Practical-2

AIM: Understand and identify header fields of layers of TCP/IP protocol stack.

Tools Required: WordPad or Notepad.
Submission: After writing the answer into this word document, Student needs to change name to his ID followed by a practical number. Ex 20ce005_Pr1.docx. Upload on assignment segment.
Rubrics: Nicely drafted document with clarity in answers leads to full marks. Otherwise, submission carries a proportional mark.

Watch and refer following videos for a better understanding of the header fields of layers of TCP/IP:

Material 1. **Ethernet frame ():** https://www.youtube.com/watch?v=SoTRqDLND6Y
Material 2. **IPv4 header format ()**: https://www.youtube.com/watch?v=3Y70y6dM7Cs
Material 3. **IPv4 Vs IPv6()**: https://www.youtube.com/watch?v=NkE9_iRPi1I
Material 4. **TCP and UDP ():** https://www.youtube.com/watch?v=r4HbLQuqvrM

Students need to fill the empty table and write answers to questions.

As per the discussion in classroom, any user starts internet access through browser or network applications. Following figure 2.1 explain scenario of receiving data at NIC Card. NIC card receives signals and it converts into sequence of 0's and 1's. After receiving data it sends data for the further processing to TCP/IP protocol stack. In this exercise you need to identify boundaries of fields of headers, describe and understand flow of information in protocol stack.

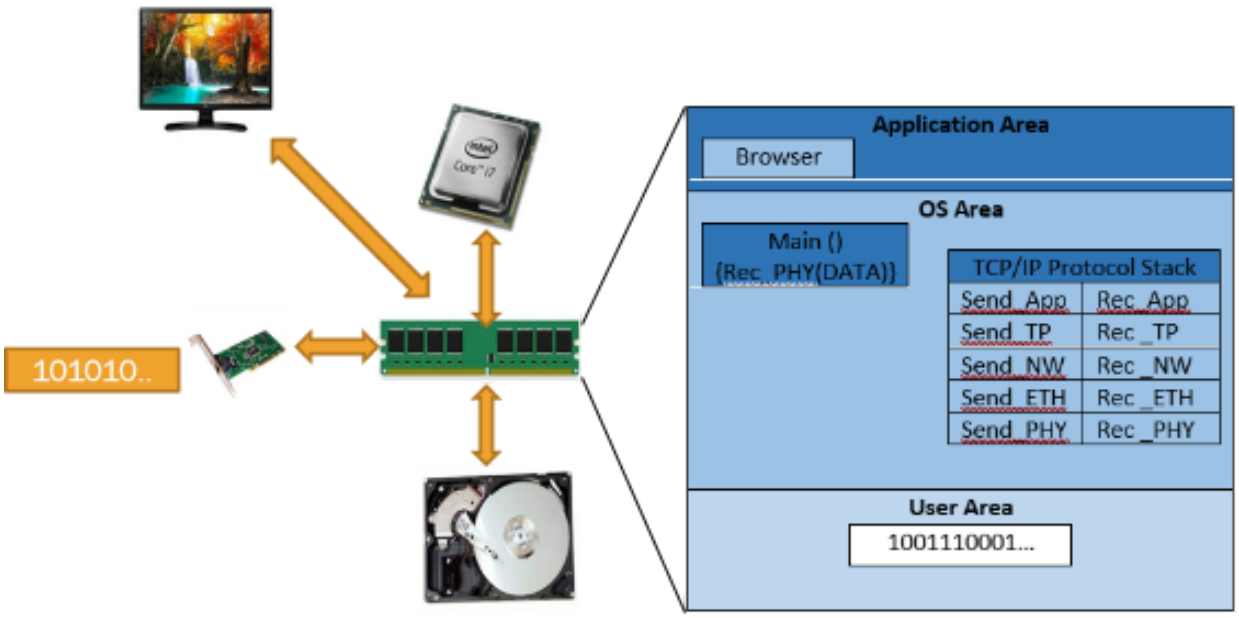

Figure 2.1 Real Scenario

2.1 Input data stream: TCP

This is the data stream which receiver NIC card receives from wire and stores into memory. Length of bits stream is 432 bits.

