**Practical-2**

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

**2.1 Input data stream: TCP**

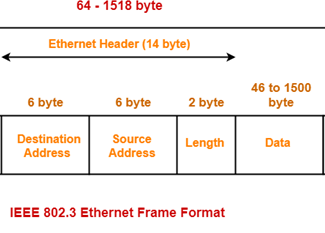
This is data stream which receiver NIC card receives from wire and stores into memory.

000000000001101010001100011010110111011010101100111010001101100011010001010001101111001111110001000010000000000001000101000000000000000000101000000101011011110101000000000000001000000000000110000000000000000010101100000100000000110001111011100011101111101010110111010011101100010101110011000000011011101101001001111011110111110100011010111100100000100000011010001001110101000000010000000100000000101011111110111011100000000000000000

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

|  |  |  |  |
| --- | --- | --- | --- |
| Data Link (Ethernet) Header | Network Header | Transport Header | Data |

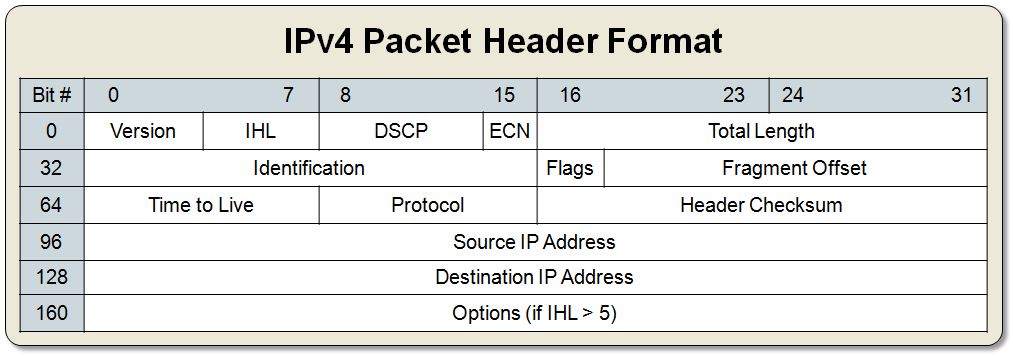
**2.2 Header format of Ethernet**

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**2.3 Header fields of Ethernet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Destination MAC Address | 48 bits | 001A8C6B76AC | It contains the MAC address of the destination device. |
| Source MAC Address | 48 bits | E8D8D146F3F1 | It contains the MAC address of the source device |
| Type | 16 bits | 0800 | This field stores information about the protocol of the upper layer |

**2.4 Header format of Network**



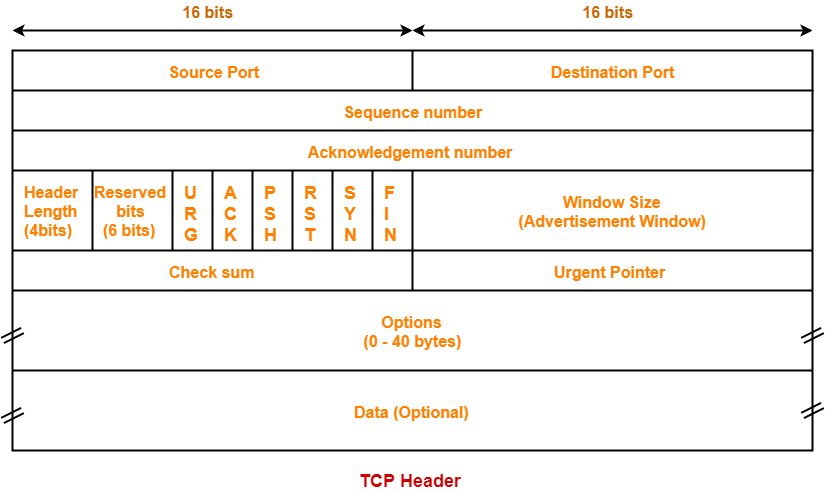
**2.5 Header format of network**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0100 | 0101 | 0000000 | 0 | 0000000000101000 | |
| 0001010110111101 | | | | 01 | 00000000000000 |
| 10000000 | | 00000110 | | 0000000000000000 | |
| 10101100000100000000110001111011 | | | | | |
| 10001110111110101011011101001110 | | | | | |
| 11000101011100110000000110111011 | | | | | |

