CS311: Data Communication

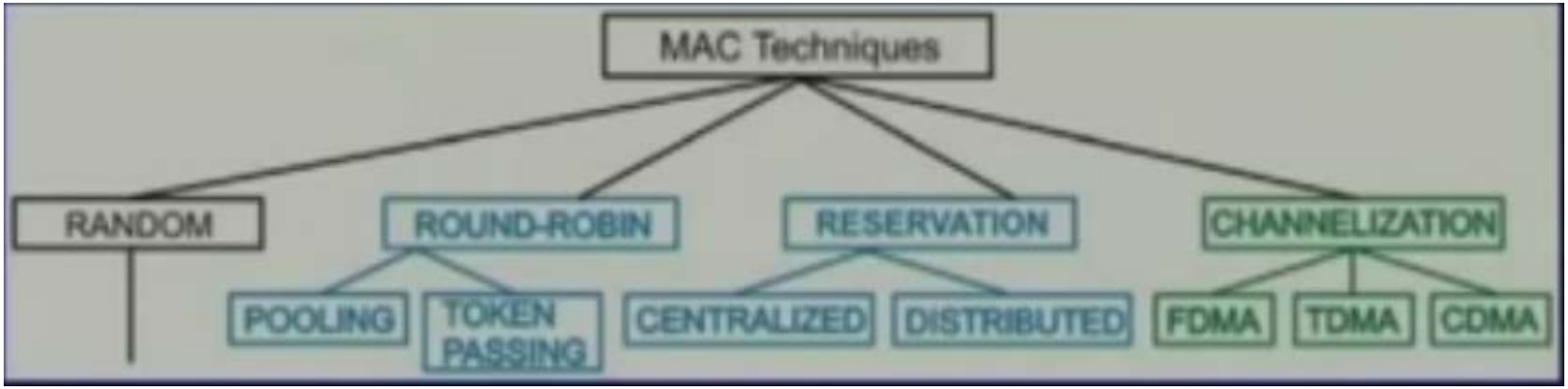
Medium Access Control - II

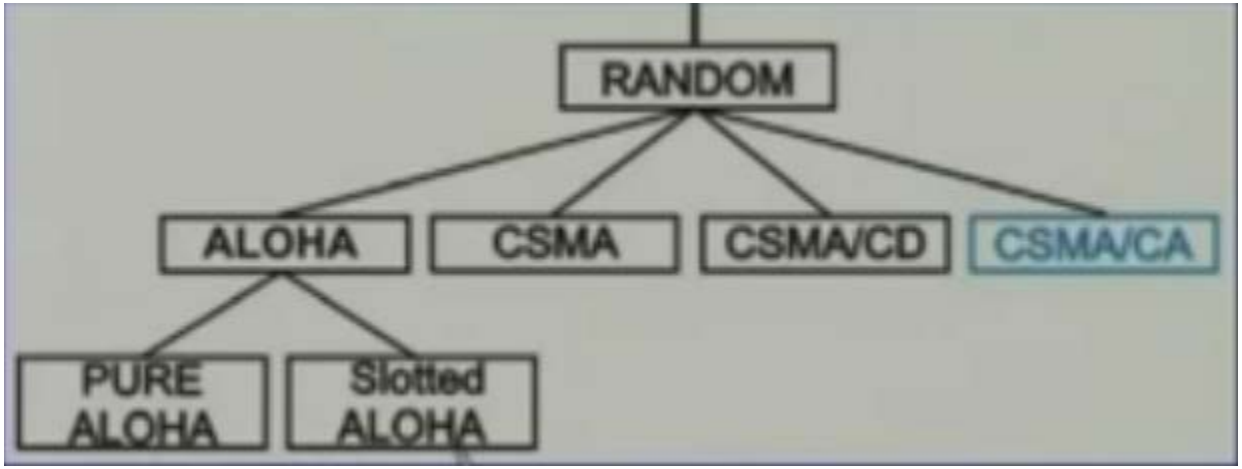
Dr. Manas Khatua
Assistant Professor
Dept. of CSE
IIT Jodhpur
E-mail: manaskhatua@iitj.ac.in

Outline of the Lecture

- Collision-free protocols
- Carrier Sense Multiple Access with Collision Avoidence (CSMS/CA) technique
- Round robin MAC techniques
  - Polling
  - Token passing
- Reservation base MAC techniques
  - Distributed schemes
  - Centralized schemes

MAC Techniques



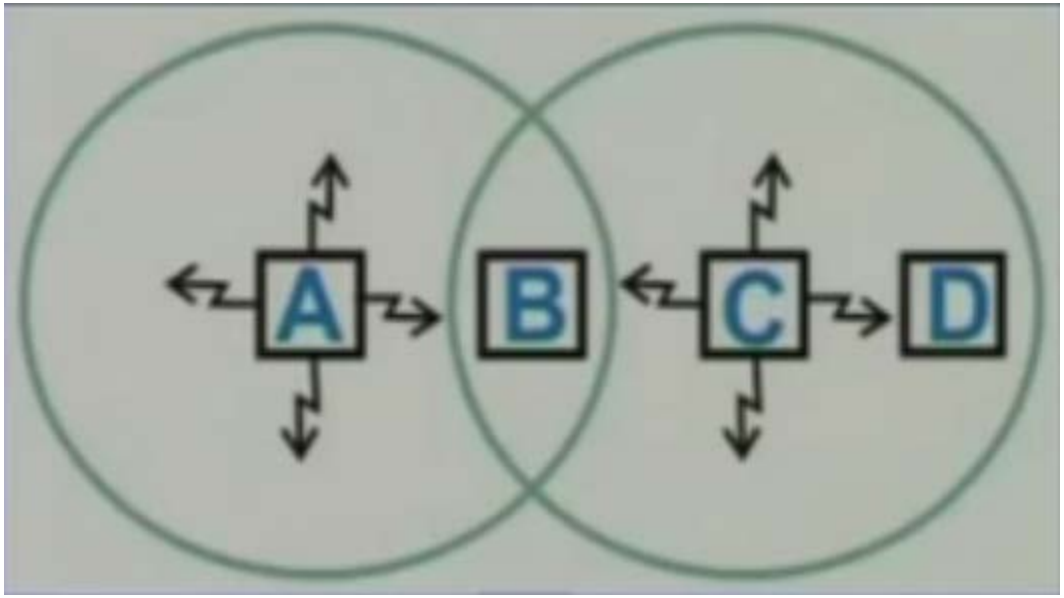


Need for CSMA/CA

- Proliferations of portable computers need to use radio signals for communication
- All radio trasmitters have some fixed range
- When a reciever is within the range of two active transmitters, the resulting signal will generally get garble
- CSMA/CD is unsuitabe in such an enviromen
- There are so called hidden station and exposed station problems
- Suitable technique needs to be developed for this kind of environment

