



Link Layer Addressing



Overview

- MAC Addresses
- Address Resolution Protocol (ARP)
- Sending a Datagram to a Node off the Subnet



Hello!

I am Syed Jahangir

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MAC Address

Questions Popping in your head



Are we out of
Mac address?

Where
is it
used?

What is a
MAC
Address?

Why do we need
MAC Address when
we already have IP
Addresses?

How is it
assigned
to an
interface?



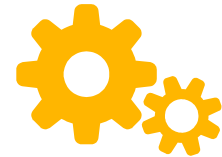
What's a **MAC** Address?

- **Media Access Control** address is the physical address that uniquely identifies a hardware interface.
- Also known as **LAN** Address.
- It is a **48-bit hexadecimal** address.
- The format of a MAC address is MM:MM:MM:SS:SS:SS.
- MAC address is burned into the ROM of **Network Interface Card** (NIC).
- Each computing device has a unique MAC Address.

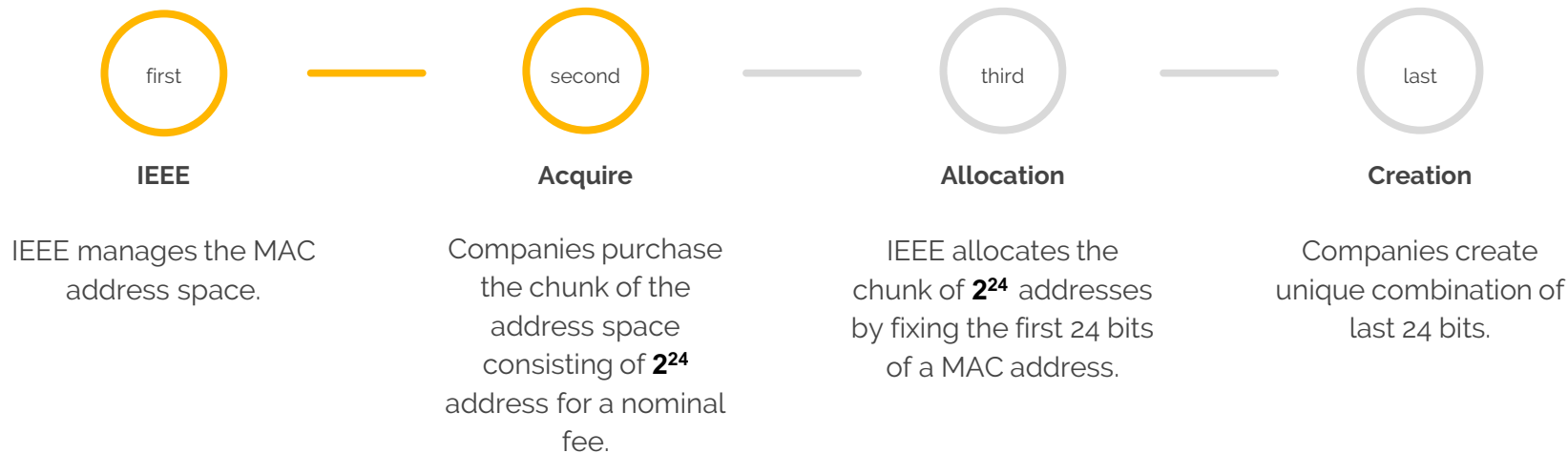
Where is it used?



- Every computer needs to be connected with each other in order to communicate with each other.
- It is the low level basis through which ethernet based network functions.



How are **MAC** addresses assigned?



Are we out of MAC addresses?



**World population is around
7.6 billion.**



- MAC Address is 6 byte long giving it 2^{48} possible addresses.

$$281,474,976,710,656 / 7,600,000,000 = 37306$$

- That means each and every person in the world can have 37306 different devices without any muddles.
- Whoa! Isn't that a big number ?

