Ethernet specification

Table of Contents

1. TERMINOLOGY

- **MAC** : Media Access Control
- **ARP** : Address Resolution Protocol
- **IP** : Internet Protocol
- **ICMP** : Media Access Control
- **VLAN** : Virtual Local Area Network
- **UDP** : User Datagram protocol
- **TCP** : Transmission Control Protocol
- **IPCP** : Ip Command protocol

2. Ethernet protocol list

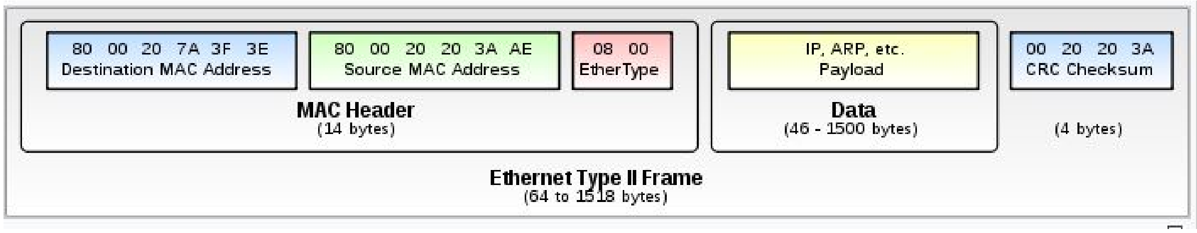
- Layer 2
  - ARP
  - VLAN
- Layer 5
  - ICMP
  - IPCP

3. MAC_HEADER

Every Ethernet network interface card (NIC) is given a unique identifier called a MAC address. This is assigned by the manufacturer of the card and each manufacturer that complies with IEEE standards can apply to the IEEE Registration Authority for a range of numbers for use in its products.

3.1. introduce

The header features destination and source MAC addresses (each six octets in length), the EtherType field and, optionally, an IEEE 802.1Q tag or IEEE 802.1ad tag



3.2. format introduce

- destination MAC Address
    - The destination MAC Address has 6 bytes .
    - This field contains the address of station for which the data is intended. The left most bit indicates whether the destination is an individual address or a group address. An individual address is denoted by a zero, while a one indicates a group address. The next bit into the DA indicates whether the address is globally administered, or local. If the address is globally administered the bit is a zero, and a one of it is locally administered. There are then 46 remaining bits. These are used for the destination address itself.
    - The ASDM MAC Address is 02:00:00:00:14:01
- Source MAC Address
    - The source address consists of six bytes, and it is used to identify the sending station. As it is always an individual address the left most bit is always a zero.
- Length/Type
    - This field is two bytes in length. It provides MAC information and indicates the number of client data types that are contained in the data field of the frame. It may also indicate the frame ID type if the frame is assembled using an optional format.(IEEE 802.3 only).
    - For our project, we use the ipv4 protocol and 8021q protocol
        - if the protocol is IPV4,The value of this field should be 0x0800
        - if the protocol is VLAN(8021q),The value of this field should be 0x8100

4. ARP TEST

4.1. arp introduce

The Address Resolution Protocol (ARP) is a communication protocol used for discovering the link layer address, such as a MAC address, associated with a given internet layer address, typically an IPv4 address.