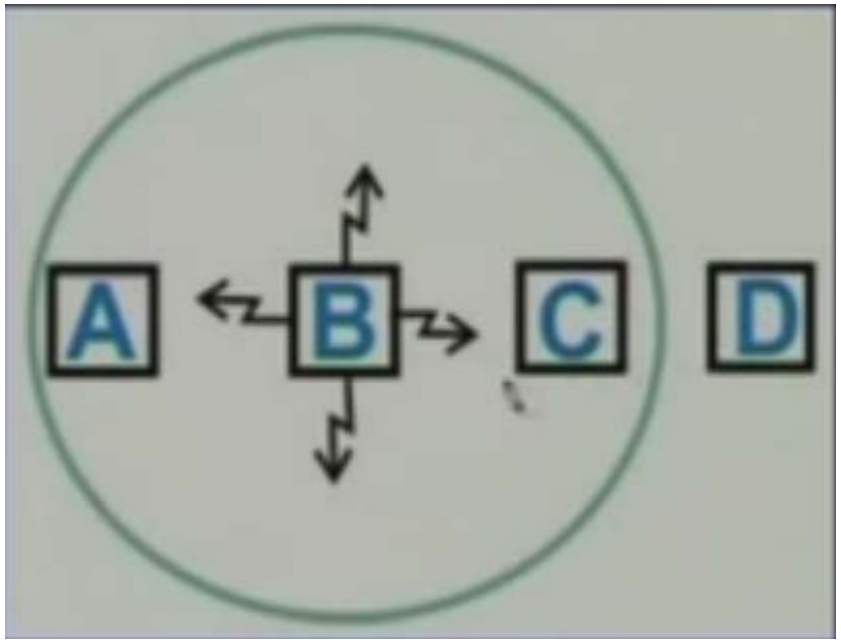
The Hidden Station Problem

- Both A and C tries to communicate with B simultaneously
- Both the signals will reach B and collision will occur, but A and C will not detect the collision



Exposed Station Problem

- Station B wants to send a frame to A, which is also listened by C, which assumes that medium is not free
- But, in practise C can send to D

