Multiple Access – Pure ALOHA

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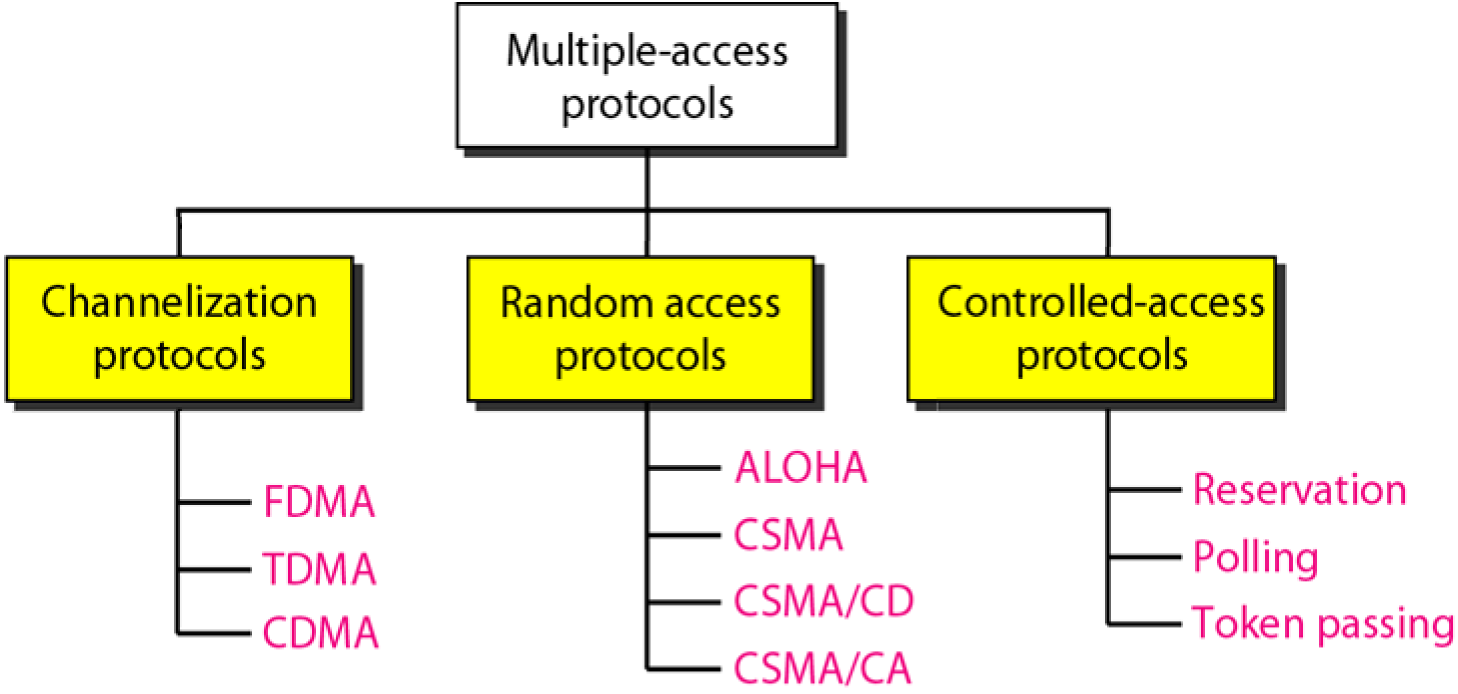
Multiple Access

- ✓ A common communication Channel is shared by Multiple nodes
- ✓ MAC Layer allocates Channel for a Node
- ✓ MAC Layer operates various Protocols

Multiple Access Protocols



Multiple Access – Random Access Protocols

- ✓ All stations have equal rights
- ✓ A station does not control another station
- ✓ A station does not allow/deny another station
- ✓ A station operates a Protocol when it has to send

Multiple Access – Random Access Protocols

- ✓ There is no scheduled time for a station to send
- ✓ Any station can transmit at any time
- ✓ Transmission is random among the stations
- ✓ Random access methods

Multiple Access – Random Access Protocols

- ✓ There are no rules on which station should send next
- ✓ Stations compete with one another to access the medium
- ✓ Contention methods

Multiple Access – Random Access Protocols

- ✓ If more than one station tries to send, there is an access conflict-collision
- ✓ Frames will be either destroyed or modified
- ✓ So each station follows a procedure

Multiple Access – Random Access Protocols

Procedure Must be handled ….

