COMPUTER NETWORK
Lab 6

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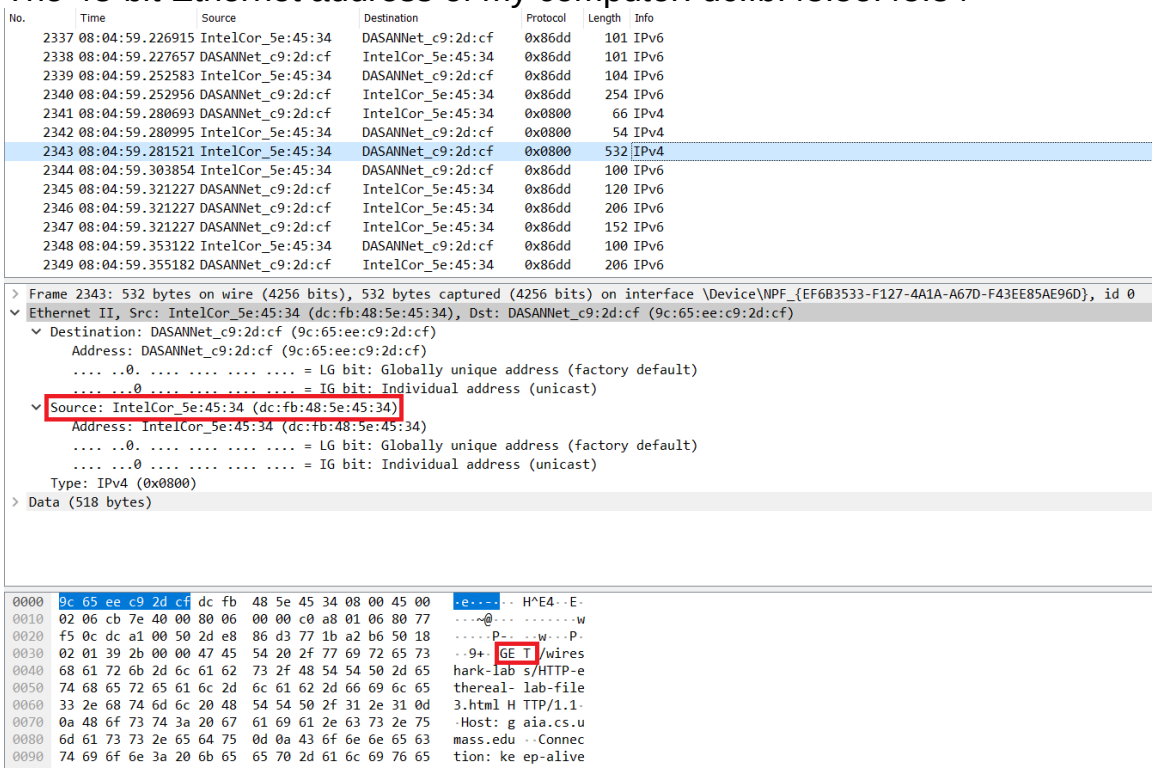
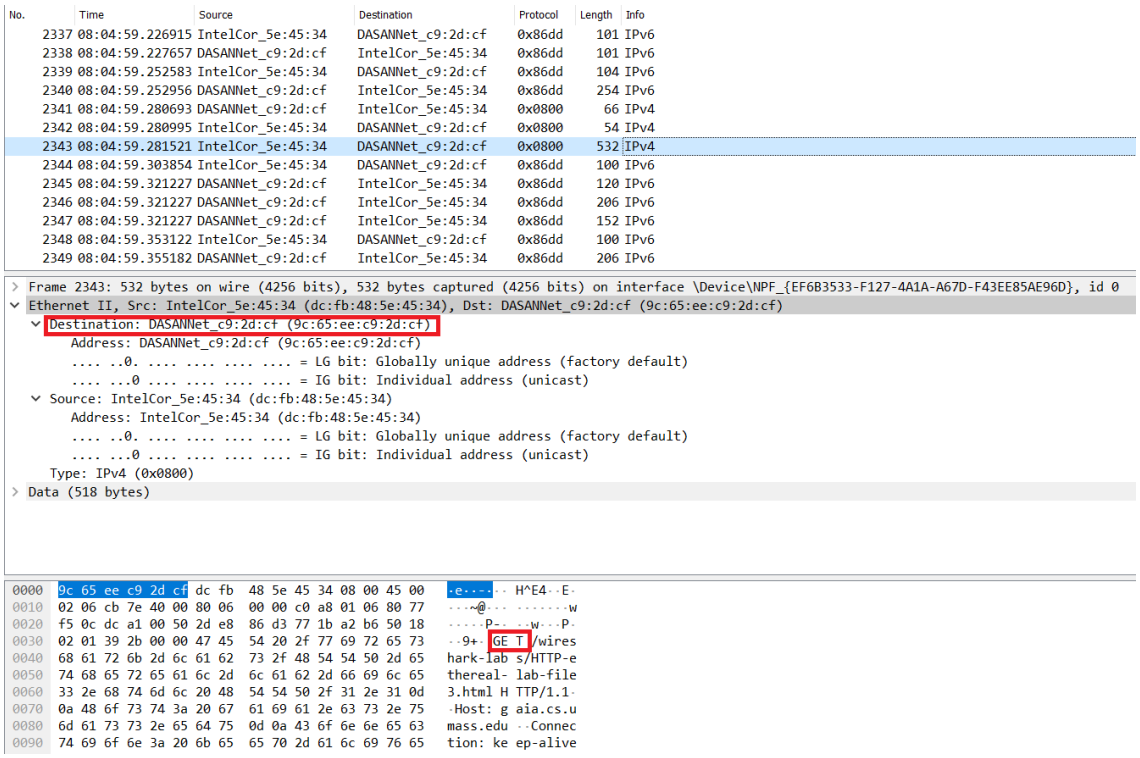
I/ Capturing and analyzing Ethernet frames

