Practical-2

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

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.

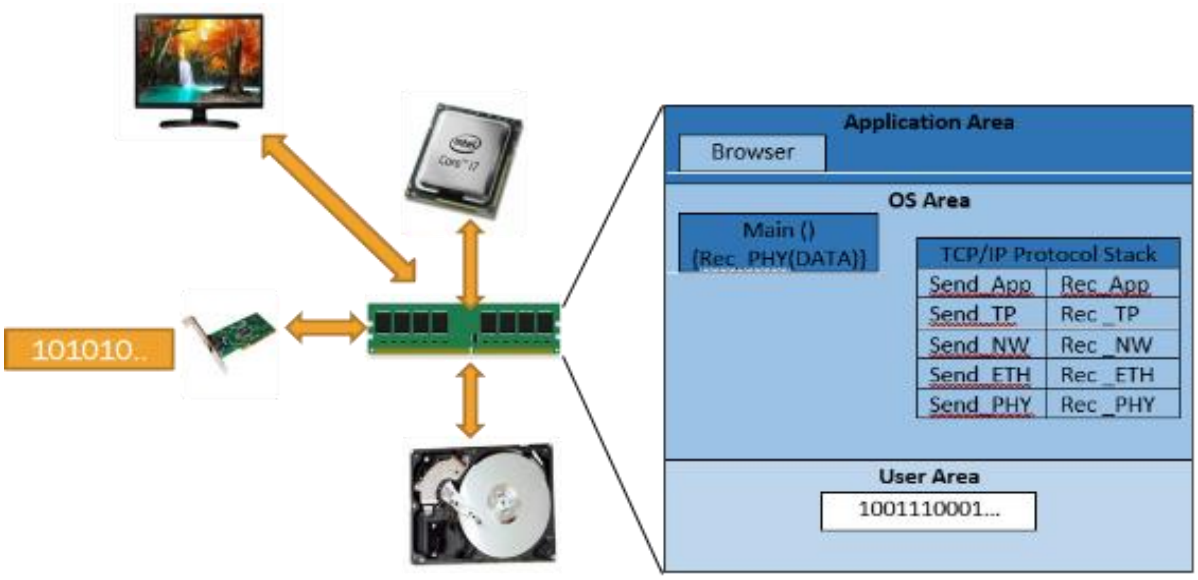

Figure 2.1 Real Scenario

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.

000000000001101010001100011010110111011010101100111010001101100011010001010001101111001111110001000010000000000010001010000000000000000000101000001010110111101010000000000000010000000000001100000000000000000101011000001000000001100011110111000111011111010101101110100111011000101

01110011000000011011101101001001111011110111110100011010111100100000100000110100010011101010000000100000001000000001010111111101110111000000000000000

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

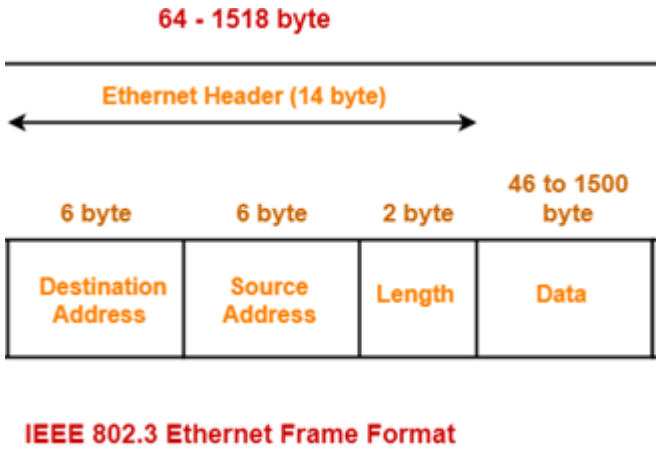

Figure 2.2 Ethernet Header Format

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

000000000001101010001100011010110111011010101100	11101000110110001101000101000110 1111001111110001	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