000000000001101010001100011010110111011010101100111010001101100011010001010001101
111001111110001000010000000000010000101000000000000000000010100000010101101111010100000000000000100000000000001100000000000000000010101100000010000000011000111101110001111011101110101011011101001110110001010111001100000001101110110100100111101111011101110100011010111100100000100000011010001001110101000000010000000100000000101011111110111011100000000000000000

Abstract view of data with respect to the location of headers and data in the actual data stream.

Data Link (Ethernet) Header	Network Header	Transport Header	Data

Initial 112 bits contains Ethernet Header (Refer section 2.2), Next 160 bits contains IP Header (Refer section 2.3), Next 160 bits contains TCP Header (Refer section 2.4).

2.2 Header format of Ethernet

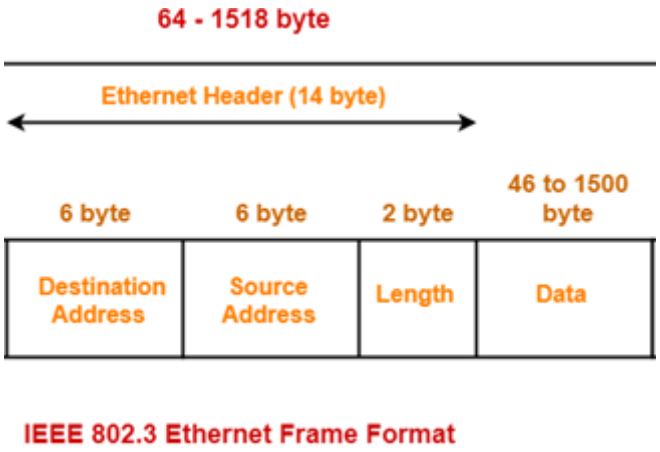

Figure 2.2 Ethernet Header Format

Section 2.1 contains bit stream. copy and paste respected number of bits into following table 2.1 to prepare ethernet header field boundary.

Table 2.1 Header format of ethernet

0000000000011010100011000110101 10111011010101100	1110100011011000110100010100011 01111001111110001	0000100000 000000

From table 2.1, fill table 2.2 with respected value and explanation meaning of each field. Refer the following link for better understanding. Refer video 1 in material 1 for further understanding.

Reference Link : https://en.wikipedia.org/wiki/Ethernet_frame#Header
https://en.wikipedia.org/wiki/EtherType

Table 2.2 Header fields of Ethernet

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Destination MAC Address	48 bits	00:1A:8C:6B:76:AC	Receiver's MAC address
Source MAC Address	48 bits	E8:D8:D1:46:F3F1	Sender's MAC address
Type	16 bits	0x800	0x800 indicates, Network Header type is IPv4 Header

