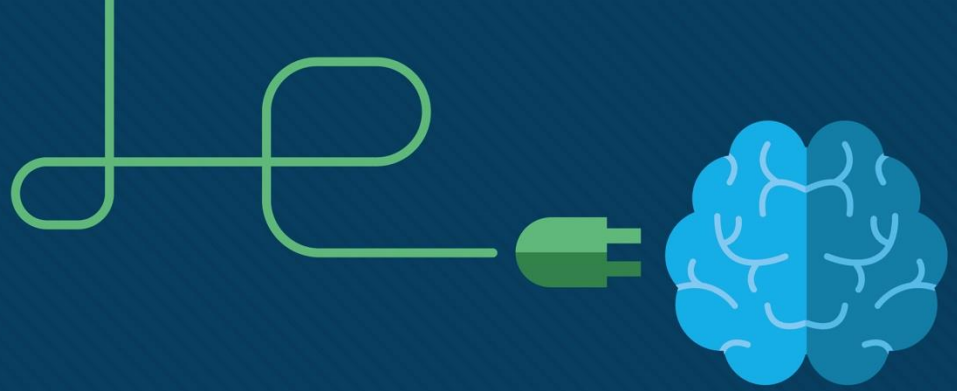

Module 9: Adres Çözümleme

CCNA1

Introduction to Networks v7.0
(ITN)

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Module Objectives

Module Title: Address Resolution

Module Objective: Explain how ARP and ND enable communication on a network.

Topic Title	Topic Objective
MAC and IP	Compare the roles of the MAC address and the IP address.
ARP	Describe the purpose of ARP.
Neighbor Discovery	Describe the operation of IPv6 neighbor discovery.

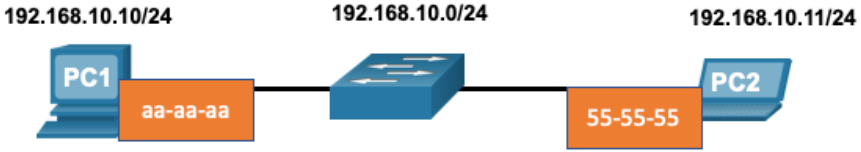
9.1 MAC and IP

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.

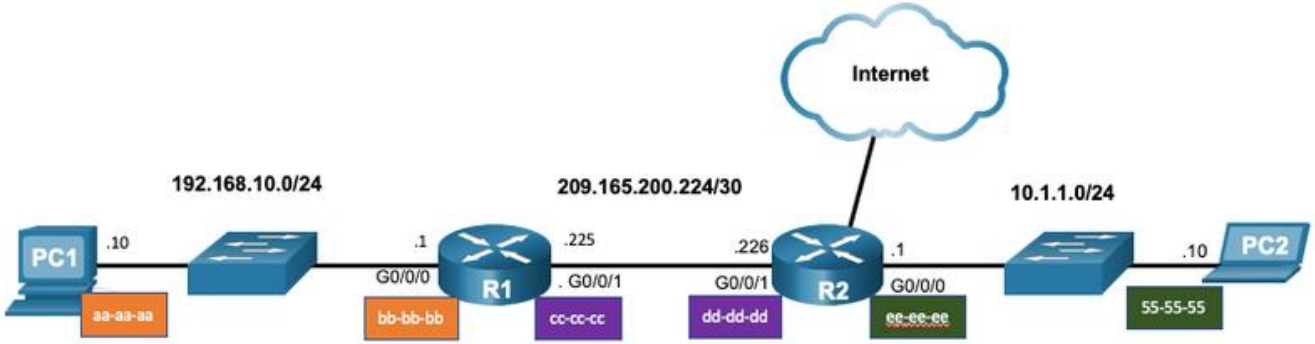


Destination MAC	Source MAC	Source IPv4	Destination IPv4
55-55-55	aa-aa-aa	192.168.10.10	192.168.10.11