IP

VS

MAC



- 32- bit
- Network-Layer
- Hierarchal
 - Not Portable
- Street Address

- 48- bit
- Link-Layer
- Flat
 - Portable
- Aadhaar Number

Address Resolution Protocol

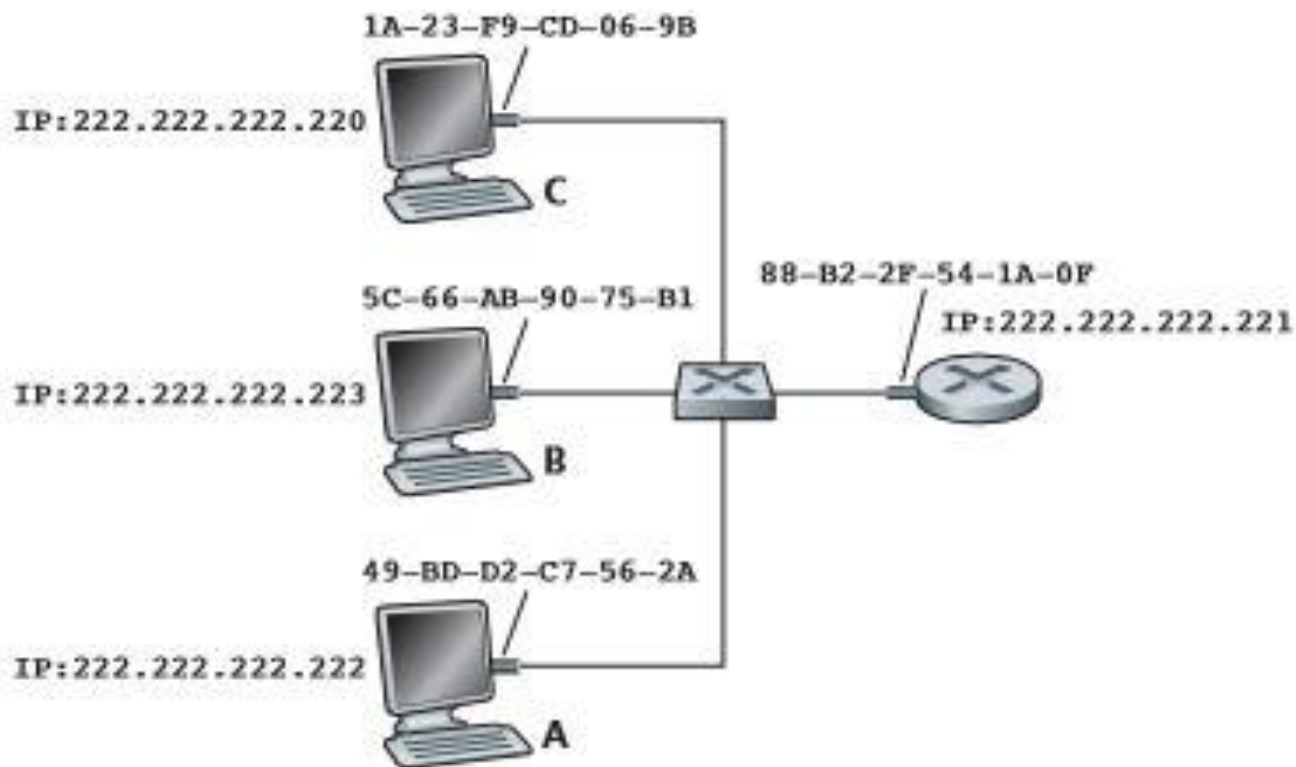


- What is **ARP** ?
- Why do we need **ARP** ?



Address Resolution Protocol

- It is the protocol which translates between MAC address and IP address.
- ARP takes destination's IP and returns its MAC address.