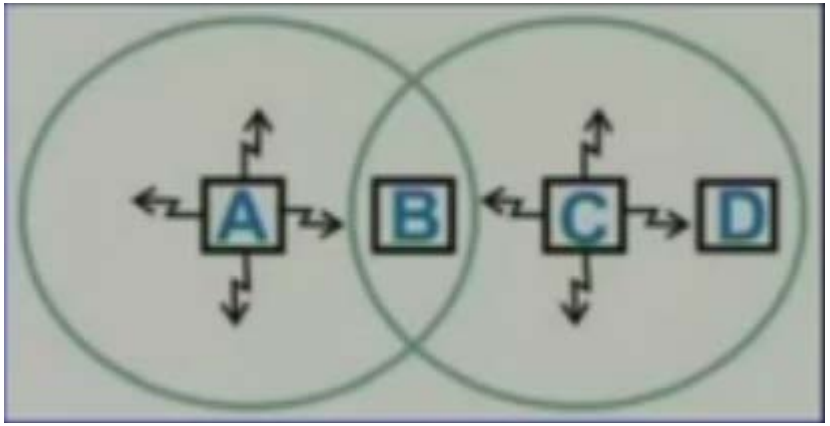


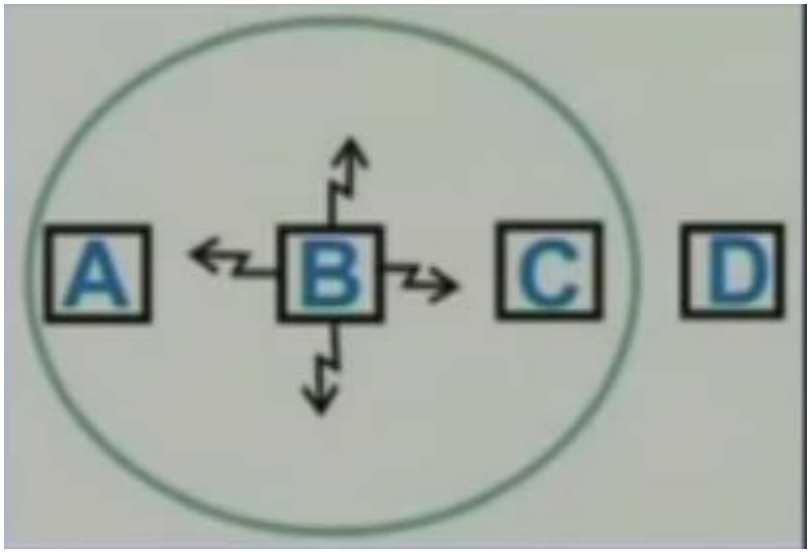
CSMA/CA

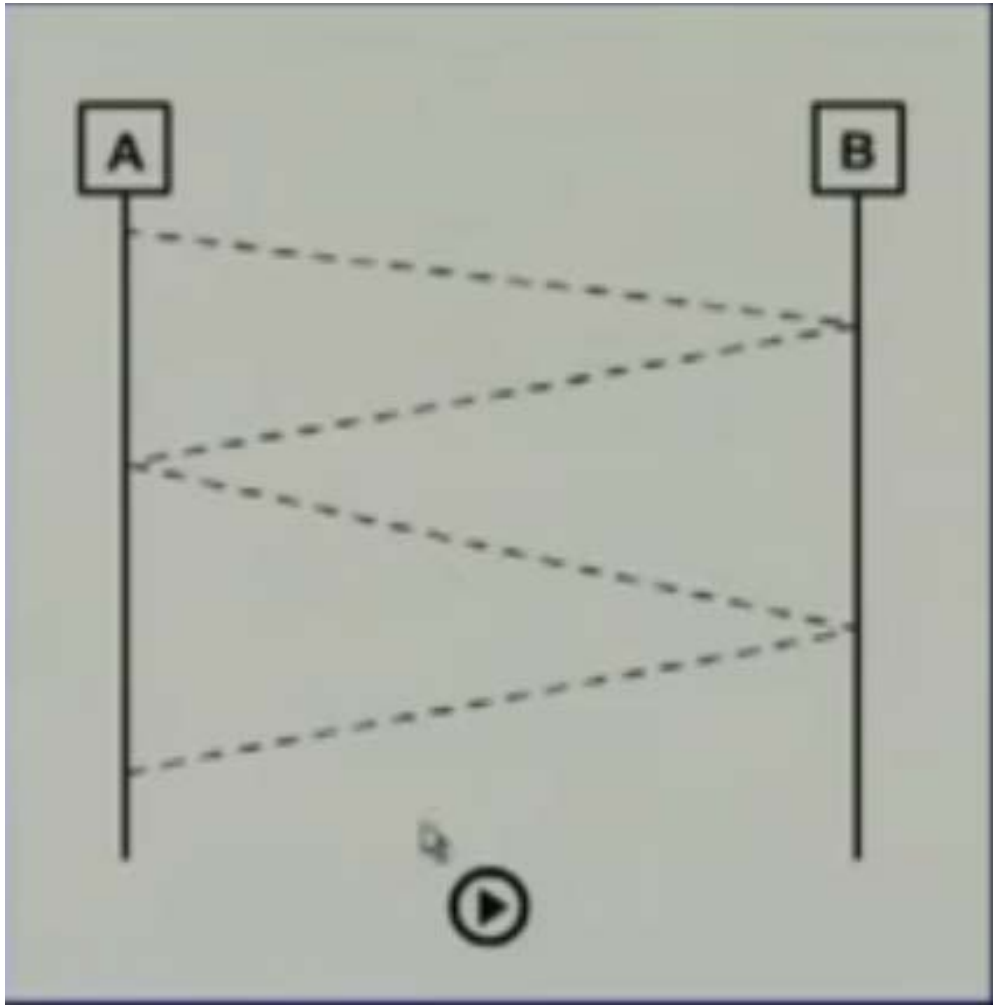
Carrier Sense Multiple Access with Collision Avoidence (CSMA/CA)

- Sender sends a short frame called Request to send RTS (20bytes) to the destination. RTS also contains the length of the data frame.
- Destination station responds with a short (14 bytes) clear to send (CTS) frame.
- After recieving the CTS, the sender starts sending the data frame.
- If collision occurs, CTS frame is recieved within a certain period time.

