

- 1) What is a MAC address, and how is it different from an IP address?

A MAC address is a physical address, programmed into a NIC. It is used to exchange information over a *single* link. An IP address, however, is a virtual address, used to guide datagrams to their terminal subnet. In theory, MAC addresses are, unique, though it is possible to force some devices to use an altered MAC address (security concerns?). A MAC address moves with the NIC, whereas an IP address may change from network to network.

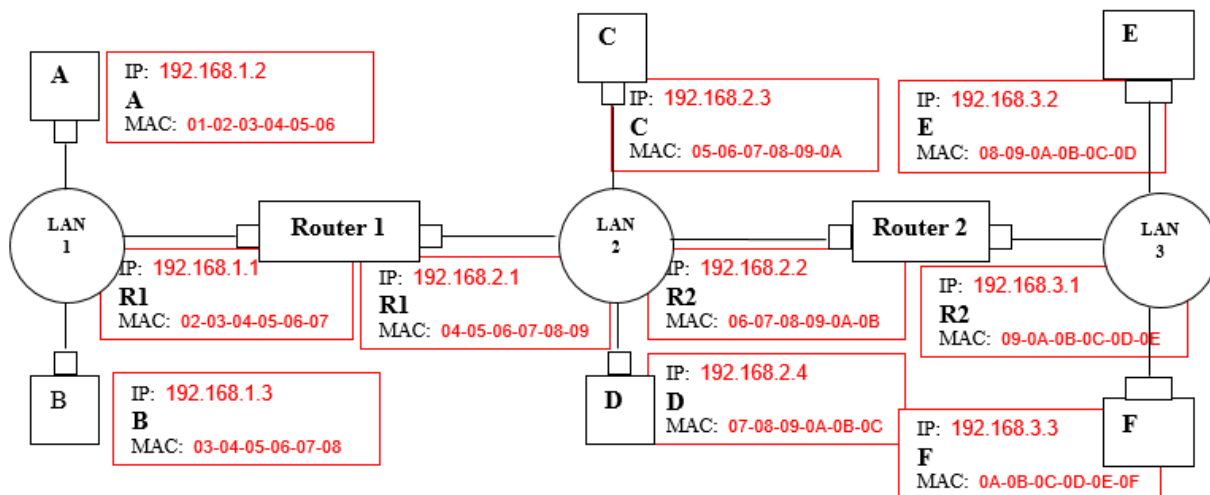
- 2) What is the MAC address FF-FF-FF-FF-FF-FF used for?

It is reserved as the MAC broadcast address. Every device on a link will process frames addressed to this address. This is used, for example, in DHCP (review).

- 3) What is ARP used for?

ARP (Address Resolution Protocol) is used to obtain the MAC address for an adjacent device, given the device's IP address.

- 4) Given the following diagram, which represents 3 LANs connected by 2 routers.
- Assign IPv4 addresses to all of the NICs. For LAN1, use addresses in 192.168.1.0 / 24. For LAN2, use addresses in 192.168.2.0 / 24. For LAN3, use addresses in 192.168.3.0 / 24. See example answer for (b)
 - Assign MAC addresses to all of the NICs. Example solution (others possible)



- c. List the steps for **E** to send a datagram to **B**. Assume that all of the ARP tables are up-to-date.
1. Forwarding table in **E** determines that the datagram should be routed to interface 192.168.3.1.
 2. **E** finds the corresponding MAC address in its ARP table, and creates an Ethernet packet with destination address 09-0A-0B-0C-0D-0E and source address of 08-09-0A-0B-0C-0D.
 3. Router 2 receives the packet and extracts the datagram. Its routing table indicates that the datagram is to be routed to 192.168.2.1.
 4. Router 2 finds the corresponding MAC address in its ARP table, and sends the Ethernet packet with destination address 04-05-06-07-08-09 and source address of 06-07-08-09-0A-0B.
 5. The process of associating routing table IP addresses with ARP table MAC addresses continues until the packet has reached Host **B**.
- d. List the steps for **E** to send a datagram to **B**. Assume that **E**'s ARP table is empty, but all of the other ARP tables are up-to-date.
- ARP in **E** must now determine the MAC address of 192.168.3.1.
1. Forwarding table in **E** determines that the datagram should be routed to interface 192.168.3.1
 2. **E** doesn't find the corresponding MAC address in its ARP table. It sends out an ARP query packet in a broadcast Ethernet frame containing 192.168.3.1
 3. Router 2 receives the query packet and sends to Host **E** an ARP response packet.
 4. This ARP response packet is carried by an Ethernet frame with Ethernet destination address 08-09-0A-0B-0C-0D and source address 09-0A-0B-0C-0D-0E
 5. **E**'s ARP table is updated to match 192.168.3.1 to 09-0A-0B-0C-0D-0E.
 6. The rest of the journey is described in the solution to (c).