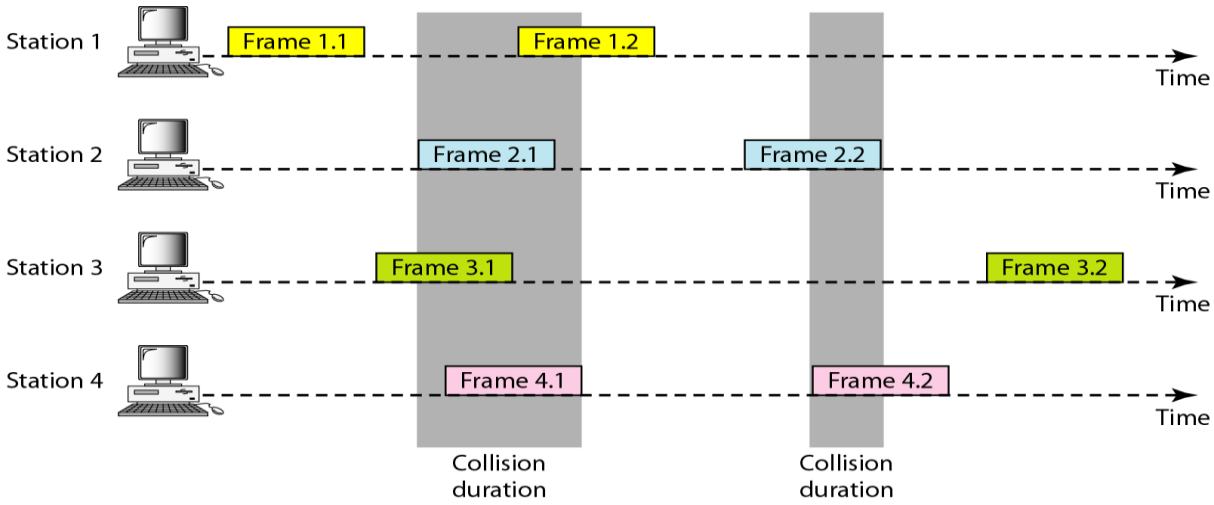
Course Name: A Level (2nd Sem) Subject: DCN

Topic: Random Access Protocols [ALOHA] Date: 27-04-20

ALOHA:

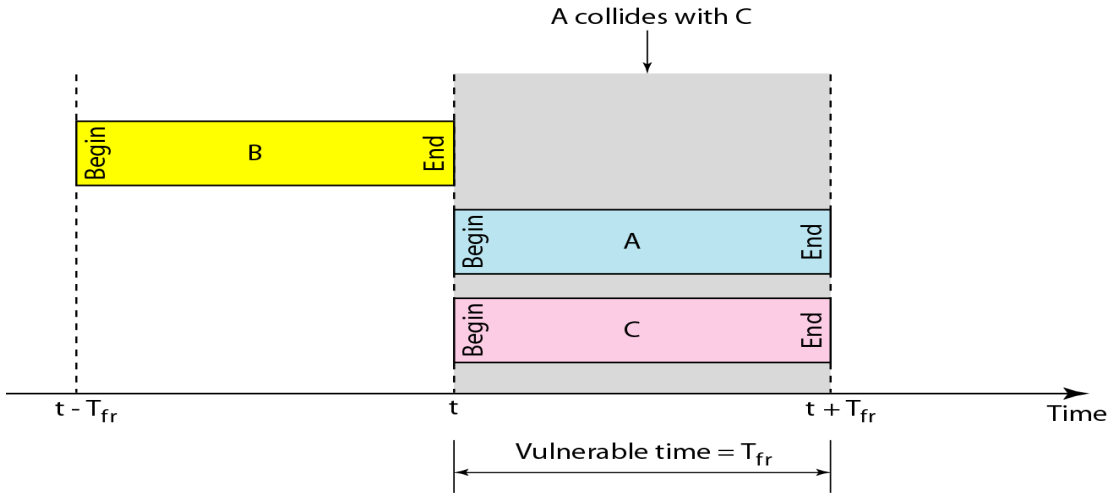
- ALOHA, the earliest random access method was developed at the University of Hawaii in early 1970. It was designed for a radio (wireless) LAN, but it can be used on any shared medium.
- The original ALOHA protocol is called **pure ALOHA**. This is a simple, but elegant protocol.
- The idea is that each station sends a frame whenever it has a frame to send. There is the possibility of collision between frames from different stations. The medium is shared between the stations. When a station sends data, another station may attempt to do so at the same time. The data from the two stations collide and become garbled. Figure shows an example of frame collisions in pure ALOHA.



- In the figure there are four stations that contend with one another for access to the shared channel. 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. 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.

- When a station sends a frame, it expects the receiver to send an acknowledgment. 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 TB.

Vulnerable time: Let us find the length of time, the vulnerable time, in which there is a possibility of collision. We assume that the stations send fixed-length frames with each frame taking T_{fr} second to send. 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 $t-T_{fr}$ 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 $t + T_{fr}$. 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.
From the figure, we can see that the vulnerable time, during which a collision may occur in pure ALOHA, is 2 times the frame transmission time.

Pure ALOHA vulnerable time = 2 x T_f

Throughput: It can be proved that the average number of successful transmissions for pure ALOHA is **$S = G \times e^{-2G}$** where G the average number of frames generated by the system during one frame transmission time. The maximum throughput **S_{max} 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. This is an expected result because the vulnerable time is 2 times the frame transmission time. Therefore, if a station generates only one frame in this vulnerable time (and no other stations generate a frame during this time), the frame will reach its destination successfully.

The throughput for pure ALOHA is S =G x e-2G.
The maximum throughput Smax =0.184 when G =(1/2).

Exercises:

1. **Define random access and list three protocols in this category.**

2. **How does ALOHA technique help to prevent collisions in the shared channel? Why there is still possibility of collision between frames from different stations in this arrangement?**

3. **Define Vulnerable time and Throughput. What are their values in case of Pure ALOHA?**