Four Way Handshaking Protocol

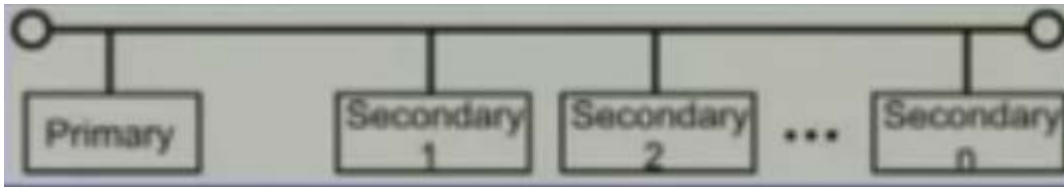


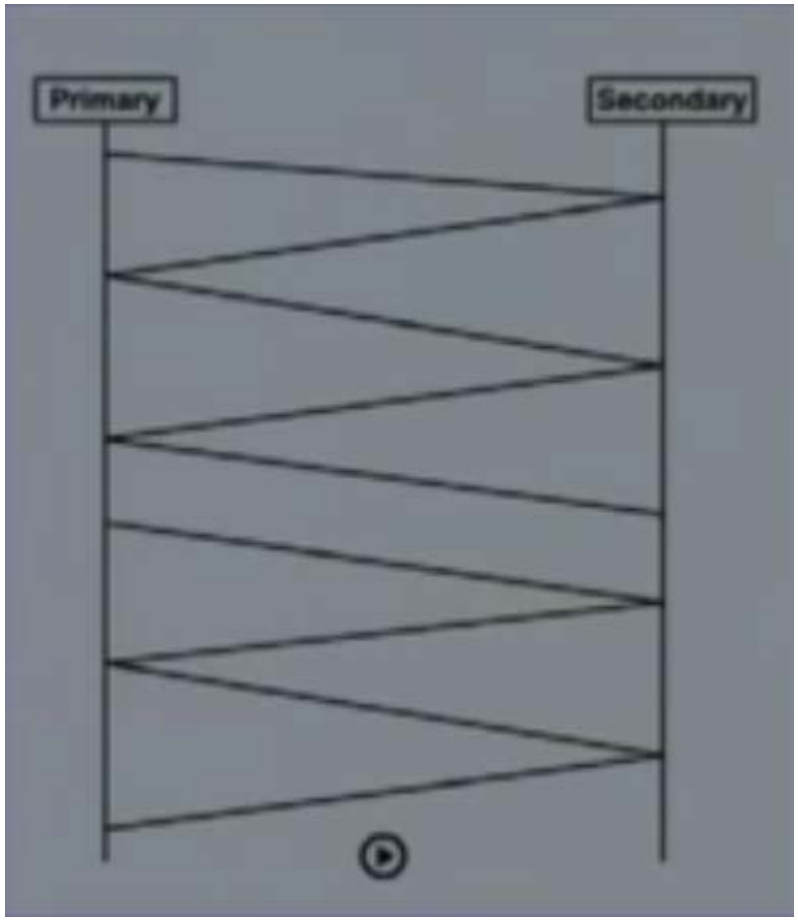




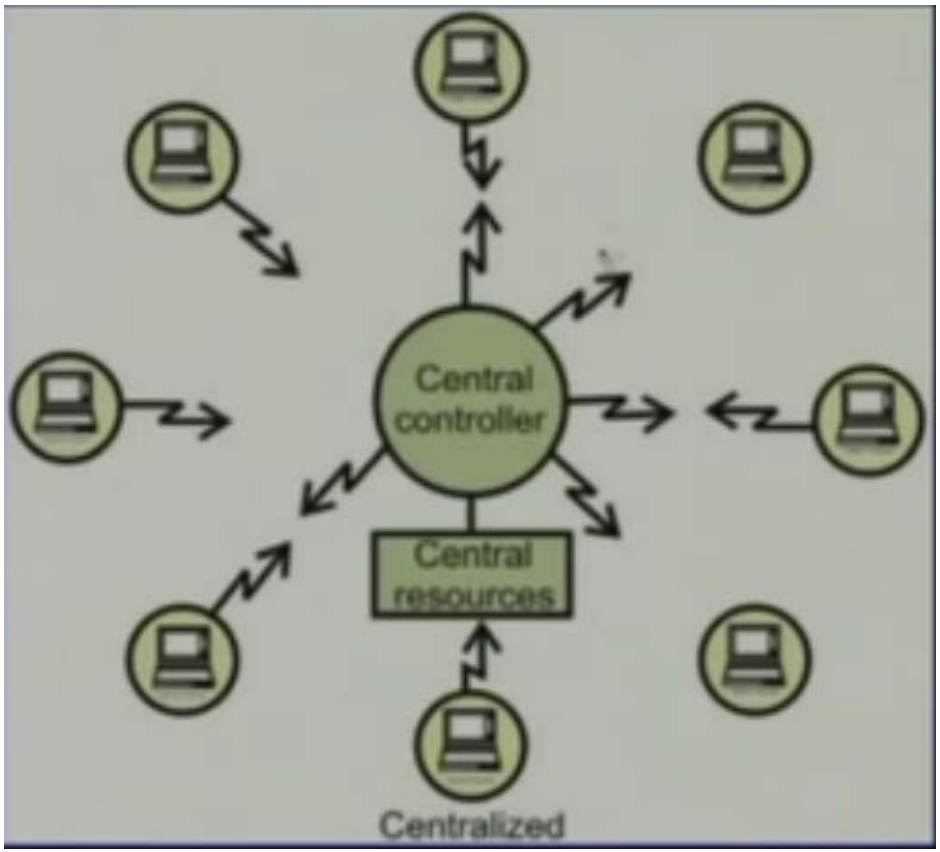
Polling

- Stations take turns in accessing the medium
- One station is designated as primary and others are secondary stations
- Select mode when primary sends data
- Polling when the primary wants to recieve data