4.2. purpose

To ensure link communication between ASDM and Chadoc is normal

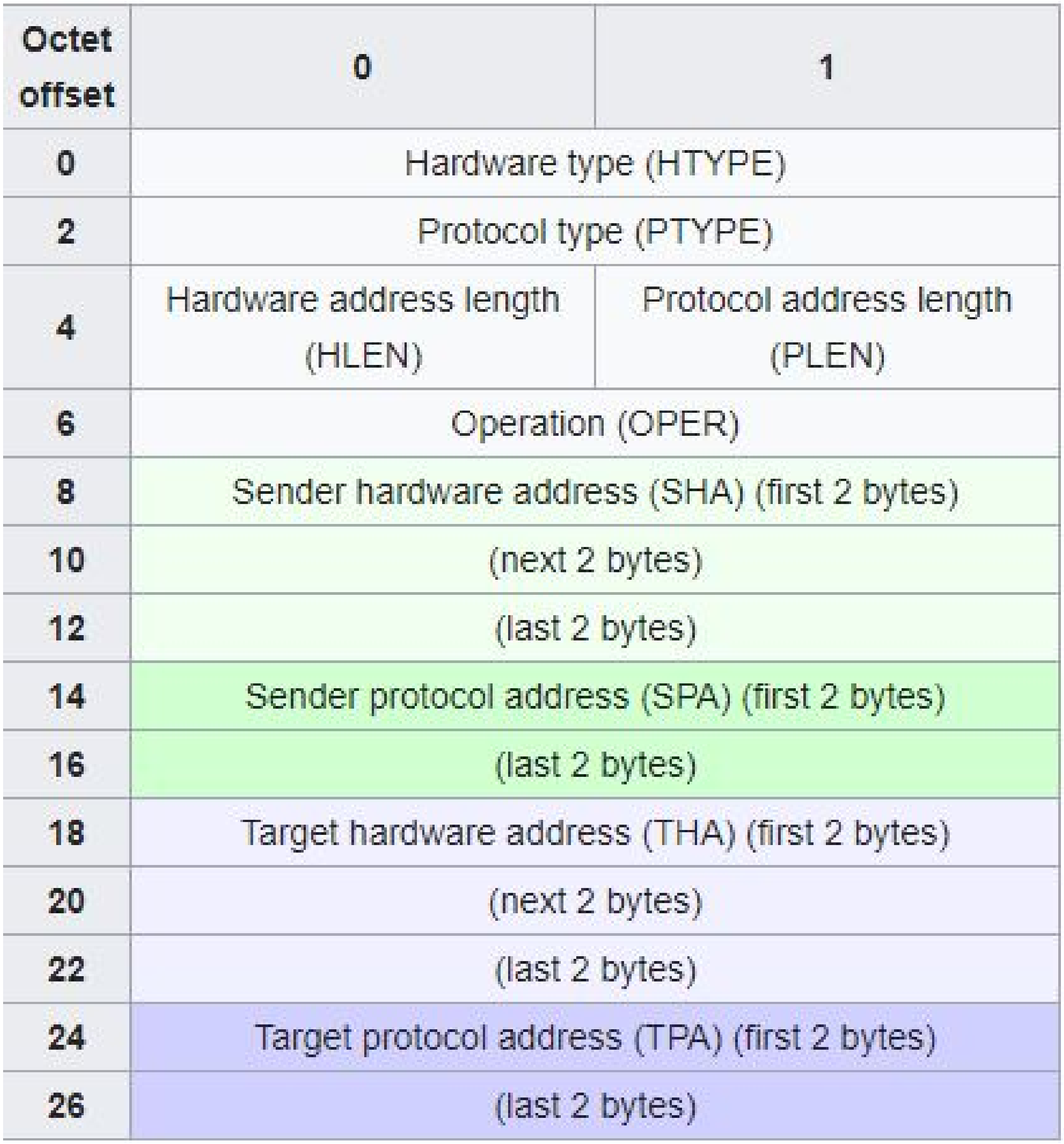
4.3. Message

- The Chadoc tool should send ARP request message to ASDM

According to the requirement

1. The Ip address of ASDM is 198.18.36.1

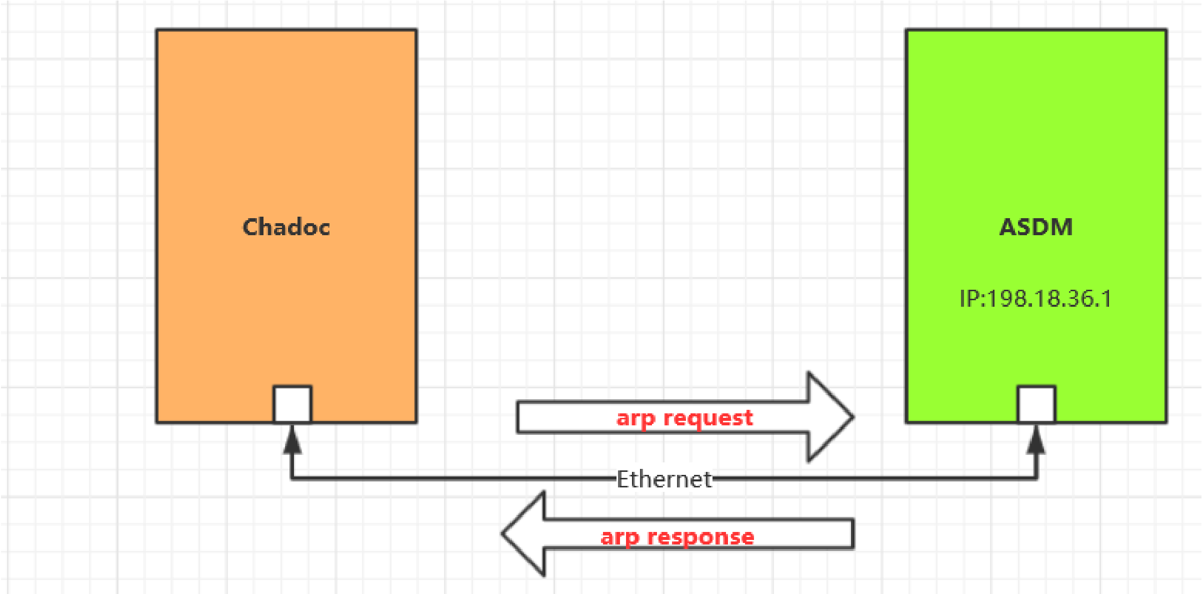
2. The MAC address of ASDM is 02:00:00:00:14:01
    - Internet Protocol (IPv4) over Ethernet ARP packet



Octet offset	0	1
0	Hardware type (HTYPE)	
2	Protocol type (PTYPE)	
4	Hardware address length (HLEN)	Protocol address length (PLEN)
6	Operation (OPER)	
8	Sender hardware address (SHA) (first 2 bytes)	
10	(next 2 bytes)	
12	(last 2 bytes)	
14	Sender protocol address (SPA) (first 2 bytes)	
16	(last 2 bytes)	
18	Target hardware address (THA) (first 2 bytes)	
20	(next 2 bytes)	
22	(last 2 bytes)	
24	Target protocol address (TPA) (first 2 bytes)	
26	(last 2 bytes)	

4.4. Chadoc Test Description

1. Prepare for networking as shown below



2. Simulate an ARP request message and send to ASDM

Expected Result

- The Chadoc tool will receive an ARP reply from ASDM
    - In the ARP reply message， The ASDM MAC Address is 02:00:00:00:14:01,IP adress is 198.18.36.1

5. VLAN TEST

5.1. introduce

A virtual LAN (VLAN) is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2)

The protocol most commonly used today to support VLANs is IEEE 802.1Q

5.2. purpose

To ensure that ASDM can receive and sent vlan message.

5.3. vlan distribution in ASDM

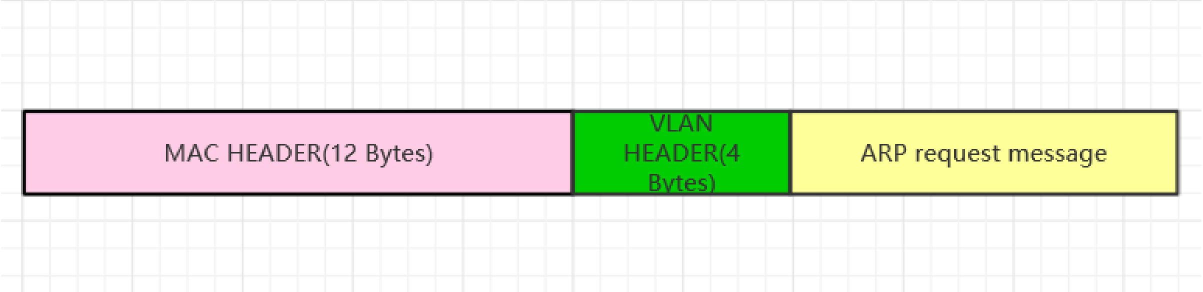
vlan ID	node name	function
5	VGM-ASDM	Traffic Jam Pilot
6	VGM-ASDM	IPLM

5.4. Chadoc Test Description

1. Simulate an ARP request message with vlan tag 5 (VID set to 5)and send to ASDM

2. Simulate an ARP request message with vlan tag 6 (VID set to 6) and send to ASDM

This message as shown bleow



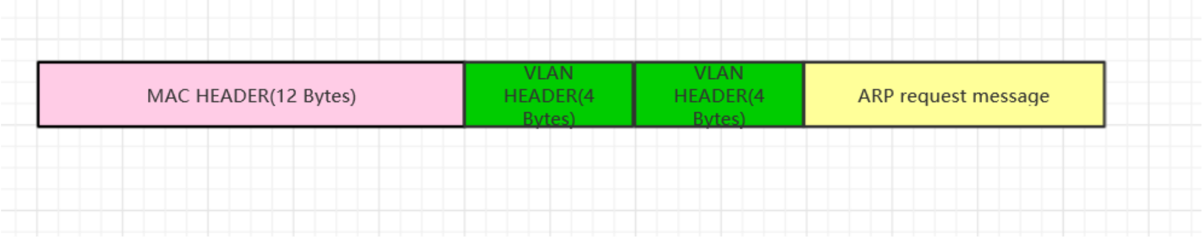
Expected Result

- The ARP reply message could be received by Chadoc
  - In the ARP reply message，The ASDM MAC Address is 02:00:00:00:14:01,IP adress is 198.18.36.1

5.5. Double tagging test

- Need to check ASDM will discard all the Double tagging messages.

