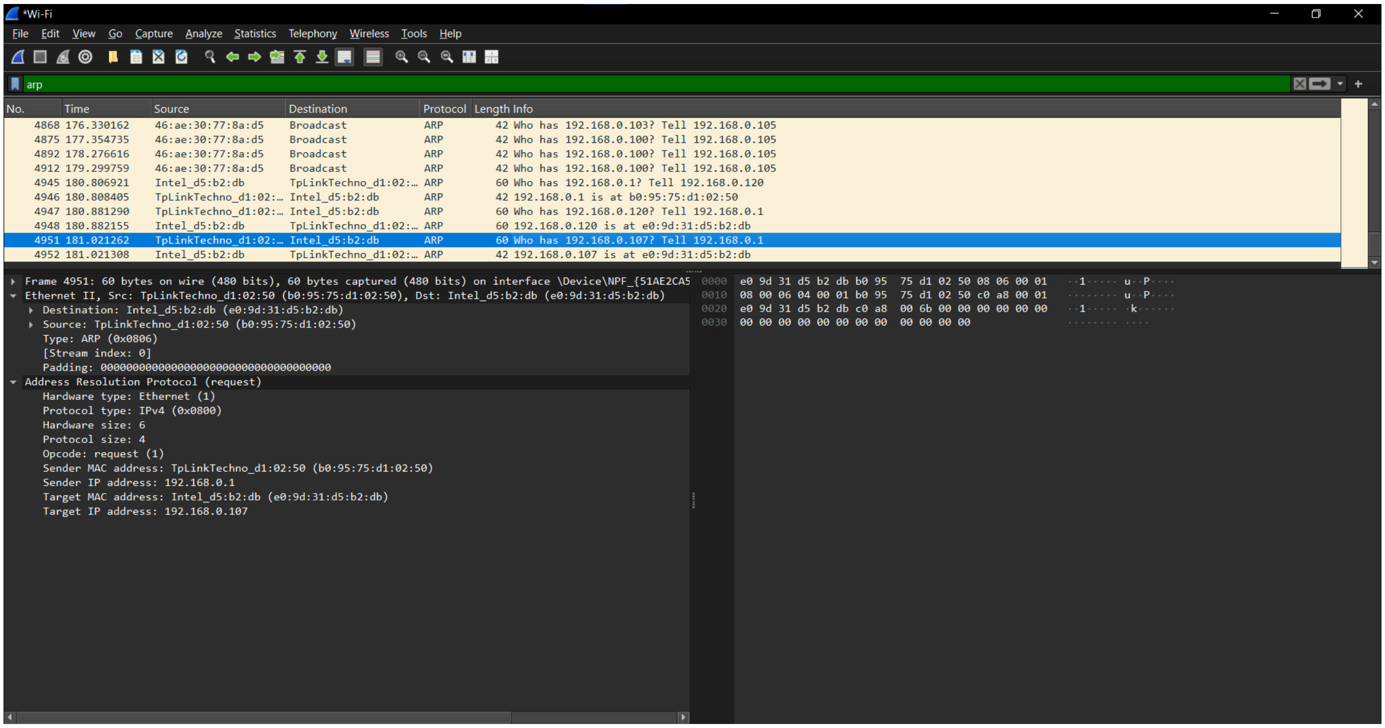
1)Capture and analyze ARP packets using Wireshark. Inspect the ARP request and reply frames when your device attempts to find the router's MAC address.

Discuss the importance of ARP in packet forwarding.

1. **Maps IP Addresses to MAC Addresses**
    a. Since Ethernet uses **MAC addresses** but IP communication uses **IP addresses**, ARP is necessary for mapping them.
2. **Enables Communication in LAN**
    a. Before sending an IP packet, the sender must find the **receiver's MAC address** using ARP.
3. **Supports Default Gateway (Router) Discovery**
    a. When a device wants to communicate outside the LAN, it **first finds the router's MAC address** via ARP.
4. **Impacts Network Performance**
    a. Excessive ARP requests can cause **network congestion** (e.g., ARP storms).
    b. ARP spoofing can be exploited in **man-in-the-middle attacks**.

