

Mobile Computing

Lecture 5

ALOHA



CONTENTS



- Random Access
- Maximum Propagation Delay
- Aloha
- Pure Aloha
- Slotted Aloha
- Efficiency

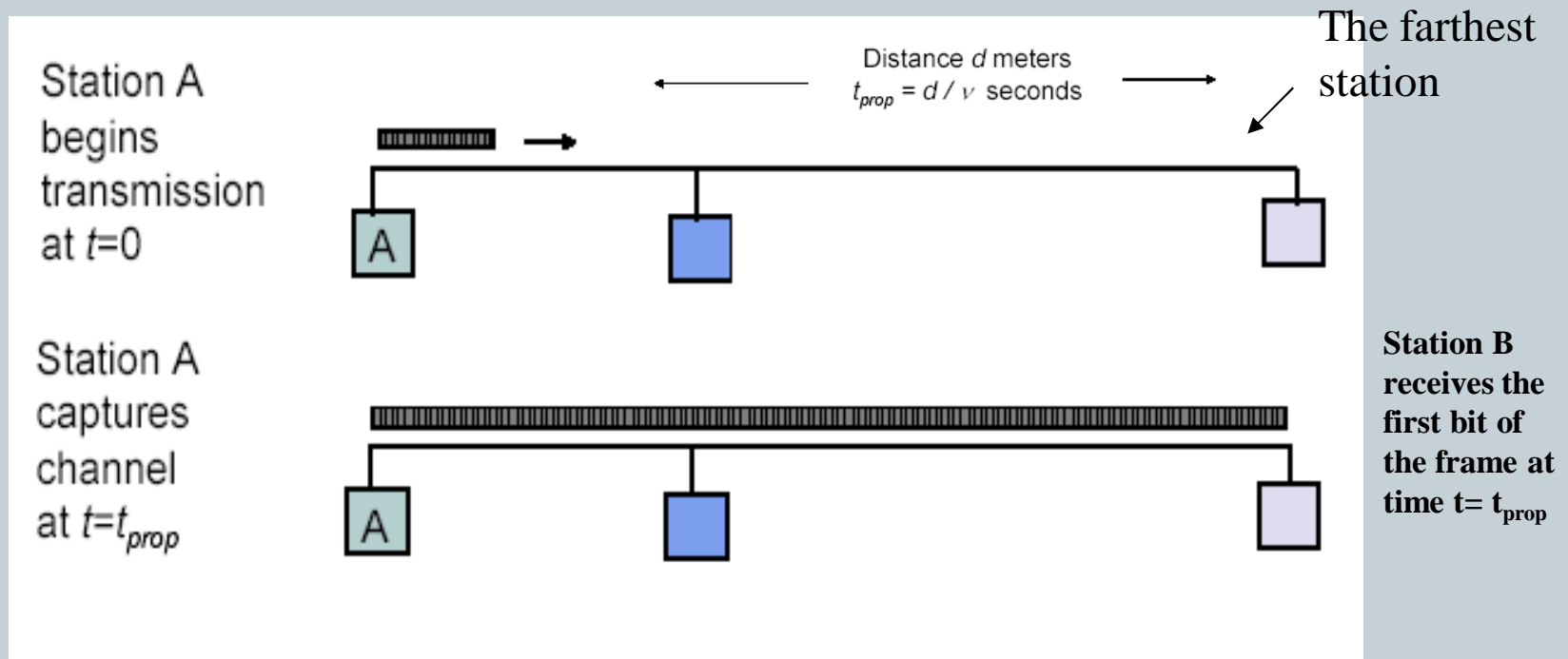
Random Access



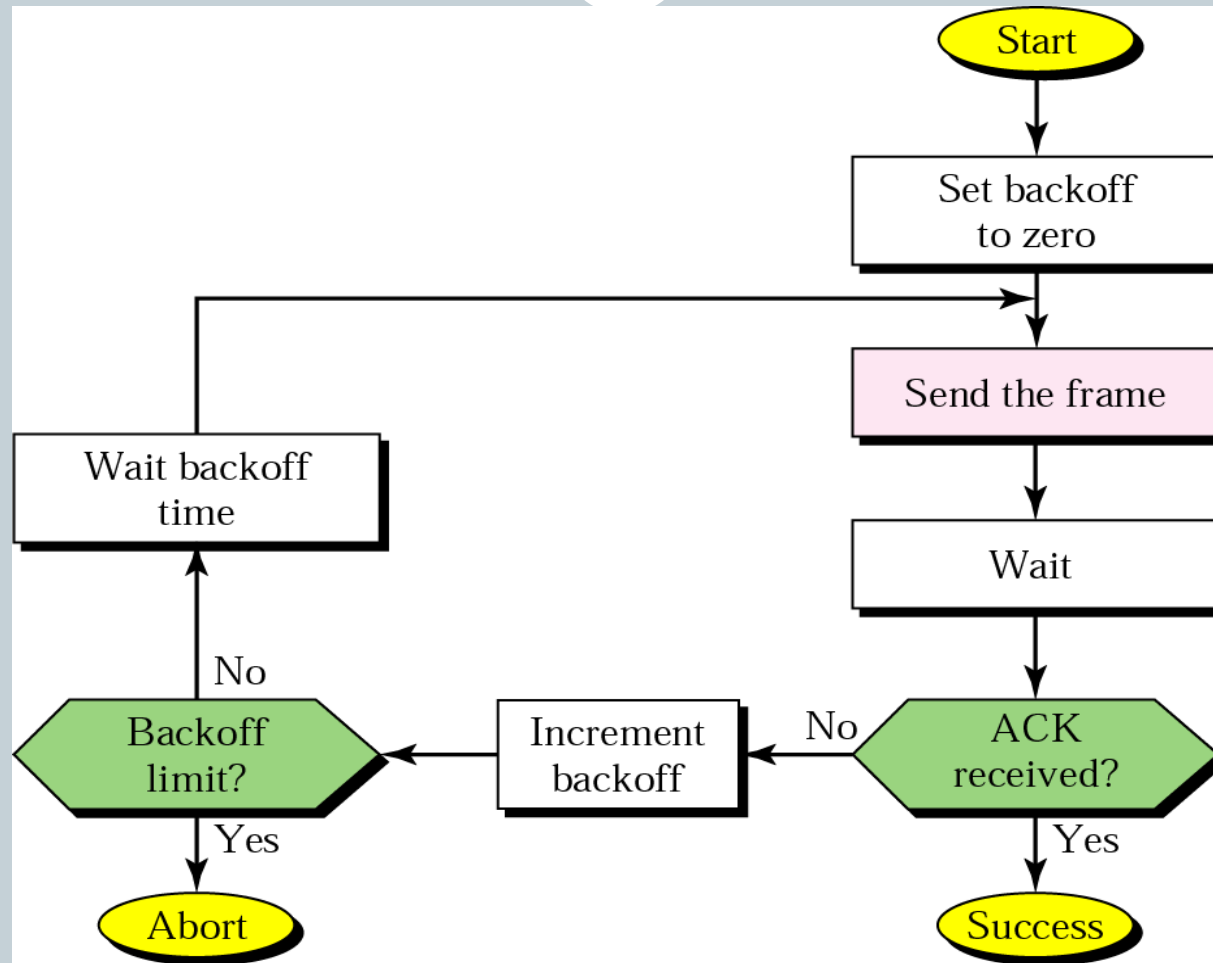
- **Random Access (or contention) Protocols:**
 - No station is superior to another station and none is assigned the control over another.
 - A station with a frame to be transmitted **can use the link directly based** on a procedure defined by the protocol to make a decision on whether or not to send.
- **ALOHA Protocols:** Was designed for **wireless LAN** and can be used for **any shared medium**
- **Pure ALOHA Protocol Description**
 - All frames from any station are of fixed length (**L bits**)
 - Stations transmit at equal **transmission time** (*all stations produce frames with equal frame lengths*).
 - A station that has data **can transmit at any time**
 - **After transmitting a frame**, the sender **waits** for an **acknowledgment** for an amount of time (time out) equal to the **maximum round-trip propagation delay** = $2 * t_{prop}$ (**see next slide**)
 - If **no ACK** was received, sender assumes that the **frame or ACK** has been destroyed and **resends** that frame after it **waits for a random amount of time**
 - If station fails to receive an ACK after repeated transmissions, **it gives up**
 - **Channel utilization or efficiency or Throughput** is the **percentage** of the transmitted frames that arrive **successfully** (without collisions) or the **percentage** of the **channel bandwidth** that will be used for transmitting frames without collisions
 - ALOHA Maximum channel utilization is **18%** (i.e, if the system produces **F frames/s**, then **0.18 * F** frames will arrive **successfully on average without the need of retransmission**).