2.3 Header format of Network

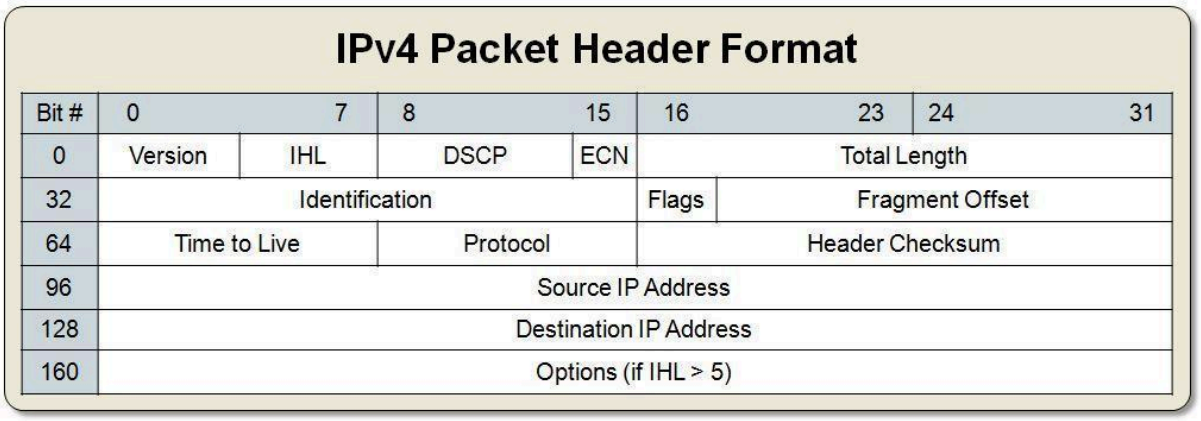

Figure 2.3 IPv4 header format

Section 2.1 contains bit stream. copy and paste respected number of bits into following table 2.3 to prepare ethernet header field boundary.

Table 2.3 Header format of network

0100	0101	000000	00	0000000000101000
0001010110111101			010	0000000000000
10000000		00000110		0000000000000000
10101100000100000000110001111011				
10001110111110101011011101001110				

From table 2.3, fill table 2.4 with respected value and explanation meaning of each field. Refer the following link for better understanding. Refer video 2 in material 2 for further understanding.

Reference Links:

https://en.wikipedia.org/wiki/IPv4#Header

DCSP & ECN: https://en.wikipedia.org/wiki/Type_of_service#DSCP_and_ECN

Flags: https://en.wikipedia.org/wiki/IPv4#Flags

Protocol: https://en.wikipedia.org/wiki/List_of_IP_protocol_numbers

Table 2.4 Header fields of Network

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Version	4 bits	0x4	IP Datagram version 4
IHL	4 bites	0x5	5*32bits=160bits=20bytes
DSCP	6 bits	0x0	---
ECN	2 bits	0x0	---
Total length	16 bits	0x28	Total length of 40 bytes
Identification	16 bits	0x15BD	
flags	3 bits	0x2	2 bit More Fragment (MF)
Fragment offset	13 bits	0x0	This packet does not contain fragments.
Time to live	8 bits	0x80	128 Hops / Routers
Protocol	8 bits	0x06	This packet should be give to TCP receive procedure. As its value indicates TCP.
Header checksum	16 bits	0x0	No checksum included in this header.
Source IP Address	32 bits	172.16.12.123	Source IP: 172.16.12.123, its local machine
Destination IP Address	32 bits	142.250.183.78	Destination: 142.250.183.78, it is situated in ____ country

