Open system Interconnection (OSI)

Datalink Layer-Aloha & Ethernet in Networking,Ethernet Frame Format

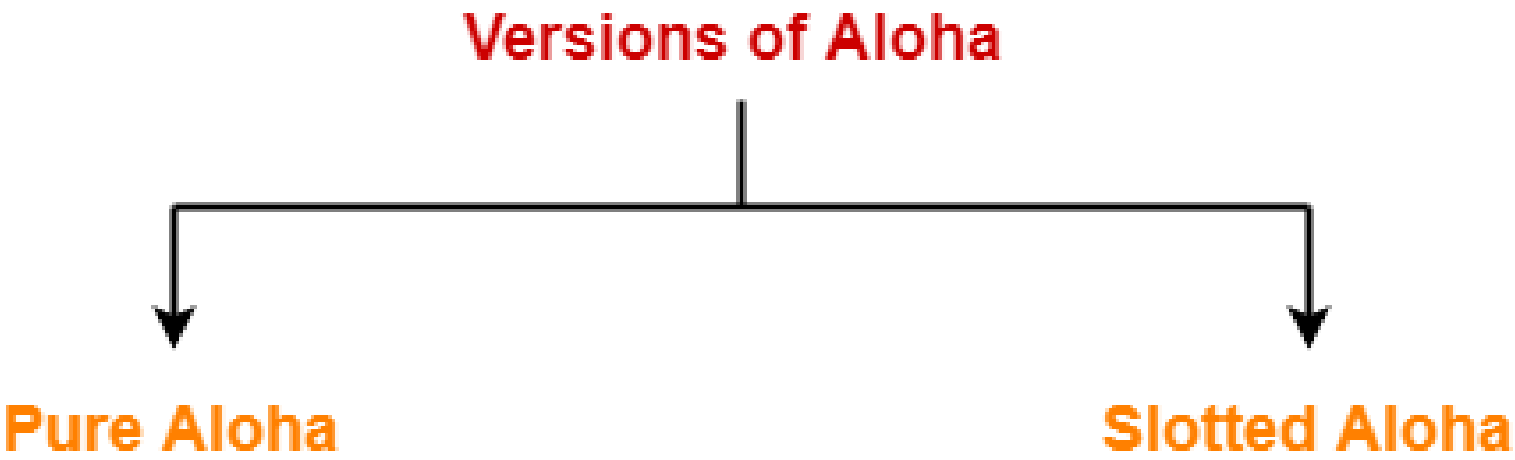
Munesh Singh

Indian Institute of Information Technology, Design and Manufacturing Kancheepuram,
Chennai, Tamil Nadu 600127