Maximum Propagation Delay

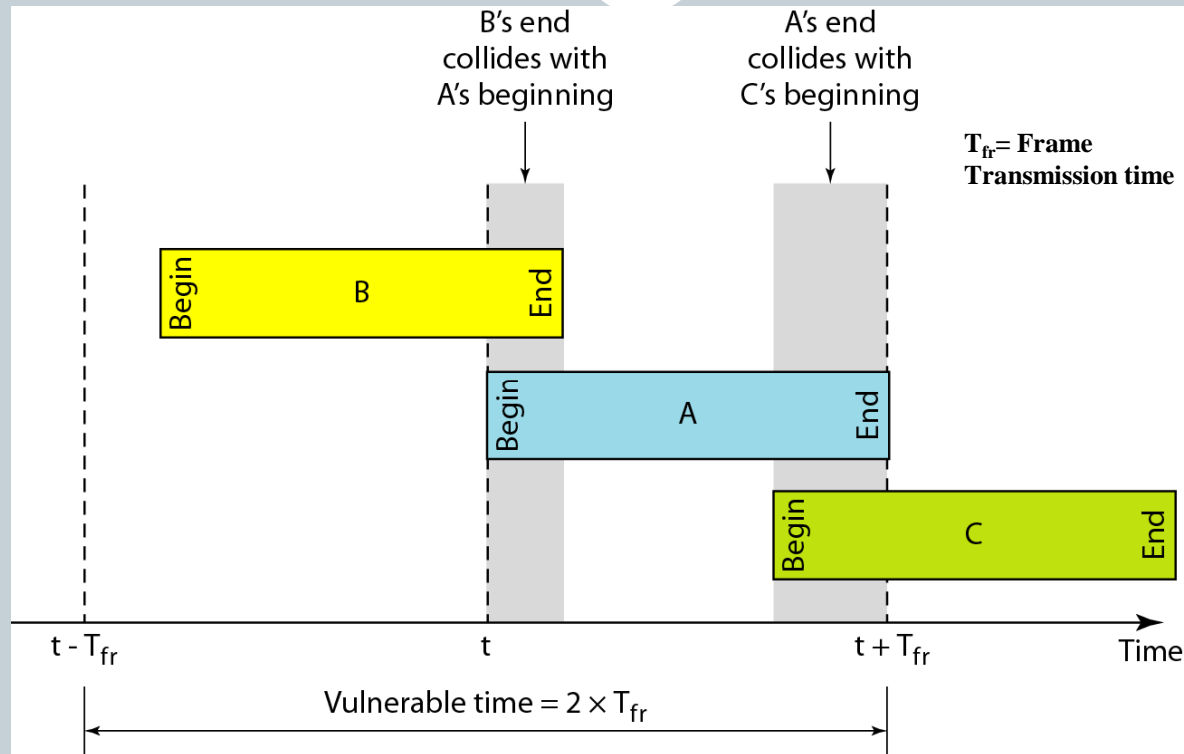
- **Maximum propagation delay** (t_{prop}): time it takes for a bit of a frame to travel between the **two most widely** separated stations.