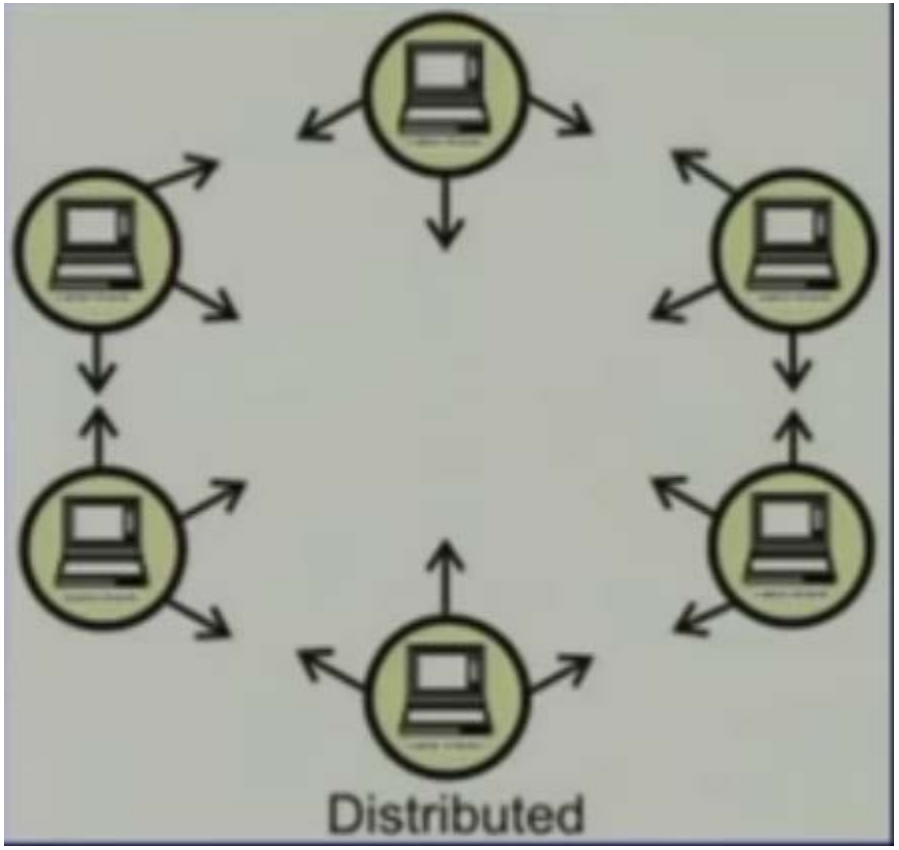


Polling



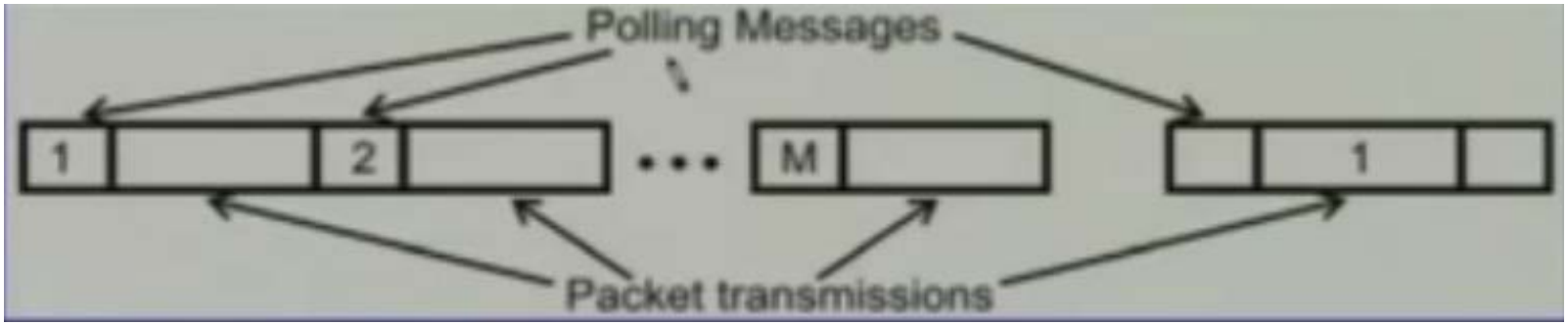
- Central controller may a frequency band to send outbound messages
- Other stations share a different frequency to send inbound messages
- The techniques is called frequency-division duplex approach (FDD)

Polling

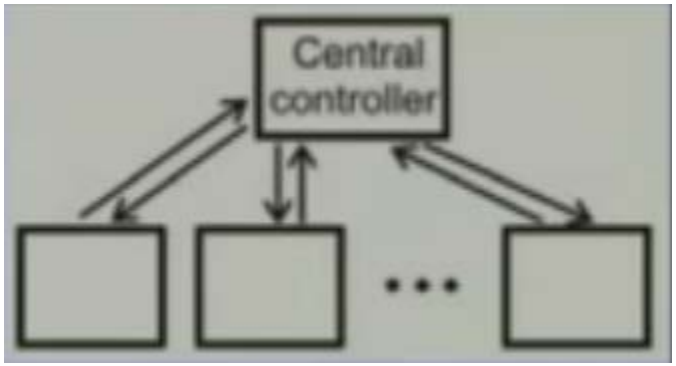


- Polling without a central controller
- All stations recieve signals from other stations
- Stations develop a polling order list, using some protocol

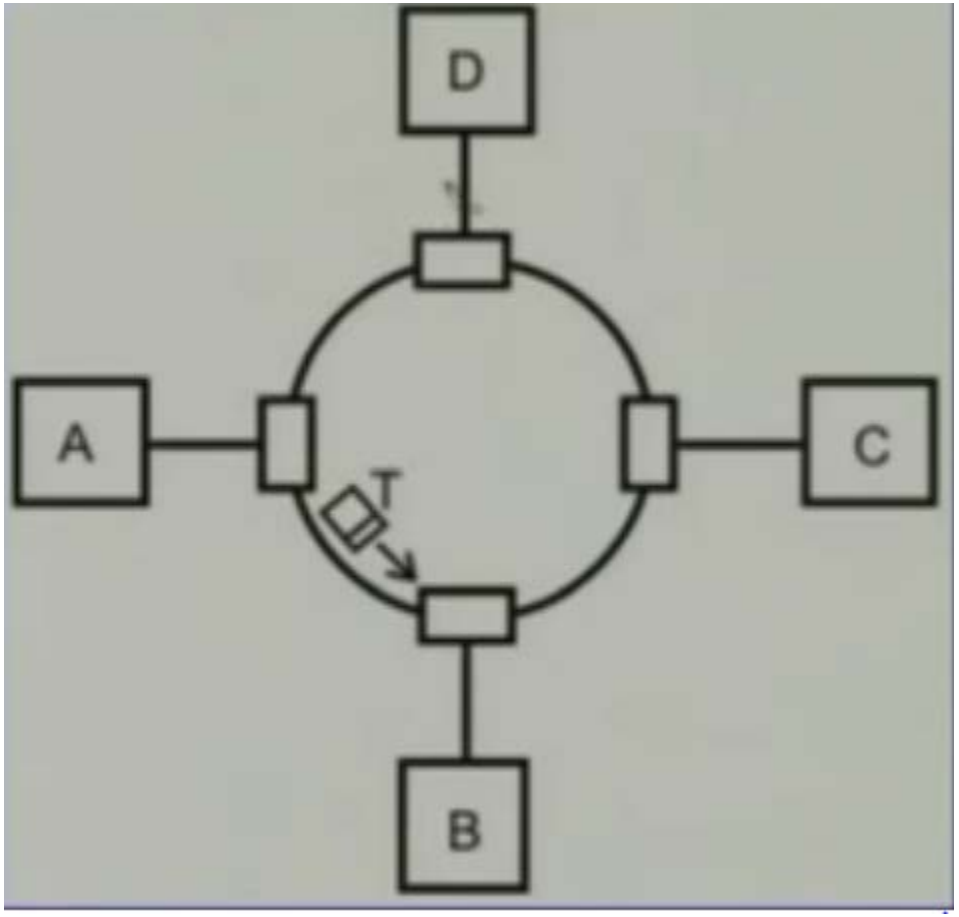
Polling



- Walk time: time required for propogation of message and a station begins transmission
- Total walk time can be considered as the overhead in the polling process

