Section 5.3: Address Resolution Protocol

Upon completion of this section, you should be able to:

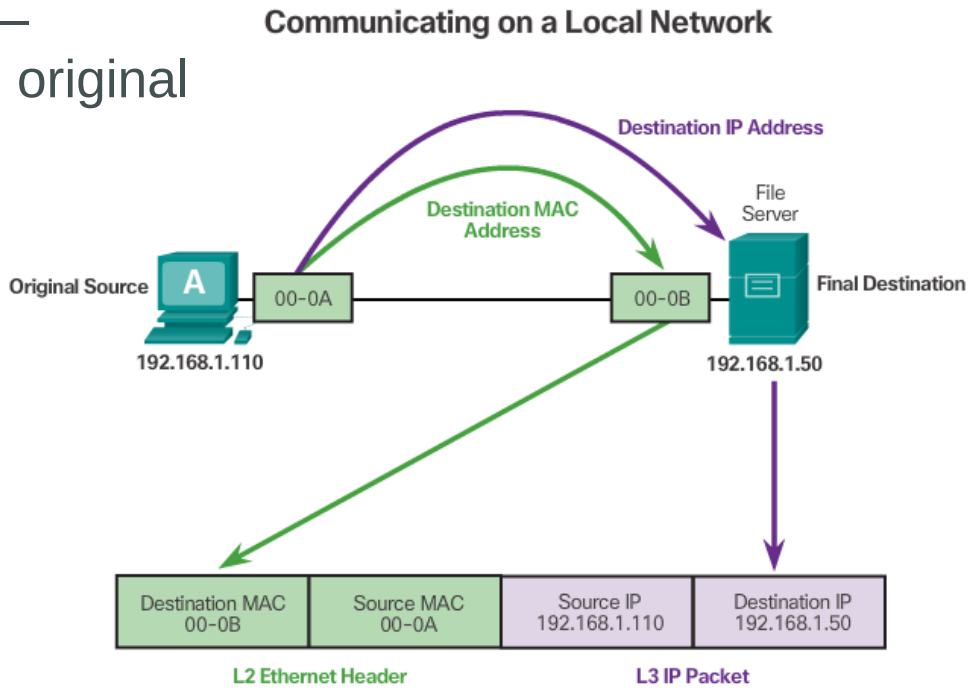
- Compare the roles of the MAC address and the IP address.
- Describe the purpose of ARP.
- Explain how ARP requests impact network and host performance.