Procedure for ALOHA protocol

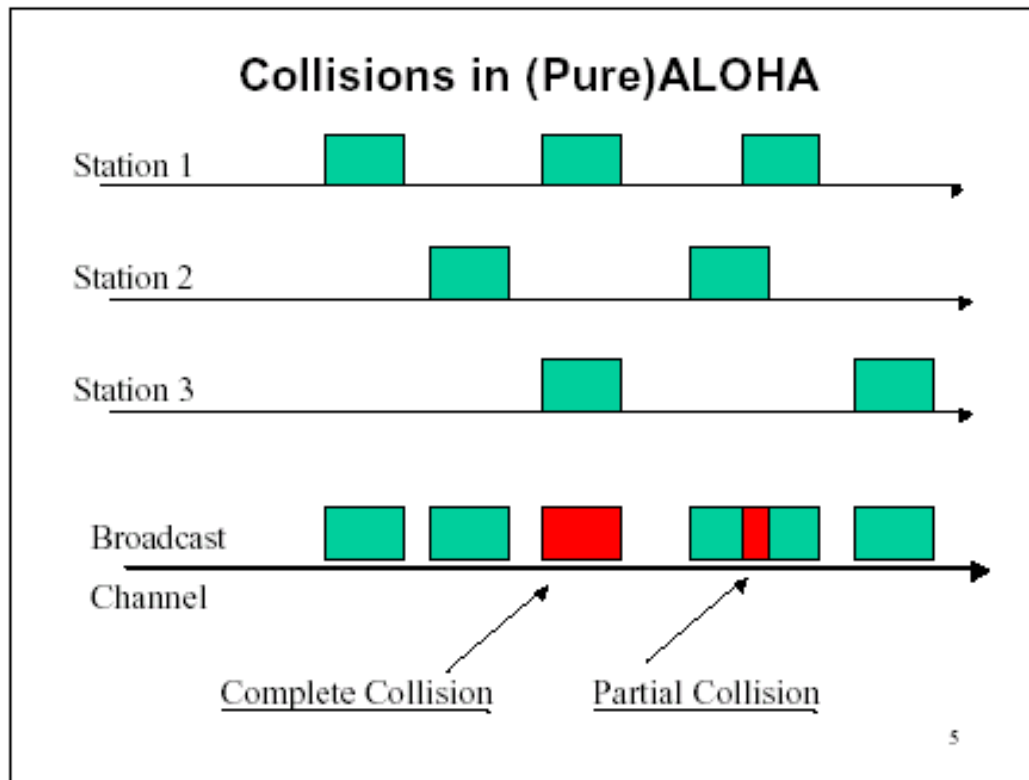


Critical time for pure ALOHA protocol



If the frame transmission time is T sec, then the vulnerable time is $= 2 T$ sec. This means no station should send during the T -sec before this station starts transmission and no station should start sending during the T -sec period that the current station is sending.

Pure Aloha



In pure ALOHA, frames are transmitted at completely arbitrary times.

Cont..



The throughput (S) for pure ALOHA is

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

The maximum throughput
 $S_{\max} = 0.184$ when $G = (1/2)$.