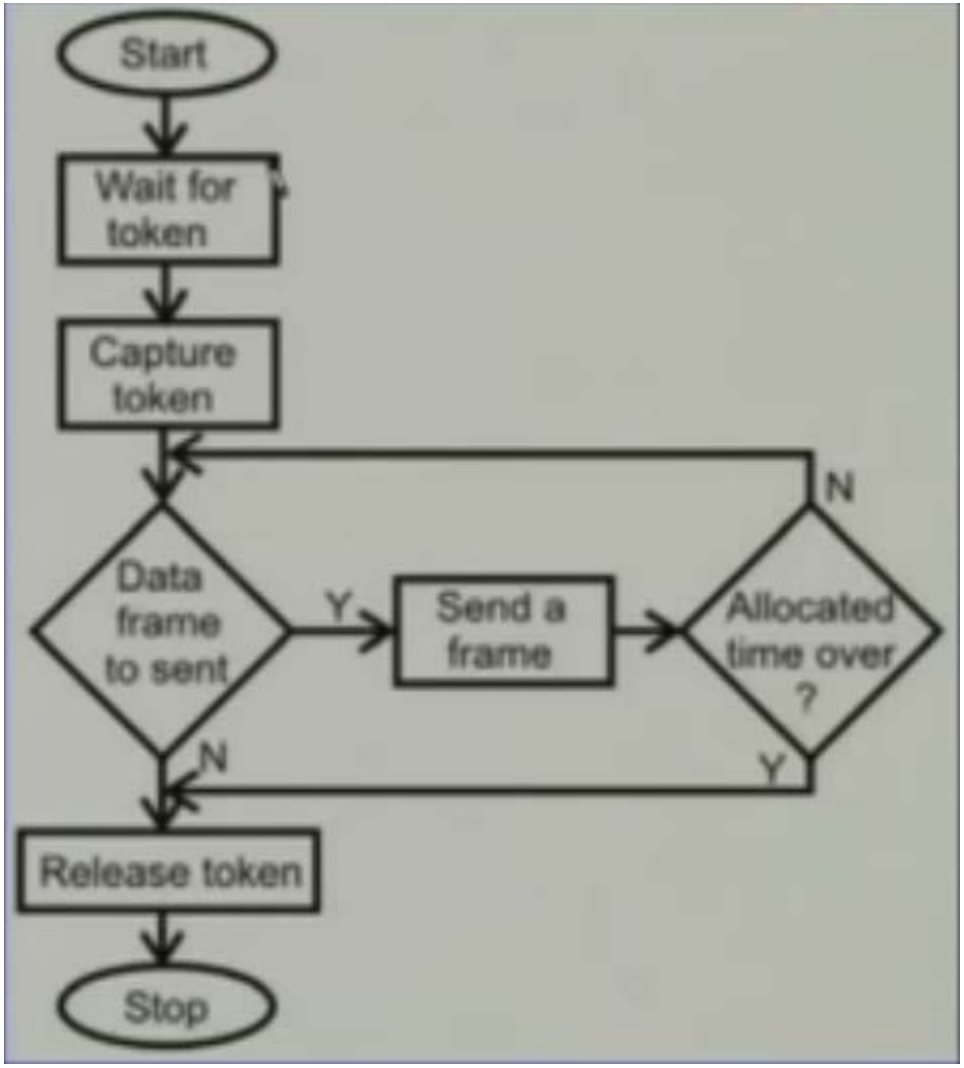


Token Passing



- All stations are logically connected in the form of the ring
- Control of the access to the medium is performed using a token; a special bit pattern
- Token is circulated in round robin manner. Holder of token has the right to transmit

Token Passing



Performance of Token Passing

- Key parameters:
- Throughput: It is a measure of the successful traffic
- Delay: It is a measure of time between when a packet is ready and when it is delievered
- A station starts sending a packet at t = t_0, completes transmission at t = t_0 + a, receives the tail at t_0 +1+a, receives the tail at t_0 + 1 + a.
- Average time (delay) required to send a token tto the next station = a/N.
- Throughput S = 1/(1 + a/N) for a<1

  S = 1/a(1 + 1/N) for a>1.