Topic 5.3.1: MAC and IP

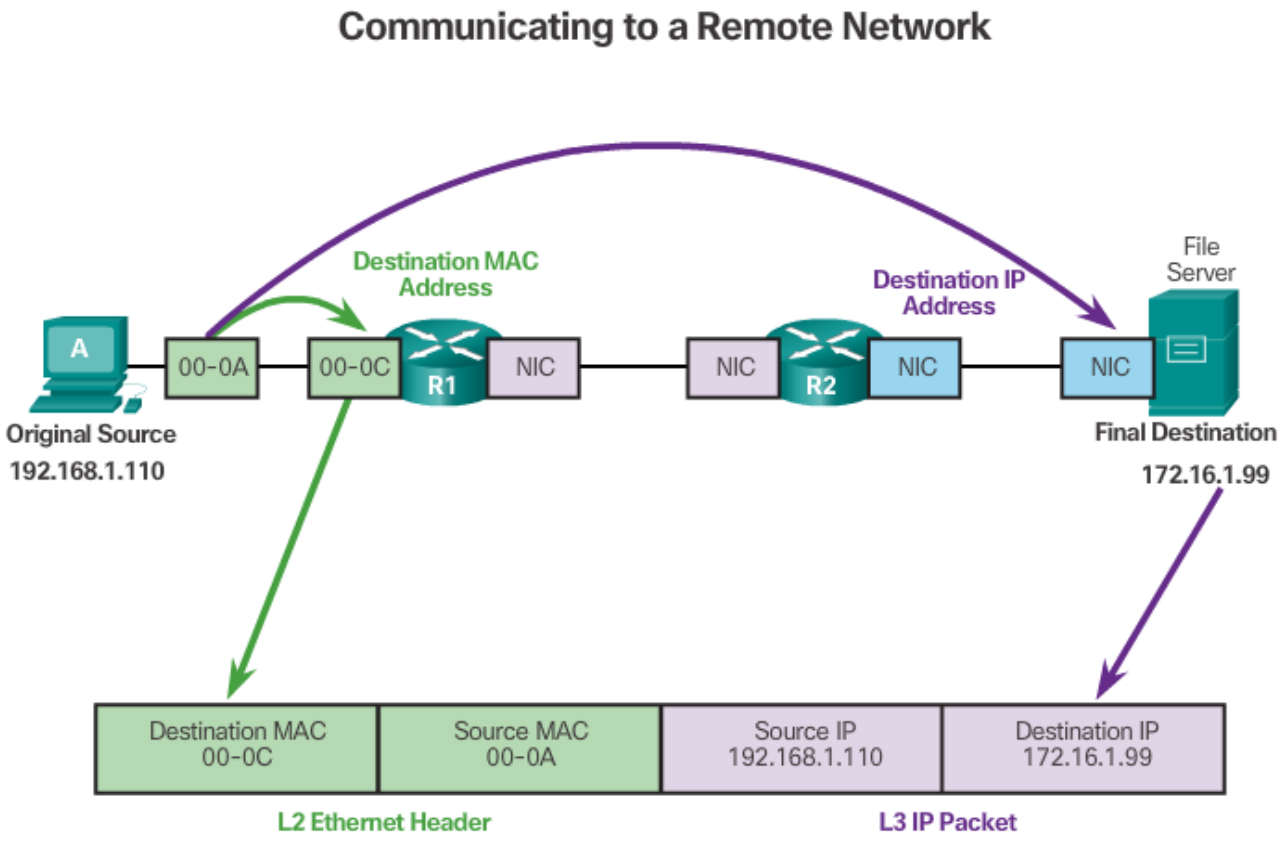
Destination on the Same Network

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

- Physical address (the MAC address) – Used for Ethernet NIC to Ethernet NIC communications on the same network.
- Logical address (the IP address) – Used to send the packet from the original source to the final destination.