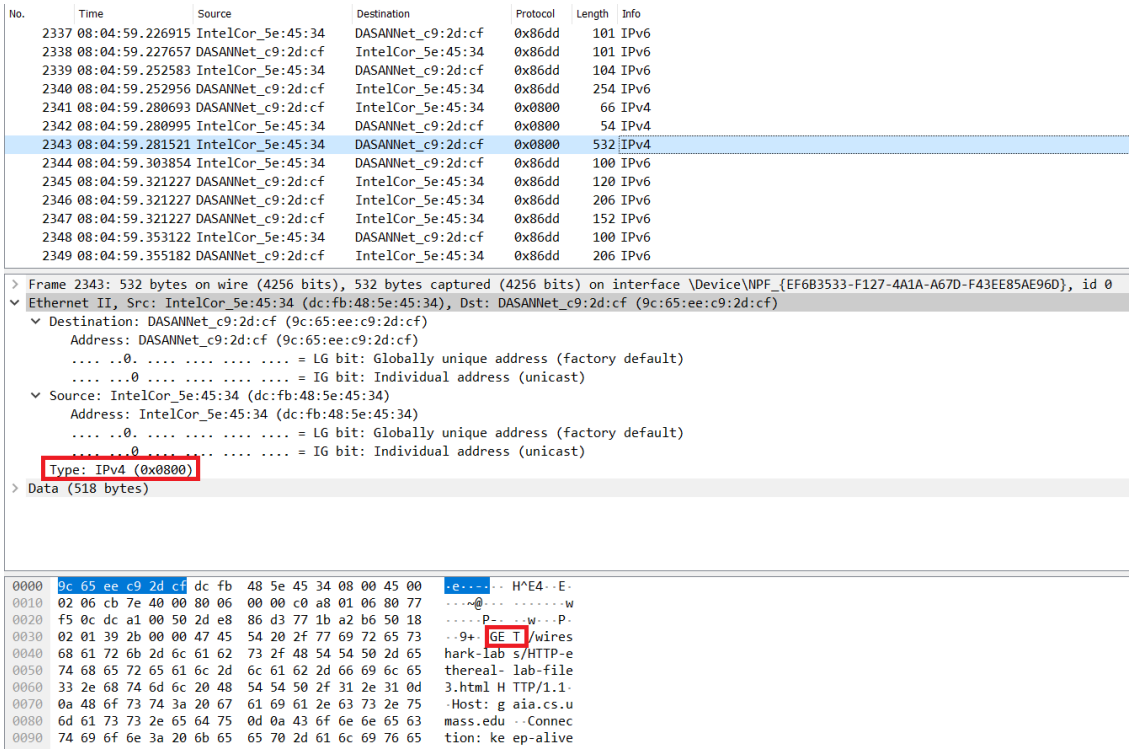
1. What is the 48-bit Ethernet address of your computer?
   Ans:
   The 48-bit Ethernet address of my computer: dc:fb:48:5e:45:34



2. What is the 48-bit destination address in the Ethernet frame? Is this the Ethernet address of gaia.cs.umass.edu? What device has this as its Ethernet address?
   Ans: The destination address 9c:65:ee:c9:2d:cf is not the Ethernet address of gaia.cs.umass.edu. It is the address of my DASANNet router, which is the link used to get off the subnet.