Destination on Remote Network

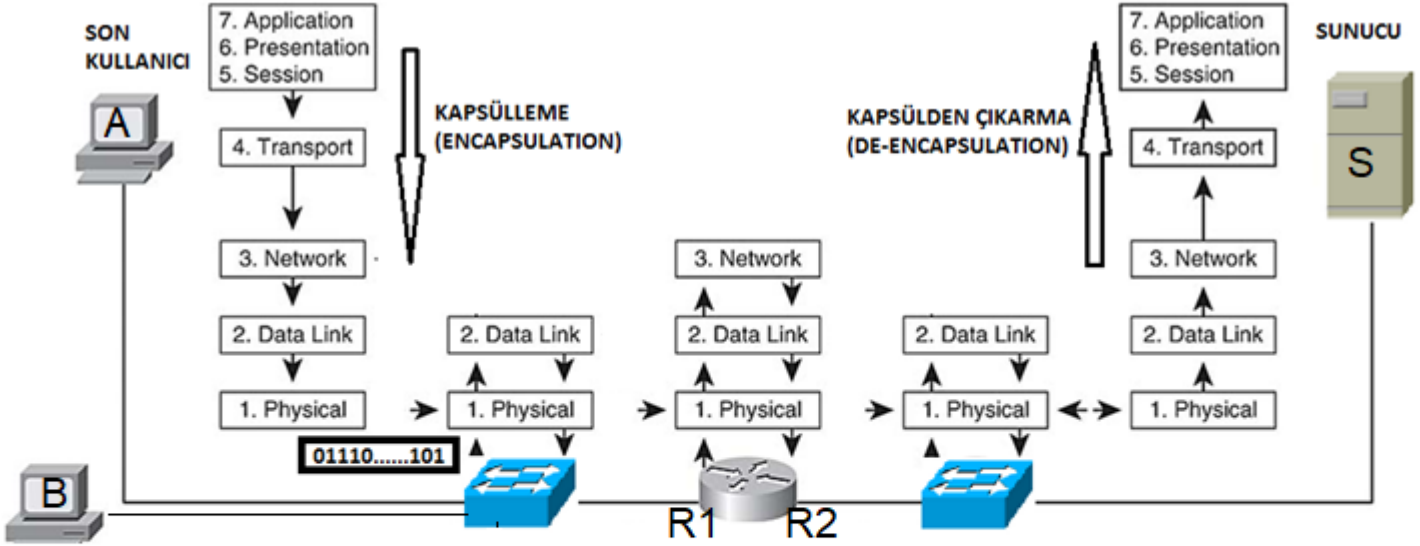
When the destination IP address is on a remote network, the destination MAC address is that of the default gateway.

