



Address Resolution

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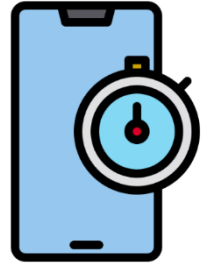
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Naryn, 10:20am, October 12, 2022



Lessons learnt last time



- Ethernet Frames: Explain how the Ethernet sublayers are related to the frame fields
- Ethernet MAC Address: Describe the Ethernet MAC address
- The MAC Address Table: Explain how a switch builds its MAC address table and forwards frames
- Switch Speeds and Forwarding Methods: Describe switch forwarding methods and port settings available on Layer 2 switch ports

What we gonna discuss today?



- 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

MAC and IP

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- MAC and IP

MAC and IP

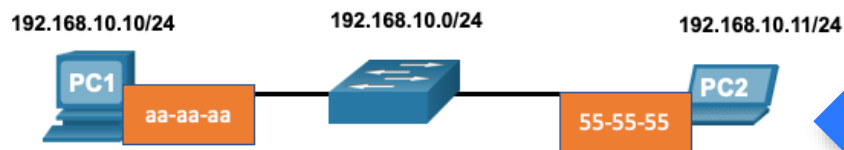
- Destination on Same Network

- 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

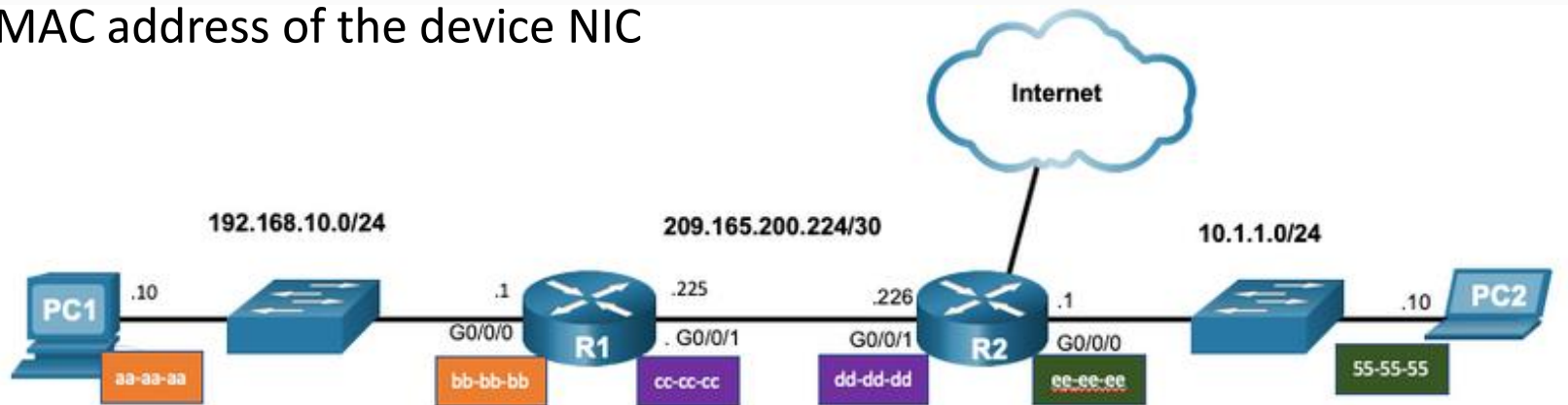
MAC and IP

- 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

ARP

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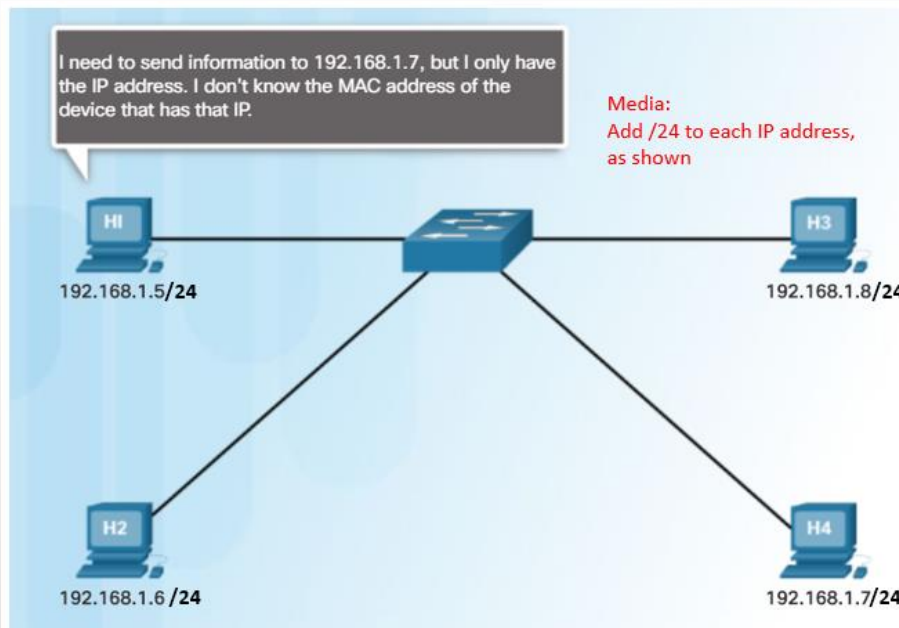
- ARP (Address Resolution Protocol)

ARP

- ARP Overview

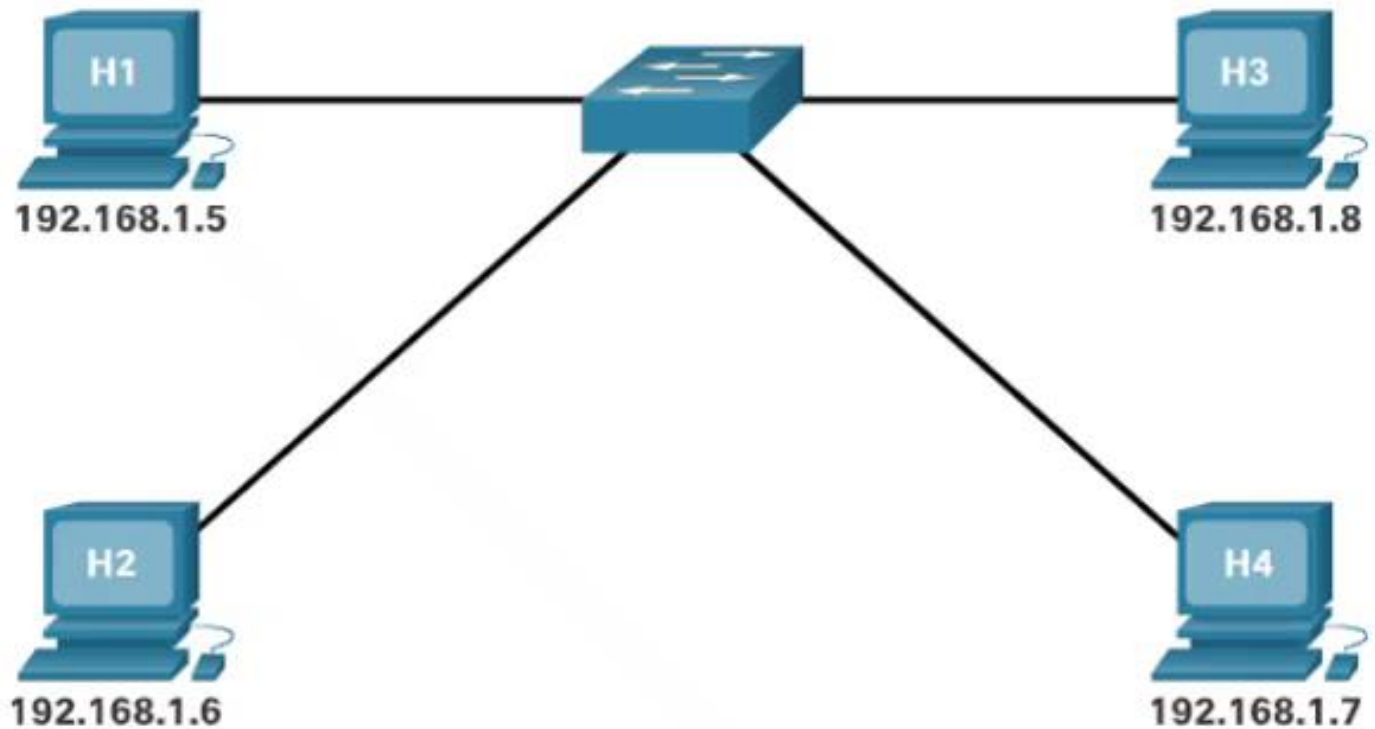
- A device uses ARP to determine the destination MAC address of a local device when it knows its IPv4 address. **ARP provides two basic functions:**