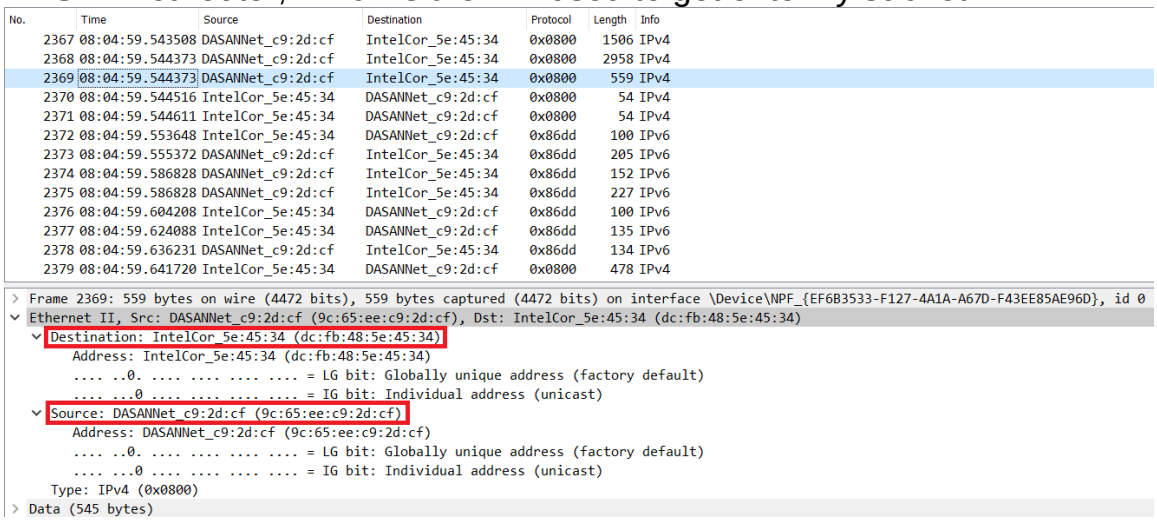


3. Give the hexadecimal value for the two-byte Frame type field. What upper layer protocol does this correspond to?
   Ans: The hexadecimal value for the two-byte Frame type field is 0x0800. This corresponds to the IP protocol (the frame type field indicates that the nest layer above IP – the layer to which the payload of ths Ethernet frame will be passed – is IP).



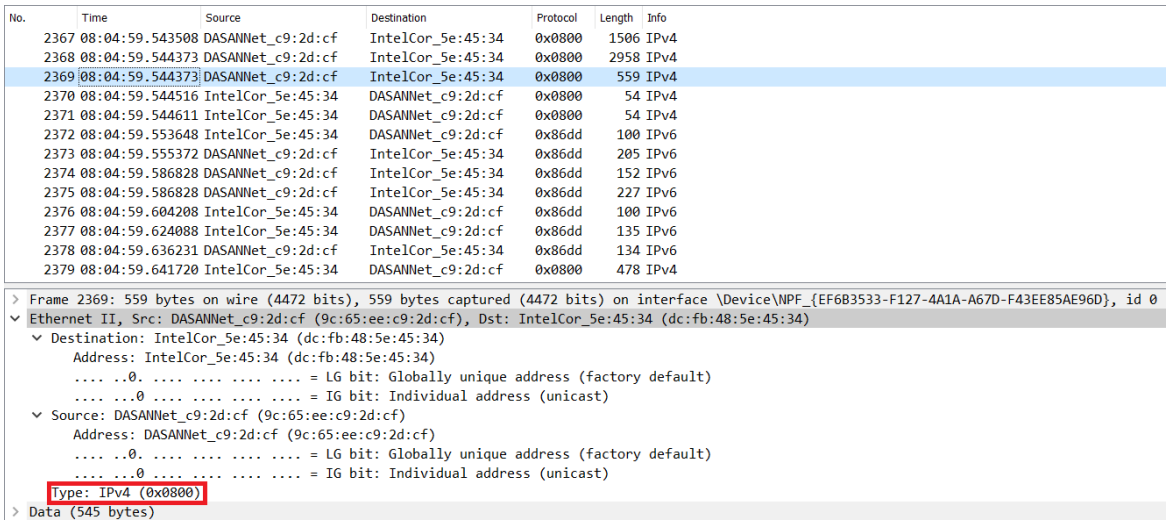
4. How many bytes from the very start of the Ethernet frame does the ASCII “G” in “GET” appear in the Ethernet frame?
   Ans: The ASCII “G” appears 52 bytes from the start of the Ethernet frame. There are 14 B Ethernet frame, and then 20 bytes of IP header followed by 20 bytes of TCP header before the HTTP data is encountered.

5. What is the value of the Ethernet source address? Is this the address of your computer, or of gaia.cs.umass.edu? What device has this as its Ethernet address?
   Ans:
   The source address 9c:65:ee:c9:2d:cf is neither the Ethernet address of gaia.cs.umass.edu nor the address of my computer. It is the address of my DASANNet router, which is the link used to get onto my subnet.



6. What is the destination address in the Ethernet frame? Is this the Ethernet address of your computer?
   Ans: The destination address dc:fb:48:5e:45:34 is the address of my computer.

7. Give the hexadecimal value for the two-byte Frame type field. What upper layer protocol does this correspond to?
   Ans: The hexadecimal value for the two-byte Frame type field is 0x0800. This value corresponds to the IP protocol.



No.	Time	Source	Destination	Protocol	Length	Info
2367	08:04:59.543508	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x0800	1506	IPv4
2368	08:04:59.544373	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x0800	2958	IPv4
2369	08:04:59.544373	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x0800	559	IPv4
2370	08:04:59.544516	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x0800	54	IPv4
2371	08:04:59.544611	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x0800	54	IPv4
2372	08:04:59.553648	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6
2373	08:04:59.555372	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	205	IPv6
2374	08:04:59.586828	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	152	IPv6
2375	08:04:59.586828	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	227	IPv6
2376	08:04:59.604208	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6
2377	08:04:59.624088	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	135	IPv6
2378	08:04:59.636231	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	134	IPv6
2379	08:04:59.641720	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x0800	478	IPv4

