CS311: Data Communication

Medium Access Control - I

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Outline of the lecture

- Inroduction
- Broadcast networks
- Issues in MAC
- Goals in MAC
- MAC techniques
- Random Access MAC techniques
  - ALOHA CSMA
  - CSMA/CD CSMA/CA

On completion, the student will be able to

- Explain the goals and requirements MAC techniques
- Identify the key issues related to MAC techniques
- Give an outline of possible techniques
- Distinguish between centralized distributed MAC techniques
- Classify various contention based techniques such ALOHA, CSMA, CSMA/CD, CSMA/CA
- Compare performance of contention based techniques

Introduction

- Types of network

  - Switched communication networks:

- Users are interconnected by means of transmission lines, multiplexers and switches.

  - Broadcast networks:

- A single transmission media is shared by all the users and information is broadcast by an user into the medium.

Broadcast Networks

- Examples:

  - Multi-tapped bus

  - Ring networks sharing a medium

  - Satellite communication using sharing of uplink and downlink frequency bands

  - Packet radio network

  - Wireless communication stations sharing a frequency band

  - Broadcast network require a protocol to orchestrate the transmission from the users

Issues in MAC

- The question is “who goes next?”
- The protocols used for this purpose are known as medium access control (MAC) techniques
- The key issues involved – where and how the control excercised

Where ?

- Centralized : a designated station has an authority to grant access to the network.
  - Simple logic at each station
  - Greater control to provide features like priority,overrides and guaranteed bandwidth
  - Easy coordination
  - Lower reliability
- Distributed: stations can dynamically determine transmission order.
  - Complex, reliable and scalable

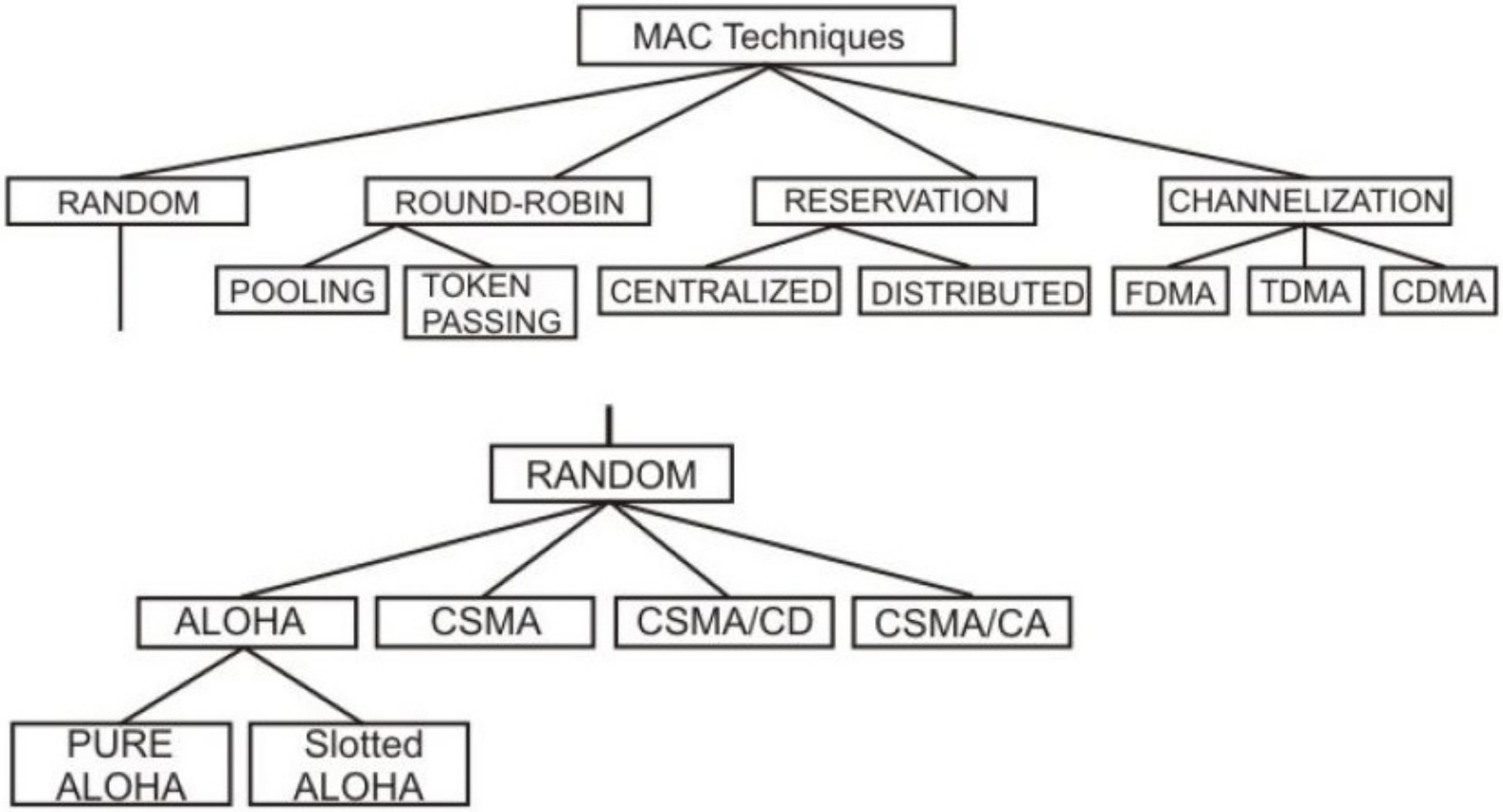
How?