**2.6 Header fields of Network**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Version | 4 | 4 | How to process the received data |
| IHL | 4 | 5 | It tells the total length of the IPv4 datagram |
| DSCP | 7 | 0 | Differentiated Services Code Point (DSCP) is a means of classifying and managing network traffic and of providing quality of service (QoS) in modern Layer 3 IP networks |
| ECN | 1 | 0 | An electronic communication network (ECN) is a digital system that matches buyers and sellers looking to trade securities in the financial markets. |
| Total Length | 16 | 0028 | Length of header + Data(16bits), which has a maximum value 20 bytes |
| Identification | 16 | 15BD | Unique Packet Id for identifying the group of fragments of a single IP datagram |
| Flags | 2 | 1 | Reserved bit |
| Fragment Offset | 14 | 0000 | Represents the number of data bytes ahead of the particular fragment in the particular Datagram |
| Time To Live | 8 | 80 | Datagram’s lifetime. It prevents the datagram to loop through the network by restricting the number of Hops taken by a Packet before delivering to the Destination. |
| Protocol | 8 | 06 | Name of the protocol to which the data is to be passed |
| Header Checksum | 16 | 0000 | 16 bits header checksum for checking errors in the datagram header |
| Source IP Address | 32 | AC100C7B | 32 bits IP address of the sender |
| Destination IP Address | 32 | 8EFAB74E | 32 bits IP address of the receiver |
| Options | 32 | C57301BB | Optional information such as source route, record route. Used by the Network administrator to check whether a path is working or not. |

**2.7 Header format of transport layer : TCP**



**2.8 Header fields of transport layer**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0100100111101111 | | | | | | | | 0111110100011010 |
| 11110010000010000001101000100111 | | | | | | | | |
| 01010000000100000001000000001010 | | | | | | | | |
| 1111 | 111011 | 1 | 0 | 1 | 1 | 1 | 0 | 0000000000000000 |
|  | | | | | | | |  |

**2.9 Header fields of Transport Layer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_-**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Source Port | 16 | 49DF | It is used to define the address of the application program in a source computer |
| Destination Part | 16 | 7D1A | It is used to define the address of the application program in a destination computer. |
| Sequence Number | 32 | F2081A27 | sequence number field represents the position of the data in an original data stream |
| Acknowledgement number | 32 | 5010100A | A 32-field acknowledgement number acknowledge the data from other communicating devices |
| Header length | 4 | F | It specifies the size of the TCP header |
| Reserved bits | 6 | 3B | It is a six-bit field which is reserved for future use. |
| URG | 1 | 1 | The URG field indicates that the data in a segment is urgent. |
| ACK | 1 | 0 | When ACK field is set, then it validates the acknowledgement number. |
| PSH | 1 | 1 | The PSH field is used to inform the sender that higher throughput is needed so if possible, data must be pushed with higher throughput. |
| RST | 1 | 1 | The reset bit is used to reset the TCP connection when there is any confusion occurs in the sequence numbers |
| SYN | 1 | 1 | The SYN field is used to synchronize the sequence numbers in three types of segments: connection request, connection confirmation ( with the ACK bit set ), and confirmation acknowledgement. |
| FIN | 1 | 0 | The FIN field is used to inform the receiving TCP module that the sender has finished sending data. |
| Window size | 16 | 0 | The window is a 16-bit field that defines the size of the window. |
|  |  |  |  |

**2.10 Exercise-1: Input Sequence TCP**

11101000110110001101000101000110111100111111000100000000000110101000110001101010111011010101100000010000000000001000101000000000000000000101000101111111101001001000000000000000100000000000110110011101101000001100111001110111000110001100110101011000001000000001100011110110000000110111011111100101100100000110001000100000000010111100000111001000000000001000010100110100101000000010000000000001111101110110000100111010000000000000000000000000000000000000000000000000000000000000000