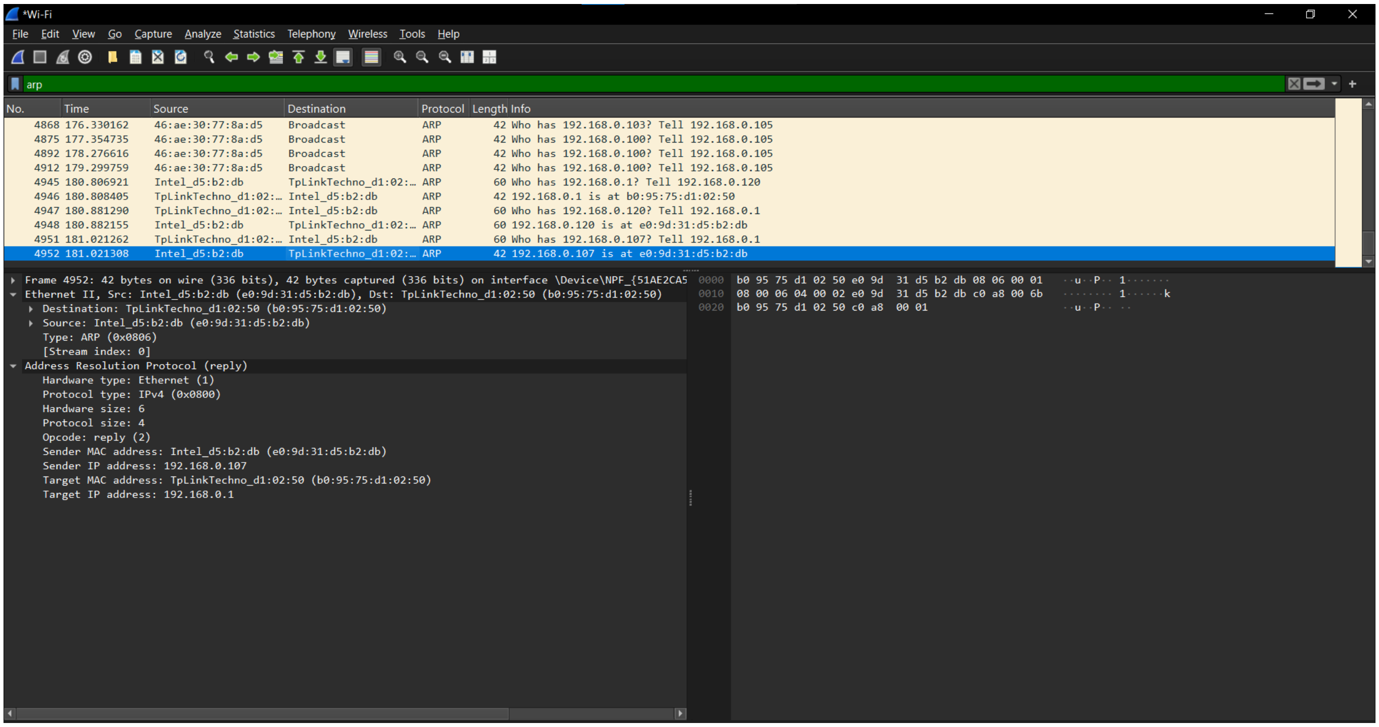
ARP Request for Router



```
No.   Time        Source              Destination         Protocol Length Info
 4868 176.330162  46:ae:30:77:8a:d5   Broadcast           ARP       42 Who has 192.168.0.103? Tell 192.168.0.105
 4875 177.354735  46:ae:30:77:8a:d5   Broadcast           ARP       42 Who has 192.168.0.100? Tell 192.168.0.105
 4892 178.276616  46:ae:30:77:8a:d5   Broadcast           ARP       42 Who has 192.168.0.100? Tell 192.168.0.105
 4912 179.299759  46:ae:30:77:8a:d5   Broadcast           ARP       42 Who has 192.168.0.100? Tell 192.168.0.105
 4945 180.806921  Intel_d5:b2:db      TpLinkTechno_d1:02:… ARP      60 Who has 192.168.0.1? Tell 192.168.0.120
 4946 180.808405  TpLinkTechno_d1:02:… Intel_d5:b2:db     ARP       42 192.168.0.1 is at b0:95:75:d1:02:50
 4947 180.881290  TpLinkTechno_d1:02:… Intel_d5:b2:db     ARP       60 Who has 192.168.0.120? Tell 192.168.0.1
 4948 180.882155  Intel_d5:b2:db      TpLinkTechno_d1:02:… ARP      60 192.168.0.120 is at e0:9d:31:d5:b2:db
 4951 181.021262  TpLinkTechno_d1:02:… Intel_d5:b2:db     ARP       60 Who has 192.168.0.107? Tell 192.168.0.1
 4952 181.021308  Intel_d5:b2:db      TpLinkTechno_d1:02:… ARP      42 192.168.0.107 is at e0:9d:31:d5:b2:db
```

```
▸ Frame 4951: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface \Device\NPF_{51AE2CA5
▾ Ethernet II, Src: TpLinkTechno_d1:02:50 (b0:95:75:d1:02:50), Dst: Intel_d5:b2:db (e0:9d:31:d5:b2:db)
  ▸ Destination: Intel_d5:b2:db (e0:9d:31:d5:b2:db)
  ▸ Source: TpLinkTechno_d1:02:50 (b0:95:75:d1:02:50)
    Type: ARP (0x0806)
    [Stream index: 0]
    Padding: 000000000000000000000000000000000000
▾ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: TpLinkTechno_d1:02:50 (b0:95:75:d1:02:50)
    Sender IP address: 192.168.0.1
    Target MAC address: Intel_d5:b2:db (e0:9d:31:d5:b2:db)
    Target IP address: 192.168.0.107
```

```
0000  e0 9d 31 d5 b2 db b0 95  75 d1 02 50 08 06 00 01   ··1·····u··P····
0010  08 00 06 04 00 01 b0 95  75 d1 02 50 c0 a8 00 01   ········u··P····
0020  e0 9d 31 d5 b2 db c0 a8  00 6b 00 00 00 00 00 00   ··1······k······
0030  00 00 00 00 00 00 00 00  00 00 00 00               ············
```



arp

```