2.4 Header format of transport layer: TCP

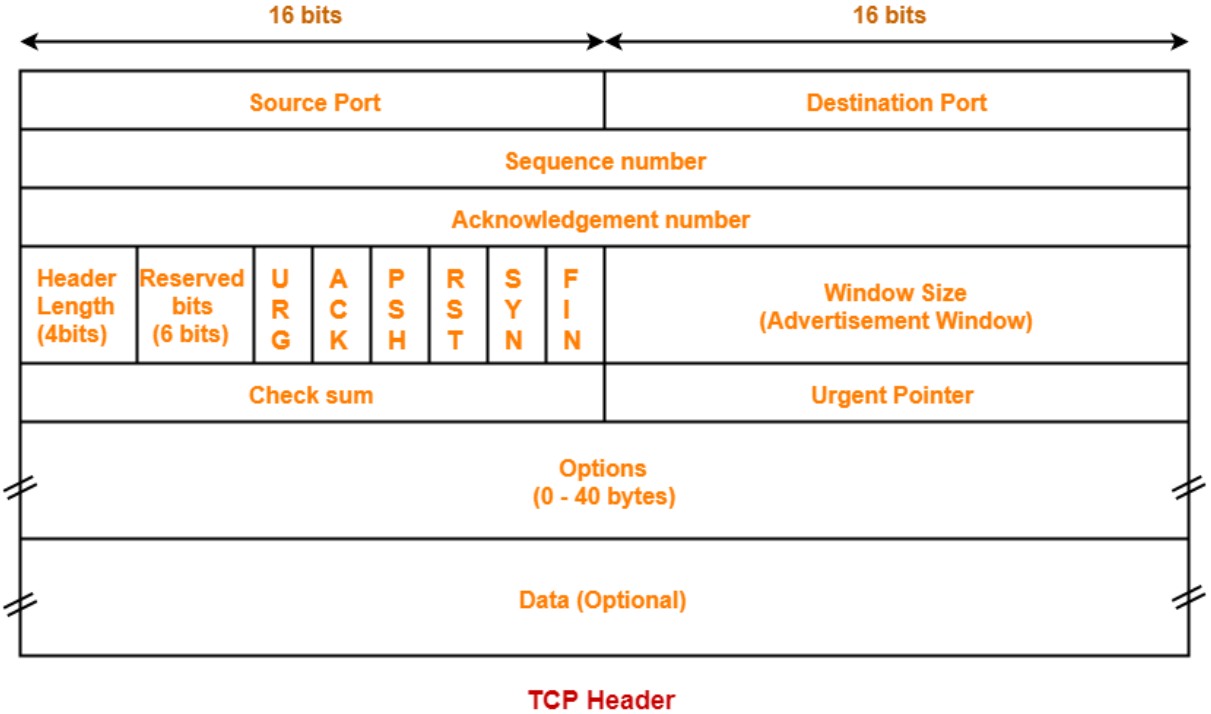

Figure 2.4 TCP Header format

Section 2.1 contains bit stream. copy and paste respected number of bits into following table 2.5 to prepare ethernet header field boundary.

Table 2.5 Header fields of transport layer

1100010101110011								0000000110111011
01001001111011110111110100011010								
11110010000010000001101000100111								
0101	000000	0	1	0	0	0	0	0001000000001010
1111111011101110								0000000000000000

From table 2.5, fill table 2.6 with respected value and explanation meaning of each field. Refer the following link for better understanding. Refer video 4 in material 4 for further understanding.

Reference Link :
https://en.wikipedia.org/wiki/Transmission_Control_Protocol#TCP_segment_structure
Flags: https://www.gatevidyalay.com/transmission-control-protocol-tcp-header/
Port : https://www.adminsub.net/tcp-udp-port-finder/

Table 2.6 Header fields of Transport Layer: _____

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Source Port	16 Bits	50547	Sender machine's application's logical port number 50547.
Destination Port	16 Bits	443	Receiver machine's receiving logical port number 443 which indicates source wants communicate security using https protocol.
Sequence Number	32 Bits	0x49EF7D1A	Unique ID assigned by sender to maintain order of packers at receiver side.
Acknowledgement Number	32 Bits	0xF2081A27	This is acknowledge of sent packet.
Header Length	4 Bits	0x5	Total header Length is 5*32bits=160bits=20bytes
Reserved Bits	6 Bits	0x0	-
URG	1 Bit	0	
ACK	1 Bit	1	This packet contains valid acknowledgement number.
PSH	1 Bit	0	No Push
RST	1 Bit	0	No RST
SYN	1 Bit	0	No SYN
FIN	1 Bit	0	NO Fin
Window Size	16 Bits	0x100A	4106
Checksum	16 Bits	0xFEEE	Error identification in packet.
Urgent Pointer	16 Bits	0x0	No urgent content in this packet.

Exercise-1: Input Sequence TCP

11101000110110001101000101000110111100111111000100000000000110101000110001101011011101101010110000001000000000000100010100000000000000000001010001011111111010010010000000000000000100000000000011011001110110100000110011100111011100011000110011010101100000100000000110001111011000000011011101111110010110010000011000100010000000001011110000011100100000000000010000101001101001010000000100000000000011111011101100001001110100000000000000000000000000000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Destination MAC Address	48 bits		
Source MAC Address			
Type			

Header fields of Network

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**

Header fields of Transport Layer: _____

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**

Exercise-2: Input Sequence of UDP

11101000110110001101000101000110111100111111000100000000010100000101011010101011111100100110011100010000000000000100010100000000000000000001010000010000101011001000000000000000010000000000010001101010011000100110101100000100000000101101000111101011000001000000001100011110111111001110010000000001101001111010000000000010100100011101001111111111010010000000000001011110011100000100000000000000000000000000100000000000000001000011111101100100000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Destination MAC Address	48 bits		
Source MAC Address			
Type			