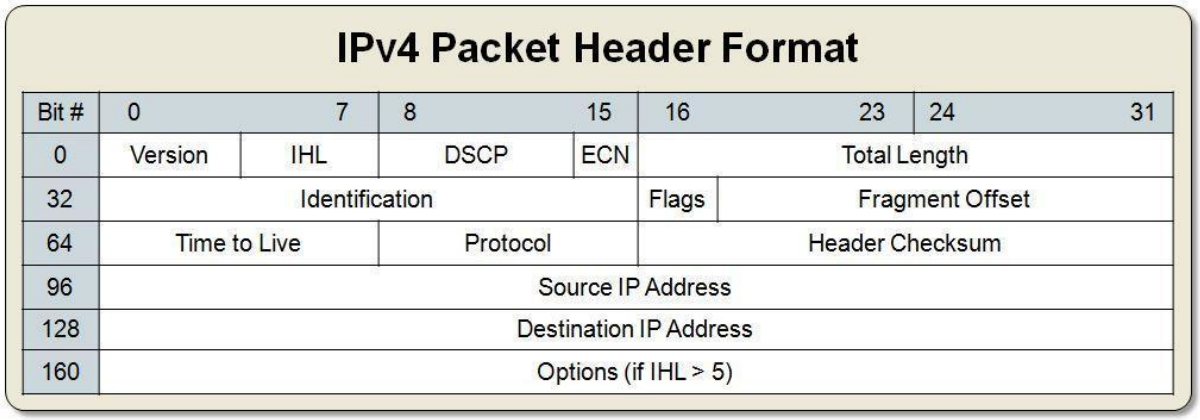

Figure 2.3 IPv4 header format

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

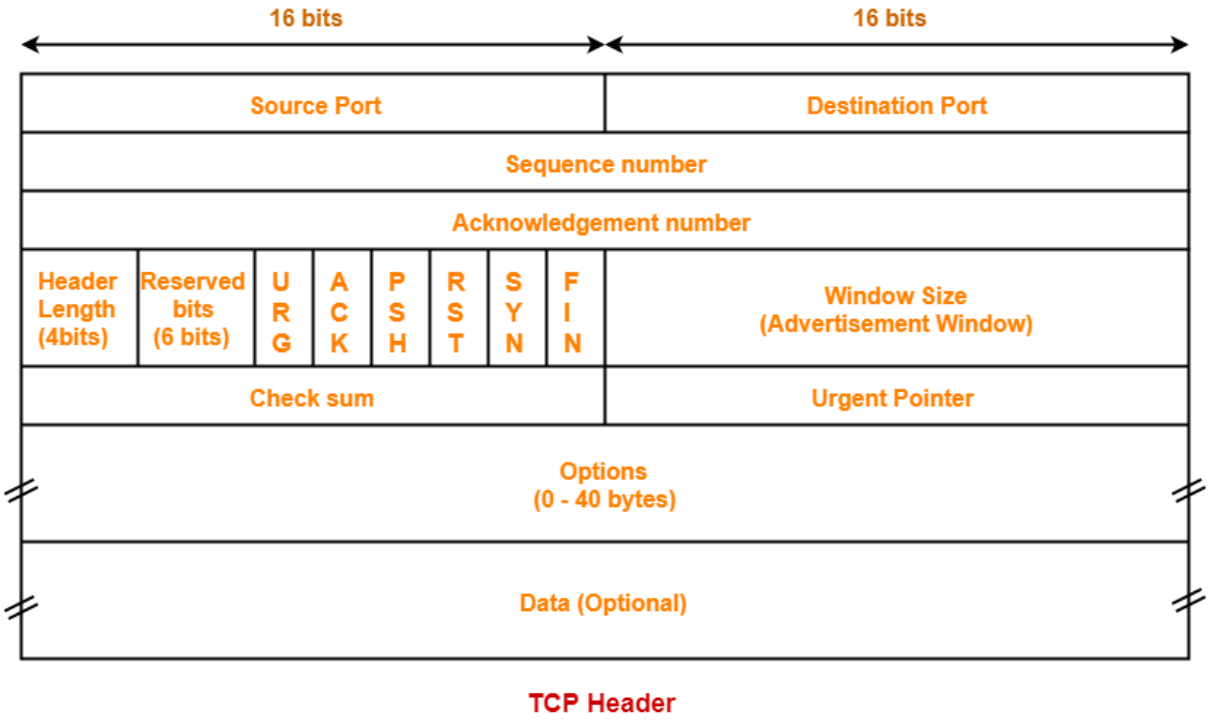

Figure 2.4 TCP Header format

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 acknowledged 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

11101000110110001101000101000110111100111111000100000000000011010100011
00011010110111011010101100000010000000000001000101000000000000000010
10001011111111010010010000000000000001000000000001101100111011010000001
10011100111011100011000110011010101100000100000000110001111011000000001
10111011111100101100100000110001000100000000010111100000111001000000000
00010000101001101001010000000100000000000011111011011000010011101000000
00000000000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

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

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 bits	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	0xBFD2	
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	0x40	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	0xCED0	No checksum included in this header.
Source IP Address	32 bits	173.19.55.814	Source IP: 173.19.55.814, its local machine
Destination IP Address	32 bits	288.673.292.3	Destination: 288.673.292.3, it is situated in ____ country

Header fields of Transport Layer: _____

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Source Port	16 Bits	443	Sender machine's application's logical port number 443.
Destination Port	16 Bits	62152	Receiver machine's receiving logical port number 62152 which indicates source wants communicate security using https protocol.
Sequence Number	32 Bits	0x311005E0	Unique ID assigned by sender to maintain order of packers at receiver side.
Acknowledgement Number	32 Bits	0x311005E0	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	0xFB	4106
Checksum	16 Bits	0xB09D	Error identification in packet.
Urgent Pointer	16 Bits	0x0	No urgent content in this packet.

Exercise-2: Input Sequence of UDP

