Module 9: Address Resolution

Introduction to Networks v7.0
(ITN)

9.1 MAC and IP

MAC and IP
Destination on Same Network

There are two primary addresses assigned to a device on an Ethernet LAN:

- **Layer 2 physical address (the MAC address)** – Used for NIC to NIC communications on the same Ethernet network.
- **Layer 3 logical address (the IP address)** – Used to send the packet from the source device to the destination device.

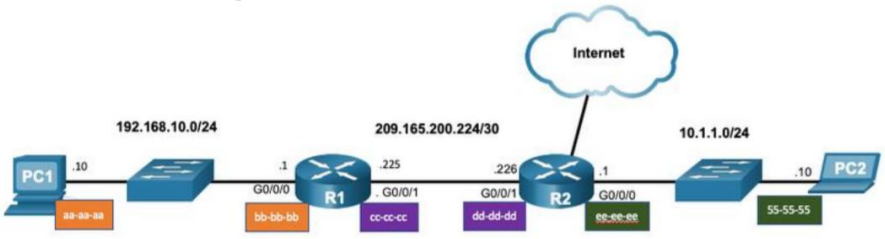
Layer 2 addresses are used to deliver frames from one NIC to another NIC on the same network. If a destination IP address is on the same network, the destination MAC address will be that of the destination device.

Destination MAC	Source MAC	Source IPv4	Destination IPv4
55-55-55	aa-aa-aa	192.168.10.10	192.168.10.11

MAC and IP
Destination on Remote Network

When the destination IP address is on a remote network, the destination MAC address is that of the default gateway.

- ARP is used by IPv4 to associate the IPv4 address of a device with the MAC address of the device NIC.
- ICMPv6 is used by IPv6 to associate the IPv6 address of a device with the MAC address of the device NIC.



Destination MAC	Source MAC	Source IPv4	Destination IPv4
bb-bb-bb	aa-aa-aa	192.168.10.10	10.1.1.10

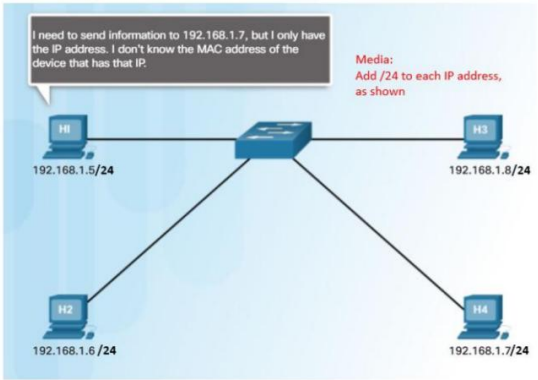
9.2 ARP

ARP
ARP Overview

A device uses ARP to determine the destination MAC address of a local device when it knows its IPv4 address.

ARP provides two basic functions:

- Resolving IPv4 addresses to MAC addresses
- Maintaining an ARP table of IPv4 to MAC address mappings



ARP

ARP Functions

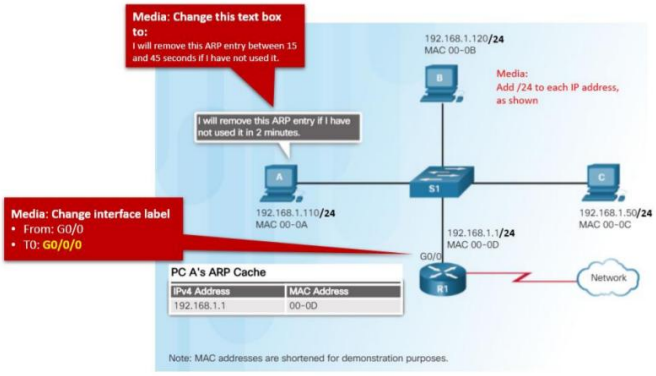
To send a frame, a device will search its ARP table for a destination IPv4 address and a corresponding MAC address.

- If the packet's destination IPv4 address is on the same network, the device will search the ARP table for the destination IPv4 address.
- If the destination IPv4 address is on a different network, the device will search the ARP table for the IPv4 address of the default gateway.
- If the device locates the IPv4 address, its corresponding MAC address is used as the destination MAC address in the frame.
- If there is no ARP table entry is found, then the device sends an ARP request.