Header fields of Network

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**

Header fields of Transport Layer: _____

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**

Exercise-3: Input Sequence: ARP Broadcast

11111111111111111111111111111111111111111111111111000000110001111011010010101000
11100010100010000001000000001100000000000000000100001000000000000000000110000001000
00000000000001111000000110001111011010010101000111000101000100101011000001000000
01000001000010000000000000000000000000000000000000000000000000010101100000100000000
01111001110100000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Destination MAC Address	48 bits		
Source MAC Address			
Type			

Header fields of _____

Header field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**

Exercise-4: Input Sequence: ARP Reply

11111111111111111111111111111111111111111111111110100110000010001101111111100111011
1110011100010110000100000000110000000000000000010000100000000000000001100000010000
0000000000001001001100000100011011111110011101111100111000101110101100000010000000
0111001101011000000000000000000000000000000000000000000001010110000010000000
1110011010110000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	Length of Field (in bits)	Header field Value (Hex Value)	Meaning
Destination MAC Address	48 bits		
Source MAC Address			
Type			

Header fields of _____________

Header Field Name	Length of Field (in bits)	Header field Value (Hex Value)	Meaning

Questions and answers:

1. What do you mean by TTL (Time to Live)?

Answer:

2. What is the significance of Sequence Number and Acknowledgment Number in TCP format?

Answer:

3. What is the full form of the MAC address? What is the significance of source and destination MAC address?

Answer:

4. What is the full form of IP, TCP, UDP and ARP?

Answer:

Gate Questions:

1. **What is the maximum size of data that the application layer can pass on to the TCP layer below?**
   A) Any size
   B) 216 bytes - size of TCP header
   C) 216 bytes
   D) 1500 bytes

Ans:

2. **The protocol data unit (PDU) for the application layer in the Internet stack is:**
   A) Segment
   B) Datagram
   C) Message
   D) Frame

Ans:

3. **A TCP message consisting of 2100 bytes is passed to IP for delivery across two networks. The first network can carry a maximum payload of 1200 bytes per frame and the second network can carry a maximum payload of 400 bytes per frame, excluding network overhead. Assume that IP overhead per packet is 20 bytes. What is the total IP overhead in the second network for this transmission?**
   A) 40 bytes
   B) 80 bytes
   C) 120 bytes
   D) 160 bytes

Ans:

4. **Which one of the following statements is FALSE?**
   A) TCP guarantees a minimum communication rate
   B) TCP ensures in-order delivery
   C) TCP reacts to congestion by reducing sender window size
   D) TCP employs retransmission to compensate for packet loss

Ans:

5. **In TCP, a unique sequence number is assigned to each**
   A) byte
   B) word
   C) segment
   D) message

Ans:

6. **Consider the following statements about the timeout value used in TCP.**
   i. **The timeout value is set to the RTT (Round Trip Time) measured during TCP connection establishment for the entire duration of the connection.**
   ii. **Appropriate RTT estimation algorithm is used to set the timeout value of a TCP connection.**
   iii. **Timeout value is set to twice the propagation delay from the sender to the receiver.**

   Which of the following choices hold?

A) (i) is false, but (ii) and (iii) are true
B) (i) and (iii) are false, but (ii) is true
C) (i) and (ii) are false, but (iii) is true
D) (i), (ii) and (iii) are false

Ans:

7. Consider an IP packet with a length of 4,500 bytes that includes a 20-byte IPv4 header ans 40-byte TCP header. The packet is forwarded to an IPv4 router that supports a Maximum Transmission Unit (MTU) of 600 bytes. Assume that the length of the IP header in all the outgoing fragments of this packet is 20 bytes. Assume that the fragmentation offset value stored in the first fragment is 0.

The fragmentation offset value stored in the third fragment is _____ .

