Address Resolution Protocol (ARP) is a protocol used to map IP addresses to MAC addresses in a network. It helps when one device wants to communicate with another device in the network.

Working of ARP:

1) In a situation where device 1 wants to communicate to device 2, it first checks whether the MAC address of device 2 is present in the ARP cache of device 1.
2) If it is present then it directly communicates with device 2 using the MAC address of that device.
3) If it is not present then device 1 will broadcast an ARP request message to all the devices in the network. The message will contain device 1's ip address , MAC address and ip address of device 2.
4) All devices will check whether their ip address matches with destination address in the broadcast message. If it does not match they will drop it.
5) When the packet reaches device 2 it will draft an ARP reply message add its ip and MAC address to the message and send it only to device 1.
6) Device 1 will receive the ARP reply message and update its ARP cache accordingly and start communication with device 2.

Experiment Configurations:

1) Open GNS3, design and make the connections according to the network in the image.
2) Configue the ip addresses of the router, end devices in the network.
3) Choose a connection between a switch and an end device.
4) Right click the connection and select capture option to open wireshark and capture the traffic flowing through the connection.
5) Ping another device in the network from that device.
6) Apply ARP filter to see and anlayze ARP messages.
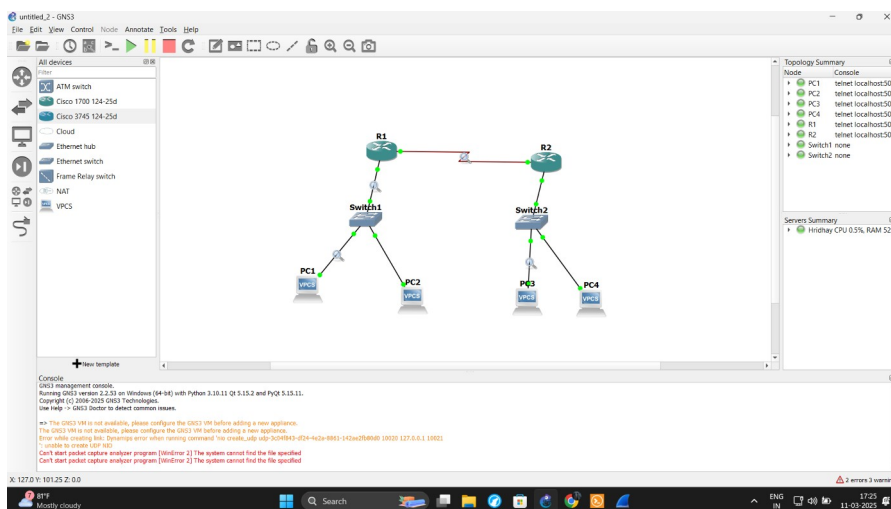
```
Connected to Dynamips VM "R2" (ID 2, type c3745) - Console port
Press ENTER to get the prompt.
e contact us by sending email to
export@cisco.com.

Cisco 3745 (R7000) processor (revision 2.0) with 249856K/12288K bytes of memory.
Processor board ID FTX0945W0MY
R7000 CPU at 350MHz, Implementation 39, Rev 2.1, 256KB L2, 512KB L3 Cache
3 FastEthernet interfaces
4 Serial interfaces
3 Serial(sync/async) interfaces
DRAM configuration is 64 bits wide with parity enabled.
151K bytes of NVRAM.

SETUP: new interface FastEthernet0/0 placed in "shutdown" state
SETUP: new interface Serial0/0 placed in "shutdown" state
SETUP: new interface FastEthernet0/1 placed in "shutdown" state
SETUP: new interface Serial0/1 placed in "shutdown" state
SETUP: new interface Serial0/2 placed in "shutdown" state
SETUP: new interface FastEthernet1/0 placed in "shutdown" state
SETUP: new interface Serial2/0 placed in "shutdown" state
SETUP: new interface Serial2/1 placed in "shutdown" state
SETUP: new interface Serial2/2 placed in "shutdown" state
SETUP: new interface Serial2/3 placed in "shutdown" state
% Crashinfo may not be recovered at flash:crashinfo
% This file system device reports an error


Press RETURN to get started!

sslinit fn

*Mar  1 00:00:03.783: %SW_VLAN-4-IFS_FAILURE: VLAN manager encountered file oper
ation error: call = ifs_open/read / code = 3588 (No device available)
    / bytes transfered = 0
*Mar  1 00:00:03.799: %LINEPROTO-5-UPDOWN: Line protocol on Interface VoIP-Null0
, changed state to up
*Mar  1 00:00:03.891: %SYS-5-CONFIG_I: Configured from memory by console
*Mar  1 00:00:03.955: %LINEPROTO-5-UPDOWN: Line protocol on Interface IPv6-mpls,
 changed state to up
*Mar  1 00:00:04.067: %SYS-5-RESTART: System restarted --
Cisco IOS Software, 3700 Software (C3745-ADVENTERPRISEK9-M), Version 12.4(25d),
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2010 by Cisco Systems, Inc.
Compiled Wed 18-Aug-10 08:18 by prod_rel_team
```