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



ARP

- ARP Functions



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

- ARP Request

Video – ARP Operation – ARP Request

This video will cover an ARP request for a MAC address.



ARP

- ARP Reply

Video – ARP Operation – ARP Reply

This video will cover an ARP reply in response to an ARP request.

ARP

- ARP Role in Remote Communications

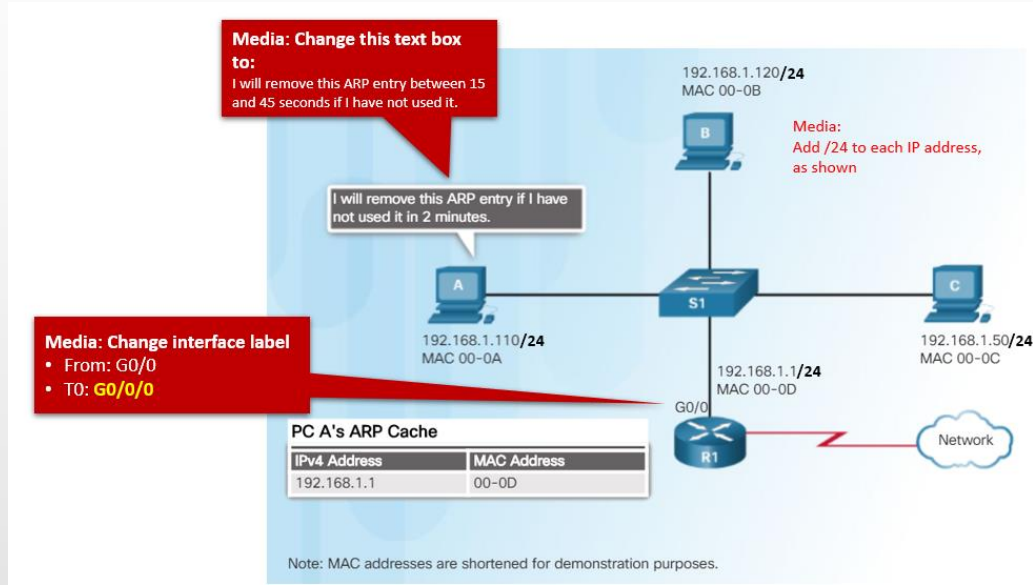
Video – ARP Role in Remote Communications

This video will cover how an ARP request will provide a host the MAC address of the default gateway.

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 (**Cisco IOS: default value is 14400 seconds**)
- 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

