Computer Networks

Ethernet

Ethernet is one of the standard LAN technologies used for building wired LANs.
It is defined under IEEE 802.3.

Ethernet uses bus topology.In bus topology, all the stations are connected to a single half duplex link.

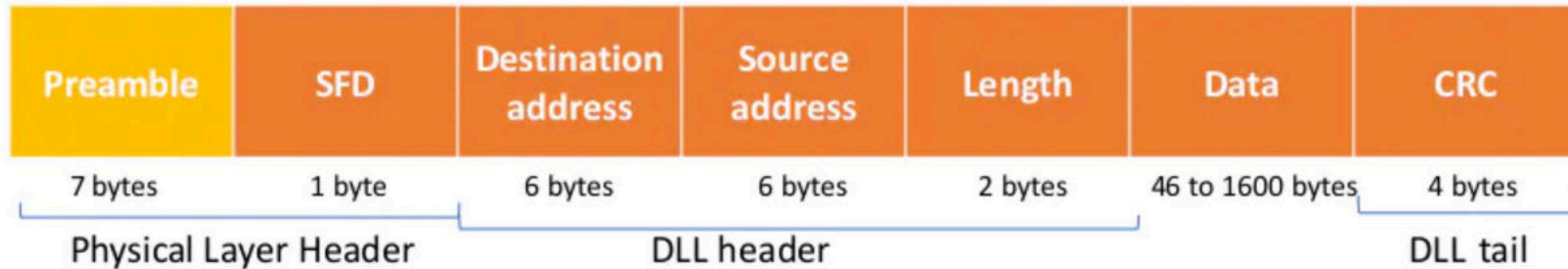Ethernet uses CSMA / CD as access control method to deal with the collisions.

Ethernet uses Manchester Encoding Technique for converting data bits into signals.

For Normal Ethernet, operational bandwidth is 10 Mbps.

For Fast Ethernet, operational bandwidth is 100 Mbps.

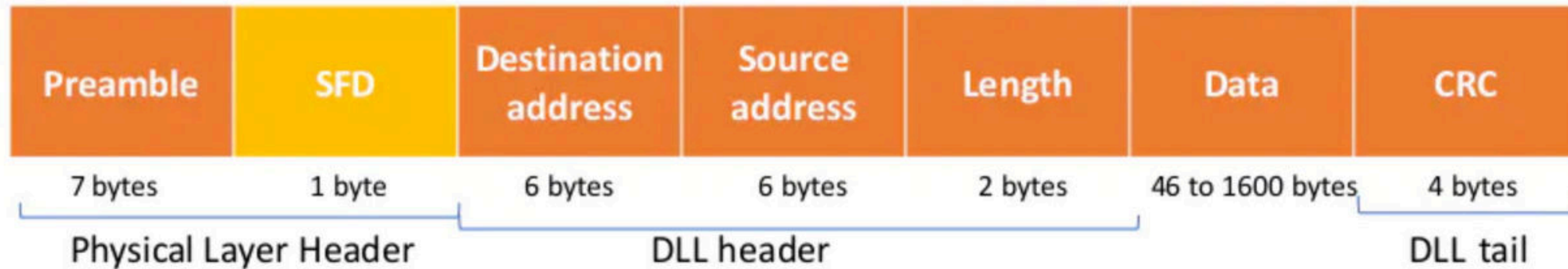For Gigabit Ethernet, operational bandwidth is 1 Gbps.

Ethernet Frame Format

Preamble	SFD	Destination address	Source address	Length	Data	CRC
7 bytes	1 byte	6 bytes	6 bytes	2 bytes	46 to 1600 bytes	4 bytes

Physical Layer Header   DLL header   DLL tail

1. Preamble-

• It is a 7 byte field that contains a pattern of alternating 0's and 1's.

• It alerts the stations that a frame is going to start.

• It also enables the sender and receiver to establish bit synchronization.
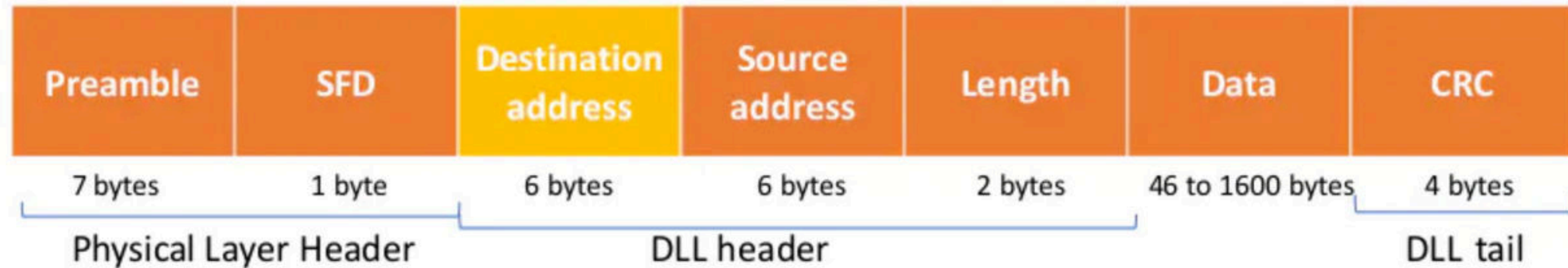
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2. Start Frame Delimiter (SFD)-