News for you
IndusInd Bank pr...   Q Search   ENG 17:26
                                                                                 IN   11-03-2025

```
 changed state to down
*Mar  1 00:00:05.687: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthern
et1/0, changed state to down
*Mar  1 00:00:05.691: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0,
 changed state to down
*Mar  1 00:00:05.691: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/1,
 changed state to down
*Mar  1 00:00:05.695: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/2,
 changed state to down
*Mar  1 00:00:05.699: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/3,
 changed state to down
R2#enable
R2#
R2#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface FastEthernet0/0
R2(config-if)#ip address 192.168.2.1 255.255.255.0
R2(config-if)#no shutdown
R2(config-if)#
*Mar  1 00:02:34.295: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Mar  1 00:02:35.295: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
R2(config-if)#do wr
Building configuration...
[OK]
R2(config-if)#exit
R2(config)#exit
R2#enabl
*Mar  1 00:02:49.927: %SYS-5-CONFIG_I: Configured from console by console
R2#enable
R2#show ip interafce brief
              ^
% Invalid input detected at '^' marker.

R2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        192.168.2.1     YES manual up                    up
Serial0/0              unassigned      YES unset  administratively down down
FastEthernet0/1        unassigned      YES unset  administratively down down
Serial0/1              unassigned      YES unset  administratively down down
Serial0/2              unassigned      YES unset  administratively down down
FastEthernet1/0        unassigned      YES unset  administratively down down
Serial2/0              unassigned      YES unset  administratively down down
Serial2/1              unassigned      YES unset  administratively down down
Serial2/2              unassigned      YES unset  administratively down down
Serial2/3              unassigned      YES unset  administratively down down
R2#enable
```

News for you
IndusInd Bank pr...   Q Search   ENG 17:27
                                                                                 IN   11-03-2025

```
LPORT      : 10022
RHOST:PORT : 127.0.0.1:10023
MTU:       : 1500

PC1> ping 192.168.2.3
192.168.2.3 icmp_seq=1 timeout
84 bytes from 192.168.2.3 icmp_seq=2 ttl=62 time=31.706 ms
84 bytes from 192.168.2.3 icmp_seq=3 ttl=62 time=31.244 ms
84 bytes from 192.168.2.3 icmp_seq=4 ttl=62 time=31.406 ms
84 bytes from 192.168.2.3 icmp_seq=5 ttl=62 time=31.375 ms

PC1> ping 192.168.2.3
84 bytes from 192.168.2.3 icmp_seq=1 ttl=62 time=30.130 ms
84 bytes from 192.168.2.3 icmp_seq=2 ttl=62 time=30.749 ms
84 bytes from 192.168.2.3 icmp_seq=3 ttl=62 time=31.333 ms
84 bytes from 192.168.2.3 icmp_seq=4 ttl=62 time=30.557 ms
84 bytes from 192.168.2.3 icmp_seq=5 ttl=62 time=31.869 ms

PC1> ping 192.168.2.4
192.168.2.4 icmp_seq=1 timeout
84 bytes from 192.168.2.4 icmp_seq=2 ttl=62 time=30.993 ms
84 bytes from 192.168.2.4 icmp_seq=3 ttl=62 time=32.358 ms
84 bytes from 192.168.2.4 icmp_seq=5 ttl=62 time=31.346 ms

PC1> ping 192.168.2.4
84 bytes from 192.168.2.4 icmp_seq=1 ttl=62 time=31.002 ms
84 bytes from 192.168.2.4 icmp_seq=2 ttl=62 time=31.783 ms
84 bytes from 192.168.2.4 icmp_seq=3 ttl=62 time=30.902 ms
84 bytes from 192.168.2.4 icmp_seq=4 ttl=62 time=31.185 ms
84 bytes from 192.168.2.4 icmp_seq=5 ttl=62 time=31.153 ms

PC1> ping 192.168.2.3
192.168.2.3 icmp_seq=1 timeout
192.168.2.3 icmp_seq=2 timeout
84 bytes from 192.168.2.3 icmp_seq=3 ttl=62 time=30.484 ms
84 bytes from 192.168.2.3 icmp_seq=4 ttl=62 time=31.156 ms
84 bytes from 192.168.2.3 icmp_seq=5 ttl=62 time=30.788 ms

PC1> ping 192.168.2.3
84 bytes from 192.168.2.3 icmp_seq=1 ttl=62 time=30.963 ms
84 bytes from 192.168.2.3 icmp_seq=2 ttl=62 time=30.755 ms
84 bytes from 192.168.2.3 icmp_seq=3 ttl=62 time=31.267 ms
84 bytes from 192.168.2.3 icmp_seq=4 ttl=62 time=30.746 ms
84 bytes from 192.168.2.3 icmp_seq=5 ttl=62 time=31.403 ms

PC1>
```