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

- The **arp -a** command displays the ARP table on a Windows 10 PC

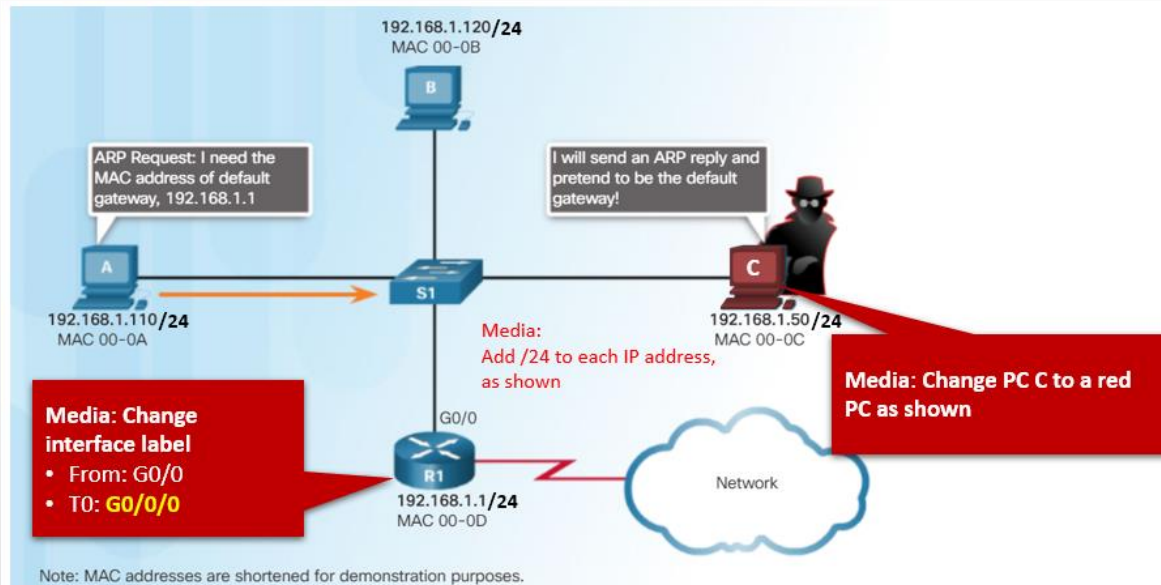
```
C:\Users\PC> arp -a

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



Neighbor Discovery

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- Neighbor Discovery

Nighbor Discovery

- IPv6 Neighbor Discovery

Video – IPv6 Neighbor Discovery

This video will explain the process of how IPv6 performs address resolution using ICMPv6 neighbor solicitation and neighbor advertisement messages.

Neighbor Discovery

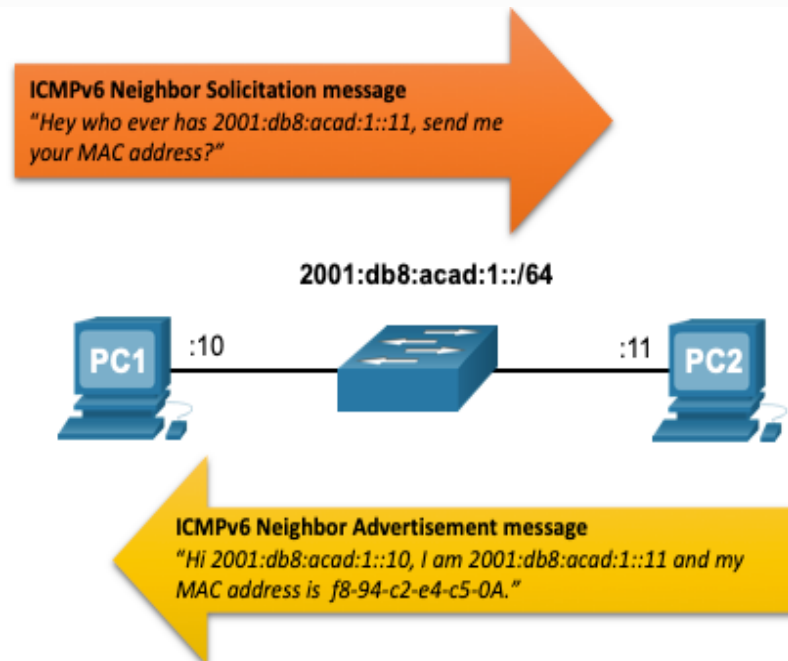


- IPv6 Neighbor Discovery Messages

- 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
- ICMPv6 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

Neighbor Discovery

- 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



Do you have any
questions or
comments?



An abstract graphic consisting of multiple concentric, overlapping circular bands in shades of blue and grey, creating a sense of depth and motion. The bands are composed of various widths and colors, some appearing as solid lines and others as more fragmented, pixelated patterns.

Thank you
for your attention !

In this presentation:

- Some icons were downloaded from flaticon.com and iconscout.com