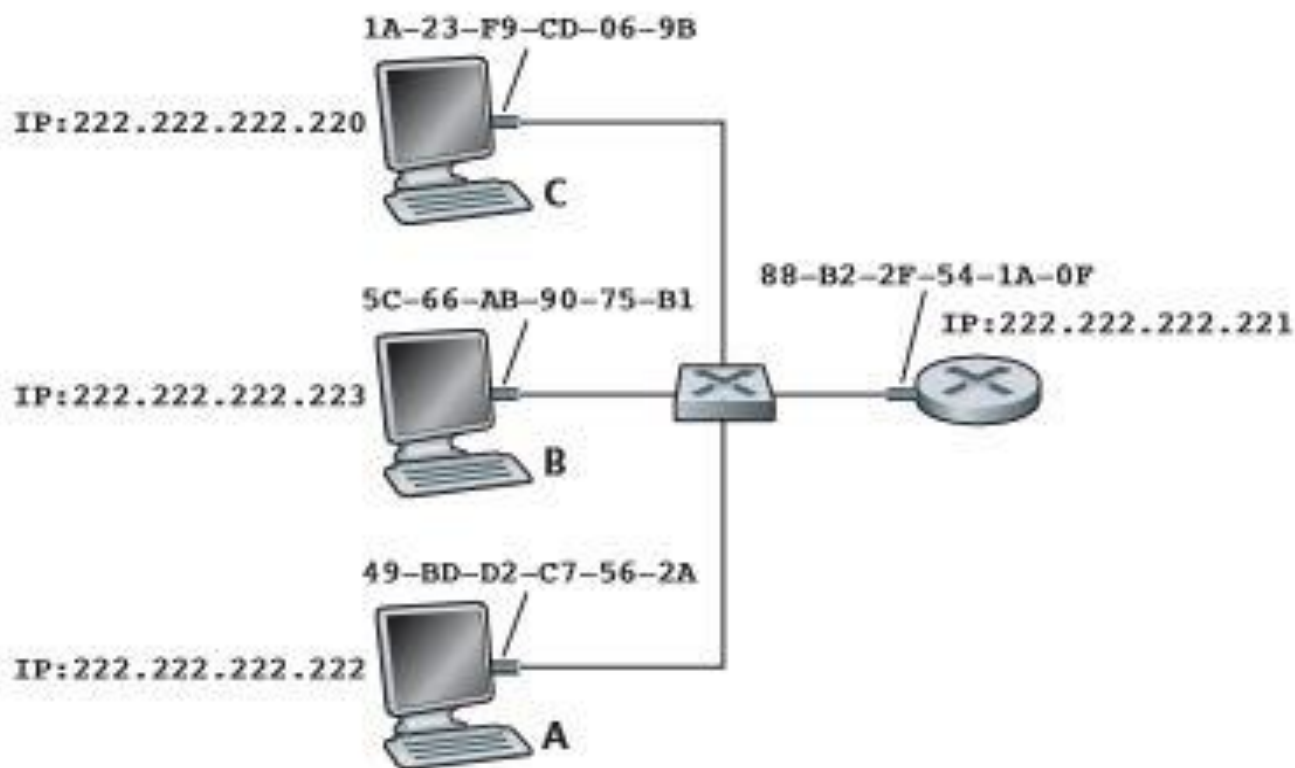


How does ARP work?

- Each host stores an ARP table in its memory.
- This table contains the mapping between IP and MAC addresses.
- Each entry in ARP table will have a Time-to-live(TLL) value after which they will be deleted from the table.
- ARP table needn't contain entry for all hosts present in the subnet.



**Let's see how ARP
works with help of
an example**





Case 1: Destination's entry is present in sender's ARP table

- This is the easiest case to handle.
- The sender just needs to look into ARP table to find destination's MAC address which is mapped to its IP address.



Case 2: Destination's entry isn't available in sender's ARP table

- Sender uses ARP protocol to resolve the address.
- First, the sender generates ARP packet which has several fields including sending and receiving IP and MAC addresses.
- The purpose of this packet is to query all hosts and routers on the subnet to determine the MAC address corresponding to the IP address which is being resolved.



- Sender passes its ARP query packet to the adapter and indicates that the packet should be sent to MAC broadcast address i.e., FF-FF-FF-FF-FF-FF.
- The adapter encapsulates the ARP query packet into a link layer frame, uses broadcast address as the destination MAC address and transmits the frame into the subnet.
- This frame is received by all the other adapters of the subnet and the ARP query in the frame is passed to its ARP module.
- The adapter which contains desired mapping sends a response ARP packet to the querying node.
- The querying node then updates its table with the obtained mapping and then sends IP datagram to the destination MAC.