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> Frame 2369: 559 bytes on wire (4472 bits), 559 bytes captured (4472 bits) on interface \Device\NPF_{EF6B3533-F127-4A1A-A67D-F43EE85AE96D}, id 0
v Ethernet II, Src: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf), Dst: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
  v Destination: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
      Address: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
      .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
  v Source: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
      Address: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
      .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Type: IPv4 (0x0800)
> Data (545 bytes)
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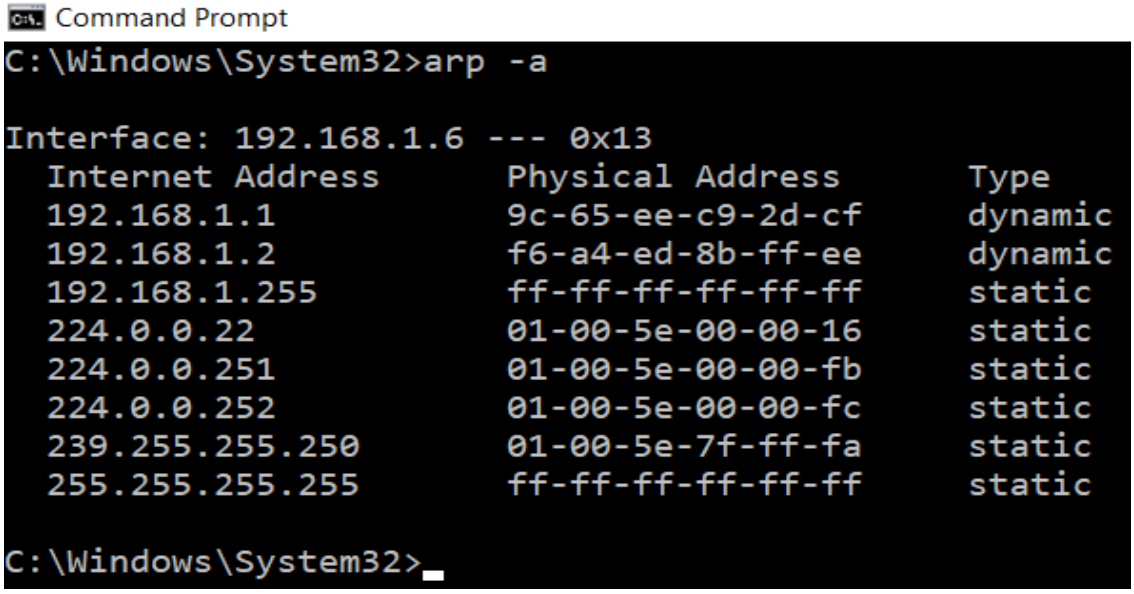
8. How many bytes from the very start of the Ethernet frame does the ASCII "O" in "OK" appear in the Ethernet frame?
   Ans: The ASCII "O" appears 52 bytes from the start of the Ethernet frame. Again, there are 14 bytes of Ethernet frame, and then 20 bytes of IP header followed by 20 bytes of TCP header before the HTTP data is encountered.

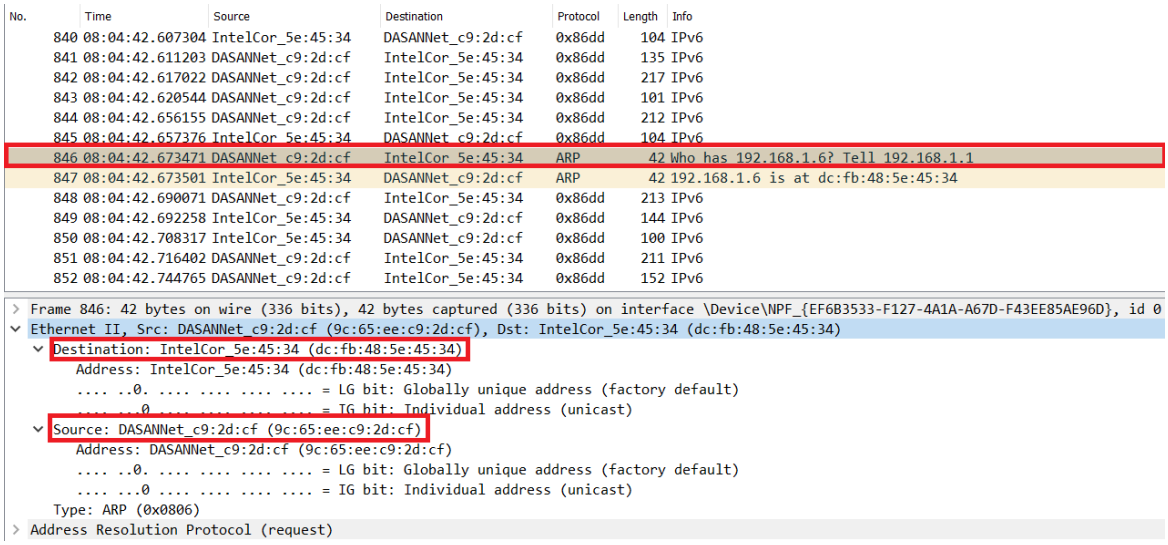
   II/ The Address Resolution Protocol

9. Write down the contents of your computer's ARP cache. What is the meaning of each column value?
   Ans: The Internet Address column contains the IP address, the Physical Address column contains the MAC address, and the type indicates the protocol type.