**Header fields of Ethernet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Destination MAC Address | 48 bits | E8D8D146F3F1 | It contains the MAC address of the destination device. |
| Source MAC Address | 48 bits | 001A8C6B76AC | It contains the MAC address of the source device |
| Type | 16 bits | 0800 | This field stores information about the protocol of the upper layer |

**Header fields of Network**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Version | 4 | 4 | How to process the received data |
| IHL | 4 | 5 | It tells the total length of the IPv4 datagram |
| DSCP | 7 | 0 | Differentiated Services Code Point (DSCP) is a means of classifying and managing network traffic and of providing quality of service (QoS) in modern Layer 3 IP networks |
| ECN | 1 | 0 | An electronic communication network (ECN) is a digital system that matches buyers and sellers looking to trade securities in the financial markets. |
| Total Length | 16 | 0028 | Length of header + Data(16bits), which has a maximum value 20 bytes |
| Identification | 16 | BFB2 | Unique Packet Id for identifying the group of fragments of a single IP datagram |
| Flags | 2 | 1 | Reserved bit |
| Fragment Offset | 14 | 0000 | Represents the number of data bytes ahead of the particular fragment in the particular Datagram |
| Time To Live | 8 | 40 | Datagram’s lifetime. It prevents the datagram to loop through the network by restricting the number of Hops taken by a Packet before delivering to the Destination. |
| Protocol | 8 | 06 | Name of the protocol to which the data is to be passed |
| Header Checksum | 16 | CED0 | 16 bits header checksum for checking errors in the datagram header |
| Source IP Address | 32 | 673B8C66 | 32 bits IP address of the sender |
| Destination IP Address | 32 | AC100C7B | 32 bits IP address of the receiver |
| Options | 32 | 011BBF2C8 | Optional information such as source route, record route. Used by the Network administrator to check whether a path is working or not. |

**Header fields of Transport Layer: \_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Source Port | 16 | 3110 | It is used to define the address of the application program in a source computer |
| Destination Part | 16 | 05E0 | It is used to define the address of the application program in a destination computer. |
| Sequence Number | 32 | E400429A | sequence number field represents the position of the data in an original data stream |
| Acknowledgement number | 32 | 501000FB | A 32-field acknowledgement number acknowledge the data from other communicating devices |
| Header length | 4 | B | It specifies the size of the TCP header |
| Reserved bits | 6 | 02 | It is a six-bit field which is reserved for future use. |
| URG | 1 | 0 | The URG field indicates that the data in a segment is urgent. |
| ACK | 1 | 1 | When ACK field is set, then it validates the acknowledgement number. |
| PSH | 1 | 1 | The PSH field is used to inform the sender that higher throughput is needed so if possible, data must be pushed with higher throughput. |
| RST | 1 | 1 | The reset bit is used to reset the TCP connection when there is any confusion occurs in the sequence numbers |
| SYN | 1 | 0 | The SYN field is used to synchronize the sequence numbers in three types of segments: connection request, connection confirmation ( with the ACK bit set ), and confirmation acknowledgement. |
| FIN | 1 | 1 | The FIN field is used to inform the receiving TCP module that the sender has finished sending data. |
| Window size | 16 | 0000 | The window is a 16-bit field that defines the size of the window. |

**2.11 Exercise-2: Input Sequence of UDP**

111010001101100011010001010001101111001111110001000000000101000001010110101010111111001001100111000010000000000001000101000000000000000000101000001000010101100100000000000000001000000000010001101010011000100110101100000100000000101101000111101011000001000000001100011110111110011100100000000011010011110100000000000101001000110100111111111101001000000000000101111001110000010000000000000000000000010000000000000000010000111111011001000000000000000000000000000000000000000000000000

**Header fields of Ethernet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Destination MAC Address | 48 bits | E8D8D146F3F1 | It contains the MAC address of the destination device. |
| Source MAC Address | 48 bits | 005056ABF267 | It contains the MAC address of the source device |
| Type | 16 bits | 0800 | This field stores information about the protocol of the upper layer |