- ✓ When can the station access the medium?
- ✓ What can the station do if the medium is busy?
- ✓ How can the station determine the success or failure of the transmission?
- ✓ What can the station do if there is an access conflict?

Random Access Protocols - ALOHA

- A type of packet-radio network
- The first well-known wireless network
- Very simple, but not efficient!
- Uses a Simple Procedure called Multiple Access (MA)
- MA is improved with the Carrier Sense method (CSMA)
- CSMA is improved with two parallel methods
  - Collision Detection (CSMA/CD)
  - Collision Avoidance (CSMA/CA)

Random Access Protocols - ALOHA

- Variations
  - Pure-ALOHA: whenever desired, send the packet
  - Slotted-ALOHA: further divide time axis into slots

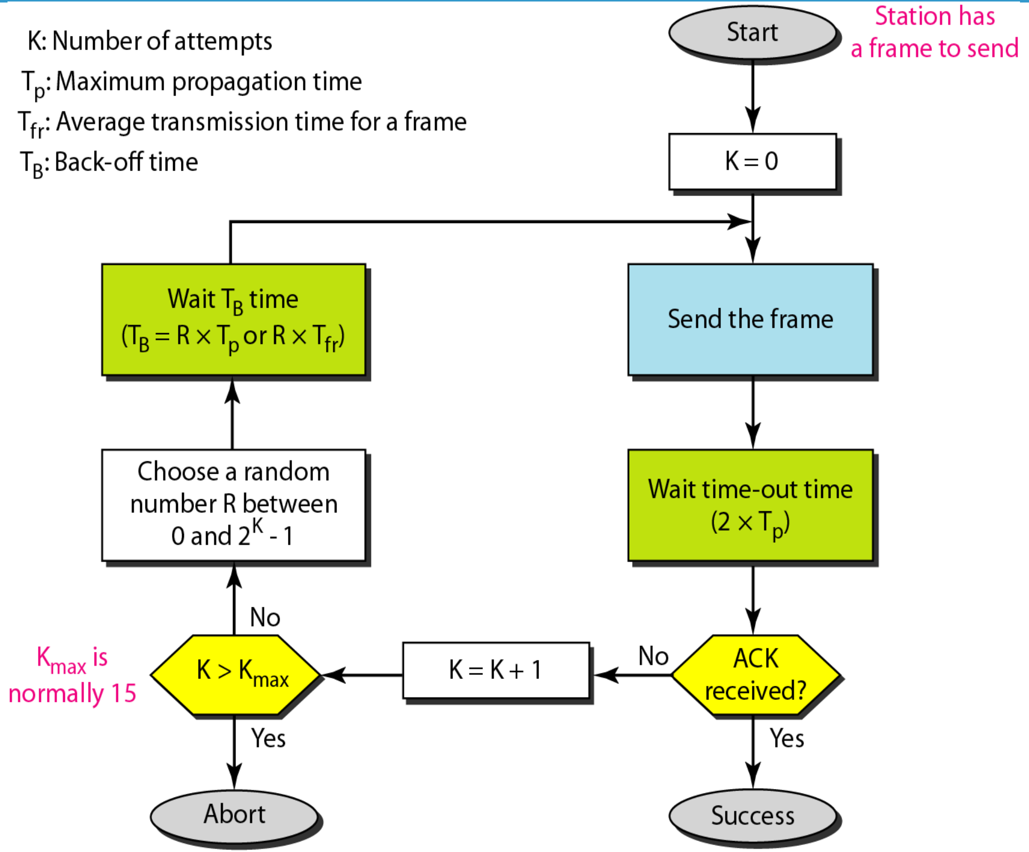
Random Access Protocols – Pure ALOHA

- ✓ 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

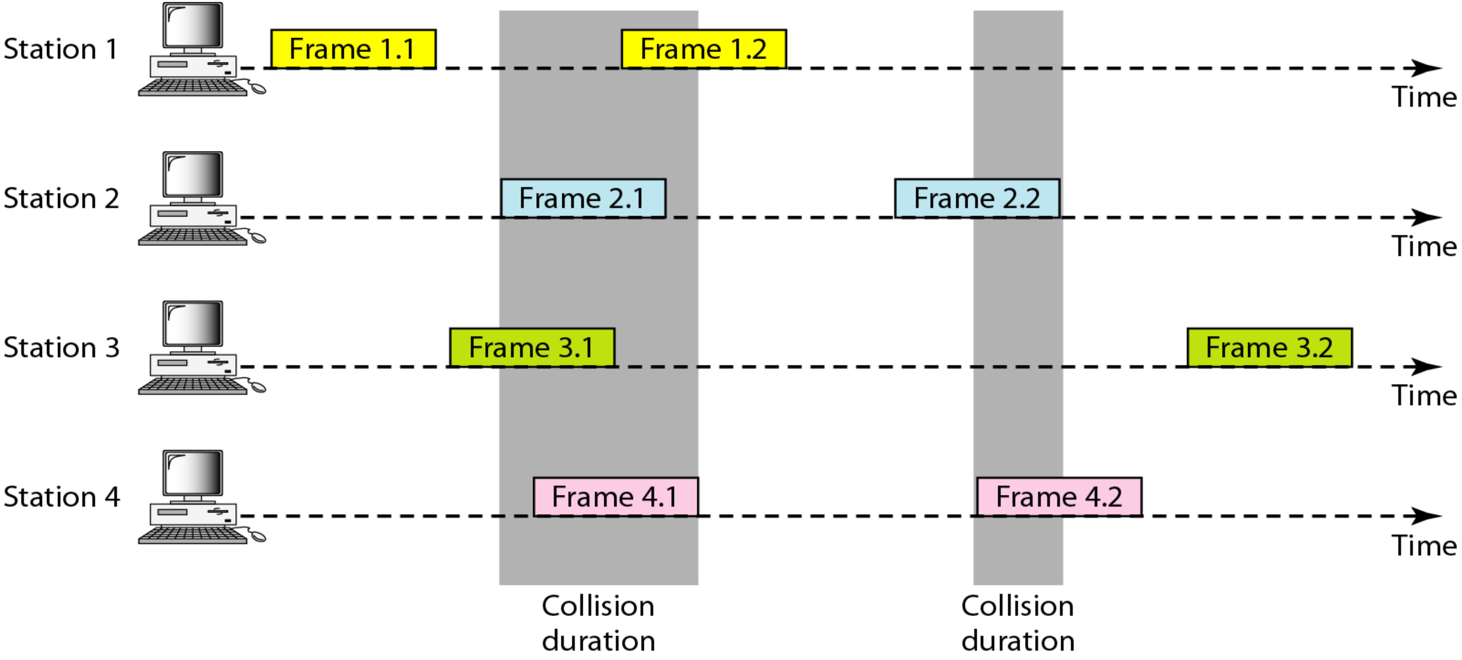
Pure ALOHA - Binary exponential back-off

- ✓ TB = R * Tp (or) R * Tfr
- ✓ R – Random number between 0 to 2K-1 where K is Attempt Number
- ✓ Tp – Maximum propagation time
- ✓ Tfr –Average transmission time for a frame
- ✓ Range of the random numbers increases after each collision
- ✓ Kmax – Maximum number of attempts for a station - usually chosen as 15

