - valid IP address

Calculation:

- Calculate the subnet mask, broadcast IP address, network IP address and other related IP address of given IP address:

  2. 170.168.60.1

- Here 170 in first octet represent the class of an IP address. Thus this IP address belongs to Class B.

- Then calculate the subnet mask, as this IP belongs to class B so the subnet mask of class B : 255.255.0.0 or /16

- Thus, 170.168. 60. 1
  Network bits Host bits

Calculation:

- We know Network IP address contain all zeros in host bits. So, to find n/w IP make all host bits equal to 0.

10101010.10101000.00000000.00000000 = 170.168.0.0

- Thus Network IP address is 170.168.0.0
- We know Broadcast IP address contain all one's in host bits. So, to find Broadcast IP make all host bits equal to 1.

10101010.10101000.11111111.11111111= 170.168.255.255

- Thus Broadcast IP address is 170.168.255.255

Calculation:

- So IP address ranges from 170.168.0.0 to 170.168.255.255

170.168.0.0 - N/w address

……..

170.168.0.255

170.168.1.0

……..

170.168.1.255

170.168.2.0

……..

170.168.2.255

…….

170.168.255.254

170.168.255.255 - Broadcast address

Calculation:

- Total IP address =65536 (256X256)
- 1 Network IP and 1 Broadcast IP both are invalid IP addresses.
- So, there are total 65534 IP addresses which are valid and can be used in network.
- Or We can also calculate as

  No. of Host bits =16

  2^16= 65536 -total IP addresses

  2^16-2 = 65534 - valid IP address