- Synchronous: dedicated specific capacity to a connection.
- Asynchronous: allocates capacity dynamically

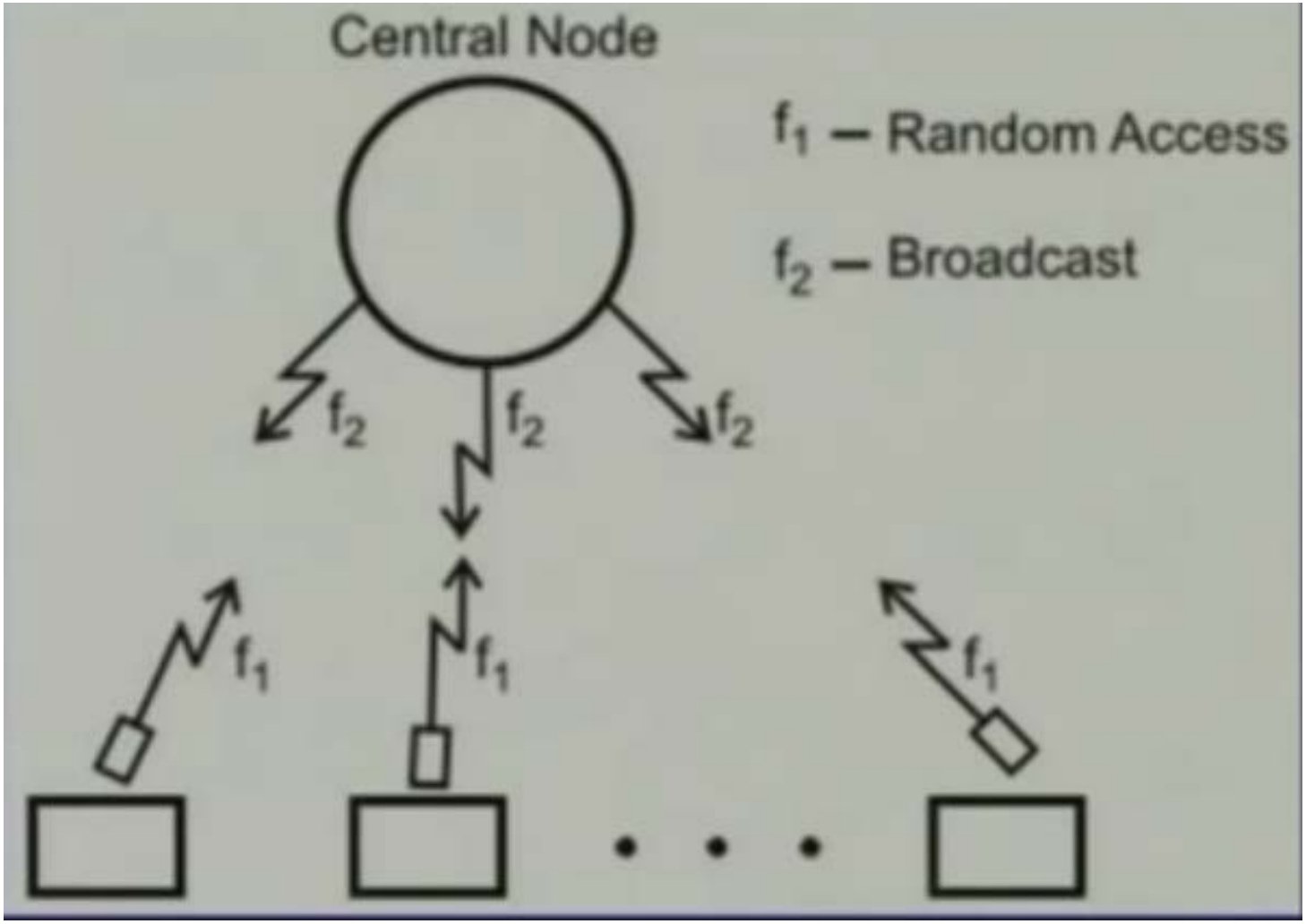
Goals of MAC

- Initialisation
- Fairness
- Priority
- Limitation to one station
- Receipt
- Error limitation
- Recovery
- Reconfigurability
- Compatibility
- Reliability