$G =$ Average number of frames generated by the system (all stations) during one frame transmission time

Random Access – Slotted ALOHA

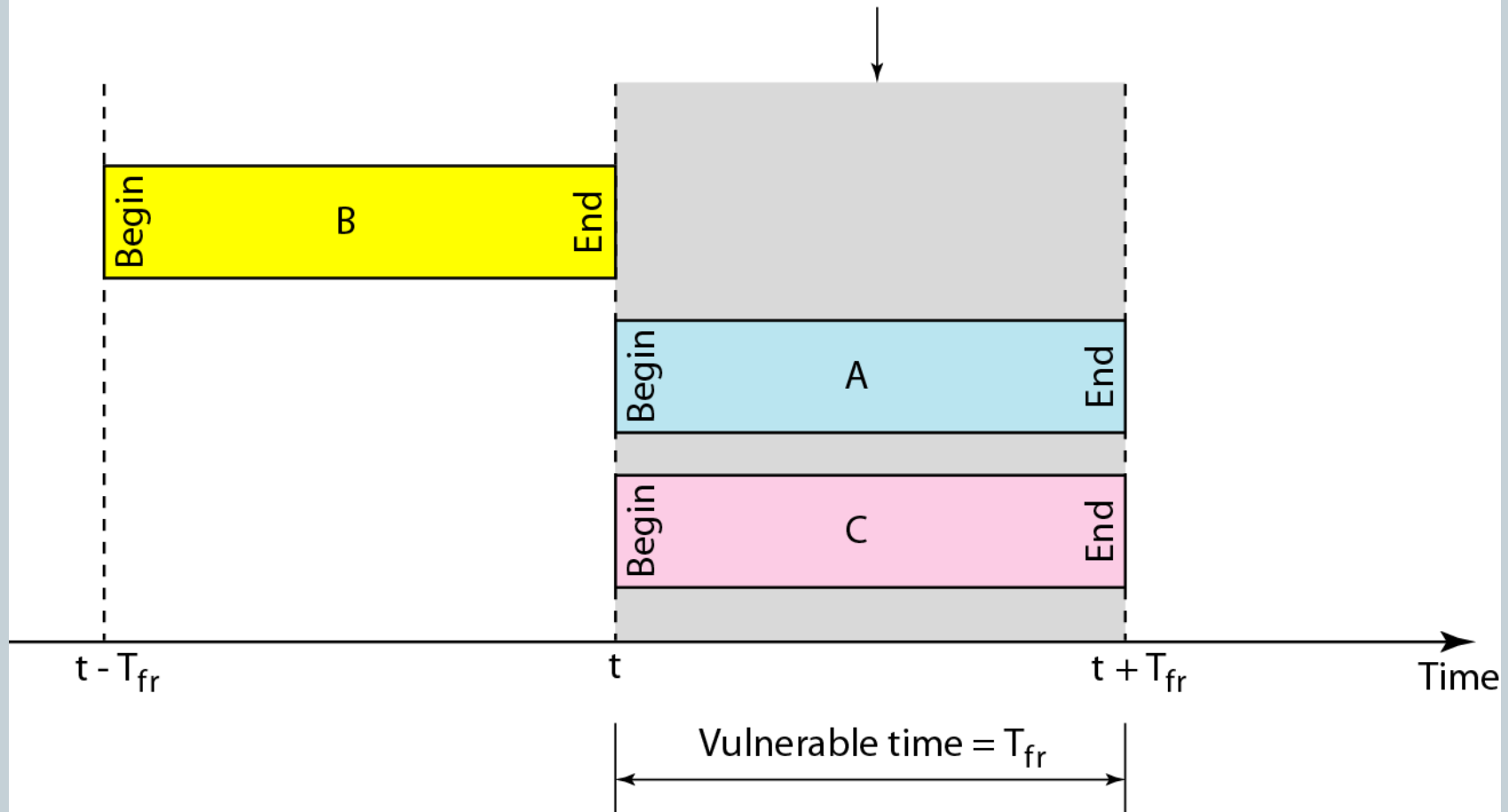


- Time is divided into slots equal to a **frame transmission time** (T_{fr})
- A station can transmit at the beginning of a slot only
- If a station misses the beginning of a slot, it has to wait until the beginning of the next time slot.
- **A central clock** or station informs all stations about the start of a each slot
- Maximum channel utilization is **37%**