Interesting points about ARP

- ARP query packet is sent within a broadcast frame whereas ARP response packet is sent within a standard frame.
- ARP is plug-and-play i.e., ARP table gets built automatically and doesn't require any system administrator to configure it.
- If a host is disconnected from the subnet, all the entries corresponding to the disconnected host get deleted after time-to-live(TLL) elapses.



Hello!

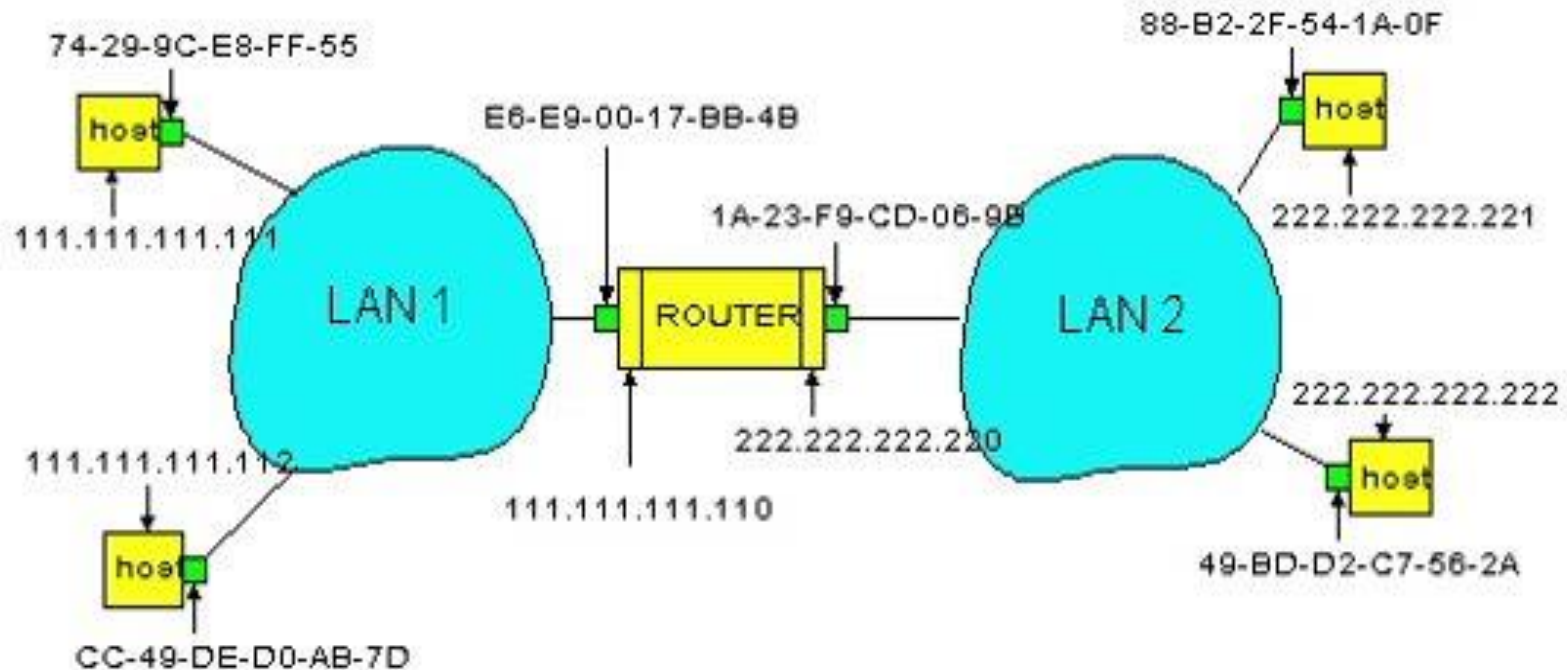
I am Anirudh Kannan V P

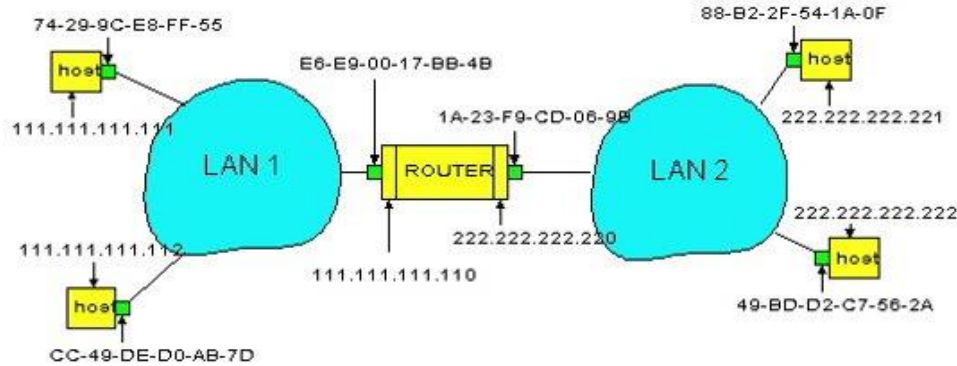
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**Sending a Datagram to a
Node off the Subnet**



Two Subnets interconnected by a router