- **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

MAC Address and IP Address



A->B s.mac:MAC-A d.mac:MAC-B | s.ip:IP-A d.ip:IP-B

Layer2 Layer3

A->S s.mac:MAC-A d.mac:MAC-R1 | s.ip:IP-A d.ip:IP-S

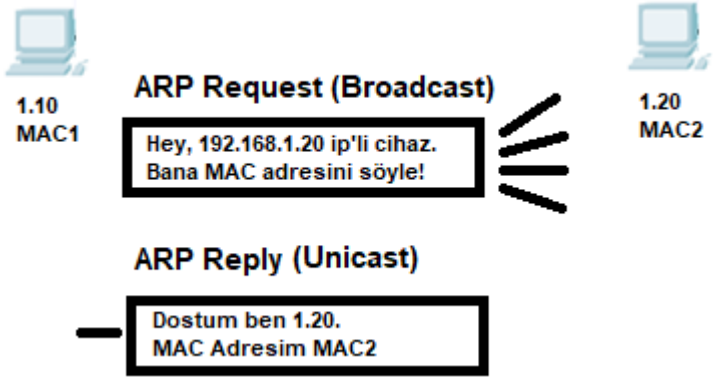
Layer2 Layer3

s.mac:MAC-R2 d.mac:MAC-S | s.ip:IP-A d.ip:IP-S

Layer2 Layer3

9.2 ARP (Address Resolution Protocol)

ARP Protokolü ve ARP Tablosu



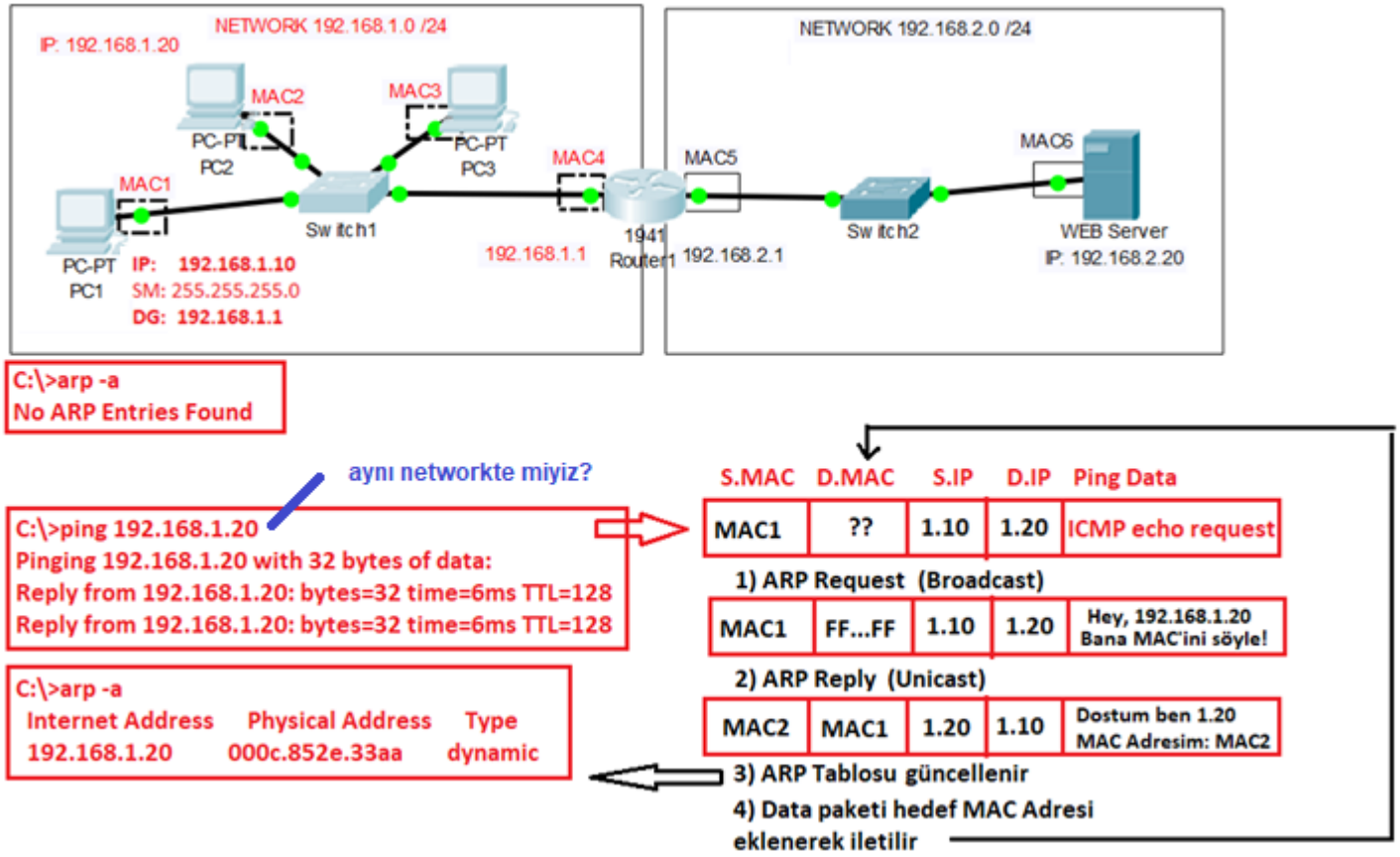
ARP:
Aynı networkte IP Adresinden MAC adresini öğrenmemizi sağlayan protokol

- **ARP protokolü ile öğrenilen bilgiler ARP Tablosuna yazılır. ARP tablosu aynı networkteki IPv4 adresleri ile MAC adreslerini eşleştirme tablosudur. Ethernet networklerinde ARP protokolü olmadan iletişim gerçekleşemez.**

```
C:\>arp -a
  Internet Address      Physical Address      Type
  192.168.1.1           0001.c7ee.eb01        dynamic
  192.168.1.20          000c.852e.33aa        dynamic
  192.168.1.30          0060.2fbe.8bce        dynamic
```