No.   Time       Source                  Destination             Protocol Length Info
 4868 176.330162 46:ae:30:77:8a:d5       Broadcast               ARP        42 Who has 192.168.0.103? Tell 192.168.0.105
 4875 177.354735 46:ae:30:77:8a:d5       Broadcast               ARP        42 Who has 192.168.0.100? Tell 192.168.0.105
 4892 178.276616 46:ae:30:77:8a:d5       Broadcast               ARP        42 Who has 192.168.0.100? Tell 192.168.0.105
 4912 179.299759 46:ae:30:77:8a:d5       Broadcast               ARP        42 Who has 192.168.0.100? Tell 192.168.0.105
 4945 180.806921 Intel_d5:b2:db          TpLinkTechno_d1:02:…    ARP        60 Who has 192.168.0.1? Tell 192.168.0.120
 4946 180.808405 TpLinkTechno_d1:02:…    Intel_d5:b2:db          ARP        42 192.168.0.1 is at b0:95:75:d1:02:50
 4947 180.881290 TpLinkTechno_d1:02:…    Intel_d5:b2:db          ARP        60 Who has 192.168.0.120? Tell 192.168.0.1
 4948 180.882155 Intel_d5:b2:db          TpLinkTechno_d1:02:…    ARP        60 192.168.0.120 is at e0:9d:31:d5:b2:db
 4951 181.021262 TpLinkTechno_d1:02:…    Intel_d5:b2:db          ARP        60 Who has 192.168.0.107? Tell 192.168.0.1
 4952 181.021308 Intel_d5:b2:db          TpLinkTechno_d1:02:…    ARP        42 192.168.0.107 is at e0:9d:31:d5:b2:db
```

```
▸ Frame 4952: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{51AE2CA5
▾ Ethernet II, Src: Intel_d5:b2:db (e0:9d:31:d5:b2:db), Dst: TpLinkTechno_d1:02:50 (b0:95:75:d1:02:50)
   ▸ Destination: TpLinkTechno_d1:02:50 (b0:95:75:d1:02:50)
   ▸ Source: Intel_d5:b2:db (e0:9d:31:d5:b2:db)
     Type: ARP (0x0806)
     [Stream index: 0]
▾ Address Resolution Protocol (reply)
     Hardware type: Ethernet (1)
     Protocol type: IPv4 (0x0800)
     Hardware size: 6
     Protocol size: 4
     Opcode: reply (2)
     Sender MAC address: Intel_d5:b2:db (e0:9d:31:d5:b2:db)
     Sender IP address: 192.168.0.107
     Target MAC address: TpLinkTechno_d1:02:50 (b0:95:75:d1:02:50)
     Target IP address: 192.168.0.1
```

```
0000  b0 95 75 d1 02 50 e0 9d  31 d5 b2 db 08 06 00 01   ··u··P·· 1·······
0010  08 00 06 04 00 02 e0 9d  31 d5 b2 db c0 a8 00 6b   ········ 1······k
0020  b0 95 75 d1 02 50 c0 a8  00 01                     ··u··P·· ··
```