This message as shown bleow



5.5.1. Chadoc Test Description

1. Simulate an ARP request message with double vlan tag 5 and vlan x (x will be between 1 and 4095 value)and send to ASDM
2. Simulate an ARP request message with vlan tag 5 and vlan x (x will be between 1 and 4095 value) and send to ASDM

Expected Result

- NO message could be received by Chadoc

6. ICMP TEST

6.1. introduce

ICMP messages are sent in several situations: for example, when a datagram cannot reach its destination, when the gateway does not have the buffering capacity to forward a datagram, and when the gateway can direct the host to send traffic on a shorter route.

6.2. Ip address of ASDM

According to the requirement

1. The MAC address of ASDM is 02:00:00:00:14:01
2. The IP address of ASDM is 198.18.36.1/255.255.0.0

6.3. Echo Message introduce

```
  0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |     Code      |          Checksum             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           Identifier          |        Sequence Number        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Data ...
+-+-+-+-+-
```

- IP Fields:
    - Addresses: The address of the source in an echo message will be the destination of the echo reply message. To form an echo reply message, the source and destination addresses are simply reversed, the type code changed to 0, and the checksum recomputed.
- IP Fields:
    - Type
        - 8 for echo message
        - 0 for echo reply message
    - Code
        - 0
    - Checksum
        - The checksum is the 16-bit ones’s complement of the one’s complement sum of the ICMP message starting with the ICMP Type. For computing the checksum , the checksum field should be zero. If the total length is odd, the received data is padded with one octet of zeros for computing the checksum. This checksum may be replaced in the future.
    - Identifier
        - If code = 0, an identifier to aid in matching echos and replies, may be zero.
    - Sequence Number
        - If code = 0, a sequence number to aid in matching echos and replies, may be zero

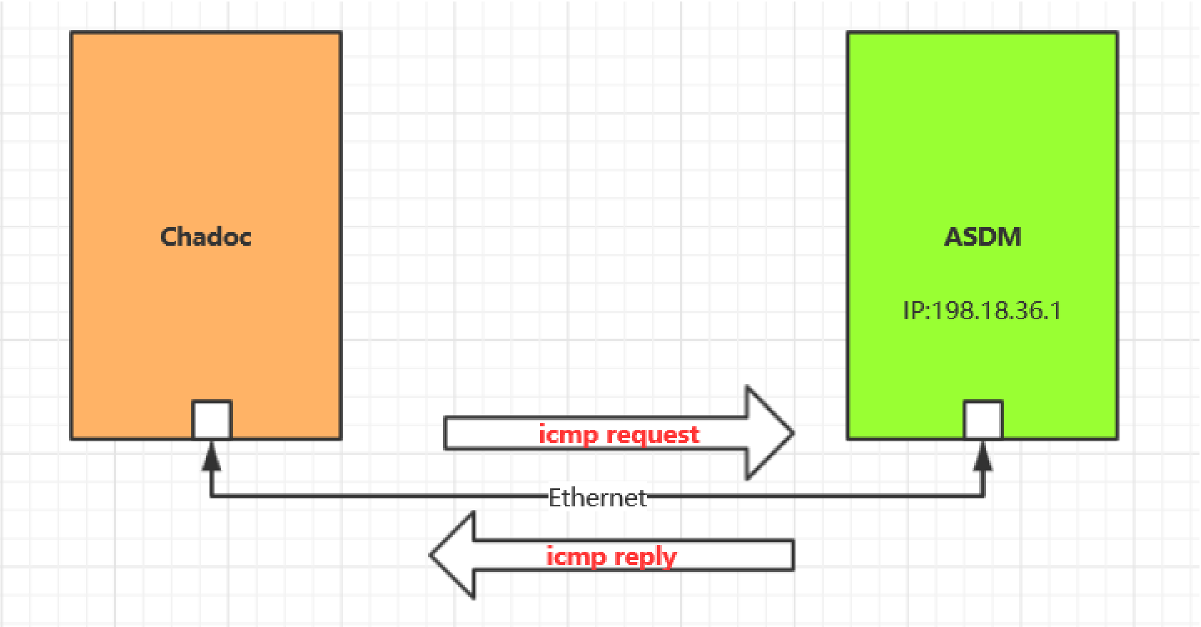
- Description
    - The data received in the echo message must be returned in the echo reply message.

      ```
      The identifier and sequence number may be used by the echo
      sender
      to aid in matching the replies with the echo requests.  For
      example, the identifier might be used like a port in TCP or UDP
      to
      identify a session, and the sequence number might be incremented
      on each echo request sent.  The echoer returns these same values
      in the echo reply.
      ```

      ```
      Code 0 may be received from a gateway or a host.
      ```

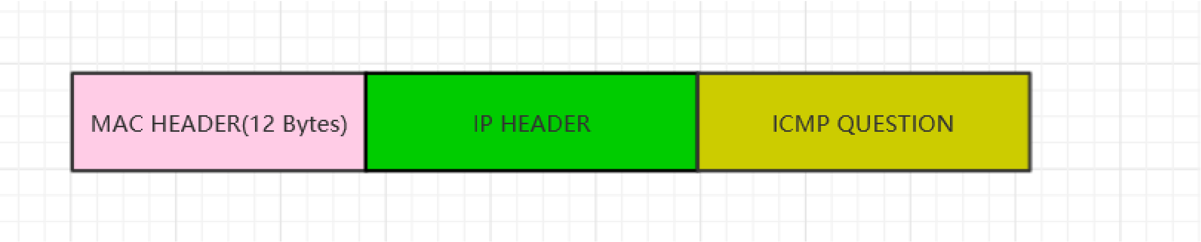
6.4. Chadoc Test Description

1. Prepare for networking as shown below



2. Simulate an ARP request message and sent to ASDM
3. Simulate an ICMP request message (destination IP address set to 198.18.36.1) to ASDM