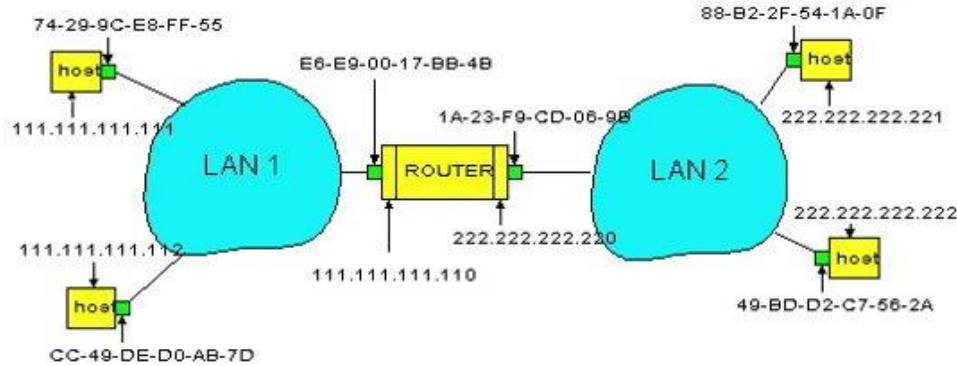


Interesting Things to Note

There are 2 types of nodes: hosts and routers

Each host has exactly one IP address and one mac address

But a router has an 2 IP addresses , 2 ARP modules and 2 adapters. Each adapter in the network has its own MAC address.



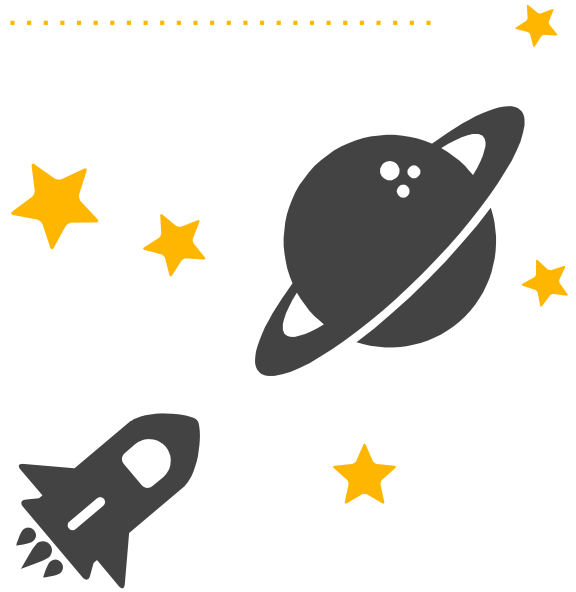
Interesting Things to Note

The network on the left LAN 1 has network address **111.111.111/24** and the network on the right has network address **222.222.222/24**

Thus all of the interfaces connected to Subnet 1 will have address of the form **111.111.111.xxx** and all of the interfaces connected to Subnet 2 will have address of the form **222.222.222.xxx**