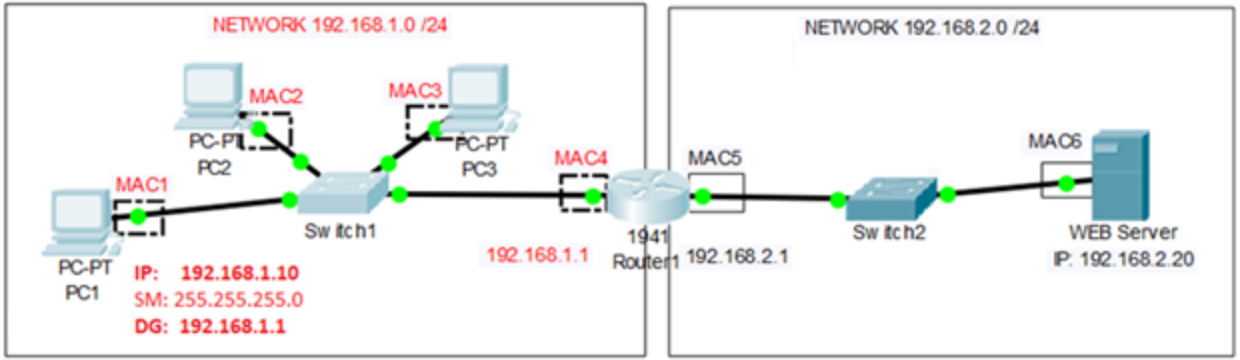
- **ARP tablosuna statik adres girişleri yapılabilir, ancak bu nadiren yapılır.**
- **ARP tablosundaki girişlerin tümünü veya bazılarını el ile kaldırmak için komutlar da kullanılabilir.**
- **ARP tablosunda belirli bir süredir kullanılmayan ARP girişlerini kaldırır**

ARP İşleyişi (İç Networkte iletişim)



- ARP tablosunda belirli bir süredir kullanılmayan ARP girişlerini kaldırır

ARP İşleyişi (Farklı bir Networkle iletişim)




```
C:\>arp -a
No ARP Entries Found
```

aynı networkte miyiz?

```
C:\>ping 192.168.2.20
Request timed out.
Reply from 192.168.2.20: bytes=32 time=1ms TTL=127
Reply from 192.168.2.20: bytes=32 time<1ms TTL=127
```

```
C:\>arp -a
  Internet Address      Physical Address      Type
  192.168.1.1           0001.c7ee.eb01        dynamic
```

S.MAC	D.MAC	S.IP	D.IP	Ping Data
MAC1	??	1.10	2.20	ICMP echo request

1) ARP Request (Broadcast)

MAC1	FF...FF	1.10	1.1	Hey Router 192.68.1.1 Bana MAC'ini söyle

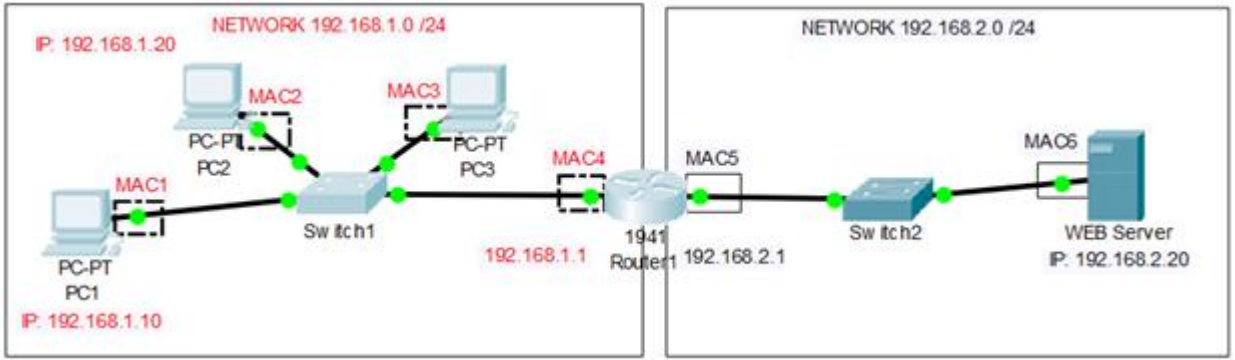
2) ARP Reply (Unicast)