11101000110110001101000101000110111100111111000100000000010100000101011010101011111100100110011100001000000000000100010100000000000000000010100000100001010110010100000000000000100000000001000110101001100010011010110000010000000010110100011110101100000100000000110001111011000000011011100000000001010000000000000000101001011100001100001000000000000000000000001000000000000000000010000011111101100100000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Destination MAC Address	48 bits	00:E8:D8:D1:46:F3F1	Receiver's MAC address
Source MAC Address	48 bits	00:50:56:AB:F267	Sender's MAC address
Type	16 bits	0x800	0x800 indicates, Network Header type is IPv4 Header

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 bits	0xA	A*32bits=320bits=40bytes
DSCP	6 bits	0x0	---
ECN	2 bits	0x0	---
Total length	16 bits	0x28	Total length of 40 bytes
Identification	16 bits	0x2159	
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	256 Hops / Routers
Protocol	8 bits	0x11	This packet should be give to TCP receive procedure. As its value indicates TCP.
Header checksum	16 bits	0xA989	No checksum included in this header.
Source IP Address	32 bits	288.673.261.5	Source IP: 288.673.261.5 its local machine
Destination IP Address	32 bits	288.673.292.3	Destination: 288.673.292.3, it is situated in ____ country

Header fields of Transport Layer: _____

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Source Port	16 Bits	443	Sender machine's application's logical port number 443.
Destination Port	16 Bits	50	Receiver machine's receiving logical port number 50 which indicates source wants communicate security using https protocol.
Sequence Number	32 Bits	0x1357921	Unique ID assigned by sender to maintain order of packers at receiver side.
Acknowledgement Number	32 Bits	0x256	This is acknowledged of sent packet.
Header Length	4 Bits	0x0	Total header Length is 0 bytes
Reserved Bits	6 Bits	0x1	1 bit
URG	1 Bit	0	
ACK	1 Bit	0	This packet doesn't contains valid acknowledgement number.
PSH	1 Bit	0	No Push
RST	1 Bit	0	No RST
SYN	1 Bit	1	SYN
FIN	1 Bit	1	Fin
Window Size	16 Bits	0xF640	4106
Checksum	16 Bits	0x0	No Error identification in packet.
Urgent Pointer	16 Bits	0x0	No urgent content in this packet.