Pure ALOHA - Frames

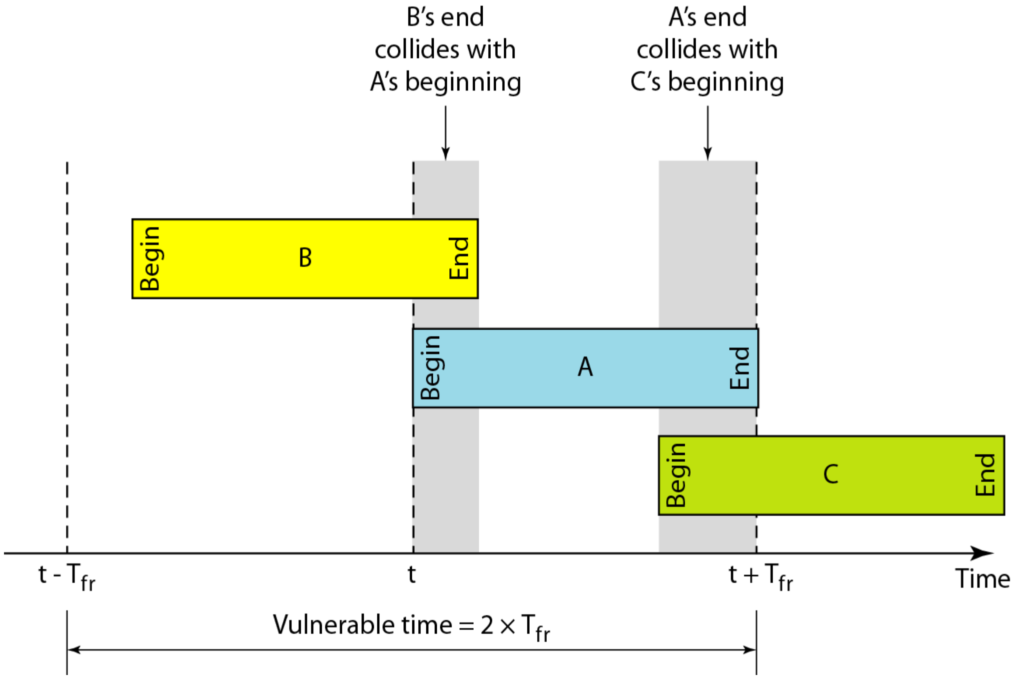


Pure ALOHA - Frames



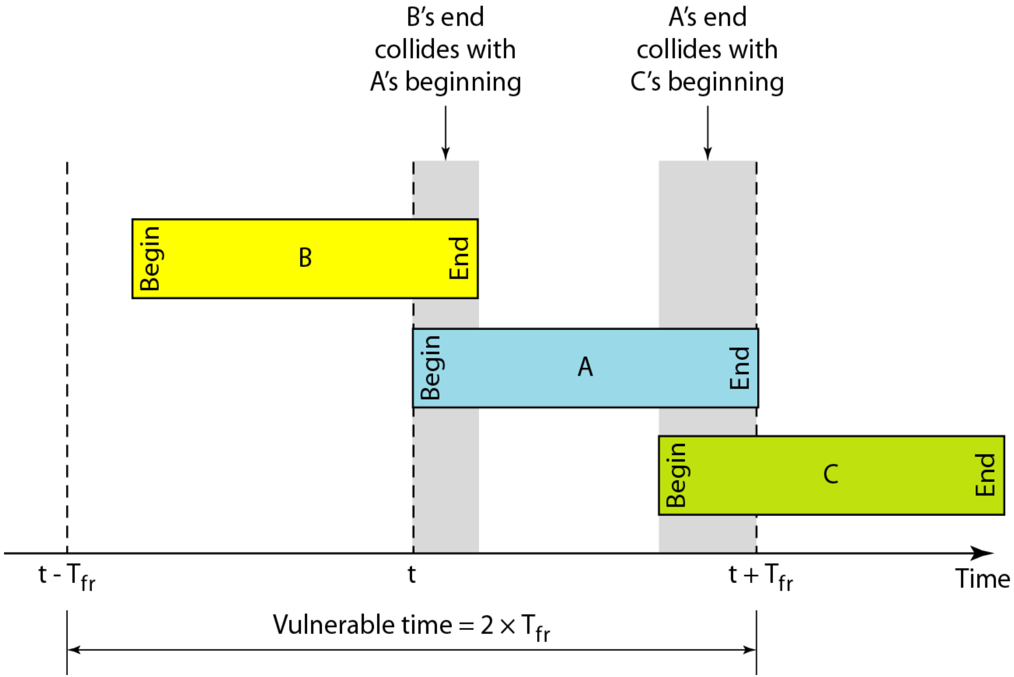
- ✓ Only two frames Frame 1.1 and Frame 3.2 survive