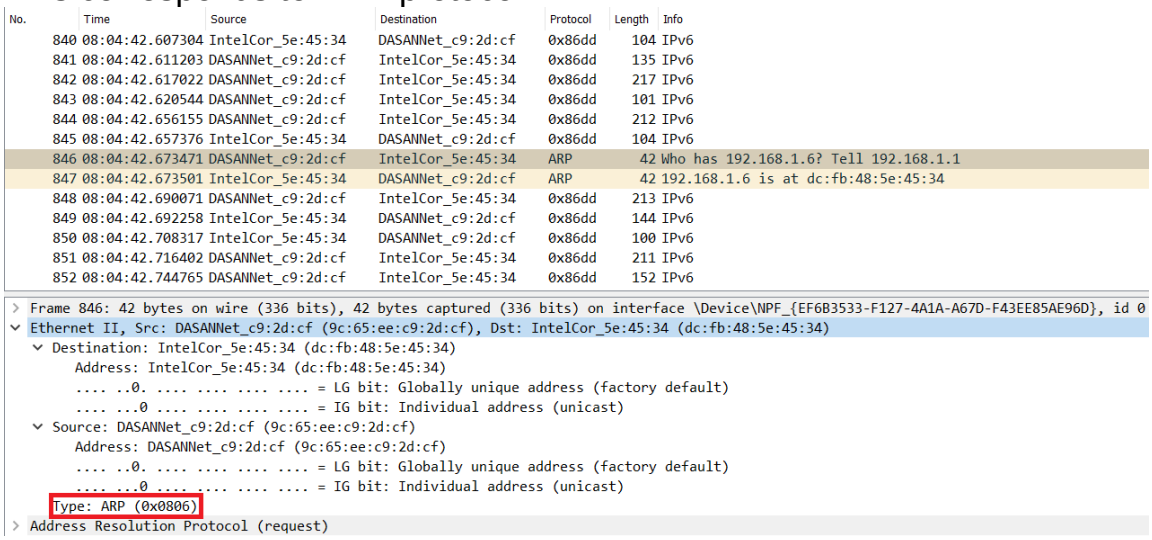
10. What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP request message?
    Ans:
    The hexadecimal value for the source address is 9c:65:ee:c9:2d:cf

The hexadecimal value for the destination address dc:fb:48:5e:45:34



No.	Time	Source	Destination	Protocol	Length	Info
840	08:04:42.607304	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
841	08:04:42.611203	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	135	IPv6
842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
843	08:04:42.620544	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	101	IPv6
844	08:04:42.656155	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	212	IPv6
845	08:04:42.657376	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
846	08:04:42.673471	DASANNet_c9:2d:cf	IntelCor_5e:45:34	ARP	42	Who has 192.168.1.6? Tell 192.168.1.1
847	08:04:42.673501	IntelCor_5e:45:34	DASANNet_c9:2d:cf	ARP	42	192.168.1.6 is at dc:fb:48:5e:45:34
848	08:04:42.690071	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	213	IPv6
849	08:04:42.692258	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	144	IPv6
850	08:04:42.708317	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6
851	08:04:42.716402	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	211	IPv6
852	08:04:42.744765	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	152	IPv6

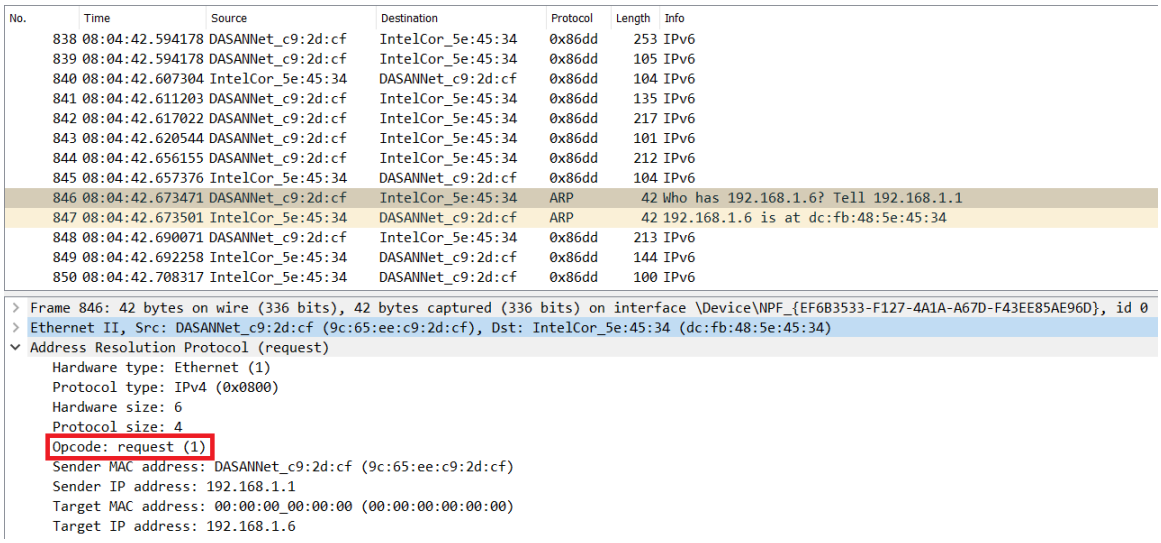
11. Give the hexadecimal value for the two-byte Ethernet Frame type field. What upper layer protocol does this correspond to?
Ans: The hexadecimal value for the Ethernet Frame type field is 0x0806. This corresponds to ARP protocol.