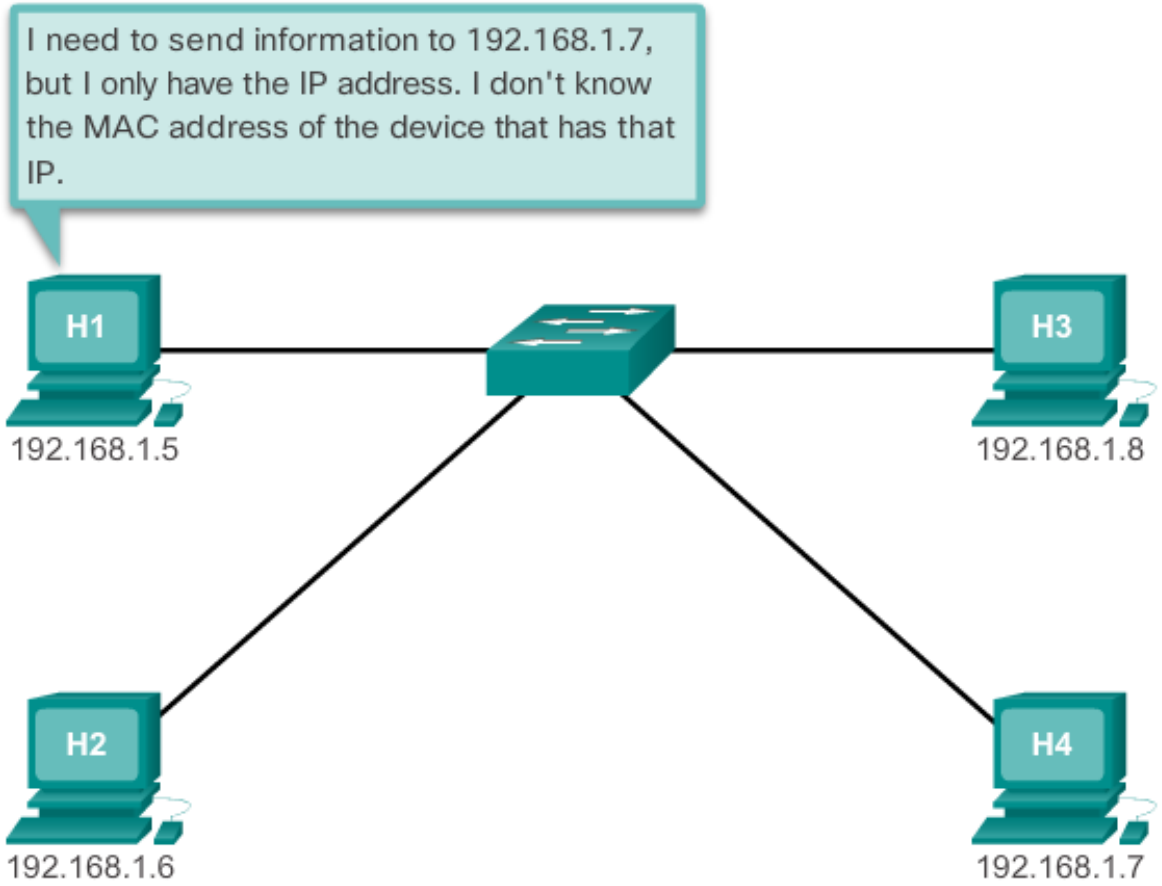
Destination on a Remote Network



MAC addresses are shortened for demonstration purposes.

Topic 5.3.2: ARP

Introduction to ARP



ARP Functions

ARP Table

- Used to find the MAC address that is mapped to the destination IPv4 address.
- If the destination IPv4 address is on the same network as the source IPv4, 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 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 no entry is found, then an ARP request is sent.

ARP Request

- Sent when a device needs a MAC address associated with an IPv4 address, and it does not have an entry in its ARP table.
- The ARP request message includes:

  Target IPv4 address – This is the IPv4 address that requires a corresponding MAC address.

  Target MAC address – This is the unknown MAC address and will be empty in the ARP request message.

- The ARP request is encapsulated in an Ethernet frame using the following header information:

  Destination MAC address – This is a broadcast address requiring all Ethernet NICs on the LAN to accept and process the ARP request.

  Source MAC address – This is the sender's MAC address.

  Type – ARP messages have a type field of 0x806.

- See VIDEO DEMONSTRATION

ARP Reply

- The device with the target IPv4 address in the ARP request will respond with an ARP reply. The ARP reply message includes:

  Sender's IPv4 address – This is the IPv4 address of the sender, the device whose MAC address was requested.

  Sender's MAC address – This is the MAC address of the sender, the MAC address needed by the sender of the ARP request.

- The ARP reply is encapsulated in an Ethernet frame using the following header information:

  Destination MAC address – This is the MAC address of the sender.

  Source MAC address – This is the sender of the ARP reply's MAC address.

  Type – ARP messages have a type field of 0x806.