Pure ALOHA - Vulnerable time for Station A



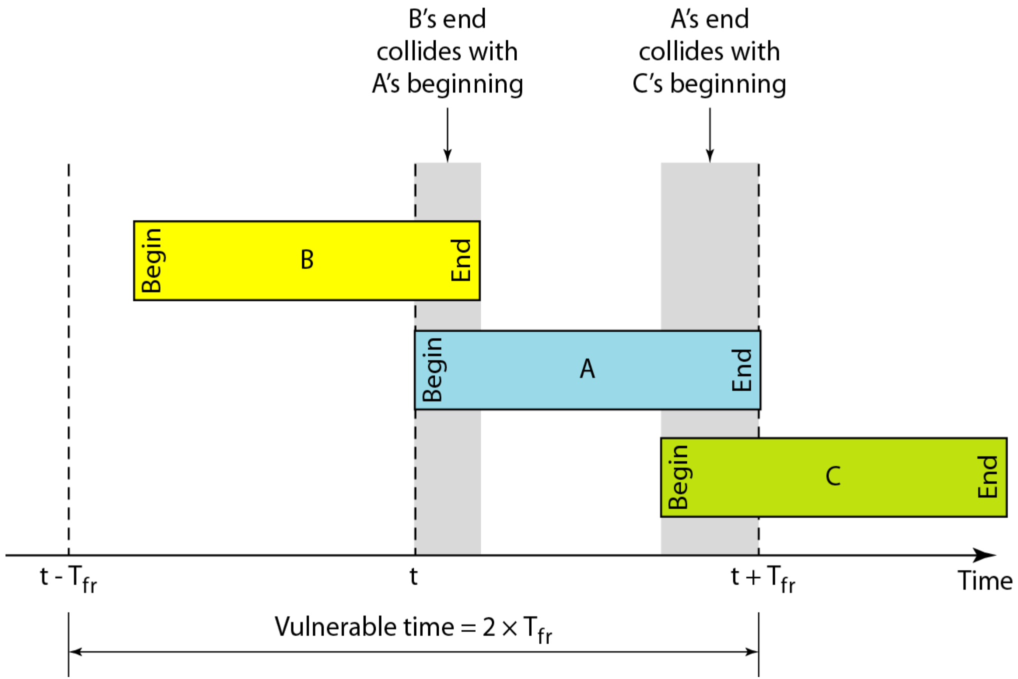
- ✓ A station may send soon after another station has started or soon before another station has finished
- ✓ Vulnerable time – The length of time in which there is a possibility of collision
- ✓ Vulnerable time = 2 * Tfr

Pure ALOHA - Vulnerable time for Station A



- ✓ Assume that the stations send fixed-length frames with each frame taking Tfr seconds to send
- ✓ 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.

Pure ALOHA - Vulnerable time for Station A



- ✓ 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.

Pure ALOHA - Vulnerable time for Station A

- ✓Throughput for the Pure ALOHA is

$$S = G \times e^{-2G}$$

- ✓The maximum throughput

$$S_{max} = 0.184 \text{ when } G= (1/2)$$

References

- ✓ Book: Data communication and Networking
  Fourth edition
  By : BEHROUZ A FOROUZAN
- ✓ Computer Networking: A Top Down Approach Featuring the Internet, 3rd edition. Jim Kurose, Keith Ross Addison-Wesley, July 2004.
- ✓ Various Relevant Websites
  - ✓ Website: www.amjadumar.com

Thank You