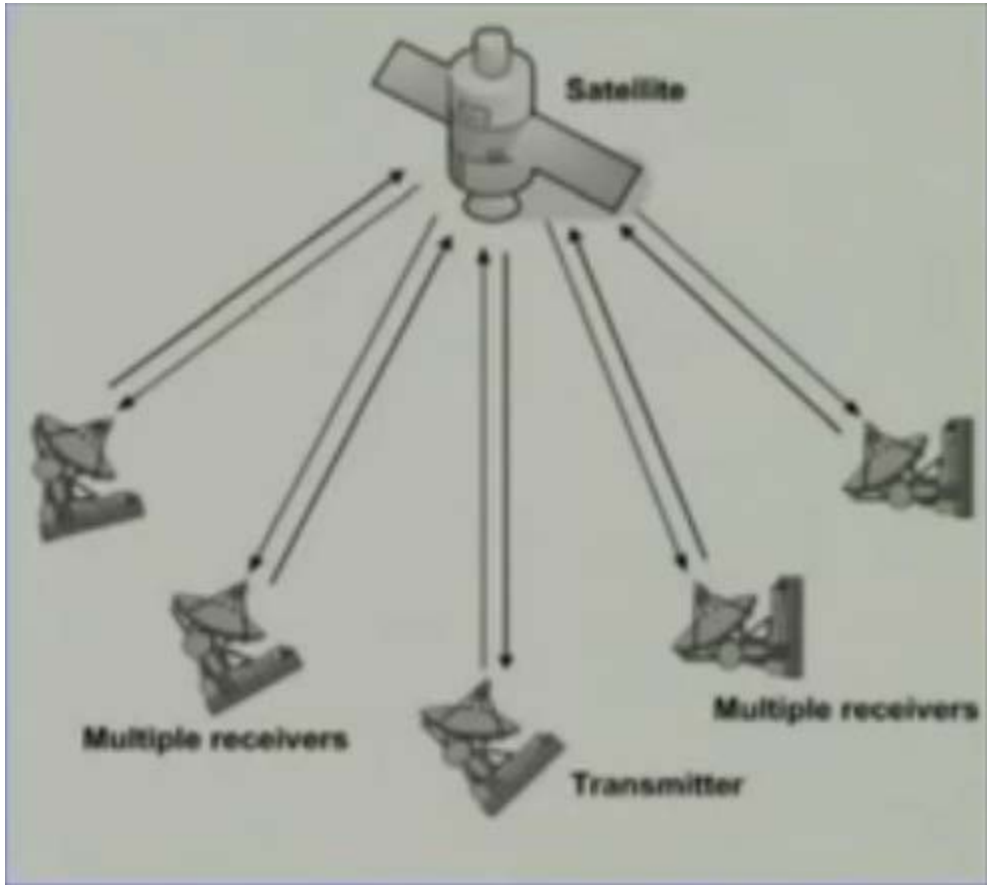
Performance Comparison

- The token ring is the least sensitive to workload and propogation effects
- CSMA/CD has the shortest delay under light load conditions, but is most sensitive to variations to load, particularly when the load is heavy
- CSMA/CD is not suitable for real-time traffic

Reservation Protocols

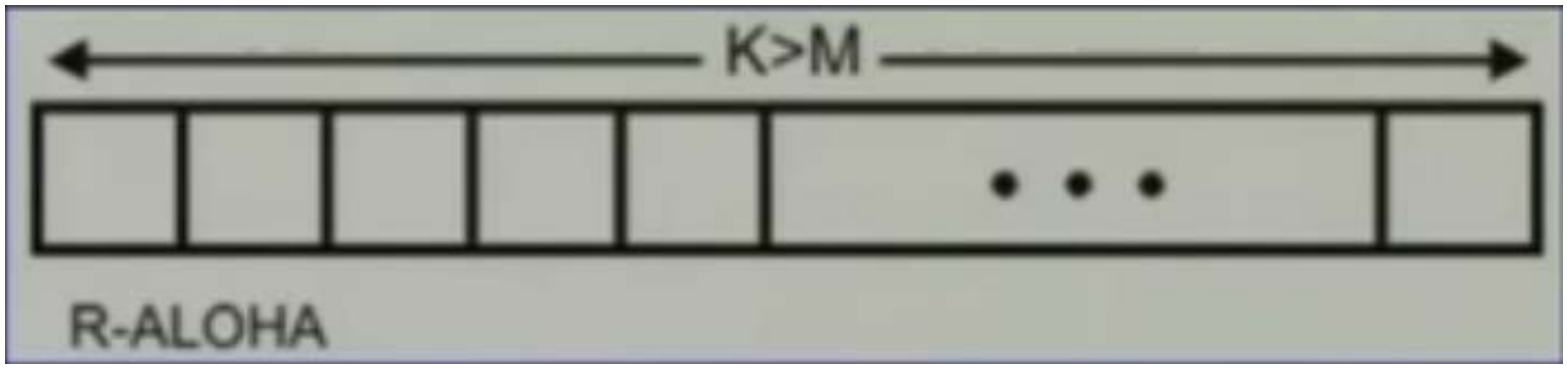
- **Unique features of satelite networks:**
- Long round-trip propogation delay (one forth of a second)
- After the round-trip delay a station comes to know whether packet transmission was successful or it suffered collision
- CSMA-based protocols are unsuitable in such a situation
- Polling and token passing protocols are also unsuitable
- Reservation-based protocols can be used
- Two categories: Distributed, Centralized

Satellite networks



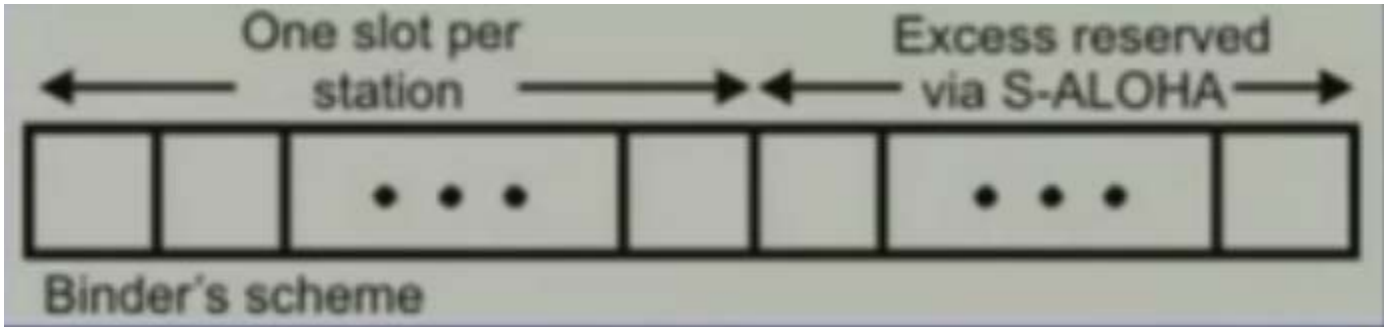
R-ALOHA

- Number of stations (K) is larger than the number of slots (M)
- A station contends for a slot in next frame
- Behaves like TDMA when a station send long streams of data
- Behaves like S-ALOHA for bursty traffic