No.	Time	Source	Destination	Protocol	Length	Info
840	08:04:42.607304	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
841	08:04:42.611203	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	135	IPv6
842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
843	08:04:42.620544	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	101	IPv6
844	08:04:42.656155	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	212	IPv6
845	08:04:42.657376	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
846	08:04:42.673471	DASANNet_c9:2d:cf	IntelCor_5e:45:34	ARP	42	Who has 192.168.1.6? Tell 192.168.1.1
847	08:04:42.673501	IntelCor_5e:45:34	DASANNet_c9:2d:cf	ARP	42	192.168.1.6 is at dc:fb:48:5e:45:34
848	08:04:42.690071	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	213	IPv6
849	08:04:42.692258	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	144	IPv6
850	08:04:42.708317	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6
851	08:04:42.716402	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	211	IPv6
852	08:04:42.744765	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	152	IPv6

12. a) How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?
Ans: The ARP opcode field begins 20 bytes from the very beginning of the Ethernet frame.

b) What is the value of the opcode field within the ARP-payload part of the Ethernet frame in which an ARP request is made?
Ans: The hexadecimal value for opcode field withing the ARP-payload of the request is 0x0001, for request.



No.	Time	Source	Destination	Protocol	Length	Info
838	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	253	IPv6
839	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	105	IPv6
840	08:04:42.607304	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
841	08:04:42.611203	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	135	IPv6
842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
843	08:04:42.620544	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	101	IPv6
844	08:04:42.656155	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	212	IPv6
845	08:04:42.657376	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
846	08:04:42.673471	DASANNet_c9:2d:cf	IntelCor_5e:45:34	ARP	42	Who has 192.168.1.6? Tell 192.168.1.1
847	08:04:42.673501	IntelCor_5e:45:34	DASANNet_c9:2d:cf	ARP	42	192.168.1.6 is at dc:fb:48:5e:45:34
848	08:04:42.690071	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	213	IPv6
849	08:04:42.692258	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	144	IPv6
850	08:04:42.708317	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6

```
> Frame 846: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{EF6B3533-F127-4A1A-A67D-F43EE85AE96D}, id 0
> Ethernet II, Src: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf), Dst: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
v Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
    Sender IP address: 192.168.1.1
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.6
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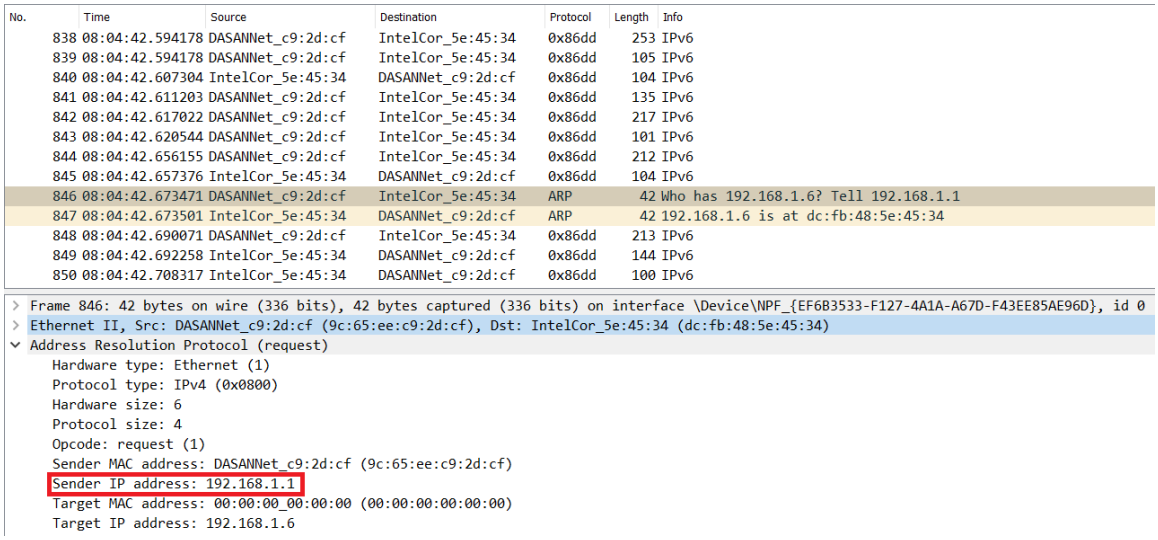
c) Does the ARP message contain the IP address of the sender?
Ans: Yes, the ARP message containing the IP address 192.168.1.1 for the sender.



No.	Time	Source	Destination	Protocol	Length	Info
838	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	253	IPv6
839	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	105	IPv6
840	08:04:42.607304	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
841	08:04:42.611203	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	135	IPv6
842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
843	08:04:42.620544	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	101	IPv6
844	08:04:42.656155	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	212	IPv6
845	08:04:42.657376	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
846	08:04:42.673471	DASANNet_c9:2d:cf	IntelCor_5e:45:34	ARP	42	Who has 192.168.1.6? Tell 192.168.1.1
847	08:04:42.673501	IntelCor_5e:45:34	DASANNet_c9:2d:cf	ARP	42	192.168.1.6 is at dc:fb:48:5e:45:34
848	08:04:42.690071	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	213	IPv6
849	08:04:42.692258	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	144	IPv6
850	08:04:42.708317	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6