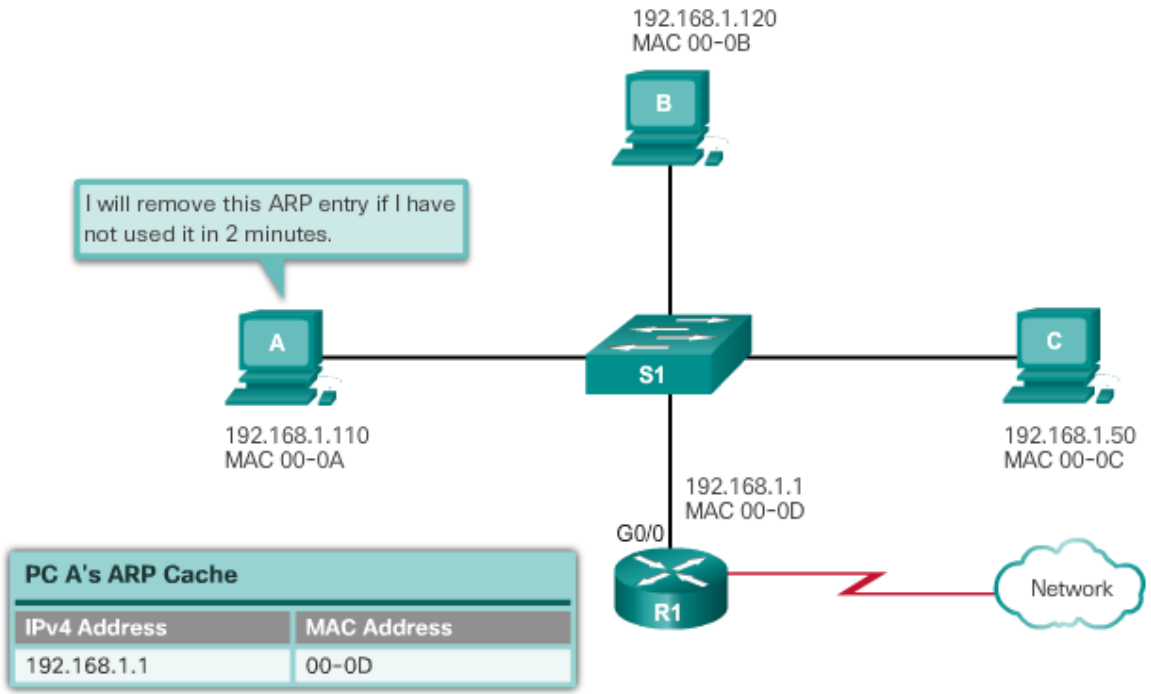
- See VIDEO DEMONSTRATION

Video Demonstration – ARP Role in Remote Communication

- When the destination IPv4 address is not on the same network as the source IPv4 address, the source device needs to send the frame to its default gateway.
- The source checks its ARP table for an entry with the IPv4 address of the default gateway.
- If there is not an entry, it uses the ARP process to determine the MAC address of the default gateway.
- See VIDEO DEMONSTRATION

Removing Entries from an ARP Table

- ARP cache timer removes ARP entries that have not been used for a specified period of time.
- Commands may also be used to manually remove all or some of the entries in the ARP table.



ARP Tables on Networking Devices

Router ARP Table

```
Router# show ip arp

                     Age
Protocol  Address          (min)  Hardware Addr   Type   Interface
Internet  172.16.233.229    -    0000.0c59.f892   ARPA   Ethernet0/0
Internet  172.16.233.218    -    0000.0c07.ac00   ARPA   Ethernet0/0
Internet  172.16.168.11     -    0000.0c63.1300   ARPA   Ethernet0/0
Internet  172.16.168.254    9    0000.0c36.6965   ARPA   Ethernet0/0
```

ARP Tables on Networking Devices (cont.)