• It is a 1 byte field which is always set to 10101011.
• The last two bits "11" indicate the end of Start Frame Delimiter and marks the beginning of the frame.
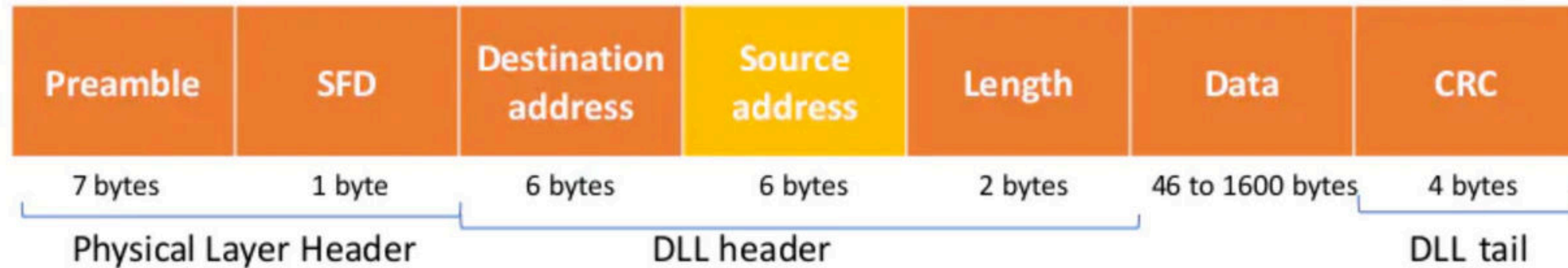
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3. Destination Address-

•It is a 6 byte field that contains the MAC address of the destination for which the data is destined.

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4. Source Address-

• It is a 6 byte field that contains the MAC address of the source which is sending the data.

Types of MAC address :-

There are three types of MAC addresses, which are:

1. Unicast MAC Address
2. Multicast MAC address
3. Broadcast MAC address

1.)Unicast MAC address:

The Unicast MAC address represents the specific NIC on the network.
A Unicast MAC address frame is only sent out to the interface which is assigned to a specific NIC and hence transmitted to the single destination device. If the LSB (least significant bit) of the first octet of an address is set to zero, the frame is meant to reach only one destination NIC.

2.)Multicast MAC Address:

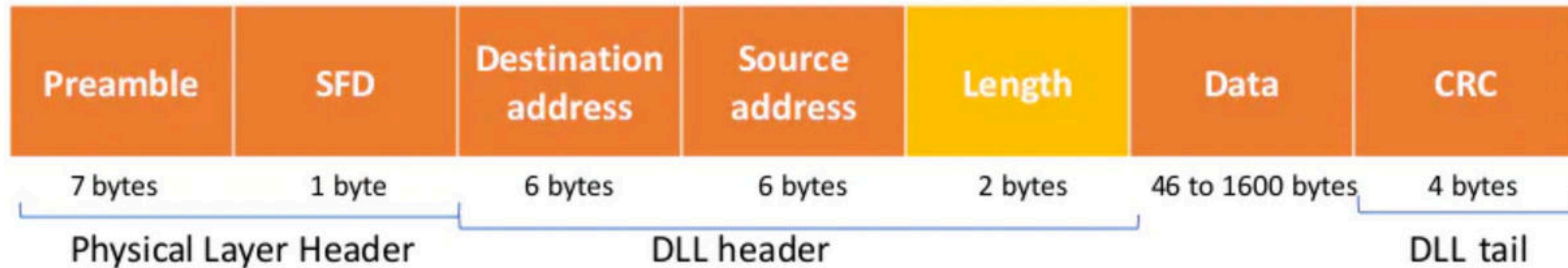Multicast addresses enables the source device to transmit a data frame to multiple devices or NICs.
In Layer-2 (Ethernet) Multicast address, LSB (least significant bit) or first 3 bytes of the first octet of an address is set to one and reserved for the multicast addresses.