October 26, 2020

There are two different versions of Aloha-

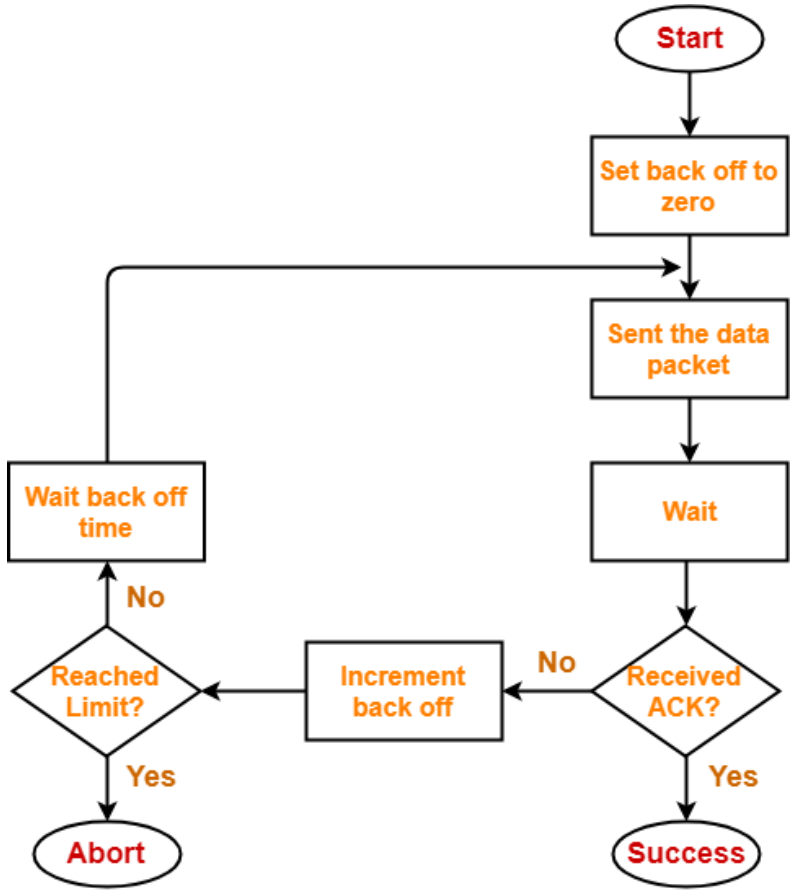
- **Pure Aloha**
- **Slotted Aloha**



Pure Aloha

- It allows the stations to transmit data at any time whenever they want.
- After transmitting the data packet, station waits for some time.
- Then, following 2 cases are possible-
  - **Case-01:**
    - Transmitting station receives an acknowledgment from the receiving station.
    - In this case, transmitting station assumes that the transmission is successful.
  - **Case-02:**
    - Transmitting station does not receive any acknowledgment within specified time from the receiving station.
    - In this case, transmitting station assumes that the transmission is unsuccessful.

- Then,
  - Transmitting station uses a Back Off Strategy and waits for some random amount of time. After back off time, it transmits the data packet again.
  - It keeps trying until the back off limit is reached after which it aborts the transmission.



Flowchart for Pure Aloha

Efficiency

- **Efficiency of Pure Aloha (η) = G x e^{-2G}**
- where G = Number of stations willing to transmit data
- **Maximum Efficiency**
  - We put d / dG = 0
  - Maximum value of occurs at G = 1/2
  - Substituting G = 1/2 in the above expression, we get-
- **Maximum Efficiency= 1/2 x $e^{-2x1/2}$=18.4%**
- Maximum Efficiency of Pure Aloha (η) = 18.4%
- The maximum efficiency of Pure Aloha is very less due to large number of collisions.

Slotted Aloha

- Slotted Aloha divides the time of shared channel into discrete intervals called as time slots.
- Any station can transmit its data in any time slot.
- The only condition is that station must start its transmission from the beginning of the time slot.
- If the beginning of the slot is missed, then station has to wait until the beginning of the next time slot.
- A collision may occur if two or more stations try to transmit data at the beginning of the same time slot.
- **Efficiency of Slotted Aloha (η) = G x e^{-G}**
- where G = Number of stations willing to transmit data at the beginning of the same time slot

Maximum Efficiency

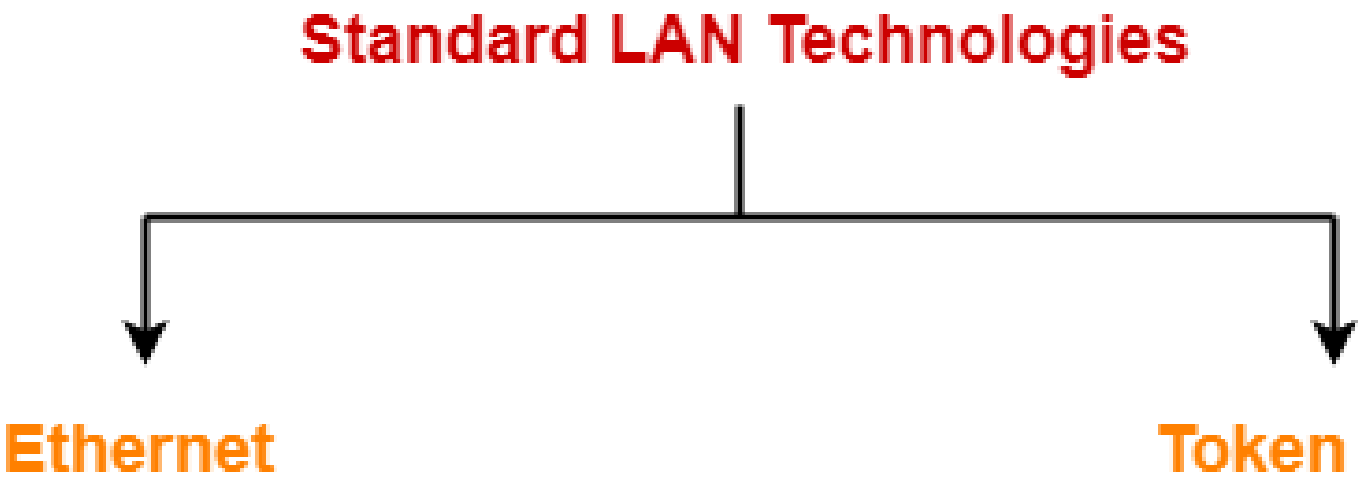
- We put d / dG = 0
- Maximum value of occurs at G = 1
- Substituting G = 1 in the above expression, we get-
  - **Maximum efficiency of Slotted Aloha=** $1xe^{-1}$**=36.8%**
- The maximum efficiency of Slotted Aloha is high due to less number of collisions.

Difference Between Pure Aloha And Slotted Aloha

Pure Aloha	Slotted Aloha
Any station can transmit the data at any time.	Any station can transmit the data at the beginning of any time slot.
The time is continuous and not globally synchronized.	The time is discrete and globally synchronized.
Vulnerable time in which collision may occur $= 2 \times T_t$	Vulnerable time in which collision may occur $= T_t$
Probability of successful transmission of data packet $= G \times e^{-2G}$	Probability of successful transmission of data packet $= G \times e^{-G}$
Maximum efficiency = 18.4% (Occurs at G = 1/2)	Maximum efficiency = 36.8% (Occurs at G = 1)
The main advantage of pure aloha is its simplicity in implementation.	The main advantage of slotted aloha is that it reduces the number of collisions to half and doubles the efficiency of pure aloha.

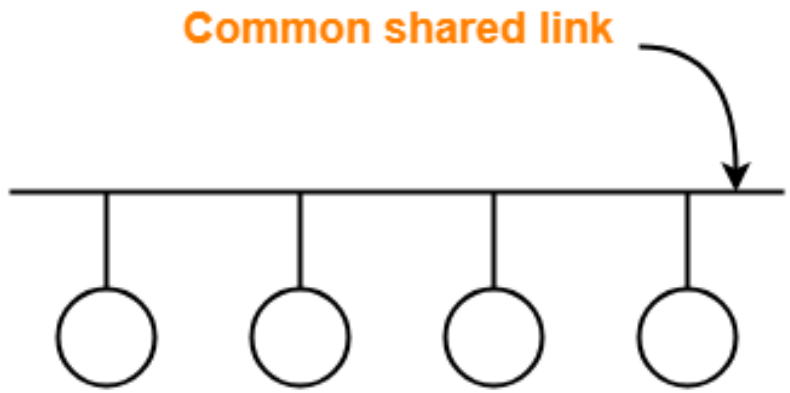
Ethernet in Networking

- Ethernet is one of the standard LAN technologies used to build wired LANs.
- Ethernet uses bus topology in which all the stations are connected to a half duplex link.
- Ethernet uses CSMA / CD as an access control method.
- Standard technologies used to build a wired LAN are-



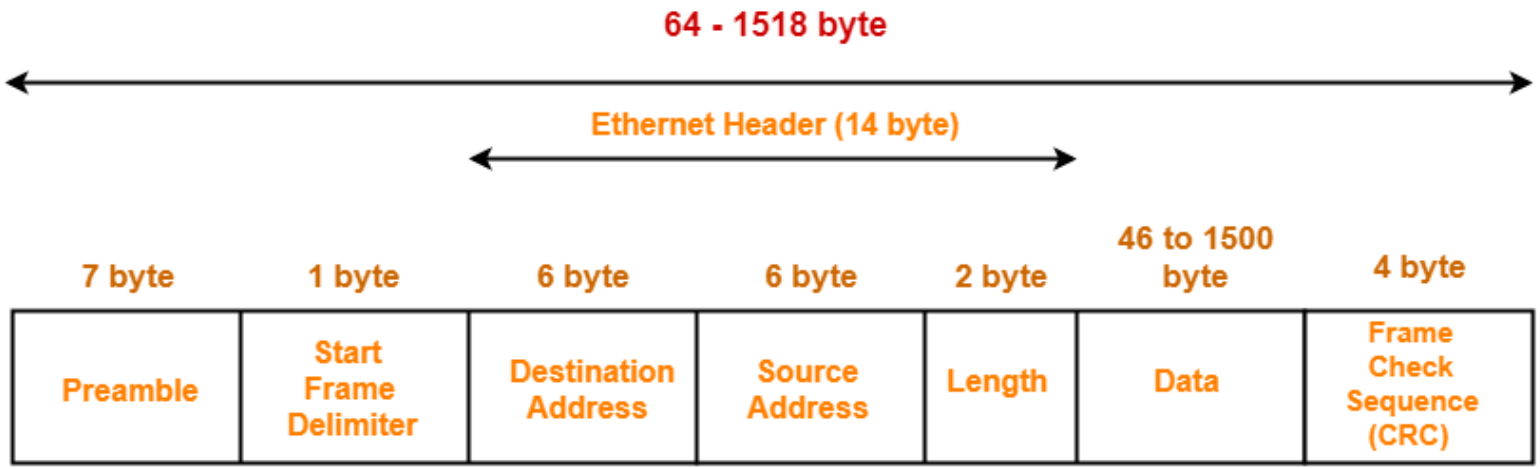
Ethernet

- Ethernet is one of the standard LAN technologies used for building wired LANs.
- It is defined under IEEE 802.3.
- **Characteristics-**
  - Ethernet uses bus topology.
  - In bus topology, all the stations are connected to a single half duplex link.



Bus Topology

- 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-**
  - IEEE 802.3 defines the following Ethernet frame format-



IEEE 802.3 Ethernet Frame Format

Ethernet Frame Format Field

- **Preamble**
  - It is a 7 byte field that contains a pattern of alternating 0s and 1s.
  - It alerts the stations that a frame is going to start.
  - It also enables the sender and receiver to establish bit synchronization.
- **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.
- **Note:**
  - The above two fields are added by the physical layer and represents the physical layer header.
  - Sometimes, Start Frame Delimiter (SFD) is considered to be a part of Preamble.
  - That is why, at many places, Preamble field length is described as 8 bytes.

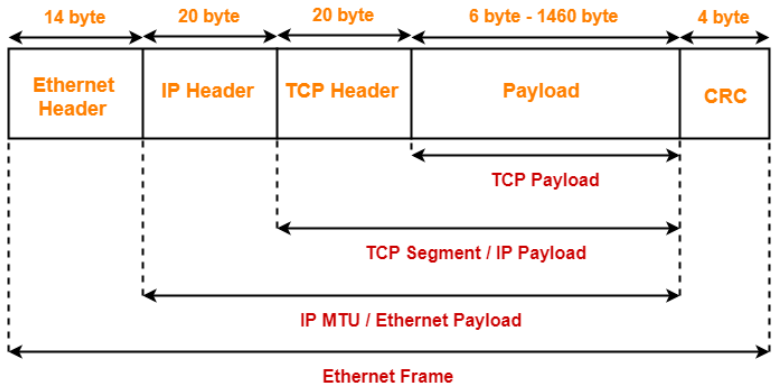
- **Destination Address**
  - It is a 6 byte field that contains the MAC address of the destination for which the data is destined.
- **Source Address**
  - It is a 6 byte field that contains the MAC address of the source which is sending the data.
- **Length**
  - It is a 2 byte field which specifies the length (number of bytes) of the data field.
  - This field is required because Ethernet uses variable sized frames.
- **NOTES**
  - 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 station.

- The following three fields collectively represents the Ethernet Header
  1. Destination Address (6 bytes)
  2. Source Address (6 bytes)
  3. Length (2 bytes)
- **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.
- **Minimum Length of Data Field**
  - 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.

- **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.

- **Limitations of Using Ethernet-**
  - **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:**
    - t 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.
  - **Token Ring overcomes these limitations of Ethernet.**
  - Important Concept
    - TCP segment sits inside the IP datagram payload field.
    - IP datagram sits inside the Ethernet payload field.



Thank You