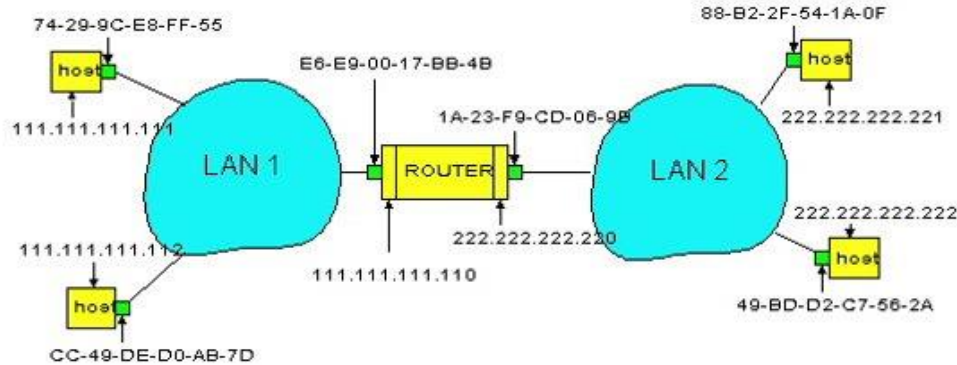
What is the goal?

Send datagram from A to B via R
Assuming that A knows B's IP address



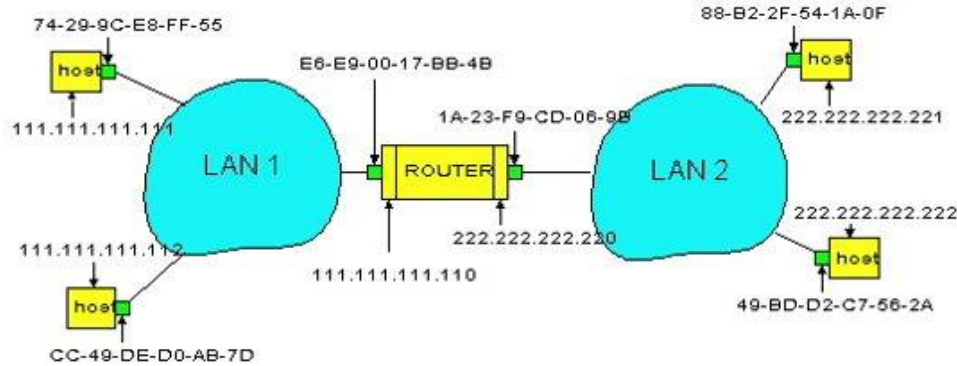


The Process



Suppose **111.111.111.111** wants to send a datagram to **222.222.222.222**. The Sending host passes its datagram to its adapter as usual.