MAC4	MAC1	1.1	1.10	Dostum ben 1.1 MAC Adresim: MAC4

3) ARP Tablosu güncellenir

4) Data paketi Default Gateway MAC Adresi eklenerek iletilir

Ağ Cihazlarında ARP Tabloları

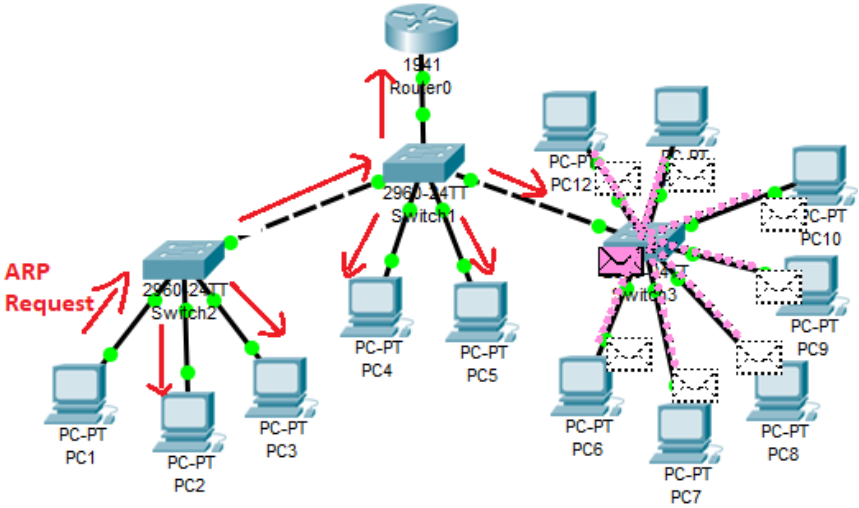



```
Router1>show ip arp
Protocol  Address          Age(min)  Hardware Addr   Type   Interface
Internet  192.168.1.1            -   0001.C7EE.EB01  ARPA   GigabitEthernet0/0
Internet  192.168.1.10          19   0003.E4E7.0B72  ARPA   GigabitEthernet0/0
Internet  192.168.2.1            -   0001.C7EE.EB02  ARPA   GigabitEthernet0/1
Internet  192.168.2.20          19   00E0.A3A7.CE87  ARPA   GigabitEthernet0/1
```

```
C:\>arp -a
  Internet Address      Physical Address      Type
  192.168.1.1           0001.c7ee.eb01        dynamic
  192.168.1.20          000c.852e.33aa        dynamic
  192.168.1.30          0060.2fbe.8bce        dynamic
```

ARP Nasıl Sorunlar Oluşturabilir? ARP Broadcasting

ARP broadcasts can flood the local media.