This message as shown bleow

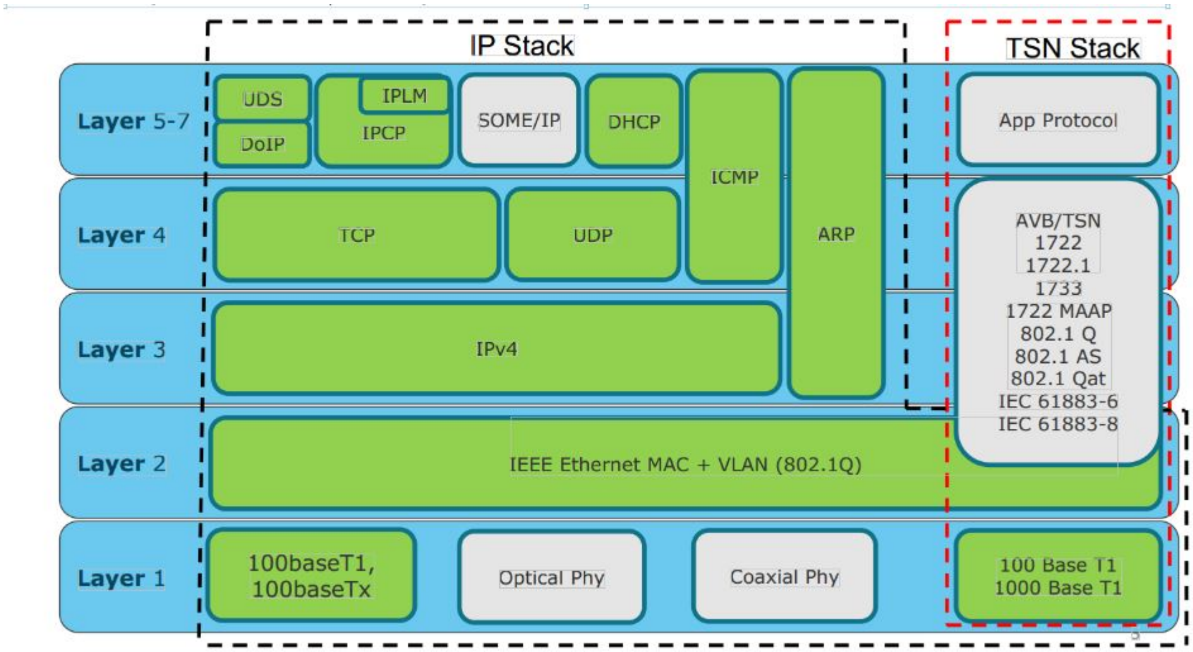


Expected Result

1. For step 2,The Chadoc tool will receive an ARP reply message from ASDM
2. For step 3,The Chadoc tool will receive a ICMP reply message from ASDM

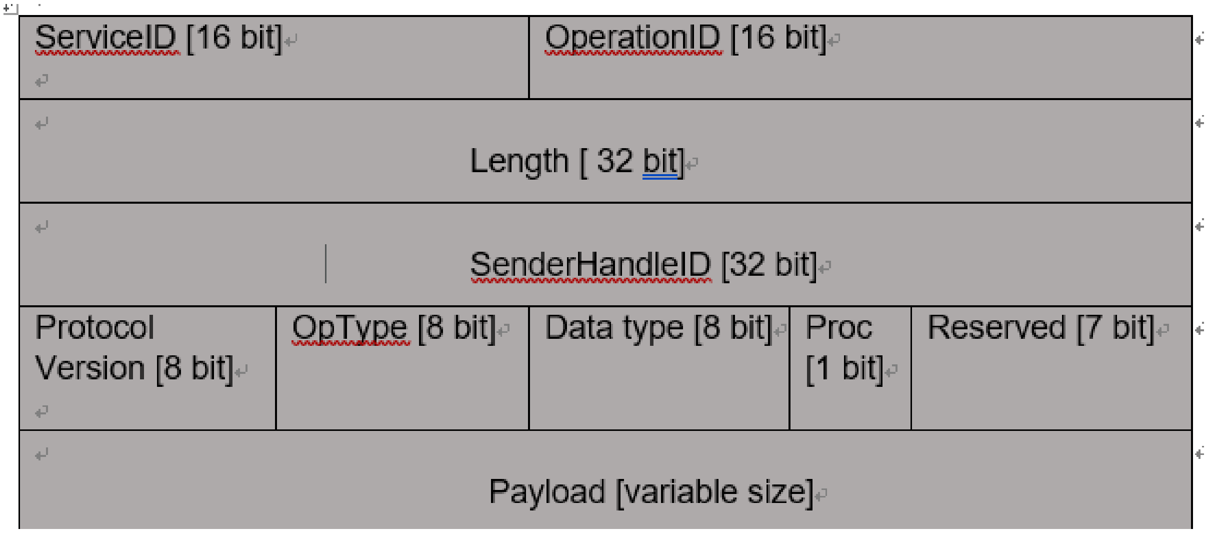
7. IPCP TEST

7.1. introduce



- IPCP use udp protocol and udp port is 50174

7.2. IPCP Header Overview



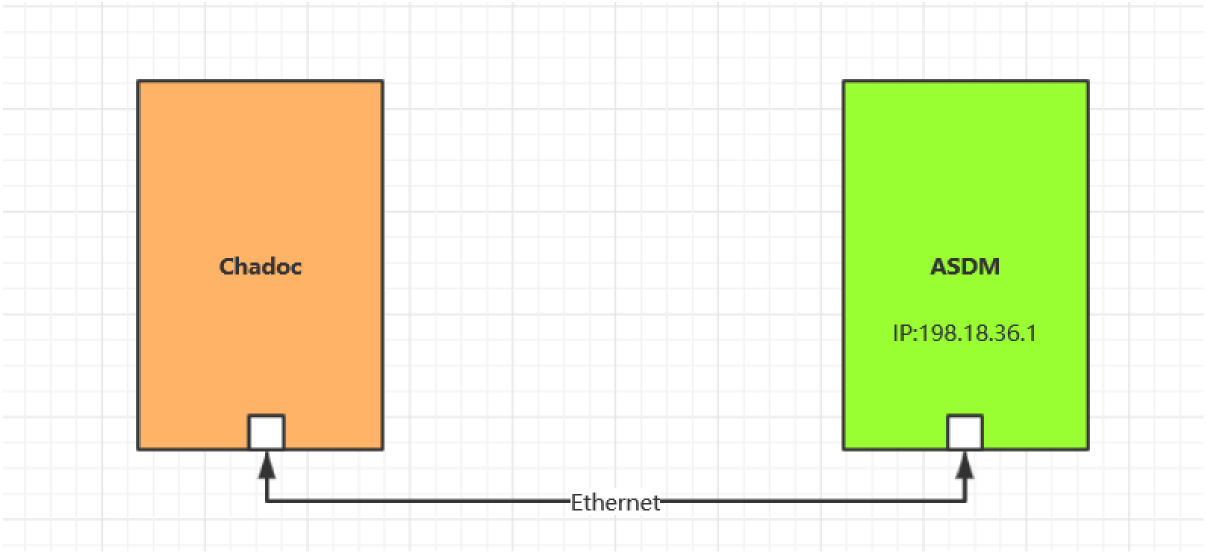
ServiceID [16 bit]		OperationID [16 bit]		
Length [32 bit]				
SenderHandleID [32 bit]				
Protocol Version [8 bit]	OpType [8 bit]	Data type [8 bit]	Proc [1 bit]	Reserved [7 bit]
Payload [variable size]				