**Header fields of Network**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Version | 4 | 4 | How to process the received data |
| IHL | 4 | 5 | It tells the total length of the IPv4 datagram |
| DSCP | 7 | 00 | Differentiated Services Code Point (DSCP) is a means of classifying and managing network traffic and of providing quality of service (QoS) in modern Layer 3 IP networks |
| ECN | 1 | 0 | An electronic communication network (ECN) is a digital system that matches buyers and sellers looking to trade securities in the financial markets. |
| Total Length | 16 | 0028 | Length of header + Data(16bits), which has a maximum value 20 bytes |
| Identification | 16 | 2159 | Unique Packet Id for identifying the group of fragments of a single IP datagram |
| Flags | 2 | 00 | Reserved bit |
| Fragment Offset | 14 | 0000 | Represents the number of data bytes ahead of the particular fragment in the particular Datagram |
| Time To Live | 8 | 80 | Datagram’s lifetime. It prevents the datagram to loop through the network by restricting the number of Hops taken by a Packet before delivering to the Destination. |
| Protocol | 8 | 11 | Name of the protocol to which the data is to be passed |
| Header Checksum | 16 | A989 | 16 bits header checksum for checking errors in the datagram header |
| Source IP Address | 32 | AC100B41 | 32 bits IP address of the sender |
| Destination IP Address | 32 | AC100C7B | 32 bits IP address of the receiver |
| Options | 32 | E7200D3D | Optional information such as source route, record route. Used by the Network administrator to check whether a path is working or not. |

**Header fields of Transport Layer:\_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Source Port | 16 | 0014 | It is used to define the address of the application program in a source computer |
| Destination Part | 16 | 8D3F | It is used to define the address of the application program in a destination computer. |
| Sequence Number | 32 | F48005E7 | sequence number field represents the position of the data in an original data stream |
| Acknowledgement number | 32 | 04000004 | A 32-field acknowledgement number acknowledge the data from other communicating devices |
| Header length | 4 | 0 | It specifies the size of the TCP header |
| Reserved bits | 6 | 00 | It is a six-bit field which is reserved for future use. |
| URG | 1 | 0 | The URG field indicates that the data in a segment is urgent. |
| ACK | 1 | 0 | When ACK field is set, then it validates the acknowledgement number. |
| PSH | 1 | 0 | The PSH field is used to inform the sender that higher throughput is needed so if possible, data must be pushed with higher throughput. |
| RST | 1 | 0 | The reset bit is used to reset the TCP connection when there is any confusion occurs in the sequence numbers |
| SYN | 1 | 0 | The SYN field is used to synchronize the sequence numbers in three types of segments: connection request, connection confirmation ( with the ACK bit set ), and confirmation acknowledgement. |
| FIN | 1 | 1 | The FIN field is used to inform the receiving TCP module that the sender has finished sending data. |
| Window size | 16 | 0FD9 | The window is a 16-bit field that defines the size of the window. |

**2.12 Exercise-3: Input Sequence: ARP Broadcast**

ffffffffffffe063da54714408060001080006040001e063da547144ac100821000000000000ac10079d000000000000000000000000000000000000

111111111111111111111111111111111111111111111111111000000110001111011010010101000111000101000100000010000000011000000000000000010000100000000000000001100000010000000000000000011110000001100011110110100101010001110001010001001010110000010000000010000010000100000000000000000000000000000000000000000000000010101100000100000000011110011101000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000

**Header fields of Ethernet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Destination MAC Address | 48 bits | FFFFFFFFFFFF | It contains the MAC address of the destination device. |
| Source MAC Address | 48 bits | E063DA547144 | It contains the MAC address of the source device |
| Type | 16 bits | 0806 | This field stores information about the protocol of the upper layer |