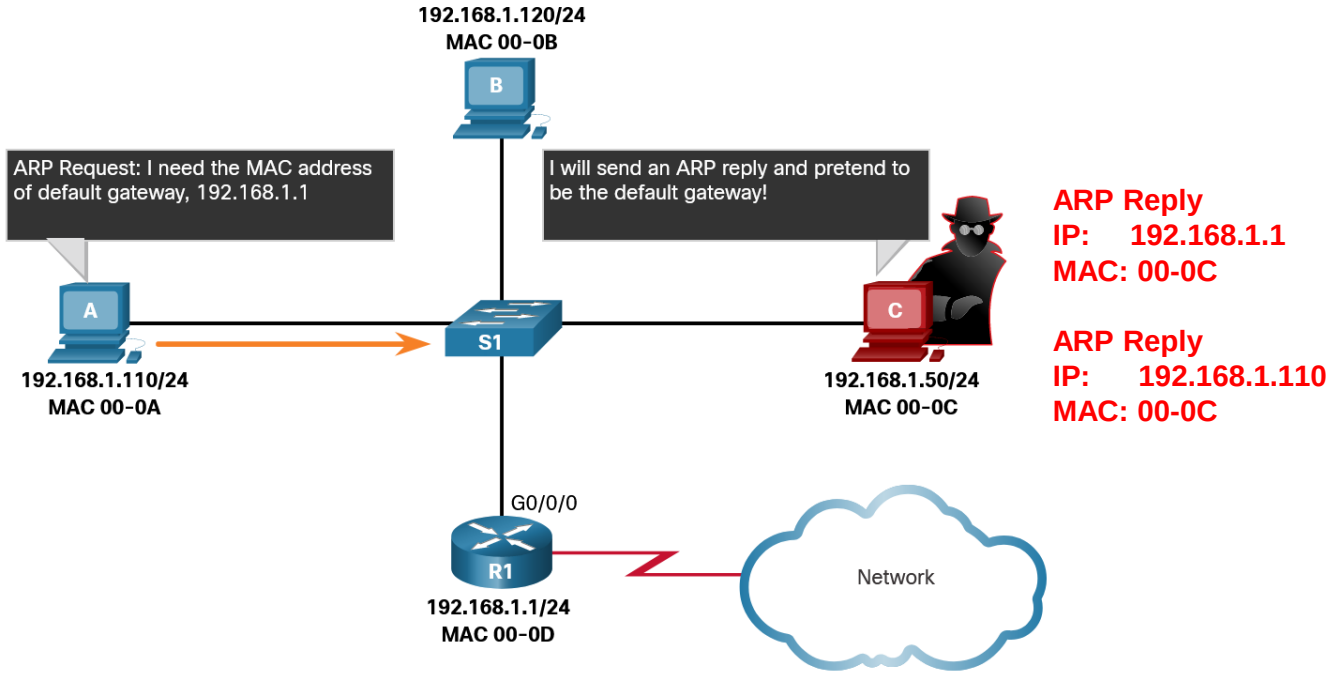


ARP Issues:

- Broadcasts, overhead on the media
- Security

- Excessive ARP broadcasts can cause some reduction in performance.

ARP Nasıl Sorunlar Oluşturabilir? ARP Spoofing Attack



Note: MAC addresses are shortened for demonstration purposes.

- 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

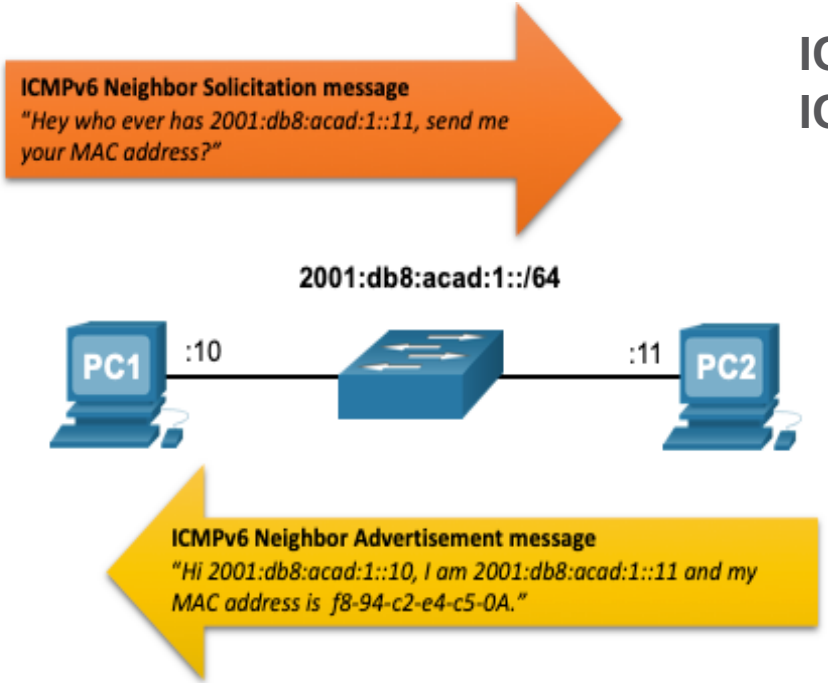
IPv6 Neighbor Discovery Messages

IPv6 **ICMPv6 Neighbor Discovery (ND)** protocol provides:

- Address resolution
- Router discovery
- Redirection services

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

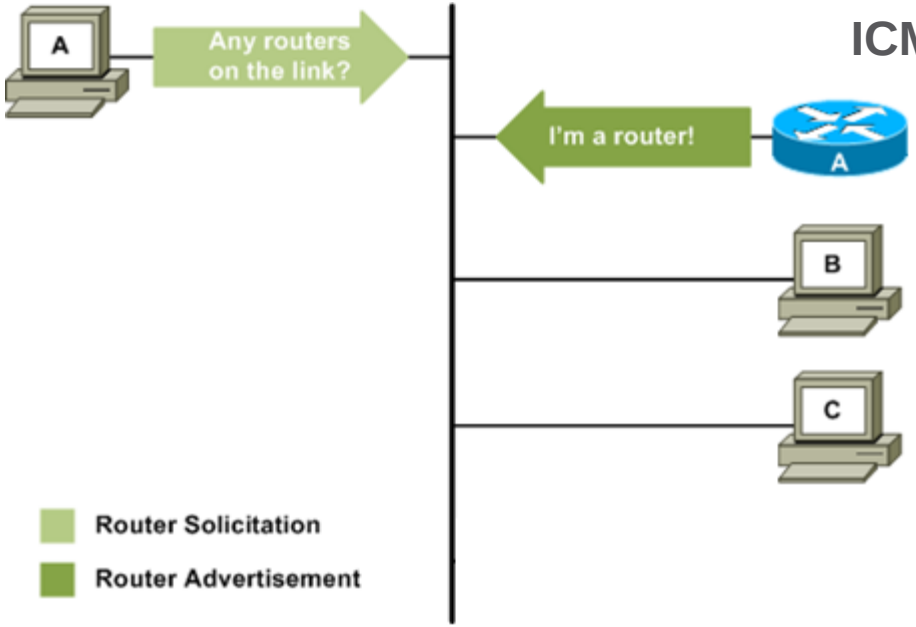
IPv6 Neighbor Discovery – Address Resolution