But the sending host must also indicate the appropriate destination MAC address



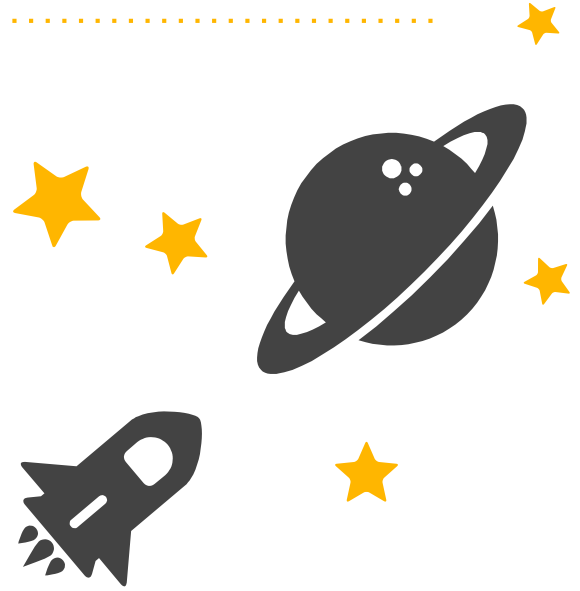
**Always
think
before you
act**

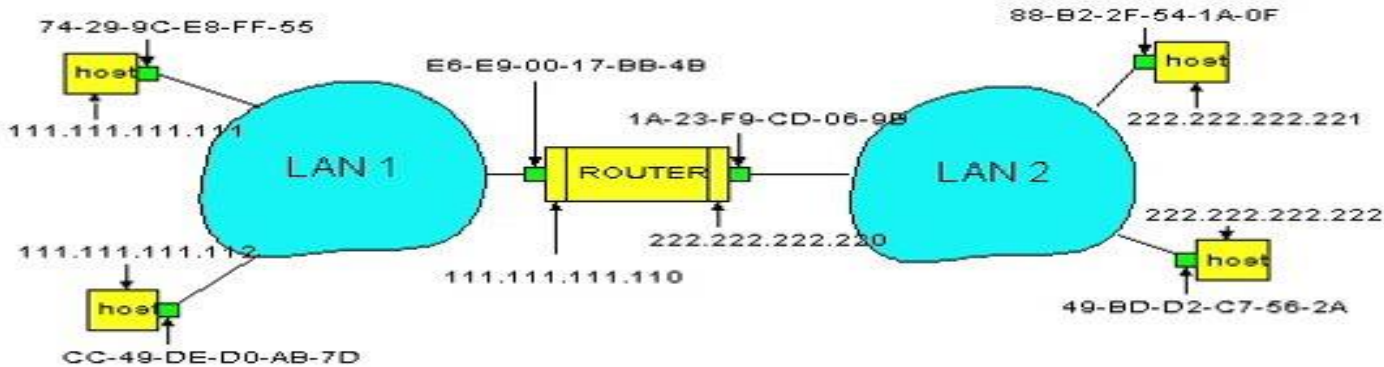
A logical quick guess would be to use the appropriate MAC address of the host 222.222.222.222 adapter namely 49-BD-D2-C7-56-2A

But this is a Blunder as none of the adapters on Subnet 1 would bother to send the IP datagram to its network layer as frame's destination address would not match the MAC address of any adapter on Subnet 1

Real Life Analogy

Remote Pen and Paper CCN Exam.



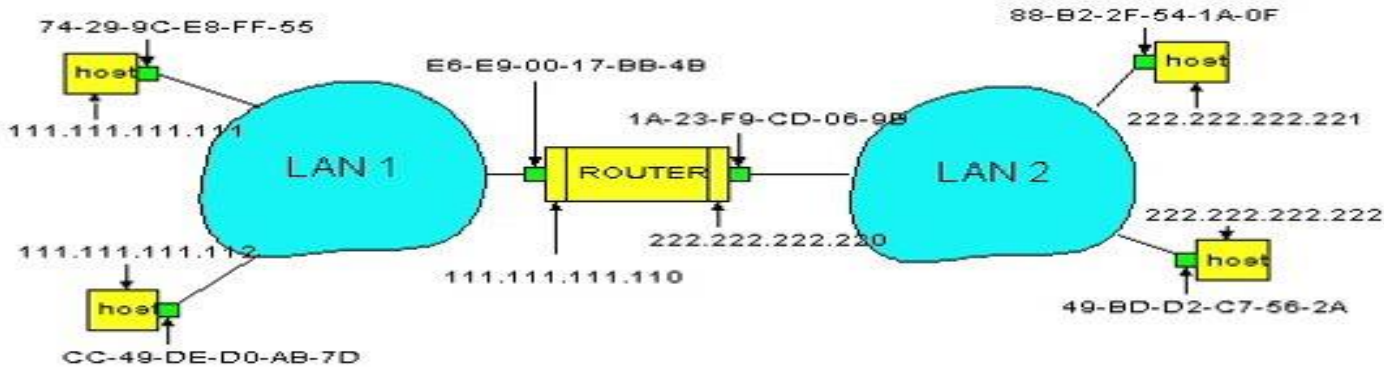


A creates datagram with source A, destination B

A uses ARP to get R's MAC address for **111.111.111.110**

A creates link-layer frame with R's MAC address as destination,
frame contains **A-to-B** IP datagram

A's adapter sends frame.



R's adapter receives frame

R removes IP datagram from Ethernet frame, sees its destined to **B**

R uses ARP to get B's MAC address

R creates frame containing A-to-B IP datagram sends to B

B receives A's datagram and thus our goal is achieved.

Conclusion

ARP for Ethernet is defined in RFC 826
Which will be discussed by the next
groups

**Be sure to Practice Questions on this
topic before the exam**





Thanks!



Any questions?