7.3. IPCP NOTIFICATION MESSAGE

- ServiceID = 0xAE
- OperationID = 0x0001
- Length = (According to the actual data length)
- SenderHandleID = 0xAE010501
- Protocol Version = 0x03
- OpType = 0X05
- DataType = 0x01
- Proc/Reserved = 0x00

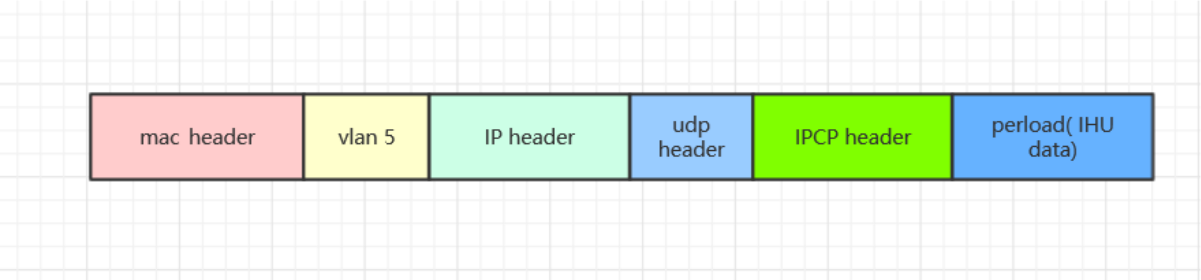
7.4. Chadoc Test Description

1. Prepare for networking as shown below



2. power up the ASDM

3. Chadoc tool send an IPCP NOTIFICATION meaasge to ASDM with vlan 5



3. repeat step 2

Expected Result

1. For step 2,The Chadoc tool will receive an IPCP SETREQUEST_NORETURN message from ASDM

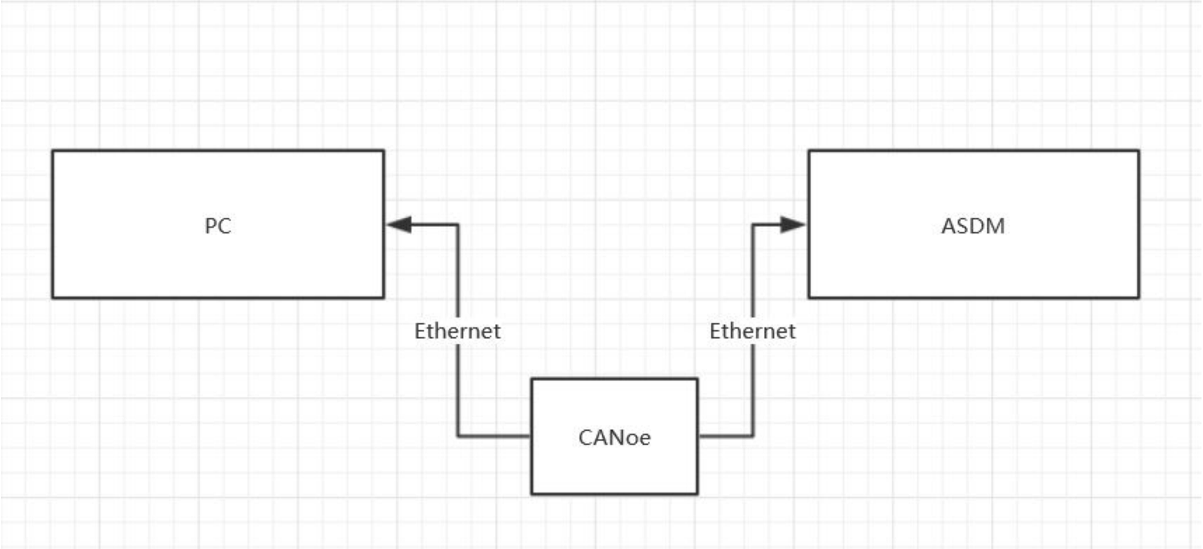
2. For step 3,The Chadoc tool will receive an IPCP ACK message from ASDM

8. example for test ARP/ICMP

8.1. Tools

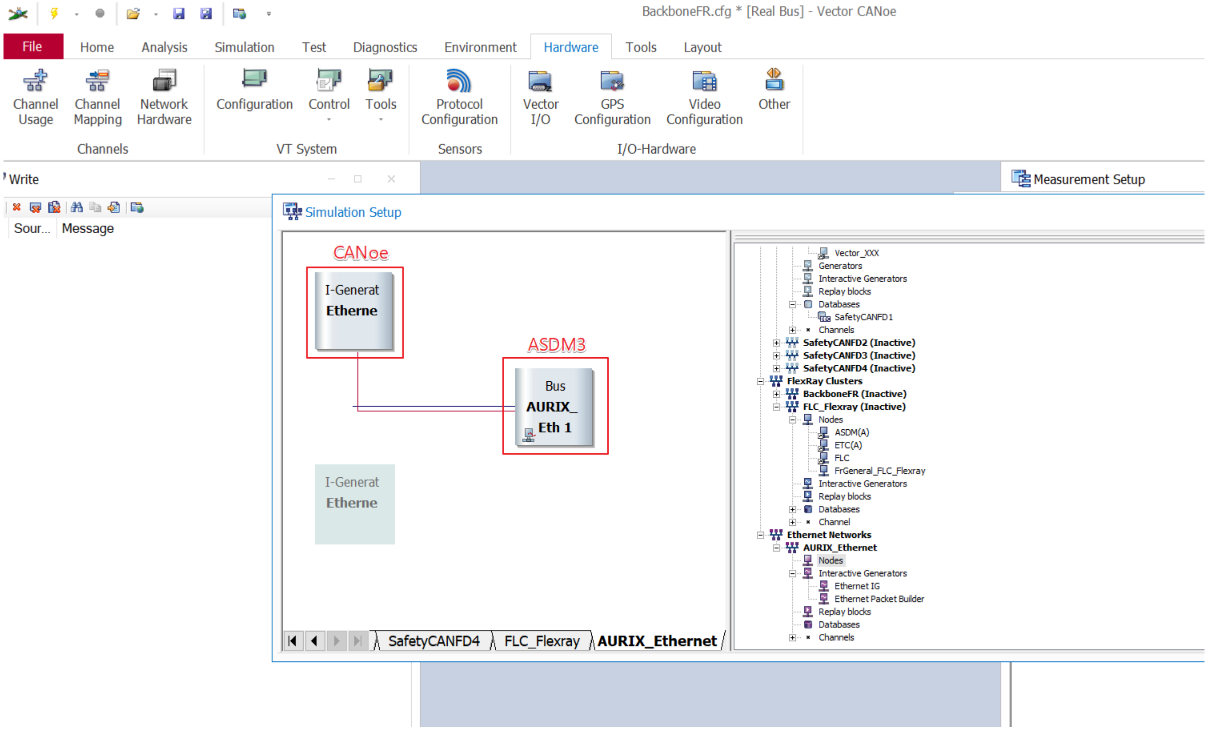
- Vector VN5610A
- ASDM boards
- PC
- power supply