ICMPv6 Neighbor Solicitation (NS)
ICMPv6 Neighbor Advertisement (NA)

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

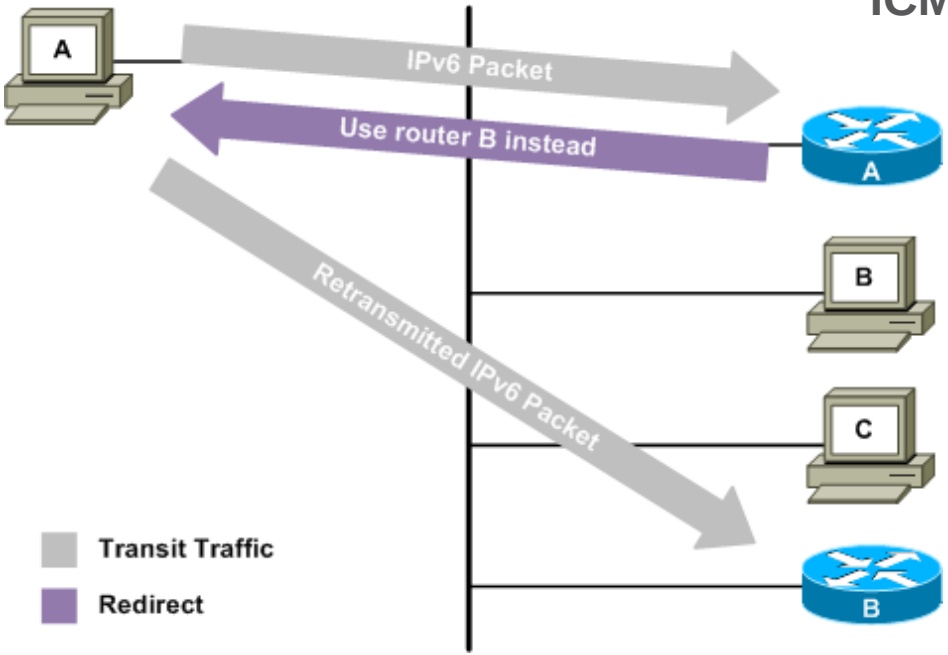
IPv6 Neighbor Discovery – Router Information



ICMPv6 Router Solicitation (RS)
ICMPv6 Router Advertisement (RA)

- IPv6 devices use Router Solicitation (RS) messages to discover Routers.
- ICMPv6 Router Advertisement (RA) are sent using special Ethernet and IPv6 multicast addresses.

IPv6 Neighbor Discovery –Route Redirection



ICMPv6 Route Redirection

- IPv6 Routers use Redirect messages to point hosts toward a more preferable router.

9.4 Module Practice and Quiz

What did I learn in this module?

- Layer 2 physical addresses (i.e., Ethernet MAC addresses) are used to deliver the data link frame with the encapsulated IP packet from one NIC to another NIC on the same network.
- If the destination IP address is on the same network, the destination MAC address will be that of the destination device.
- When the destination IP address (IPv4 or IPv6) is on a remote network, the destination MAC address will be the address of the host default gateway (i.e., the router interface).
- An IPv4 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 and maintaining a table of IPv4 to MAC address mappings.
- After the ARP reply is received, the device will add the IPv4 address and the corresponding MAC address to its ARP table.
- For each device, an ARP cache timer removes ARP entries that have not been used for a specified period of time.
- IPv6 does not use ARP, it uses the ND protocol to resolve MAC addresses.
- An IPv6 device uses ICMPv6 Neighbor Discovery to determine the destination MAC address of a local device when it knows its IPv6 address.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