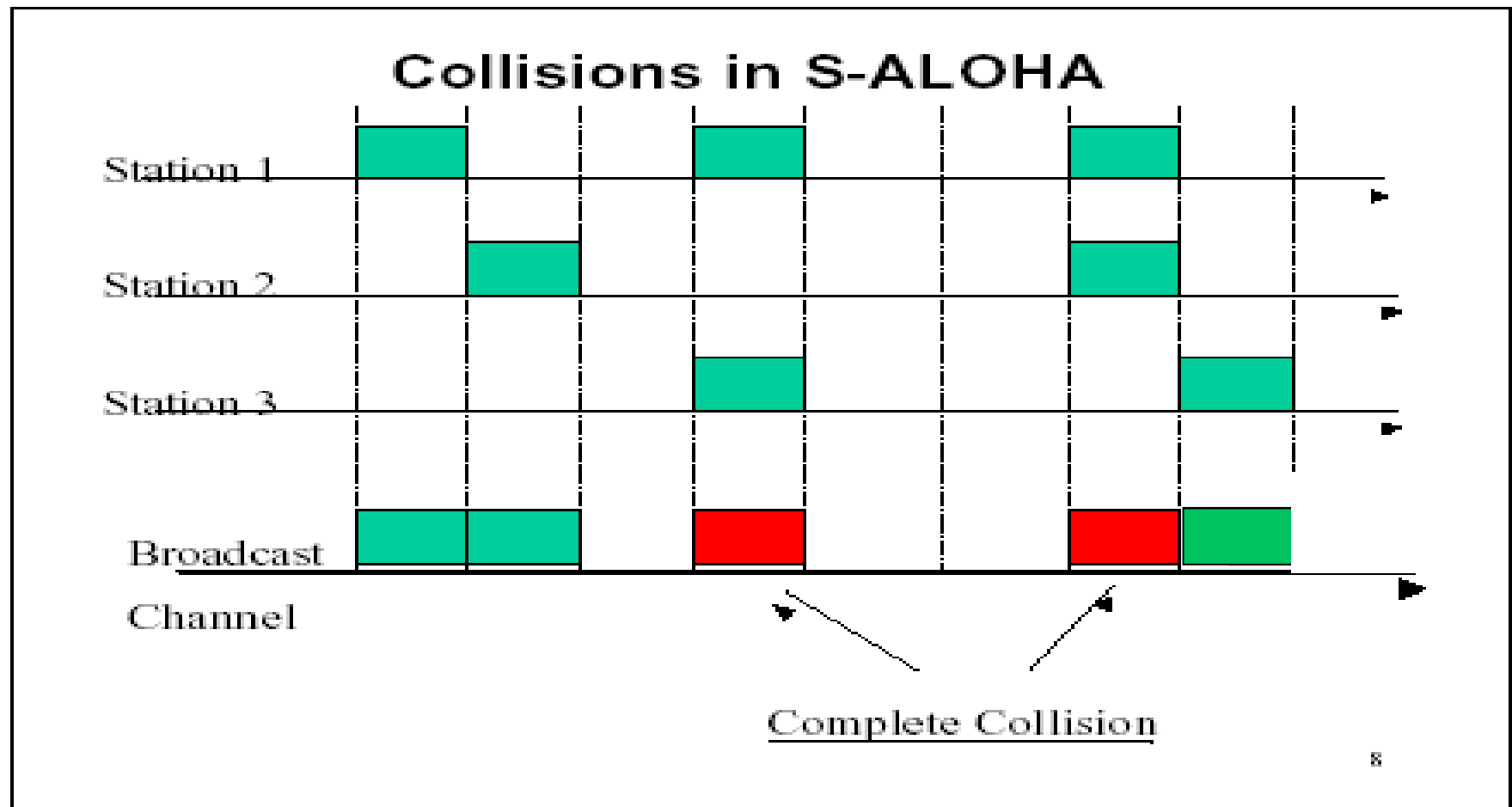
In danger time for slotted ALOHA protocol