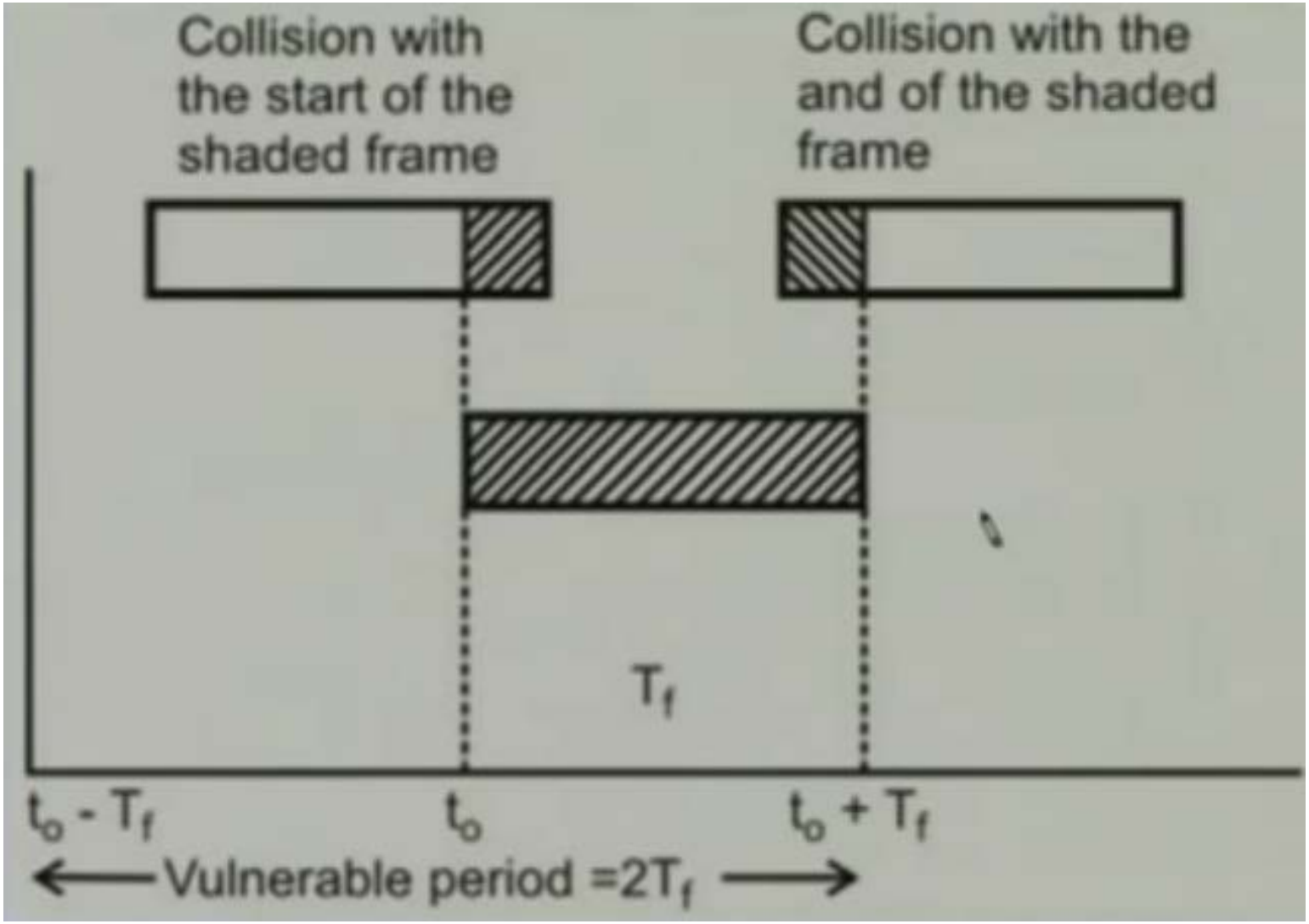
MAC Techniques



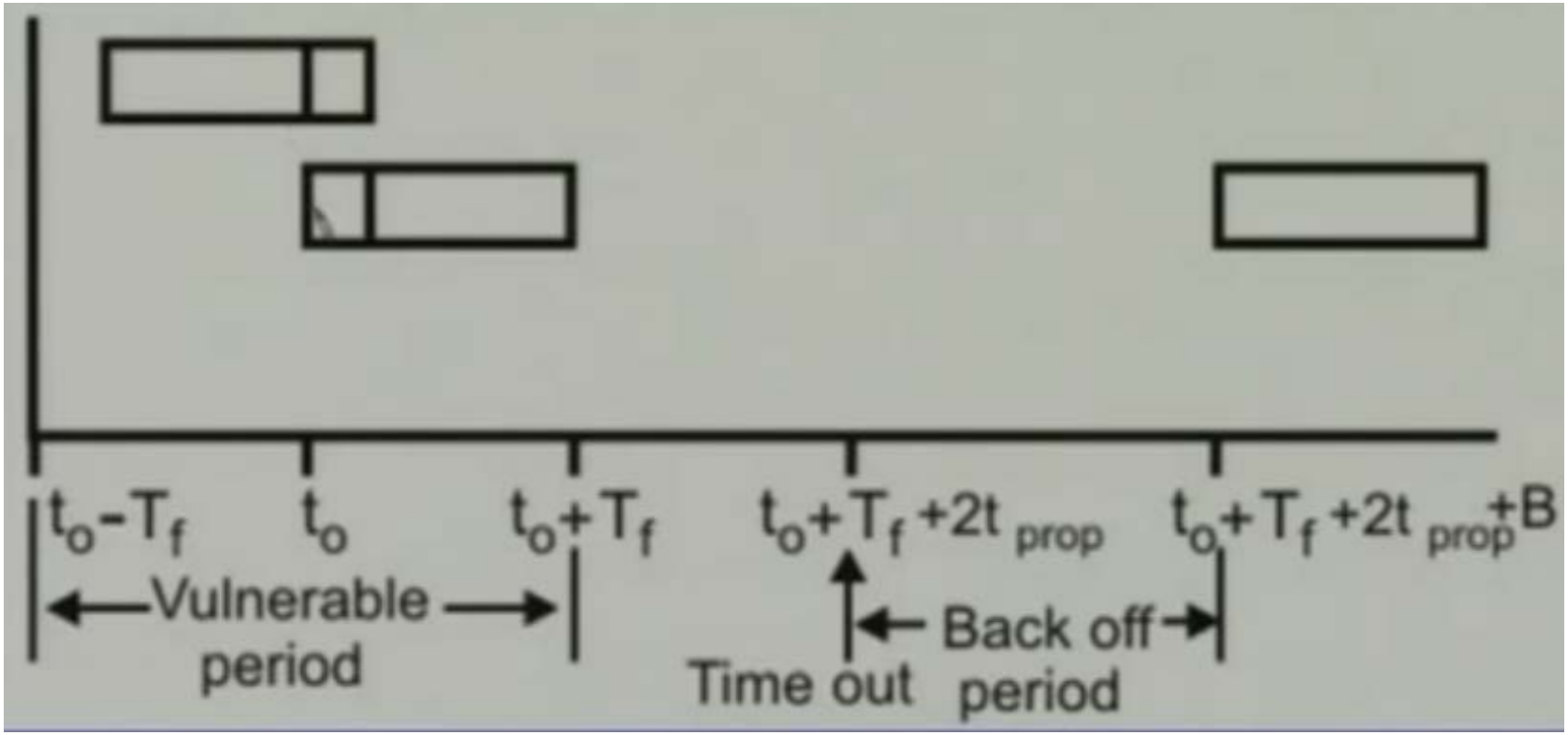
Packet Radio Network



ALOHA

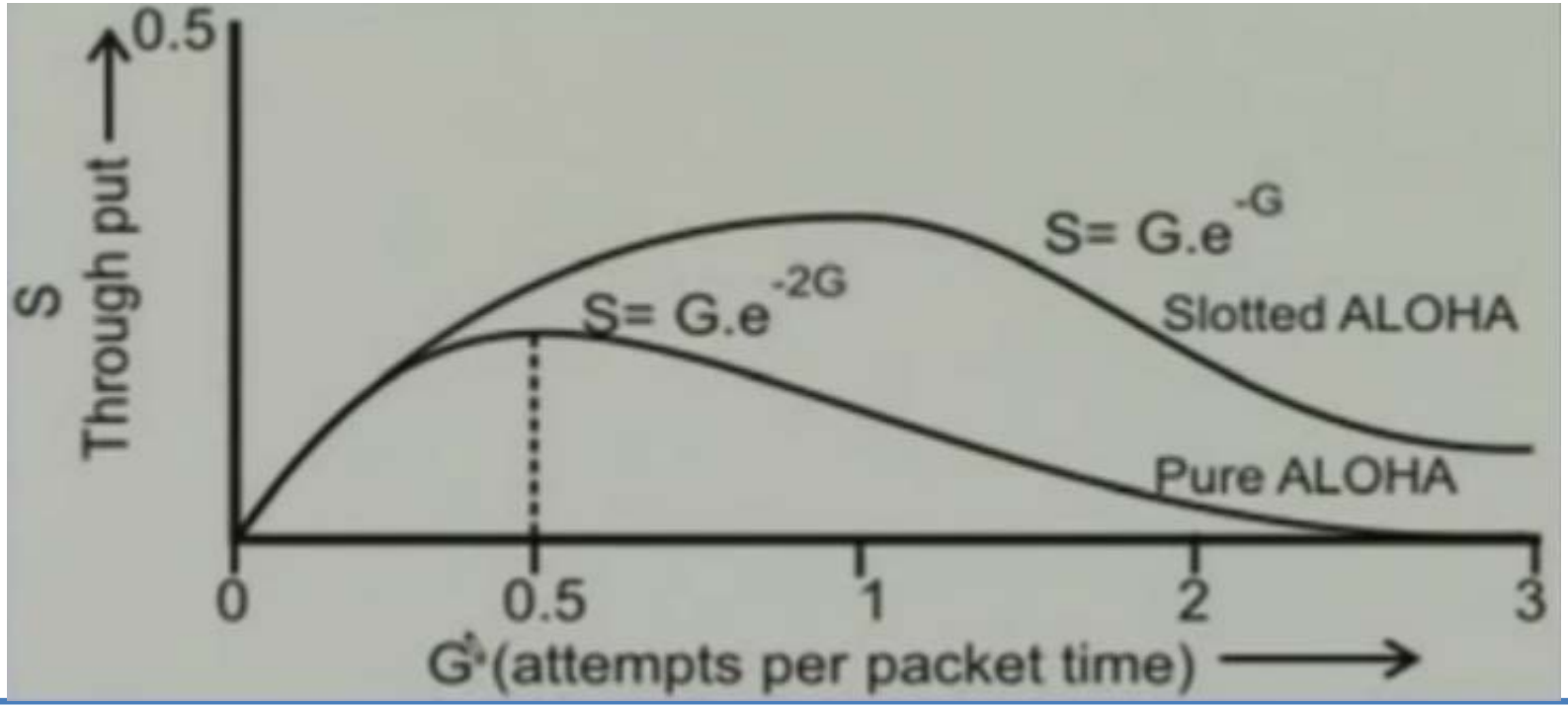

Collision with the start of the shaded frame
Collision with the and of the shaded frame
T_f
$t_o - T_f$
t_o
$t_o + T_f$
Vulnerable period $=2T_f$

ALOHA Random Access Scheme



Slotted ALOHA

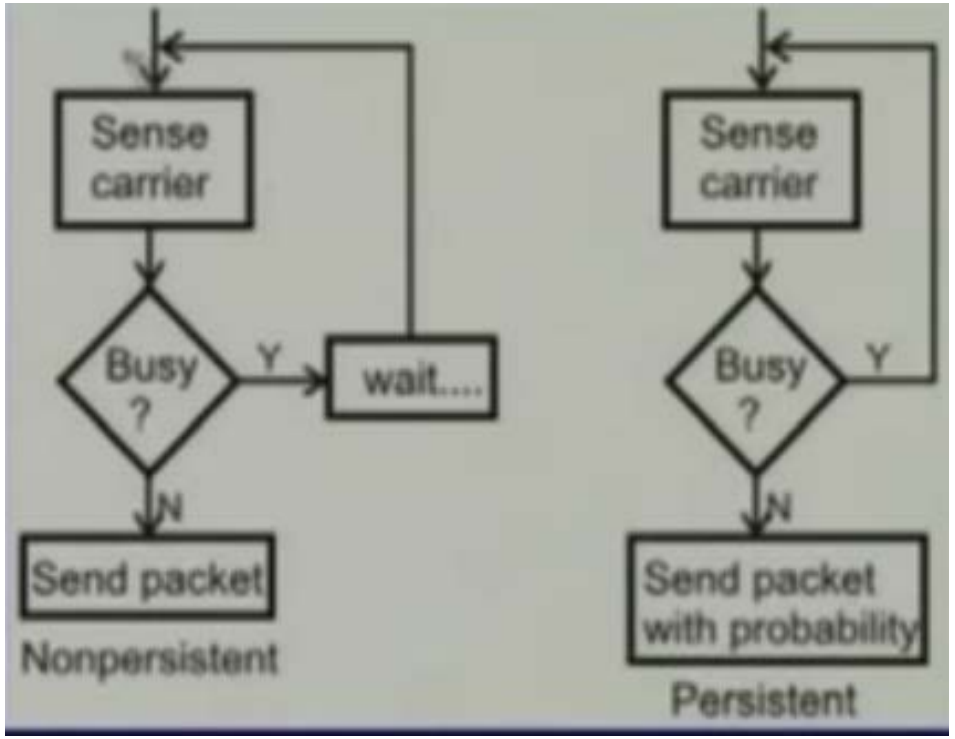
- Transmits frame in fixed time slots
- Vulnerable period reduces to 2T from T of pure ALOHA
- Performance:



CSMA

- When a station sends a packet, others know about it within a fraction of packet transmission time. This led to the development of carrier-Sense-Multiple-Access (CSMA) Protocol. Station listens to the medium before transmitting; Listen before talking (LBT).

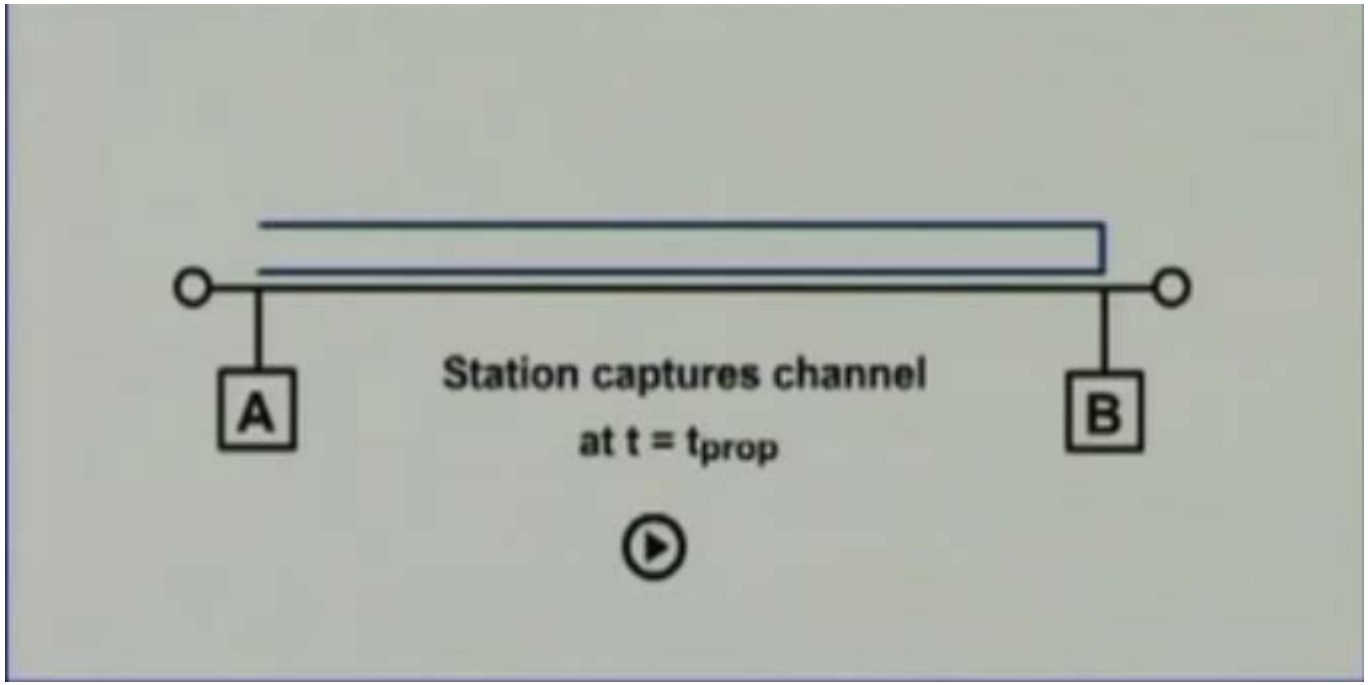
- Nonpersistent
- Persistent



CSMA

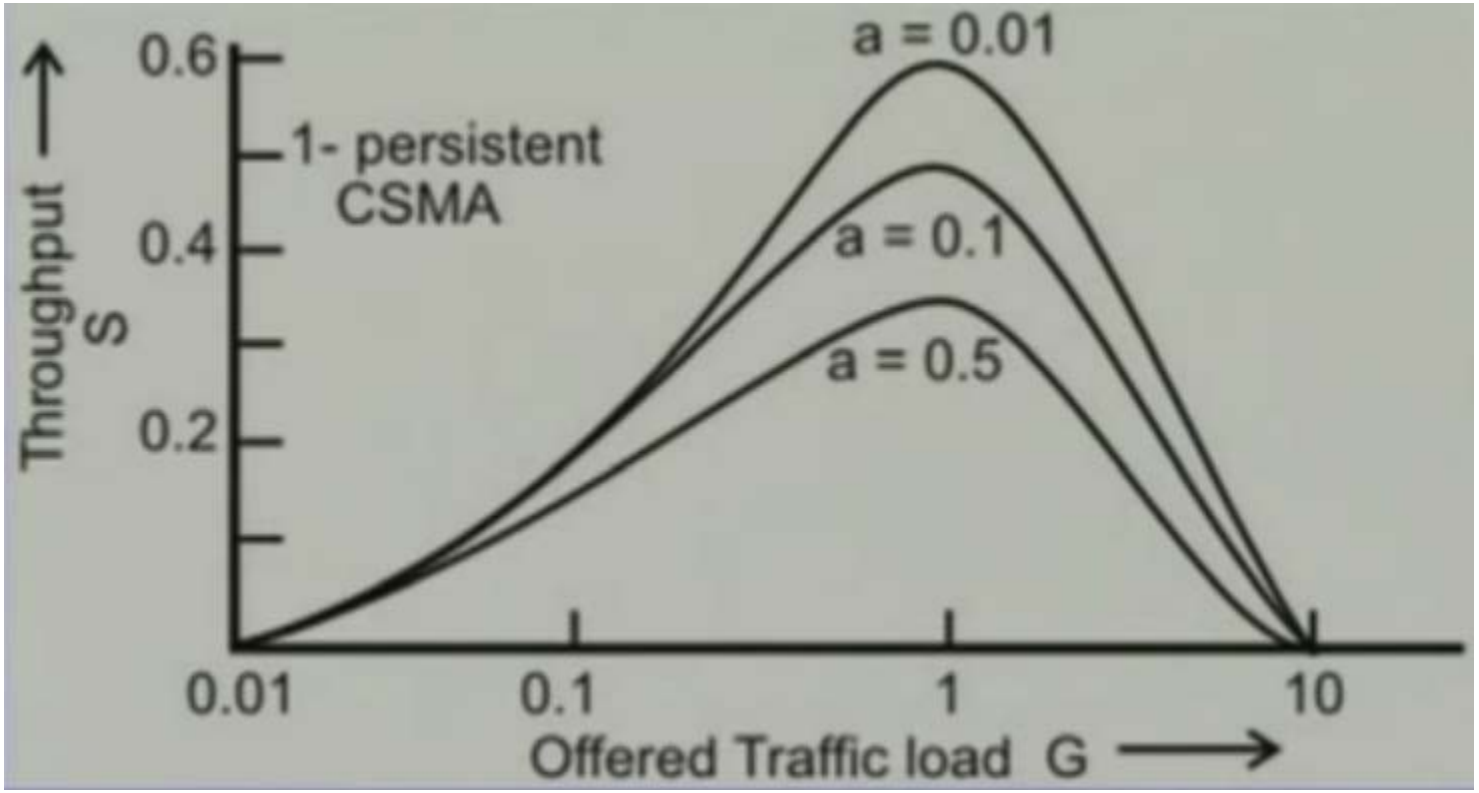
- Nonpersistent CSMA
  - If medium is idle, transmit
  - If medium is busy, wait random period and then re-sense medium
- 1-persistent CSMA
  - If medium is idle, transmit
  - If medium is busy, continue to listen until the channel is sensed idle; then transmit immediately
- P-persistent: If medium is idle, transmit with probability p.

CSMA Vulnerable Period



- Vulnerable period = t(prop) (one propagation time)

Performance of CSMA



CSMA/CD

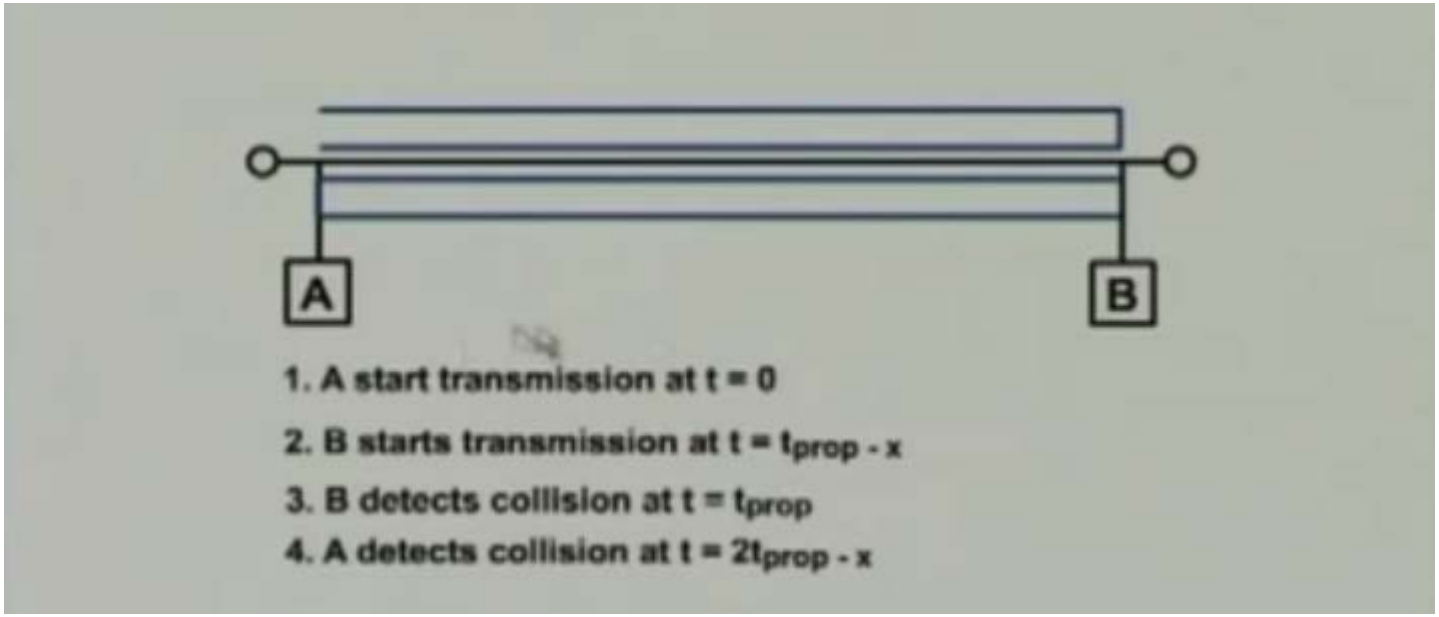
- CSMA with Collision Detection (CSMA/CD)
- Stations listens to the medium while transmitting; Listen while talking (LWT).
- Three cases:

- If channel idle:
- Packet is transmitted if nonpersistent or 1-persistent
- For p-persistent, the packet is sent with probability p or delayed by the end-to-end propagation delay with probability (1-p).

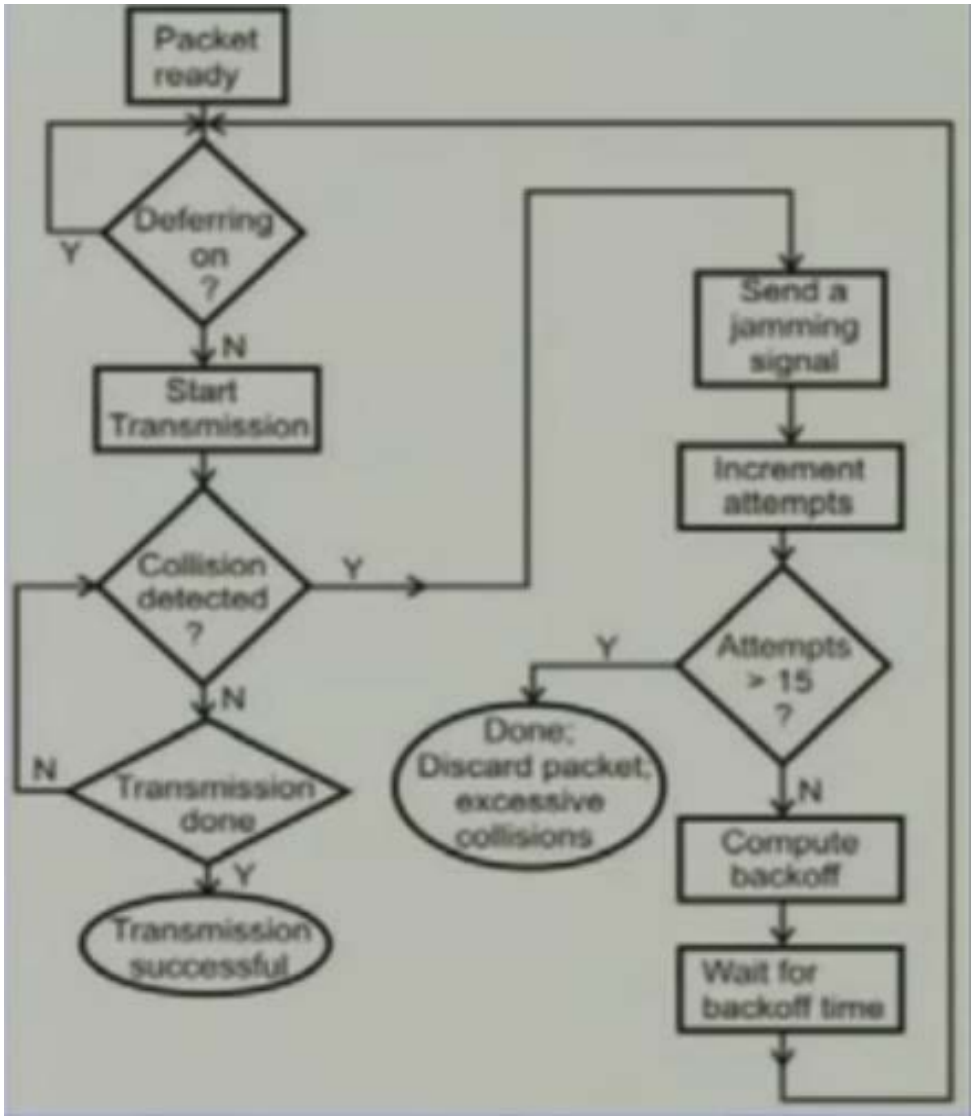
CSMA/CD

- If channel is busy:
- The packet is backed off and the algorithm is repeated for nonpersistent case
- The station defers transmission until the channel is sensed idle and then immediately transmits in 1-persistent case
- For p-persistent CSMA/CD the stations defers until the channel is idle, then follow the channel idle procedure.