Capturing from Standard input [Switch2 Ethernet0 to PC3 Ethernet0]

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arp

No.	Time	Source	Destination	Protocol	Length	Info
6	193.174946	Private_66:68:03	Broadcast	ARP	64	Who has 192.168.2.1? Tell 192.168.2.3
7	193.186513	c4:02:19:5c:00:00	Private_66:68:03	ARP	60	192.168.2.1 is at c4:02:19:5c:00:00
8	194.176509	Private_66:68:03	Broadcast	ARP	64	Who has 192.168.2.1? Tell 192.168.2.3
9	194.191256	c4:02:19:5c:00:00	Private_66:68:03	ARP	60	192.168.2.1 is at c4:02:19:5c:00:00
11	195.193057	Private_66:68:03	Broadcast	ARP	64	Who has 192.168.2.1? Tell 192.168.2.3
12	195.207117	c4:02:19:5c:00:00	Private_66:68:03	ARP	60	192.168.2.1 is at c4:02:19:5c:00:00

```
Encapsulation type: Ethernet (1)
Arrival Time: Mar 11, 2025 15:38:42.450648000 India Standard Time
UTC Arrival Time: Mar 11, 2025 10:08:42.450648000 UTC
Epoch Arrival Time: 1741687722.450648000
[Time shift for this packet: 0.000000000 seconds]
[Time delta from previous captured frame: 0.001523000 seconds]
[Time delta from previous displayed frame: 0.000000000 seconds]
[Time since reference or first frame: 193.174946000 seconds]
Frame Number: 6
Frame Length: 64 bytes (512 bits)
Capture Length: 64 bytes (512 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:arp]
[Coloring Rule Name: ARP]
[Coloring Rule String: arp]
Ethernet II, Src: Private_66:68:03 (00:50:79:66:68:03), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  Source: Private_66:68:03 (00:50:79:66:68:03)
  Type: ARP (0x0806)
  [Stream index: 3]
  Padding: 000000000000000000000000000000000000
  Frame check sequence: 0x00000000 [unverified]
  [FCS Status: Unverified]
Address Resolution Protocol (request)
  Hardware type: Ethernet (1)
  Protocol type: IPv4 (0x0800)
  Hardware size: 6
  Protocol size: 4
  Opcode: request (1)
  Sender MAC address: Private_66:68:03 (00:50:79:66:68:03)
  Sender IP address: 192.168.2.3
  Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)
  Target IP address: 192.168.2.1
```

```
0000  ff ff ff ff ff ff 00 50  79 66 68 03 08 06 00 01   ·······P yfh····
0010  08 00 06 04 00 01 00 50  79 66 68 03 c0 a8 02 03   ·······P yfh····
0020  ff ff ff ff ff ff c0 a8  02 01 00 00 00 00 00 00   ················
0030  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ················
```

Address Resolution Protocol: Protocol   Packets: 139 · Displayed: 6 (4.3%)   Profile: Default