Note –This was ..Numerical Type question.

A) 0
B) 72
C) 144
D) 216

Ans:

8. Consider two hosts P and Q connected through a router R. The maximum transfer unit (MTU) value of the link between P and R is 1500 bytes, and between R and Q is 820 bytes.

A TCP segment of size 1400 bytes was transferred from P to Q through R, with IP identification value as 0×1234. Assume that the IP header size is 20 bytes. Further, the packet is allowed to be fragmented, i.e., Don't Fragment (DF) flag in the IP header is not set by P.

Which of the following statements is/are correct?

A) Two fragments are created at R and the IP datagram size carrying the second fragment is 620 bytes.
B) If the second fragment is lost, R will resend the fragment with the IP identification value 0×1234.
C) If the second fragment is lost, P is required to resend the whole TCP segment.
D) TCP destination port can be determined by analysing only the second fragment.

Ans:

9. One of the header fields in an IP datagram is the Time to Live(TTL)field.Which of the following statements best explains the need for this field?

A) It can be used to prioritize packets
B) It can be used to reduce delays
C) It can be used to optimize throughput
D) It can be used to prevent packet looping

Ans:

10. **In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are:**
    A) Last fragment, 2400 and 2789
    B) First fragment, 2400 and 2759
    C) Last fragment, 2400 and 2759
    D) Middle fragment, 300 and 689

Ans:

11. **The maximum number of IPv4 router addresses that can be listed in the record route (RR) option field of an IPv4 header is_____.**

Ans:

12. **Consider an IP packet with a length of 4, 500 bytes that includes a 20 − byte IPv4 header ans 40 − byte TCP header. The packet is forwarded to an IPv4 router that supports a Maximum Transmission Unit (MTU) of 600 bytes. Assume that the length of the IP header in all the outgoing fragments of this packet is 20 bytes. Assume that the fragmentation offset value stored in the first fragment is 0.**

    The fragmentation offset value stored in the third fragment is_____.

Ans:

13. **For which one of the following reasons does internet protocol(IP) use the time-to-live(TTL) field in IP datagram header?**
    A) Ensure packets reach destination within that time
    B) Discard packets that reach later than that time
    C) Prevent packets from looping indefinitely
    D) Limit the time for which a packet gets queued in intermediate routers

Ans:

14. **One of the header fields in an IP datagram is the Time-to-Live (TTL) field. Which of the following statements best explains the need for this field?**
    A) It can be used to prioritize packets.
    B) It can be used to reduce delays.
    C) It can be used to optimize throughput.
    D) It can be used to prevent packet looping.

Ans:

15. **Host A (on TCP/IP v4 network A) sends an IP datagram D to host B (also on TCP/IP v4 network B). Assume that no error occurred during the transmission of D. When D reaches B, which of the following IP header field(s) may be different from that of the original datagram D?**
    i. TTL
    ii. Checksum
    iii. Fragment Offset
    A) i only
    B) i and ii only
    C) ii and iii only
    D) i, ii and iii

Ans:

16. **Host A sends a UDP datagram containing 8880 bytes of user data to host B over an Ethernet LAN. Ethernet frames may carry data up to 1500 bytes (i.e. MTU = 1500 bytes). Size of UDP header is 8 bytes and size of IP header is 20 bytes. There is no option field in IP header. How many total number of IP fragments will be transmitted and what will be the contents of offset field in the last fragment?**
    A) 6 and 925
    B) 6 and 7400
    C) 7 and 1110
    D) 7 and 8880

Ans:

17. **An IP datagram of size 1000 bytes arrives at a router. The router has to forward this packet on a link whose MTU (maximum transmission unit) is 100 bytes . Assume that the size of the IP header is 20 bytes .**

    The number of fragments that the IP datagram will be divided into for transmission is _____.

Ans:

18. **In the TCP/IP protocol suite, which one of the following is NOT part of the IP header?**
    A) Fragment Offset
    B) Source IP address
    C) Destination IP address
    D) Destination port number

Ans: