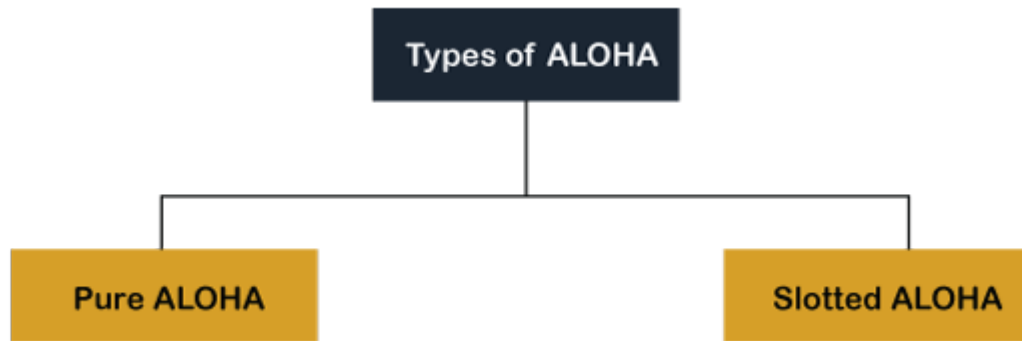**ALOHA**

It is designed for wireless LAN (Local Area Network) but can also be used in a shared medium to transmit data. Using this method, any station can transmit data across a network simultaneously when a data frameset is available for transmission.

Pure Aloha

In pure Aloha, when each station transmits data to a channel without checking whether the channel is idle or not, the chances of collision may occur, and the data frame can be lost. When any station transmits the data frame to a channel, the pure Aloha waits for the receiver's acknowledgment.

1. The total vulnerable time of pure Aloha is 2 * Tfr.

2. Maximum throughput occurs when G = 1/ 2 that is 18.4%.

3. Successful transmission of data frame is $S = G * e ^ - 2 G$.
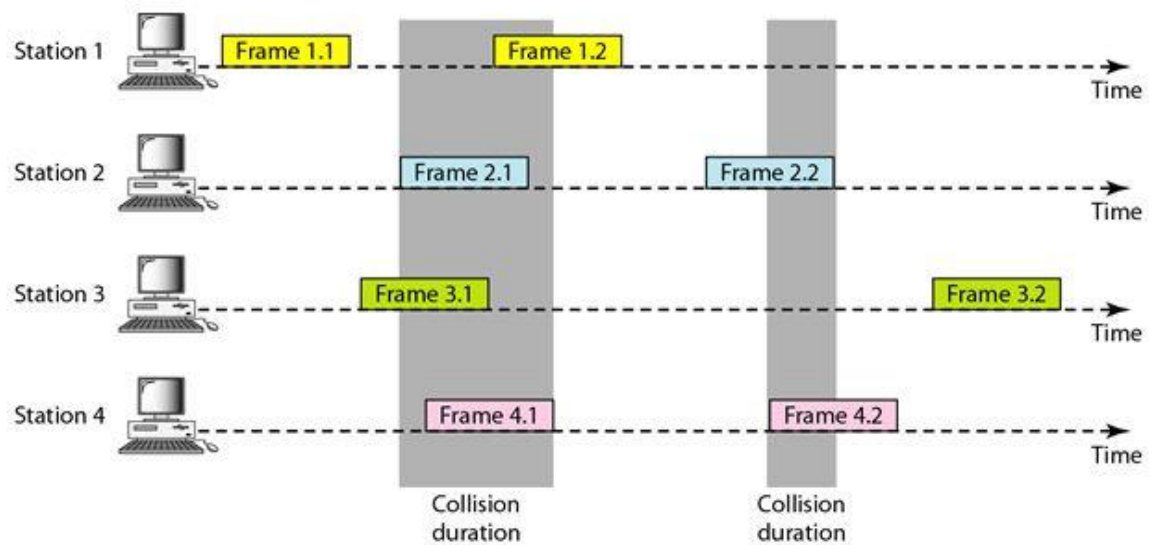
The figure shows that there are four stations and each station sends two frames; there are a total of eight frames on the shared medium. Some of these frames collide because multiple frames are in contention for the shared channel.

The above figure shows that only two frames survive: frame 1.1 from station 1 and frame 3.2 from station 3. We need to mention that even if one bit of a frame coexists on the channel with one bit from another frame, there is a collision and both will be destroyed.

It is obvious that we need to resend the frames that have been destroyed during transmission. The pure ALOHA protocol relies on acknowledgments from the receiver. If the acknowledgment does not arrive after a time-out period, the station assumes that the frame (or the acknowledgment) has been destroyed and resends the frame.

A collision involves two or more stations. If all these stations try to resend their frames after the time-out, the frames will collide again. Pure ALOHA dictates that when the time-out period passes, each station waits a random amount of time before resending its frame. The randomness will help avoid more collisions. We call this time the **back-off time.**

Vulnerable time:

The vulnerable time is in which there is a possibility of collision. We assume that the stations send fixed-length frames with each frame taking Tfr S to send. The following figure shows the vulnerable time for station A.
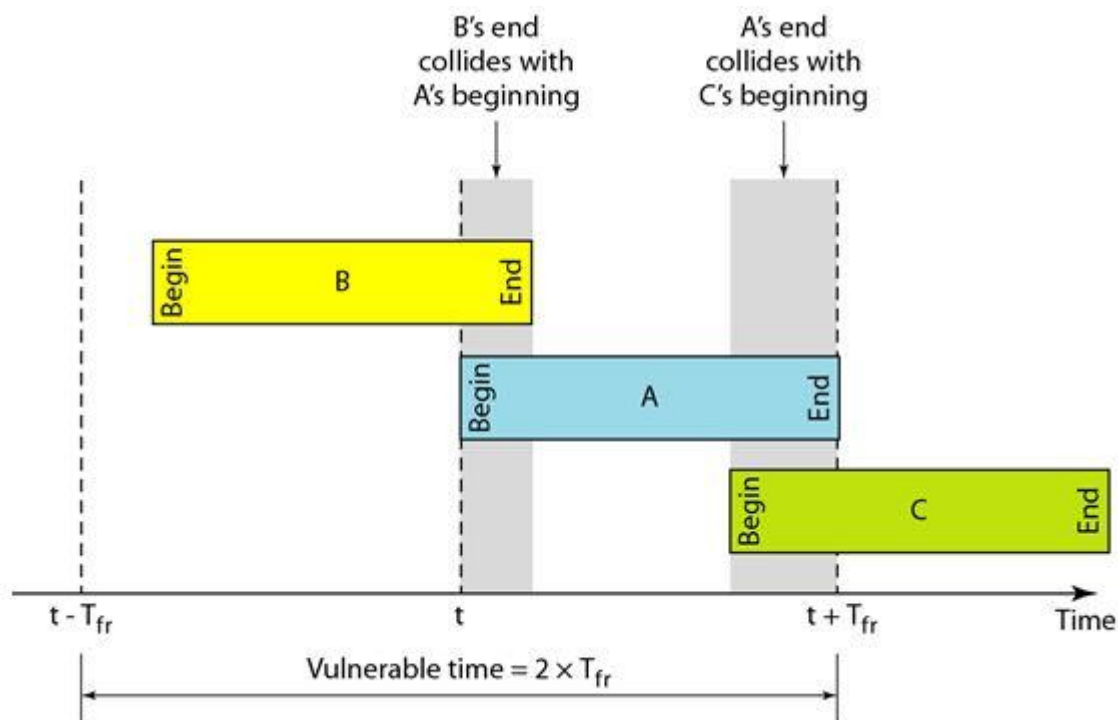
Station A sends a frame at time t. Now imagine station B has already sent a frame between t - Tfr and t. This leads to a collision between the frames from station A and station B. The end of B's frame collides with the beginning of A's frame. On the other hand, suppose that station C sends a frame between t and t + Tfr . Here, there is a collision between frames from station A and station C. The beginning of C's frame collides with the end of A's frame.

Throughput:

Let us call G the average number of frames generated by the system during one frame transmission time. Then it can be proved that the average number of successful

transmissions for pure ALOHA is $S = G \times e^{-2G}$. The maximum throughput Smax is 0.184, for G = 1. In other words, if one-half a frame is generated during one frame transmission time (in other words, one frame during two frame transmission times), then 18.4 percent of these frames reach their destination successfully.

Slotted Aloha

Pure ALOHA has a vulnerable time of 2 x Tfr. This is so because there is no rule that defines when the station can send. A station may send soon after another station has started or soon before another station has finished. Slotted ALOHA was invented to improve the efficiency of pure ALOHA.

In slotted ALOHA we divide the time into slots of Tfr s and force the station to send only at the beginning of the time slot.

