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Slotted Aloha

INTRODUCTION

A protocol developed at the University of Hawaii in the early 1970s as an improvement on the pure Aloha protocol. Slotted Aloha improves contention management through the use of beaconing, in which a receiver transmits signals at precise intervals, indicating to each source when the channel is clear to send a frame of data. Slotted Aloha essentially advertises the availability of a time slot in a channel. See also Aloha, AlohaNet, channel, clear to send, and time slot.

- Slotted ALOHA was invented to improve the efficiency of pure ALOHA as chances of collision in pure ALOHA are very high.
- Inslotted ALOHA, there is still a possibility of collision if slot two stations try to send at the beginning of the same time slot
- Slotted ALOHA still has an edge over pure ALOHA as chances of collision are reduce d to one-half.

Assumptions Made In Slotted ALOHA

- All frames consist of exactly L bits.
- Time is divided into slots of size L/R seconds (i.e., a slot equals the time to transmit one frame).
- Nodes start to transmit frames only at the beginnings of slots.
- The nodes are synchronized so that each node knows when the slots begin
- If two or more frames collide in a slot, then all the nodes detect the collision event before the slot ends.

Procedure for slotted ALOHA

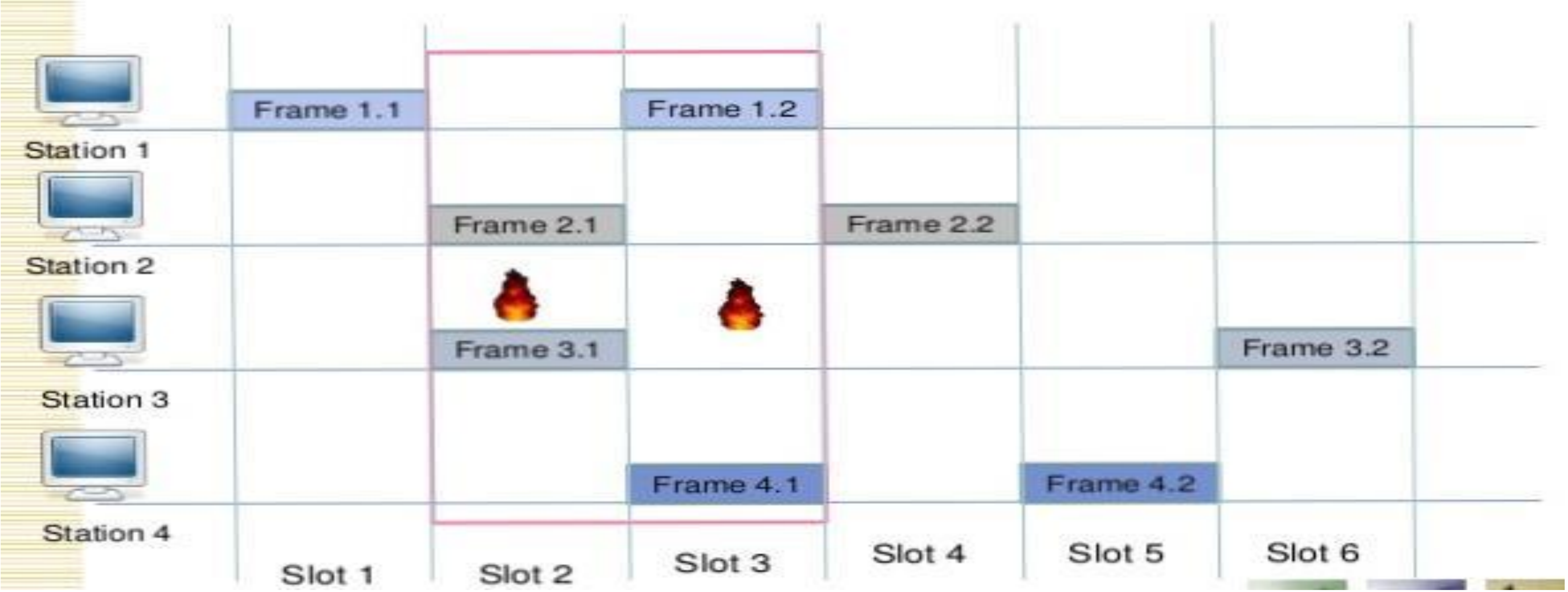
While there is a new frame A to send do

1. Send frame A at a slot boundary and wait for ACK
2. If after "some" time ACK is received, successful transmission of frame.
3. If there is a collision, the node detects the collision before the end of the slot. wait a random amount of time and go to 1

End

The node retransmits its frame in each subsequent slot with probability p until the frame is transmitted without a collision

Frames in a Slotted ALOHA network



Analysis of Slotted ALOHA

Suppose N stations have packets to send,

→each transmits in slot with probability p

→probability of successful transmission S is:

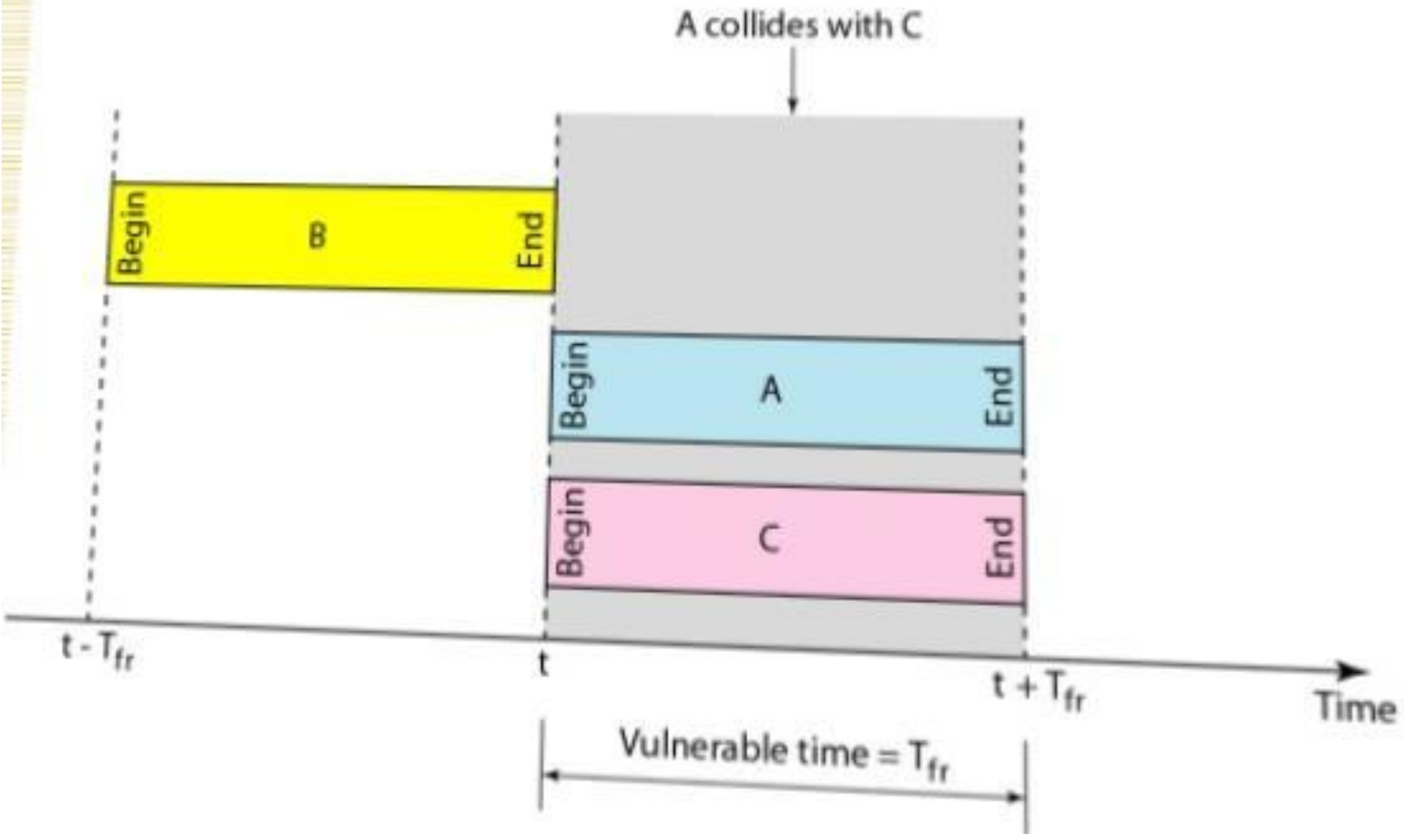
- by any specific single node: $S = p(1-p)^{(N-1)}$
- by any of N nodes

$$S = \text{Prob (only one transmits)} = N p (1-p)^{(N-1)}$$

for optimum p as N -> infty ...

$$S = 1/e = .37$$

Vulnerable time for slotted ALOHA protocol



Note that the vulnerable period is now reduced in half.

Hence,

$$P_k(t) = \frac{(\lambda t)^k e^{-\lambda t}}{k!}$$

And putting $t = T_f$ and $k = 0$, we get

$$P_0(T_f) = \frac{(\lambda \cdot T_f)^0 e^{-\lambda T_f}}{0!} = e^{-G}$$

because $\lambda = \frac{G}{T_f}$. Thus, $S = G \cdot e^{-G}$

Throughput of Slotted ALOHA

- The probability of no collision is given by

$$P(0) = e^{-G}$$

- The throughput S is

$$S = G \cdot P(0) = G \cdot e^{-G}$$

- The Maximum throughput of slotted ALOHA is

$$S_{\max} = \frac{1}{e} \approx 0.368$$

- Best ($G = 1$):
  - 37% empty
  - 37% success
  - 26% collisions

- Raising G, reduces empties but increases collisions exponentially

- Expected transmissions (includes original)

  $$E = e^G$$

  - G=0, then 1 transmission; G=1 then 2*X transmissions.

- Small increase in load, big decrease in performance.

Thank You!