Collision detection in CSMA/CD



CSMA/CD

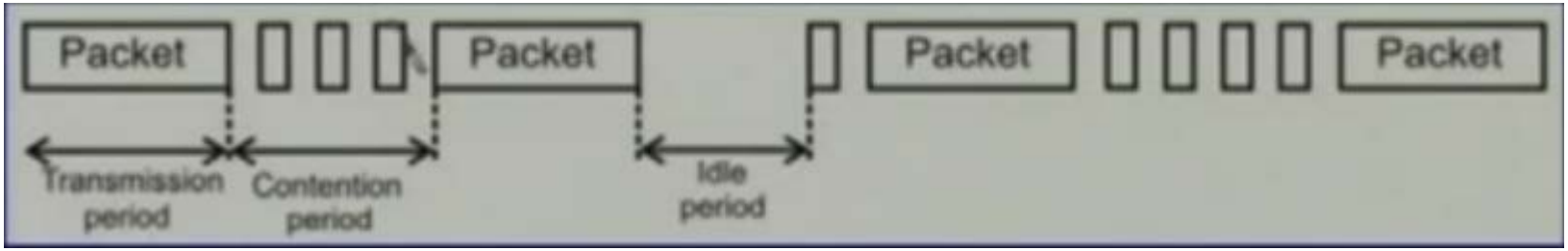


- 0<r<2(k),

Where k= (n,10),

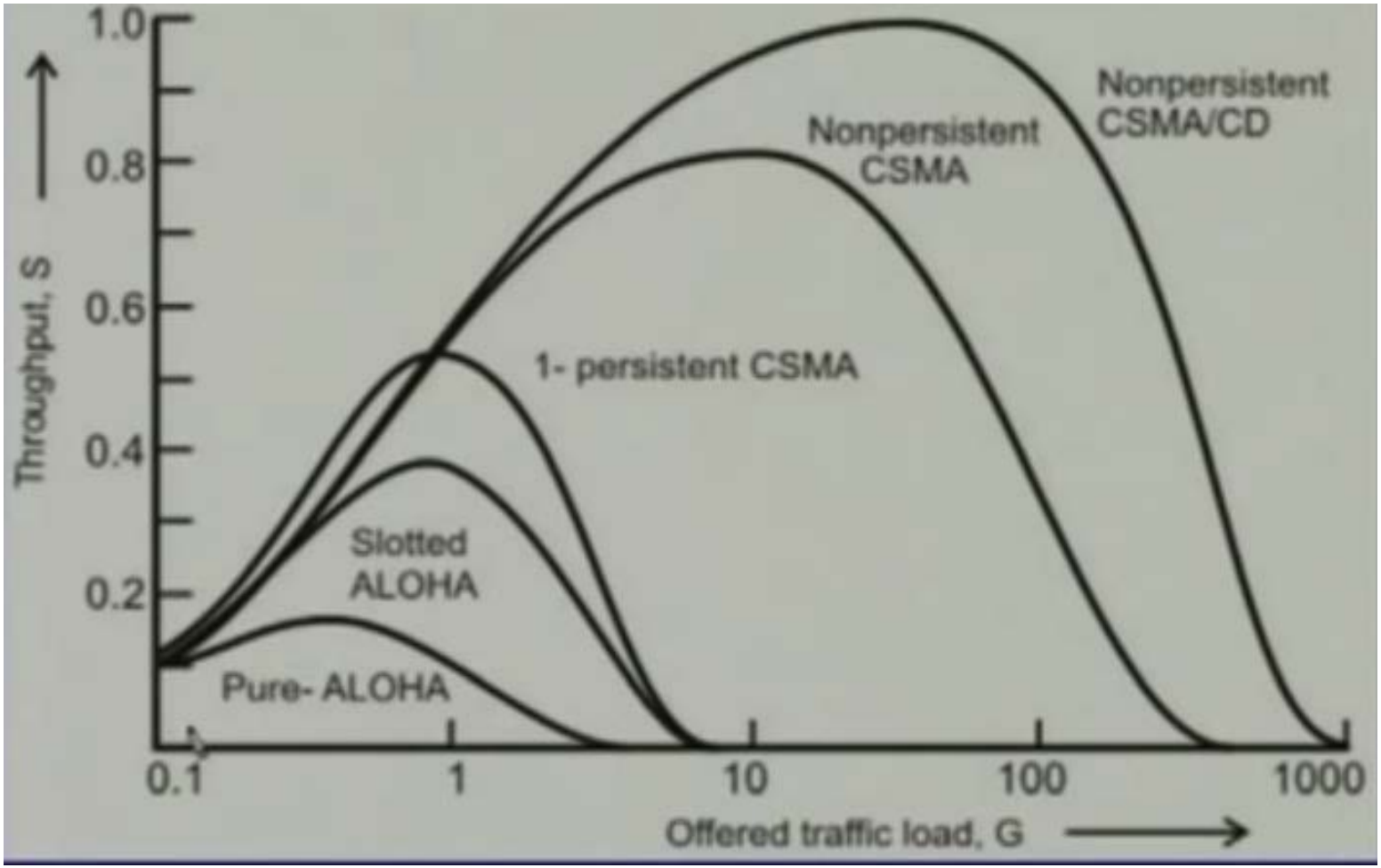
n=unsuccessful attempts

CSMA/CD



- Three states:
  - Contention
  - Transmission
  - Idle

Performance Comparison



Reference Books

1. Stallings, W., (2010), *Data and Computer Communications*, Prentice Hall
2. Forouzan, B. A., (2012), *Data Communications and Networking*, McGraw-Hill
3. NPTL Lectures, *Data Communications*, Prof. Ajit Pal, IIT Kharagpur

Thanks!