A collides with C



Random Access – Slotted ALOHA



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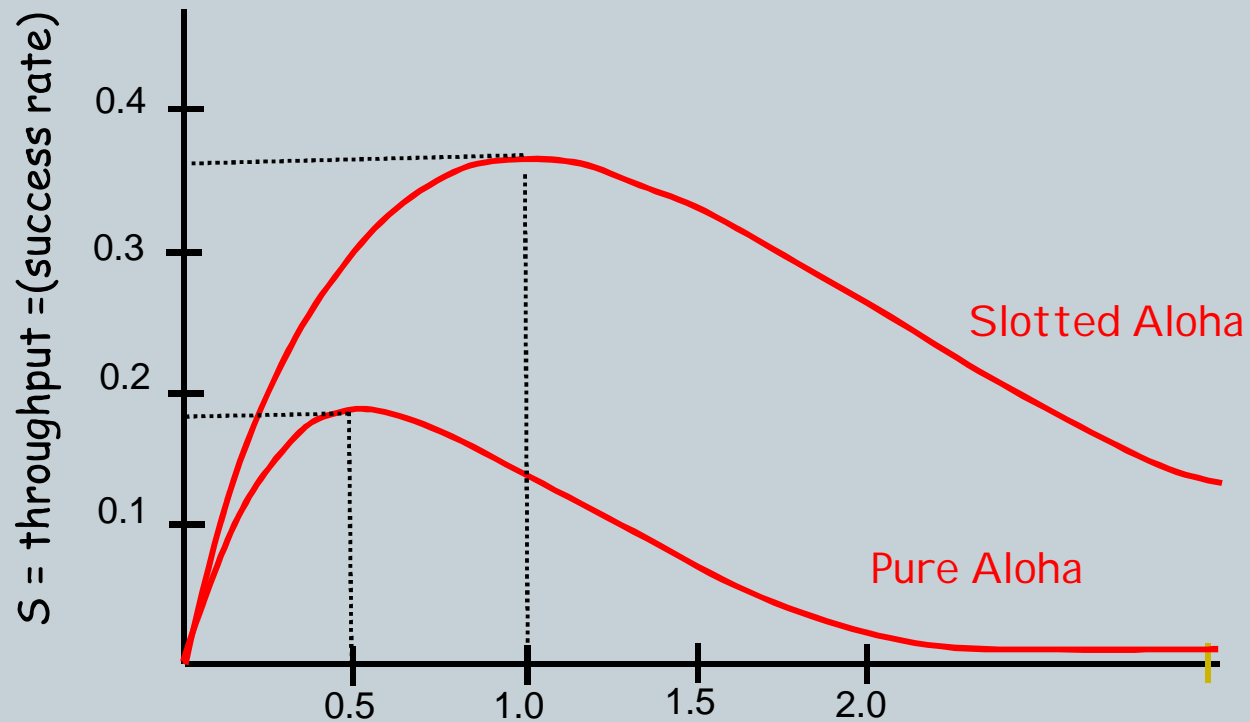
- The throughput for slotted ALOHA is

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

- The maximum throughput

$$S_{\max} = 0.368 \text{ when } G = 1.$$

Efficiency of Aloha



G = offered load rate = new frames + retransmitted
= **Total frames presented to the link per the transmission time of a single frame**

Cont..



- Advantage of ALOHA protocols
 - A node that has frames to be transmitted can **transmit continuously** at the **full rate of channel (R bps)** if it is the only node with frames
 - Simple to be implemented
 - No master station is needed to control the medium
- Disadvantage
 - If (M) nodes want to transmit, many collisions can occur and the rate allocated for each node will **not be on average R/M bps**
 - This causes low channel utilization