3.)Broadcast MAC address

It represents all devices within a Network. In broadcast MAC address, Ethernet frames with ones in all bits of the destination address (FF-FF-FF-FF-FF-FF) are known as a broadcast address.
All these bits are the reserved addresses for the broadcast. Frames that are destined with MAC address FF-FF-FF-FF-FF-FF will reach every computer belong to that LAN segment. Hence if a source device wants to send the data to all the devices within a network, that can use the broadcast address as the destination MAC address.
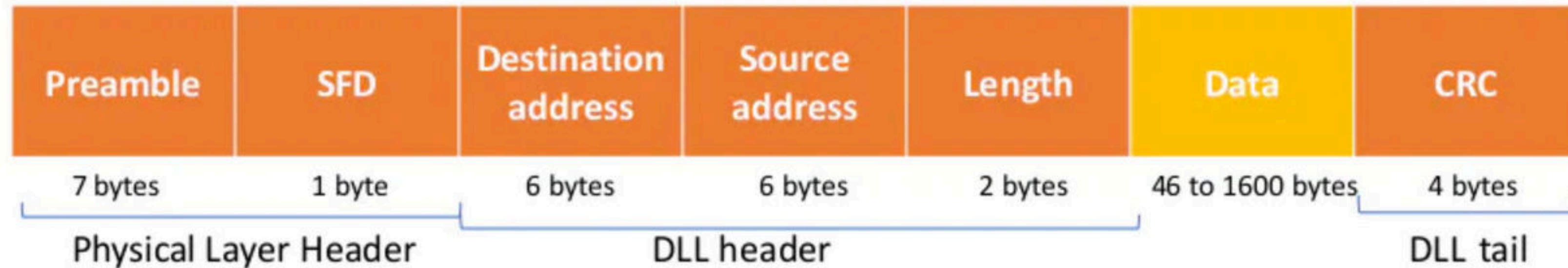
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5. Length-

- It is a 2 byte field which specifies the length (number of bytes) of the data field.
- This field is required because Ethernet uses variable sized frames.

- The maximum value that can be accommodated in this field = $2^{16} - 1 = 65535$.
- But it does not mean maximum data that can be sent in one frame is 65535 bytes.
- The maximum amount of data that can be sent in a Ethernet frame is 1500 bytes.
- This is to avoid the monopoly of any single stati

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Minimum Length of Data Field

6. Data-

•It is a variable length field which contains the actual data.

•It is also called as a **payload field**.

•The length of this field lies in the range [46 bytes , 1500 bytes].

•Thus, in a Ethernet frame, minimum data has to be 46 bytes and maximum data can be 1500 bytes.

•Ethernet uses CSMA / CD as access control method to deal with collisions.
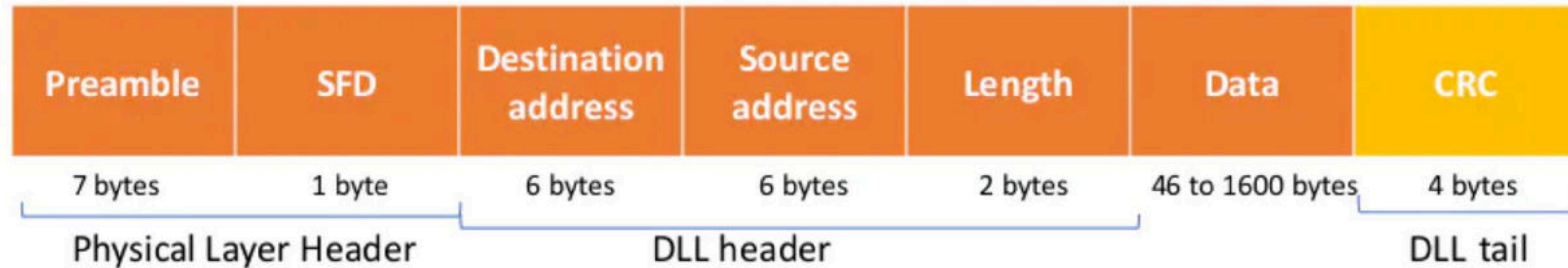
•For detecting the collisions, CSMA / CD requires-

Minimum length of data packet = 2 x Propagation delay x Bandwidth

•Substituting the standard values of Ethernet, it is found that minimum length of the Ethernet frame has to be 64 bytes starting from the destination address field to the CRC field and 72 bytes including the Preamble and SFD fields.

•Therefore, minimum length of the data field has to be = 64 bytes − (6+6+2+4) bytes = 46 bytes

Maximum Length of Data Field

•The maximum amount of data that can be sent in a Ethernet frame is 1500 bytes.

•This is to avoid the monopoly of any single station.

•If Ethernet allows the frames of big sizes, then other stations may not get the fair chance to send their data.

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7. Frame Check Sequence (CRC)-

•It is a 4 byte field that contains the CRC code for error detection.

Advantages of Using Ethernet-

It is simple to understand and implement.

Its maintenance is easy.

It is cheap.

Limitations of Using Ethernet-

Point-01:

It can not be used for real time applications.

Real time applications require the delivery of data within some time limit.

Ethernet is not reliable because of high probability of collisions.

High number of collisions may cause a delay in delivering the data to its destination.

Point-02:

It can not be used for interactive applications.

Interactive applications like chatting requires the delivery of even very small amount of data.

Ethernet requires that minimum length of the data must be 46 bytes.

Point-03:

It can not be used for client server applications.

Client server applications require that server must be given higher priority than clients.

Ethernet has no facility to set priorities.