8.2. Connection

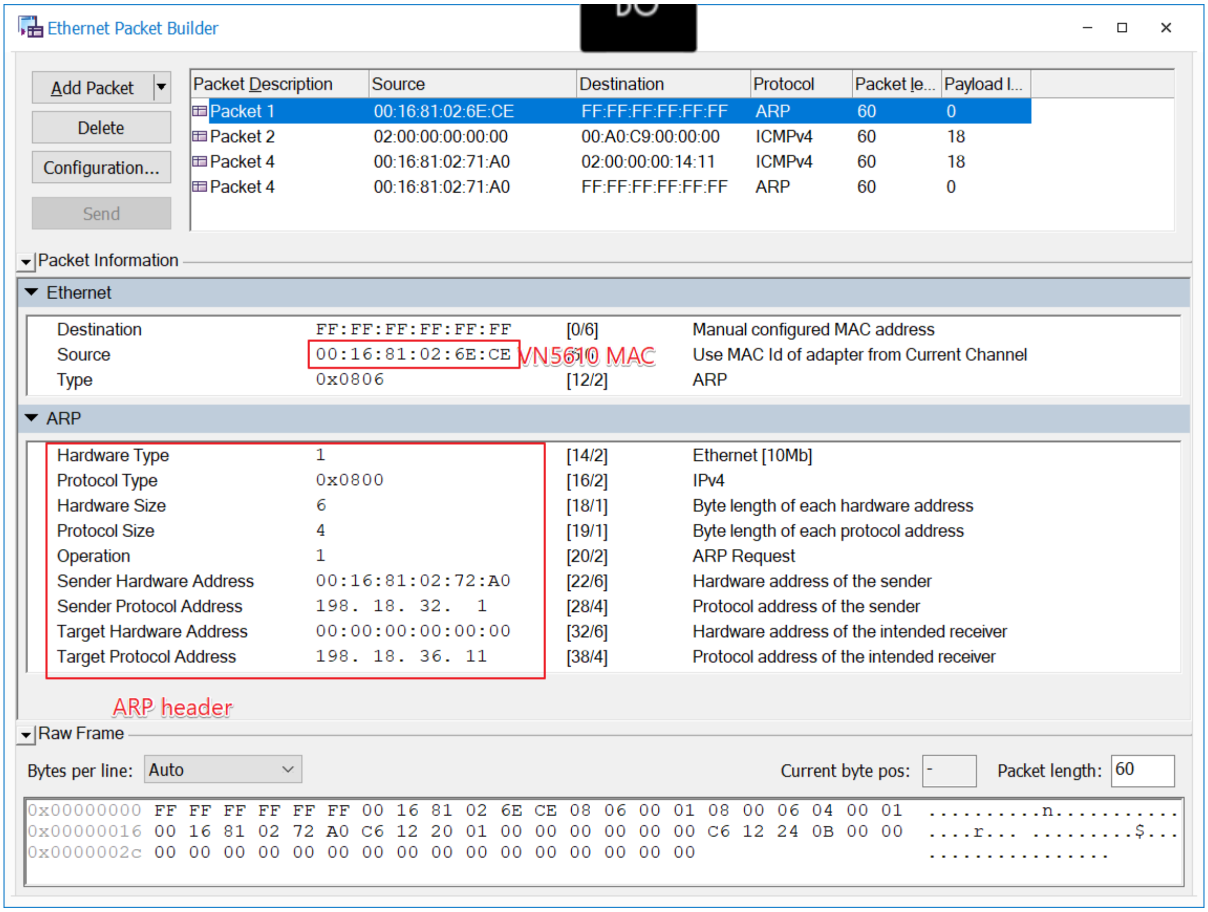


8.3. test step

- Open the software for VN5610A,Power on the ASDM3



- Config VN5610A and send A arp packet



Ethernet Packet Builder

Packet Description	Source	Destination	Protocol	Packet le...	Payload l...
Packet 1	00:16:81:02:6E:CE	FF:FF:FF:FF:FF:FF	ARP	60	0
Packet 2	02:00:00:00:00:00	00:A0:C9:00:00:00	ICMPv4	60	18
Packet 4	00:16:81:02:71:A0	02:00:00:00:14:11	ICMPv4	60	18
Packet 4	00:16:81:02:71:A0	FF:FF:FF:FF:FF:FF	ARP	60	0

Packet Information

Ethernet

Destination	FF:FF:FF:FF:FF:FF	[0/6]	Manual configured MAC address
Source	00:16:81:02:6E:CE	[6/6]	Use MAC Id of adapter from Current Channel
Type	0x0806	[12/2]	ARP

VN5610 MAC

ARP

Hardware Type	1	[14/2]	Ethernet [10Mb]
Protocol Type	0x0800	[16/2]	IPv4
Hardware Size	6	[18/1]	Byte length of each hardware address
Protocol Size	4	[19/1]	Byte length of each protocol address
Operation	1	[20/2]	ARP Request
Sender Hardware Address	00:16:81:02:72:A0	[22/6]	Hardware address of the sender
Sender Protocol Address	198. 18. 32. 1	[28/4]	Protocol address of the sender
Target Hardware Address	00:00:00:00:00:00	[32/6]	Hardware address of the intended receiver
Target Protocol Address	198. 18. 36. 11	[38/4]	Protocol address of the intended receiver