1. Maximum throughput occurs in the slotted Aloha when G = 1 that is 37%.

2. The probability of successfully transmitting the data frame in the slotted Aloha is $S = G * e^{-G}$.

3. The total vulnerable time required in slotted Aloha is Tfr.

The following figure shows an example of frame collisions in slotted ALOHA.
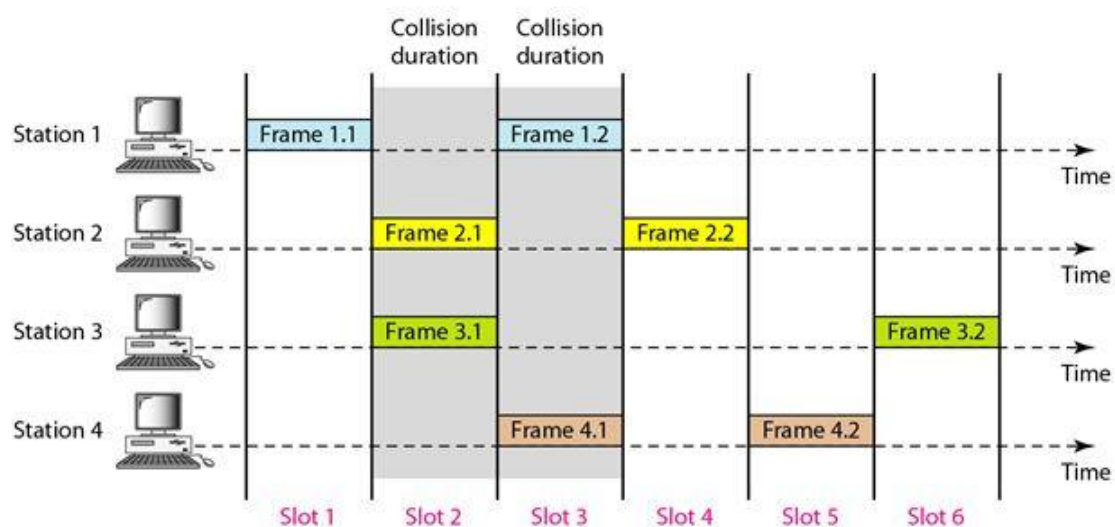
Because a station is allowed to send only at the beginning of the synchronized time slot, if a station misses this moment, it must wait until the beginning of the next time slot. This means that the station which started at the beginning of this slot has already finished sending its frame. But, still there is the possibility of collision if two stations try to send at the beginning of the same time slot. However, the vulnerable time is now reduced to one-half, equal to Tfr. The following figure shows the situation.
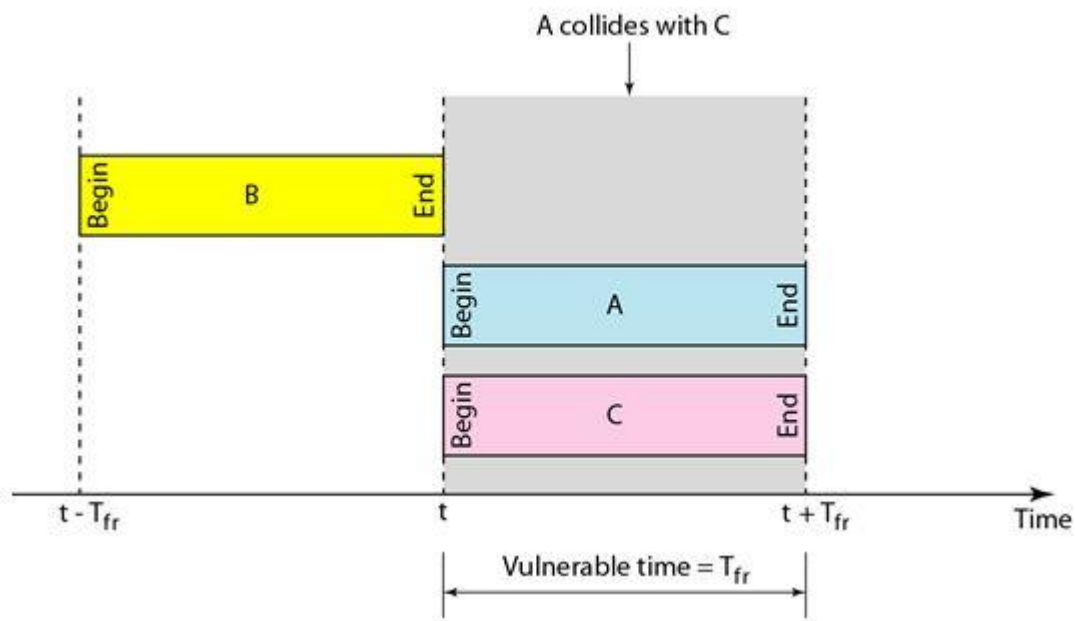
Throughput:

It can be proved that the average number of successful transmissions for slotted ALOHA is $S = G \times e^{-G}$. The maximum throughput Smax is 0.368, when $G = 1$. In other words, if a frame is generated during one frame transmission time, then 36.8 percent of these frames reach their destination successfully.