Screenshot 1: Capturing from Standard input [Switch2 Ethernet0 to PC3 Ethernet0]

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Filter: arp

No.	Time	Source	Destination	Protocol	Length Info
6	193.174946	Private_66:68:03	Broadcast	ARP	64 Who has 192.168.2.1? Tell 192.168.2.3
7	193.186513	c4:02:19:5c:00:00	Private_66:68:03	ARP	60 192.168.2.1 is at c4:02:19:5c:00:00
8	194.176509	Private_66:68:03	Broadcast	ARP	64 Who has 192.168.2.1? Tell 192.168.2.3
9	194.191256	c4:02:19:5c:00:00	Private_66:68:03	ARP	60 192.168.2.1 is at c4:02:19:5c:00:00
11	195.193057	Private_66:68:03	Broadcast	ARP	64 Who has 192.168.2.1? Tell 192.168.2.3
12	195.207117	c4:02:19:5c:00:00	Private_66:68:03	ARP	60 192.168.2.1 is at c4:02:19:5c:00:00

Section number: 1
> Interface id: 0 (-)
Encapsulation type: Ethernet (1)
Arrival Time: Mar 11, 2025 15:38:42.462215000 India Standard Time
UTC Arrival Time: Mar 11, 2025 10:08:42.462215000 UTC
Epoch Arrival Time: 1741687722.462215000
[Time shift for this packet: 0.000000000 seconds]
[Time delta from previous captured frame: 0.011567000 seconds]
[Time delta from previous displayed frame: 0.011567000 seconds]
[Time since reference or first frame: 193.186513000 seconds]
Frame Number: 7
Frame Length: 60 bytes (480 bits)
Capture Length: 60 bytes (480 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:arp]
[Coloring Rule Name: ARP]
[Coloring Rule String: arp]
> Ethernet II, Src: c4:02:19:5c:00:00 (c4:02:19:5c:00:00), Dst: Private_66:68:03 (00:50:79:66:68:03)
> Destination: Private_66:68:03 (00:50:79:66:68:03)
> Source: c4:02:19:5c:00:00 (c4:02:19:5c:00:00)
Type: ARP (0x0806)
[Stream index: 2]
Padding: 000000000000000000000000000000000000
> Address Resolution Protocol (reply)
Hardware type: Ethernet (1)
Protocol type: IPv4 (0x0800)
Hardware size: 6
Protocol size: 4
Opcode: reply (2)
Sender MAC address: c4:02:19:5c:00:00 (c4:02:19:5c:00:00)
Sender IP address: 192.168.2.1
Target MAC address: Private_66:68:03 (00:50:79:66:68:03)
Target IP address: 192.168.2.3

```
0000  00 50 79 66 68 03 c4 02  19 5c 00 00 08 06 00 01   ·Pyfh··· ·\······
0010  08 00 06 04 00 02 c4 02  19 5c 00 00 c0 a8 02 01   ········ ·\······
0020  00 50 79 66 68 03 c0 a8  02 03 00 00 00 00 00 00   ·Pyfh··· ········
0030  00 00 00 00 00 00 00 00  00 00 00 00               ········ ····
```

Address Resolution Protocol: Protocol
Packets: 140 · Displayed: 6 (4.3%)   Profile: Default

Screenshot 2: Capturing from Standard input [Switch1 Ethernet1 to PC1 Ethernet0]

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Filter: arp

No.	Time	Source	Destination	Protocol	Length Info
5	276.001468	Private_66:68:00	Broadcast	ARP	64 Who has 192.168.190.1? Tell 192.168.190.3
6	276.015966	c4:01:3f:6c:00:00	Private_66:68:00	ARP	60 192.168.190.1 is at c4:01:3f:6c:00:00