```
> Frame 846: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{EF6B3533-F127-4A1A-A67D-F43EE85AE96D}, id 0
> Ethernet II, Src: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf), Dst: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
v Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
    Sender IP address: 192.168.1.1
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.6
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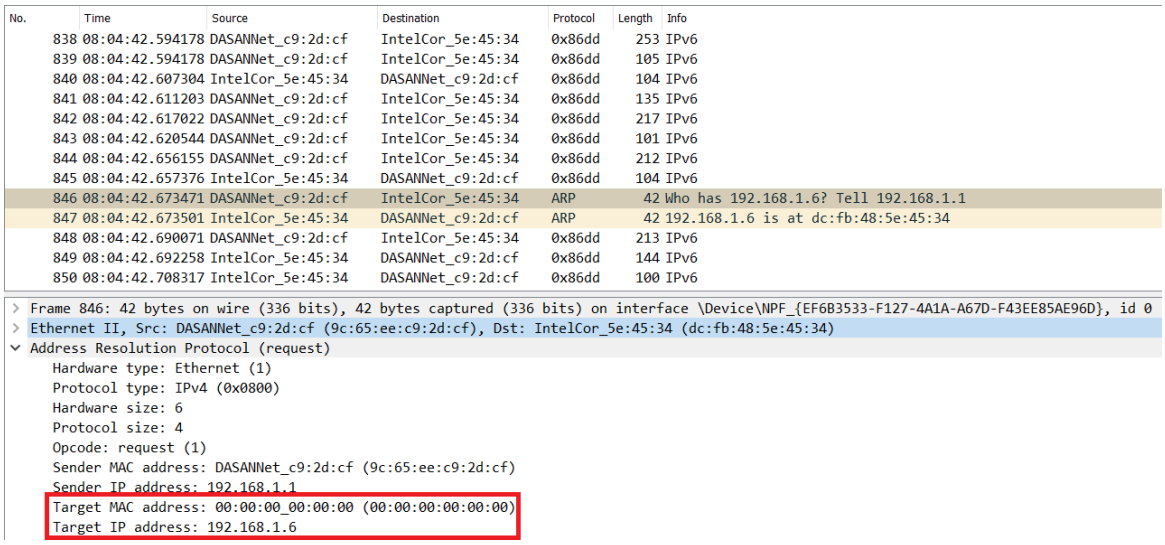
d) Where in the ARP request does the “question” appear – the Ethernet address of the machine whose corresponding IP address is being queried?
Ans: The field “Target MAC address” is set to 00:00:00:00:00:00 to question the machine whose corresponding IP address (192.168.1.6) is being queried.

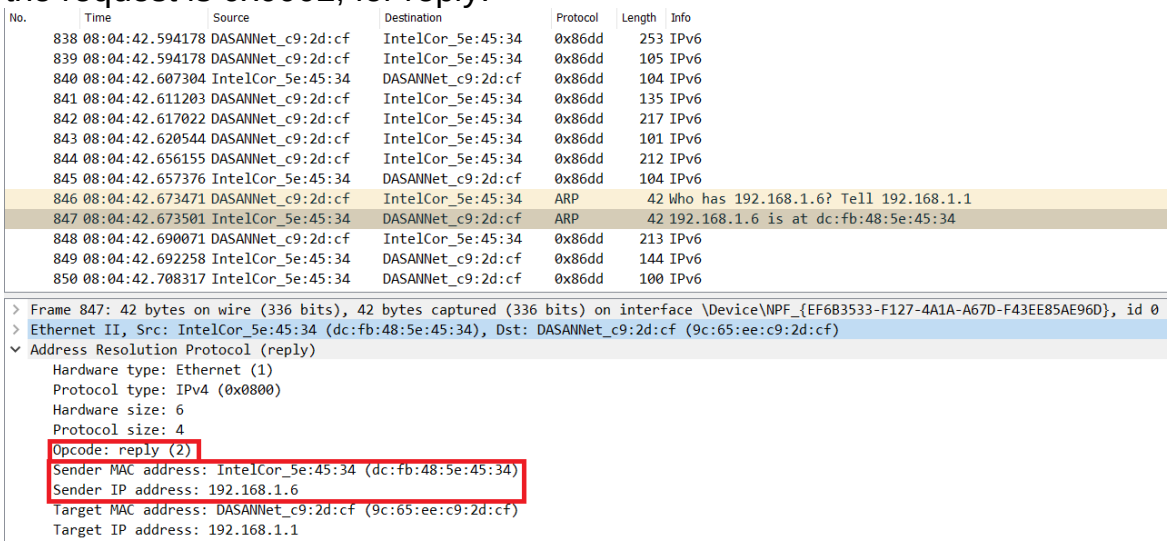


No.	Time	Source	Destination	Protocol	Length	Info
838	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	253	IPv6
839	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	105	IPv6
840	08:04:42.607304	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
841	08:04:42.611203	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	135	IPv6
842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
843	08:04:42.620544	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	101	IPv6
844	08:04:42.656155	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	212	IPv6
845	08:04:42.657376	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
846	08:04:42.673471	DASANNet_c9:2d:cf	IntelCor_5e:45:34	ARP	42	Who has 192.168.1.6? Tell 192.168.1.1
847	08:04:42.673501	IntelCor_5e:45:34	DASANNet_c9:2d:cf	ARP	42	192.168.1.6 is at dc:fb:48:5e:45:34
848	08:04:42.690071	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	213	IPv6
849	08:04:42.692258	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	144	IPv6
850	08:04:42.708317	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6

```
> Frame 846: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{EF6B3533-F127-4A1A-A67D-F43EE85AE96D}, id 0
> Ethernet II, Src: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf), Dst: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
v Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
    Sender IP address: 192.168.1.1
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.6
```

13. a) How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?
    Ans: The ARP opcode field begins 20 bytes from the very beginning of the Ethernet frame.

    b) What is the value of the opcode field within the ARP-payload part of the Ethernet frame in which an ARP response is made?
    Ans: The hexadecimal value for opcode field withing the ARP-payload of the request is 0x0002, for reply.