ARP

Removing Entries from an ARP Table

- Entries in the ARP table are not permanent and are removed when an ARP cache timer expires after a specified period of time.
- The duration of the ARP cache timer differs depending on the operating system.
- ARP table entries can also be removed manually by the administrator.



ARP

ARP Tables on Networking Devices

- The **show ip arp** command displays the ARP table on a Cisco router.
- The **arp –a** command displays the ARP table on a Windows 10 PC.

```
R1# show ip arp
Protocol  Address          Age (min)  Hardware Addr   Type   Interface
Internet  192.168.10.1           -   a0e0.af0d.e140  ARPA   GigabitEthernet0/0/0
```

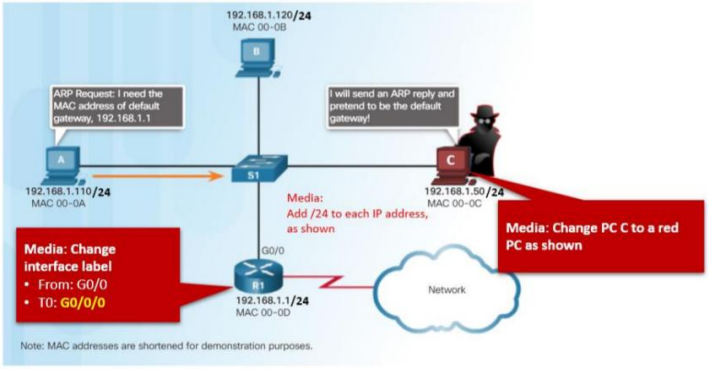
```
C:\Users\PC> arp -a

Interface: 192.168.1.124 --- 0x10
  Internet Address      Physical Address      Type
  192.168.1.1           c8-d7-19-cc-a0-86     dynamic
  192.168.1.101         08-3e-0c-f5-f7-77     dynamic
```


ARP

ARP Issues – ARP Broadcasting and ARP Spoofing

- ARP requests are received and processed by every device on the local network.
- Excessive ARP broadcasts can cause some reduction in performance.
- ARP replies can be spoofed by a threat actor to perform an ARP poisoning attack.
- Enterprise level switches include mitigation techniques to protect against ARP attacks.



9.3 IPv6 Neighbor Discovery

IPv6 Neighbor Discovery

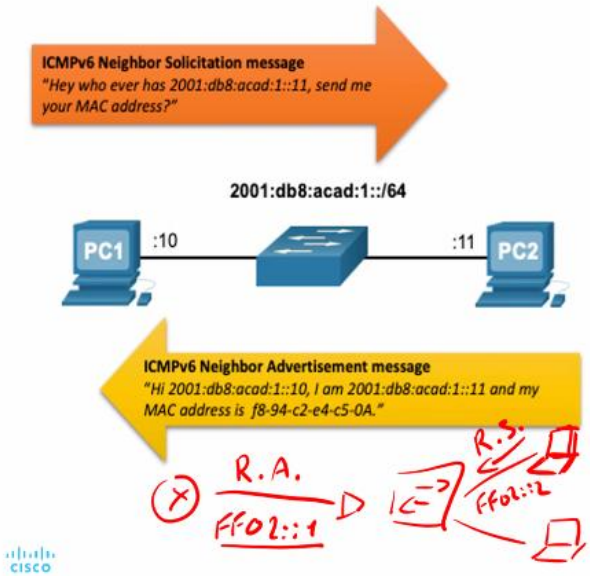
IPv6 Neighbor Discovery Messages

IPv6 Neighbor Discovery (ND) protocol provides:

- Address resolution
- Router discovery
- Redirection services

- ICMPv6 Neighbor Solicitation (NS) and Neighbor Advertisement (NA) messages are used for device-to-device messaging such as address resolution.
- ICMTPv6 Router Solicitation (RS) and Router Advertisement (RA) messages are used for messaging between devices and routers for router discovery.
- ICMPv6 redirect messages are used by routers for better next-hop selection.

IPv6 Neighbor Discovery – Address Resolution



- IPv6 devices use ND to resolve the MAC address of a known IPv6 address.
- ICMPv6 Neighbor Solicitation messages are sent using special Ethernet and IPv6 multicast addresses.

ALL-NODES = FF02::1
ALL-ROUTER = FF02::2