> Frame 5: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface -, id 0
Section number: 1
> Interface id: 0 (-)
Encapsulation type: Ethernet (1)
Arrival Time: Mar 11, 2025 15:38:42.401762000 India Standard Time
UTC Arrival Time: Mar 11, 2025 10:08:42.401762000 UTC
Epoch Arrival Time: 1741687722.401762000
[Time shift for this packet: 0.000000000 seconds]
[Time delta from previous captured frame: 55.698201000 seconds]
[Time delta from previous displayed frame: 0.000000000 seconds]
[Time since reference or first frame: 276.001468000 seconds]
Frame Number: 5
Frame Length: 64 bytes (512 bits)
Capture Length: 64 bytes (512 bits)
[Frame is marked: False]
[Frame is ignored: False]
[Protocols in frame: eth:ethertype:arp]
[Coloring Rule Name: ARP]
[Coloring Rule String: arp]
> Ethernet II, Src: Private_66:68:00 (00:50:79:66:68:00), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
> Destination: Broadcast (ff:ff:ff:ff:ff:ff)
> Source: Private_66:68:00 (00:50:79:66:68:00)
Type: ARP (0x0806)
[Stream index: 1]
Padding: 000000000000000000000000000000000000
Frame check sequence: 0x00000000 [unverified]
[FCS Status: Unverified]
> Address Resolution Protocol (request)
Hardware type: Ethernet (1)
Protocol type: IPv4 (0x0800)
Hardware size: 6
Protocol size: 4
Opcode: request (1)
Sender MAC address: Private_66:68:00 (00:50:79:66:68:00)
Sender IP address: 192.168.190.3
Target MAC address: Broadcast (ff:ff:ff:ff:ff:ff)
Target IP address: 192.168.190.1

```
0000  ff ff ff ff ff ff 00 50  79 66 68 00 08 06 00 01   ·······P yfh·····
0010  08 00 06 04 00 01 00 50  79 66 68 00 c0 a8 be 03   ·······P yfh·····
0020  ff ff ff ff ff ff c0 a8  be 01 00 00 00 00 00 00   ········ ········
0030  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   ········ ········
```

Address Resolution Protocol: Protocol
Packets: 143 · Displayed: 2 (1.4%)   Profile: Default

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

arp

No.	Time	Source	Destination	Protocol	Length Info
5	276.001468	Private_66:68:00	Broadcast	ARP	64 Who has 192.168.190.1? Tell 192.168.190.3
6	276.015966	c4:01:3f:6c:00:00	Private_66:68:00	ARP	60 192.168.190.1 is at c4:01:3f:6c:00:00

> Frame 6: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface -, id 0
    Section number: 1
  > Interface id: 0 (-)
    Encapsulation type: Ethernet (1)
    Arrival Time: Mar 11, 2025 15:38:42.416260000 India Standard Time
    UTC Arrival Time: Mar 11, 2025 10:08:42.416260000 UTC
    Epoch Arrival Time: 1741687722.416260000
    [Time shift for this packet: 0.000000000 seconds]
    [Time delta from previous captured frame: 0.014498000 seconds]
    [Time delta from previous displayed frame: 0.014498000 seconds]
    [Time since reference or first frame: 276.015966000 seconds]
    Frame Number: 6
    Frame Length: 60 bytes (480 bits)
    Capture Length: 60 bytes (480 bits)
    [Frame is marked: False]
    [Frame is ignored: False]
    [Protocols in frame: eth:ethertype:arp]
    [Coloring Rule Name: ARP]
    [Coloring Rule String: arp]
> Ethernet II, Src: c4:01:3f:6c:00:00 (c4:01:3f:6c:00:00), Dst: Private_66:68:00 (00:50:79:66:68:00)
  > Destination: Private_66:68:00 (00:50:79:66:68:00)
  > Source: c4:01:3f:6c:00:00 (c4:01:3f:6c:00:00)
    Type: ARP (0x0806)
    [Stream index: 2]
    Padding: 000000000000000000000000000000000000
> Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: c4:01:3f:6c:00:00 (c4:01:3f:6c:00:00)
    Sender IP address: 192.168.190.1
    Target MAC address: Private_66:68:00 (00:50:79:66:68:00)
    Target IP address: 192.168.190.3

```
0000  00 50 79 66 68 00 c4 01  3f 6c 00 00 08 06 00 01   ·Pyfh··· ?l······
0010  08 00 06 04 00 02 c4 01  3f 6c 00 00 c0 a8 be 01   ········ ?l······
0020  00 50 79 66 68 00 c0 a8  be 03 00 00 00 00 00 00   ·Pyfh··· ········
0030  00 00 00 00 00 00 00 00  00 00 00 00               ········ ····
```

Address Resolution Protocol: Protocol   Packets: 143 · Displayed: 2 (1.4%)   Profile: Default