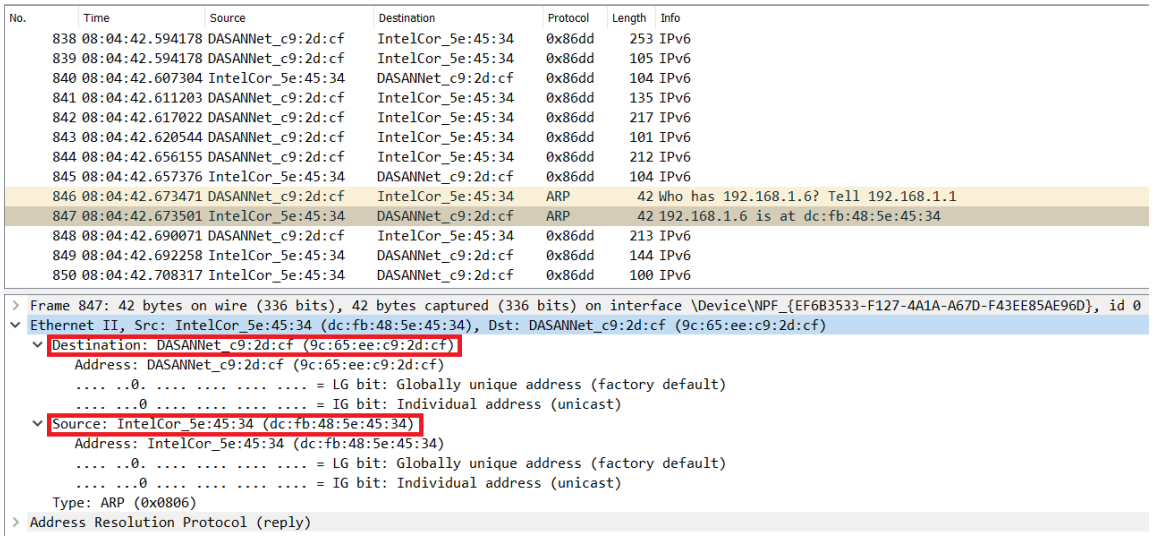


No.	Time	Source	Destination	Protocol	Length	Info
838	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	253	IPv6
839	08:04:42.594178	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	105	IPv6
840	08:04:42.607304	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
841	08:04:42.611203	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	135	IPv6
842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
843	08:04:42.620544	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	101	IPv6
844	08:04:42.656155	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	212	IPv6
845	08:04:42.657376	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	104	IPv6
846	08:04:42.673471	DASANNet_c9:2d:cf	IntelCor_5e:45:34	ARP	42	Who has 192.168.1.6? Tell 192.168.1.1
847	08:04:42.673501	IntelCor_5e:45:34	DASANNet_c9:2d:cf	ARP	42	192.168.1.6 is at dc:fb:48:5e:45:34
848	08:04:42.690071	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	213	IPv6
849	08:04:42.692258	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	144	IPv6
850	08:04:42.708317	IntelCor_5e:45:34	DASANNet_c9:2d:cf	0x86dd	100	IPv6

```
> Frame 847: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{EF6B3533-F127-4A1A-A67D-F43EE85AE96D}, id 0
> Ethernet II, Src: IntelCor_5e:45:34 (dc:fb:48:5e:45:34), Dst: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
v Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
    Sender IP address: 192.168.1.6
    Target MAC address: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
    Target IP address: 192.168.1.1
```

    c) Where in the ARP message does the “answer” to the earlier ARP request appear – the IP address of the machine having the Ethernet address whose corresponding IP address is being queried?
    Ans: The answer to the earlier ARP request appears in the”Sender MAC address” field, which contains the Ethernet address dc:fb:48:5e:45:34 for the sender with IP address 192.168.1.6.

14. What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP reply message?
    Ans:
    The hexadecimal value for the source address is dc:fb:48:5e:45:34
    The hexadecimal value for the destination address is 9c:65:ee:c9:2d:cf



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842	08:04:42.617022	DASANNet_c9:2d:cf	IntelCor_5e:45:34	0x86dd	217	IPv6
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```
> Frame 847: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{EF6B3533-F127-4A1A-A67D-F43EE85AE96D}, id 0
v Ethernet II, Src: IntelCor_5e:45:34 (dc:fb:48:5e:45:34), Dst: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
  v Destination: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
      Address: DASANNet_c9:2d:cf (9c:65:ee:c9:2d:cf)
      .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
  v Source: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
      Address: IntelCor_5e:45:34 (dc:fb:48:5e:45:34)
      .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
      .... ...0 .... .... .... .... = IG bit: Individual address (unicast)
    Type: ARP (0x0806)
> Address Resolution Protocol (reply)
```

15. Why is there no ARP reply in the packet trace?
    Ans: There is no reply in this trace, because we are not at the machine that sent the request. The ARP request is broadcast, but the ARP reply is sent back directly to the sender's Ethernet address.