Exercise-3: Input Sequence: ARP Broadcast

11111111111111111111111111111111111111111111111111000001100011110110
10010101000111000101000100000010000000011000000000000000010000100000000
00000000011000000100000000000000000111100000011000111101101001010100011
11000101000100101011000001000000001000001000010000000000000000000000000
00000000000000000000000010101100000100000000011110011101000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	Length of Field (in bits)	Header field Value (Hex Value)	Meaning
Destination MAC Address	48 bits	00:FF:FF:FF:FF:FFFF	Receiver's MAC address
Source MAC Address	48 bits	00:E0:63:DA:54:7144	Sender's MAC address
Type	16 bits	0x806	0x806 indicates, Network Header type is IPv4 Header

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 bits	0x5	5*32bits=160bits=20bytes
DSCP	6 bits	0x0	---
ECN	2 bits	0x1	---
Total length	16 bits	0x800	Total length of 40 bytes
Identification	16 bits	0x604	
Flags	3 bits	0x0	-
Fragment offset	13 bits	0x1	This packet contain 1bit fragments.
Time to live	8 bits	0xE0	128 Hops / Routers
Protocol	8 bits	0x63	This packet should be give to TCP receive procedure. As its value indicates TCP.
Header checksum	16 bits	0xDA54	No checksum included in this header.
Source IP Address	32 bits	190.03.25.904	Source IP: 190.03.25.904, its local machine
Destination IP Address	32 bits	136.380.4.1.6	Destination: 136.380.4.1.6, it is situated in ____ country

Exercise-4: Input Sequence: ARP Reply

1110000001100011110110100101010001110001010001000100110000010001101111
1110011101111100111000101100001000000001100000000000000001000010000000
0000000001100000010000000000000000100100110000010001101111111001110111
1100111000101110101100000100000000011100111010111000000110001111011010
0101010001110001010001001010110000010000000010000010000100000000000000
0000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000

Header fields of Ethernet

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Destination MAC Address	48 bits	00: E0:63:DA:54:7144	Receiver’s MAC address
Source MAC Address	48 bits	00: 4C:11:BF:9D:F38B	Sender’s MAC address
Type	16 bits	0x806	0x806 indicates, Network Header type is IPv4 Header

Header fields of Network

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Version	4 bits	0x0	IP Datagram version 0
IHL	4 bits	0x0	0*32bits=0bits=0bytes
DSCP	6 bits	0x0	---
ECN	2 bits	0x1	---
Total length	16 bits	0x800	Total length of 40 bytes
Identification	16 bits	0x604	
Flags	3 bits	0x0	-
Fragment offset	13 bits	0x2	This packet contain 2bit fragments.
Time to live	8 bits	0x4C	256 Hops / Routers

Header fields of transport layer

Header Field Name	**Length of Field (in bits)**	**Header field Value (Hex Value)**	**Meaning**
Source Port	16 Bits	55892	Sender machine's application's logical port number 55892.
Destination Port	16 Bits	7144	Receiver machine's receiving logical port number 7144 which indicates source wants communicate security using https protocol.
Sequence Number	32 Bits	0xAC100821	Unique ID assigned by sender to maintain order of packers at receiver side.
Acknowledgement Number	32 Bits	0x0	This is not acknowledged of sent packet.
Header Length	4 Bits	0x0	Total header Length is 0 bytes
Reserved Bits	6 Bits	0x0	-
URG	1 Bit	0	
ACK	1 Bit	0	This packet doesn't 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	0x0	-
Checksum	16 Bits	0x0	No Error identification in packet.
Urgent Pointer	16 Bits	0x0	No urgent content in this packet.