ARP header

Raw Frame

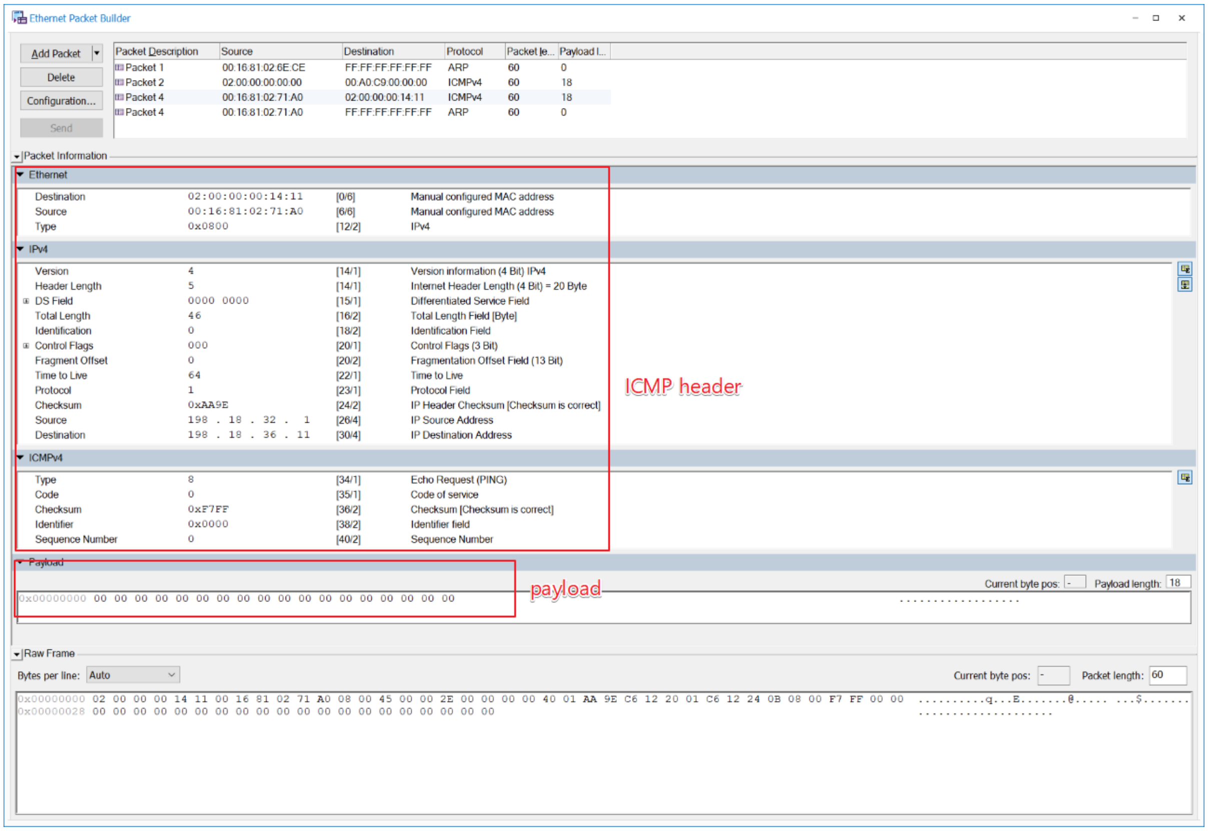
Bytes per line: Auto

Current byte pos:

Packet length: 60

```
0x00000000 FF FF FF FF FF FF 00 16 81 02 6E CE 08 06 00 01 08 00 06 04 00 01  ..........n...........
0x00000016 00 16 81 02 72 A0 C6 12 20 01 00 00 00 00 00 00 C6 12 24 0B 00 00  ....r... .........$...
0x0000002c 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00                    ................
```

- config the VN5610A and send a icmp packet



Ethernet Packet Builder

Packet Description	Source	Destination	Protocol	Packet le...	Payload l...
Packet 1	00:16:81:02:6E:CE	FF:FF:FF:FF:FF:FF	ARP	60	0
Packet 2	02:00:00:00:00:00	00:A0:C9:00:00:00	ICMPv4	60	18
Packet 4	00:16:81:02:71:A0	02:00:00:00:14:11	ICMPv4	60	18
Packet 4	00:16:81:02:71:A0	FF:FF:FF:FF:FF:FF	ARP	60	0

Packet Information

Ethernet

Destination	02:00:00:00:14:11	[0/6]	Manual configured MAC address
Source	00:16:81:02:71:A0	[6/6]	Manual configured MAC address
Type	0x0800	[12/2]	IPv4

IPv4

Version	4	[14/1]	Version information (4 Bit) IPv4
Header Length	5	[14/1]	Internet Header Length (4 Bit) = 20 Byte
⊞ DS Field	0000 0000	[15/1]	Differentiated Service Field
Total Length	46	[16/2]	Total Length Field [Byte]
Identification	0	[18/2]	Identification Field
⊞ Control Flags	000	[20/1]	Control Flags (3 Bit)
Fragment Offset	0	[20/2]	Fragmentation Offset Field (13 Bit)
Time to Live	64	[22/1]	Time to Live
Protocol	1	[23/1]	Protocol Field
Checksum	0xAA9E	[24/2]	IP Header Checksum [Checksum is correct]
Source	198 . 18 . 32 . 1	[26/4]	IP Source Address
Destination	198 . 18 . 36 . 11	[30/4]	IP Destination Address

ICMPv4

Type	8	[34/1]	Echo Request (PING)
Code	0	[35/1]	Code of service
Checksum	0xF7FF	[36/2]	Checksum [Checksum is correct]
Identifier	0x0000	[38/2]	Identifier field
Sequence Number	0	[40/2]	Sequence Number

ICMP header

Payload

Current byte pos: -

Payload length: 18

```
0x00000000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ..................
```

payload

Raw Frame

Bytes per line: Auto

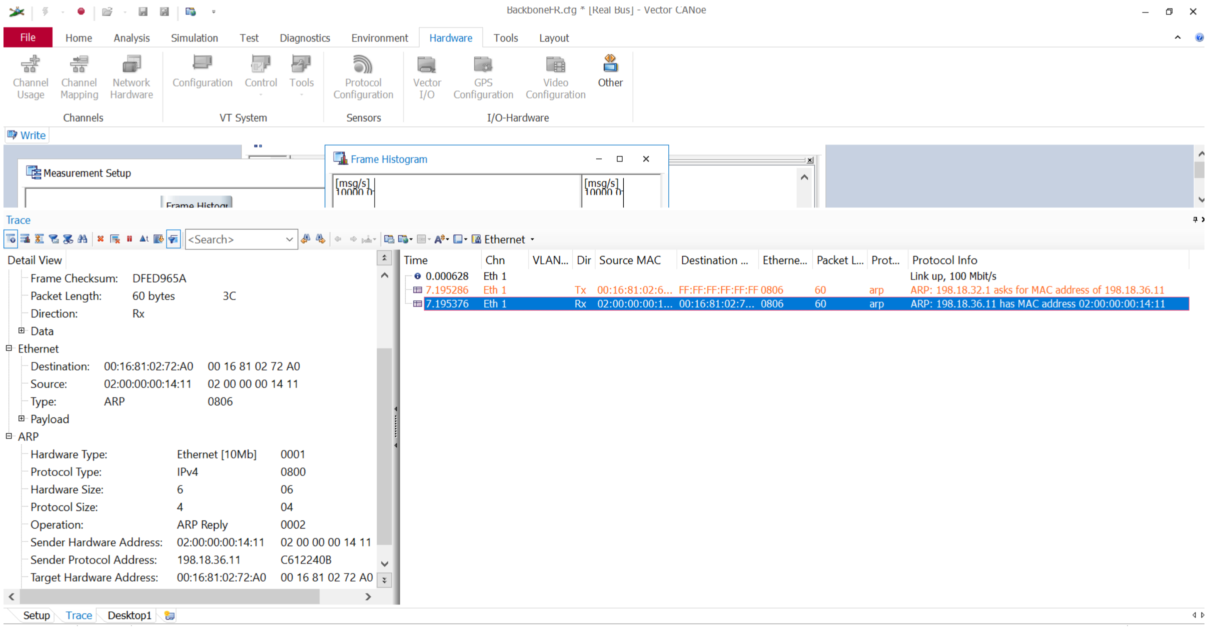
Current byte pos: -

Packet length: 60

```
0x00000000 02 00 00 00 14 11 00 16 81 02 71 A0 08 00 45 00 00 2E 00 00 00 00 40 01 AA 9E C6 12 20 01 C6 12 24 0B 08 00 F7 FF 00 00  ..........q...E.......@..... ...$.......
0x00000028 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....................
```

8.4. test result

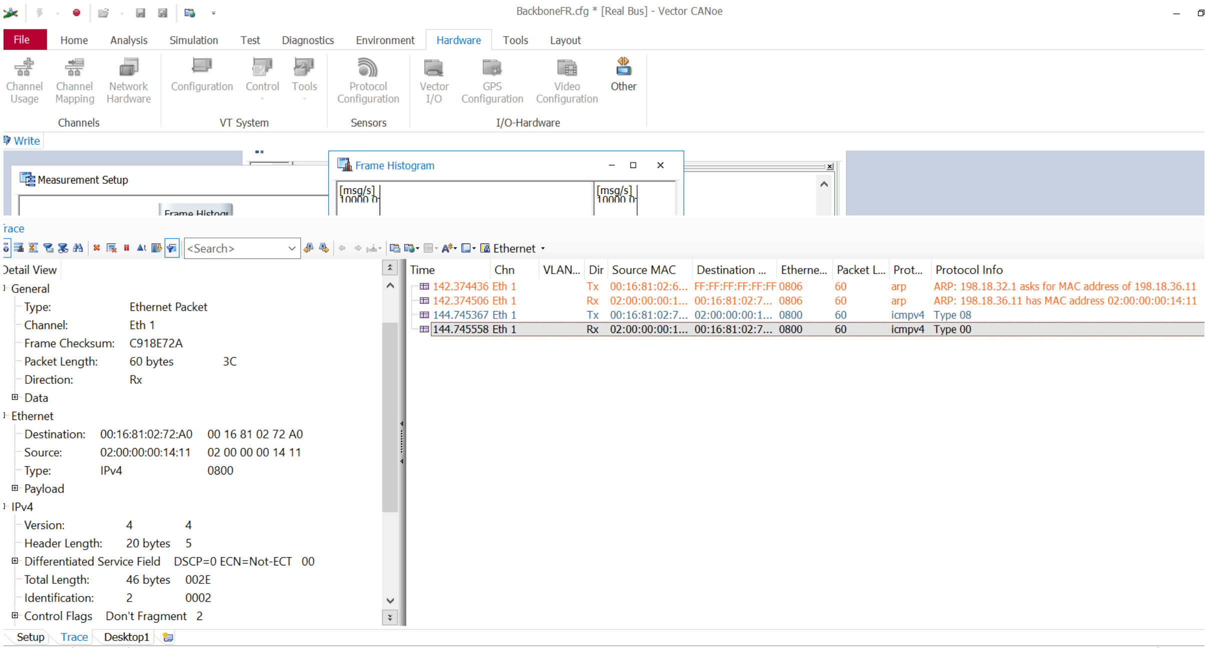
- The VN5610A receive the arp reply from ASDM



```
Detail View
   Frame Checksum:   DFED965A
   Packet Length:    60 bytes      3C
   Direction:        Rx
 ⊞ Data
⊟ Ethernet
   Destination:   00:16:81:02:72:A0   00 16 81 02 72 A0
   Source:        02:00:00:00:14:11   02 00 00 00 14 11
   Type:          ARP                 0806
 ⊞ Payload
⊟ ARP
   Hardware Type:             Ethernet [10Mb]     0001
   Protocol Type:             IPv4                0800
   Hardware Size:             6                   06
   Protocol Size:             4                   04
   Operation:                 ARP Reply           0002
   Sender Hardware Address:   02:00:00:00:14:11   02 00 00 00 14 11
   Sender Protocol Address:   198.18.36.11        C612240B
   Target Hardware Address:   00:16:81:02:72:A0   00 16 81 02 72 A0
```

Time	Chn	VLAN...	Dir	Source MAC	Destination ...	Etherne...	Packet L...	Prot...	Protocol Info
0.000628	Eth 1								Link up, 100 Mbit/s
7.195286	Eth 1		Tx	00:16:81:02:6...	FF:FF:FF:FF:FF:FF	0806	60	arp	ARP: 198.18.32.1 asks for MAC address of 198.18.36.11
7.195376	Eth 1		Rx	02:00:00:00:1...	00:16:81:02:7...	0806	60	arp	ARP: 198.18.36.11 has MAC address 02:00:00:00:14:11

- The VN5610A receive the icmp reply from ASDM



```
Detail View
 General
   Type:             Ethernet Packet
   Channel:          Eth 1
   Frame Checksum:   C918E72A
   Packet Length:    60 bytes      3C
   Direction:        Rx
 ⊞ Data
 Ethernet
   Destination:   00:16:81:02:72:A0   00 16 81 02 72 A0
   Source:        02:00:00:00:14:11   02 00 00 00 14 11
   Type:          IPv4                0800
 ⊞ Payload
 IPv4
   Version:          4          4
   Header Length:    20 bytes   5
 ⊞ Differentiated Service Field   DSCP=0 ECN=Not-ECT   00
   Total Length:     46 bytes   002E
   Identification:   2          0002
 ⊞ Control Flags   Don't Fragment   2
```

Time	Chn	VLAN...	Dir	Source MAC	Destination ...	Etherne...	Packet L...	Prot...	Protocol Info
142.374436	Eth 1		Tx	00:16:81:02:6...	FF:FF:FF:FF:FF:FF	0806	60	arp	ARP: 198.18.32.1 asks for MAC address of 198.18.36.11
142.374506	Eth 1		Rx	02:00:00:00:1...	00:16:81:02:7...	0806	60	arp	ARP: 198.18.36.11 has MAC address 02:00:00:00:14:11
144.745367	Eth 1		Tx	00:16:81:02:7...	02:00:00:00:1...	0800	60	icmpv4	Type 08
144.745558	Eth 1		Rx	02:00:00:00:1...	00:16:81:02:7...	0800	60	icmpv4	Type 00