Host ARP Table

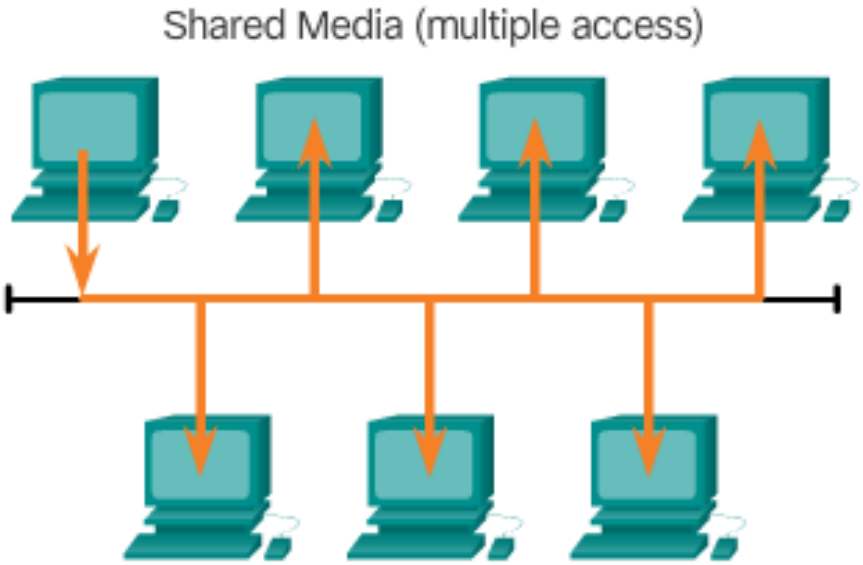
```
C:\> arp -a

Interface: 192.168.1.67 --- 0xa
  Internet Address      Physical Address      Type
  192.168.1.254         64-0f-29-0d-36-91     dynamic
  192.168.1.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 10.82.253.91 --- 0x10
  Internet Address      Physical Address      Type
  10.82.253.92          64-0f-29-0d-36-91     dynamic
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Topic 5.3.3:
ARP Issues

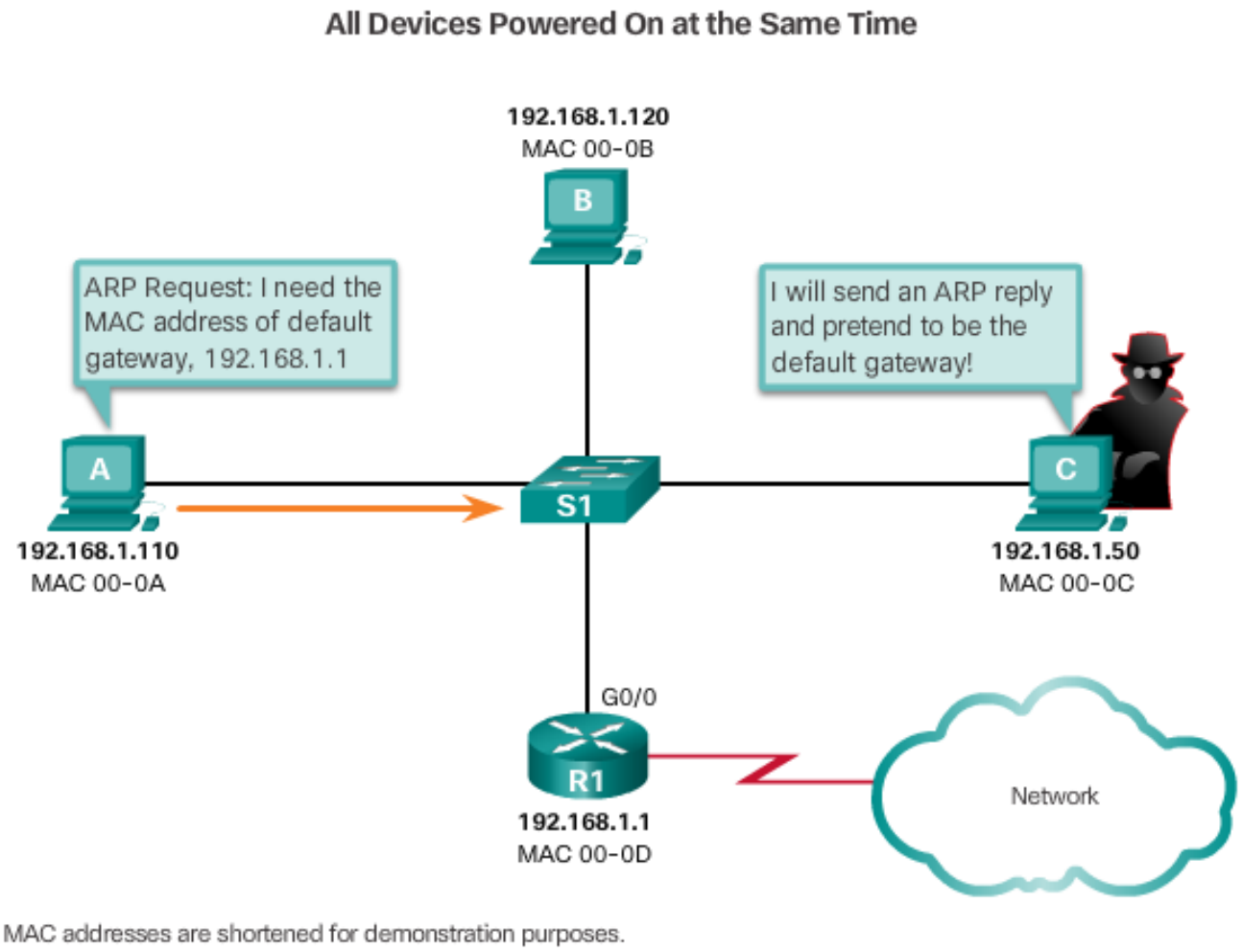
ARP Broadcasts

All devices powered on at the same time

ARP broadcasts can flood the local media.



ARP Spoofing



Section 5.4: Summary

Chapter Objectives:

- Explain the operation of Ethernet.
- Explain how a switch operates.
- Explain how the address resolution protocol enables communication on a network.

Thank you.

Cisco Networking Academy

Mind Wide Open