**Header fields of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Version | 4 | 0 | How to process the received data |
| IHL | 4 | 0 | It tells the total length of the IPv4 datagram |
| DSCP | 7 | 0 | Differentiated Services Code Point (DSCP) is a means of classifying and managing network traffic and of providing quality of service (QoS) in modern Layer 3 IP networks |
| ECN | 1 | 1 | An electronic communication network (ECN) is a digital system that matches buyers and sellers looking to trade securities in the financial markets. |
| Total Length | 16 | 0800 | Length of header + Data(16bits), which has a maximum value 20 bytes |
| Identification | 16 | 0604 | Unique Packet Id for identifying the group of fragments of a single IP datagram |
| Flags | 2 | 0 | Reserved bit |
| Fragment Offset | 14 | 0001 | Represents the number of data bytes ahead of the particular fragment in the particular Datagram |
| Time To Live | 8 | E0 | Datagram’s lifetime. It prevents the datagram to loop through the network by restricting the number of Hops taken by a Packet before delivering to the Destination. |
| Protocol | 8 | 63 | Name of the protocol to which the data is to be passed |
| Header Checksum | 16 | DA64 | 16 bits header checksum for checking errors in the datagram header |
| Source IP Address | 32 | 7144AC10 | 32 bits IP address of the sender |
| Destination IP Address | 32 | 08210000 | 32 bits IP address of the receiver |
| Options | 32 | 00000000 | Optional information such as source route, record route. Used by the Network administrator to check whether a path is working or not. |

**2.13 Exercise-4: Input Sequence: ARP Reply**

ffffffffffff4c11bf9df38b080600010800060400024c11bf9df38bac100e6b000000000000ac100e6b000000000000000000000000000000000000

111111111111111111111111111111111111111111111111010011000001000110111111100111011111001110001011000010000000011000000000000000010000100000000000000001100000010000000000000000100100110000010001101111111001110111110011100010111010110000010000000011100110101100000000000000000000000000000000000000000000000010101100000100000000111001101011000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000

**Header fields of Ethernet**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Destination MAC Address | 48 bits | FFFFFFFFFFFF | It contains the MAC address of the destination device. |
| Source MAC Address | 48 bits | 4C11BF9DF38B | It contains the MAC address of the source device |
| Type | 16 bits | 0806 | This field stores information about the protocol of the upper layer |

**Header fields of \_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |
| --- | --- | --- | --- |
| **Header field Name** | **Length of Field (in bits)** | **Header field Value (Hex Value)** | **Meaning** |
| Version | 4 | 0 | How to process the received data |
| IHL | 4 | 0 | It tells the total length of the IPv4 datagram |
| DSCP | 7 | 0 | Differentiated Services Code Point (DSCP) is a means of classifying and managing network traffic and of providing quality of service (QoS) in modern Layer 3 IP networks |
| ECN | 1 | 1 | An electronic communication network (ECN) is a digital system that matches buyers and sellers looking to trade securities in the financial markets. |
| Total Length | 16 | 0800 | Length of header + Data(16bits), which has a maximum value 20 bytes |
| Identification | 16 | 0604 | Unique Packet Id for identifying the group of fragments of a single IP datagram |
| Flags | 2 | 0 | Reserved bit |
| Fragment Offset | 14 | 0002 | Represents the number of data bytes ahead of the particular fragment in the particular Datagram |
| Time To Live | 8 | 4C | Datagram’s lifetime. It prevents the datagram to loop through the network by restricting the number of Hops taken by a Packet before delivering to the Destination. |
| Protocol | 8 | 11 | Name of the protocol to which the data is to be passed |
| Header Checksum | 16 | BF9D | 16 bits header checksum for checking errors in the datagram header |
| Source IP Address | 32 | F38BAC10 | 32 bits IP address of the sender |
| Destination IP Address | 32 | 0E6A0000 | 32 bits IP address of the receiver |
| Options | 32 | 00000000 | Optional information such as source route, record route. Used by the Network administrator to check whether a path is working or not. |

**2.14 Questions and answer:**

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

Answer: **Time to live** (TTL) refers to the amount of time or “hops” that a packet is set to exist inside a network before being discarded by a router.

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

Answer: The sequence number is the byte number of the first byte of data in the TCP packet sent (also called a TCP segment). The acknowledgement number is the sequence number of the next byte the receiver expects to receive**.**

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

Answer: Full Form – Media Access Control

In any packet transmitted over Ethernet there are two MAC-addresses present: **one is a source MAC-address and another is a destination MAC-address**. When forwarding data, Ethernet-switches use this important data

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

Answer:

* IP – Internet Protocol
* TCP – Transmission Control Protocol
* UDP – User Datagram Protocol
* ARP – Address Resolution Protocol