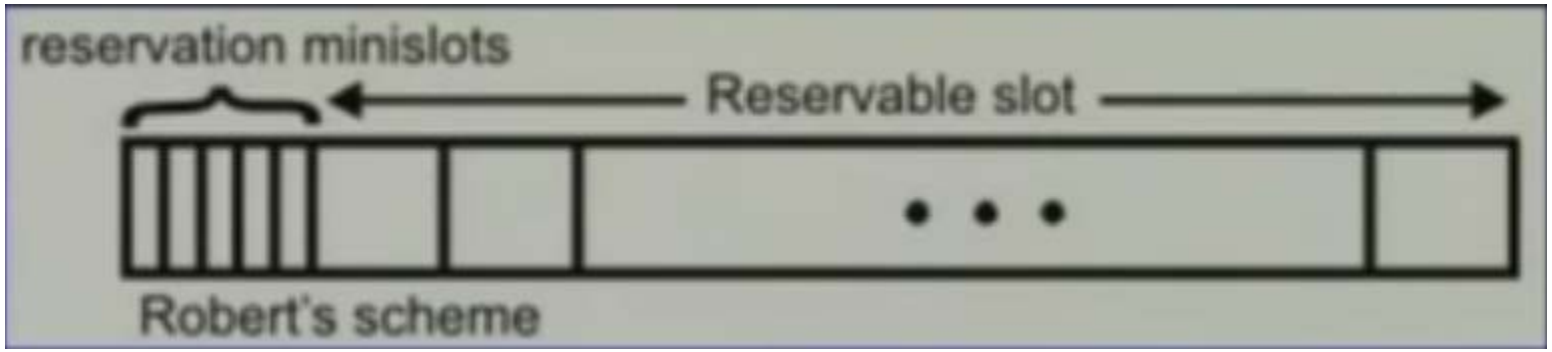
Binder's Scheme

- Number of stations (K) is smaller than the number of slots (M)
- Each station has ownership of one slot per frame
- Excess slots can be reserved using S-ALOHA
- If an owner has no data to send, the slots becomes available to others
- Superior to R-ALOHA for stream-dominated traffic



Robert's Scheme

- Explicit reservation by sending request in a minislot, which acts as common queue, in each frame
- Successful transmission in a minislot allows reservation
- For lengthy stream, there can be considerable delay

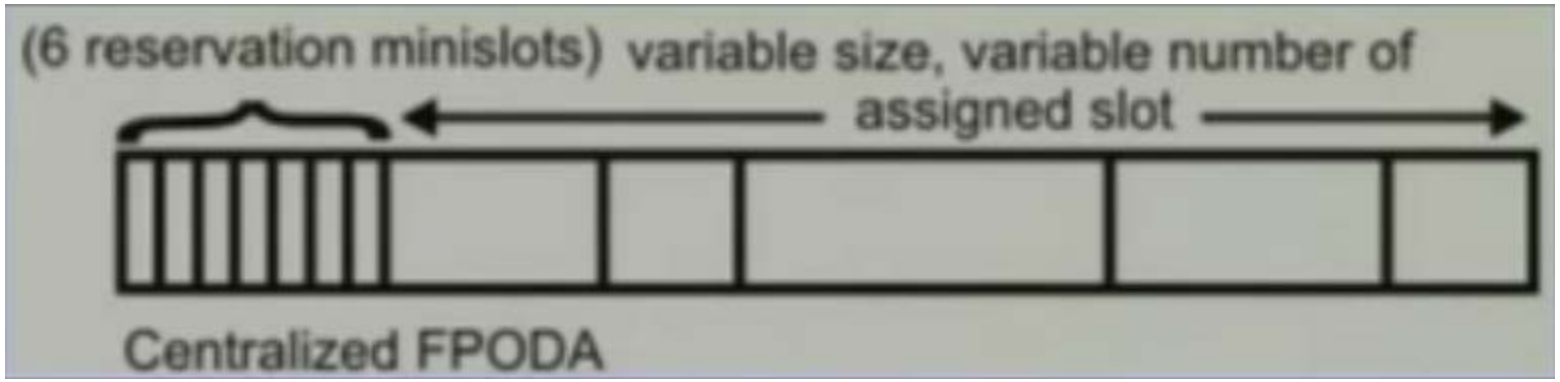


Distibuted Versus Centralized

- Distributed schemes suffer from the disadvantage of higher processing burden on each station
- Distributed schemes are vulnerable to loss of synchronization
- Two centralized schemes are discussed
  - FPODA (Fixed Priority-Oriented Demand Assignment)
  - PDAMA (Packet-Demand Access Multiple Access)

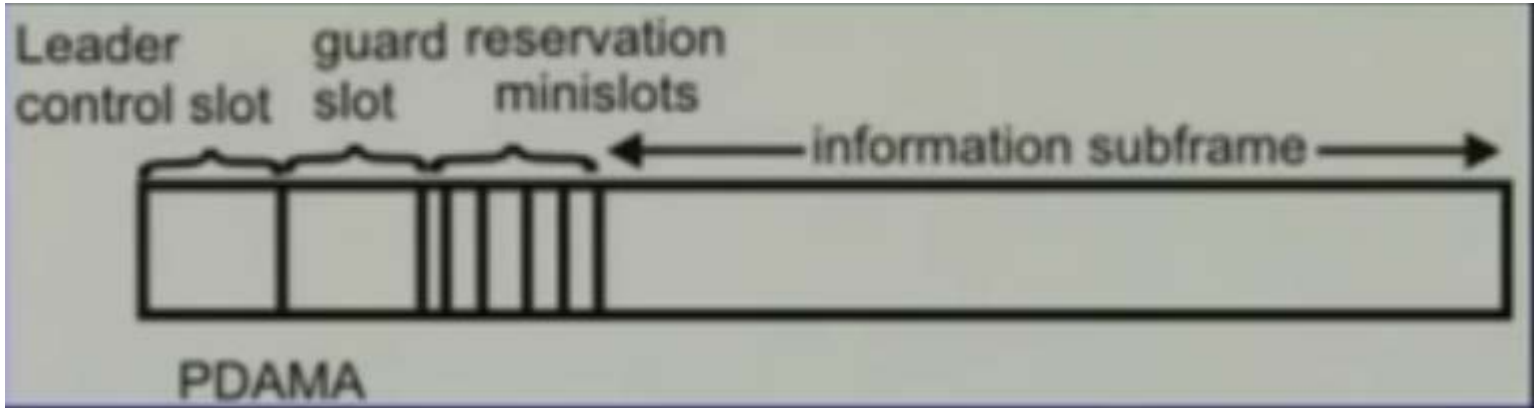
Centralized FPOMA

- Fixed Priority Oriented Demand Assignment
- It is an extension of the Robert's scheme
- One of the six stations act as a controller
- The stations can send their requests in the minislots; type of service required - priority normal/bulk
- Controller maintains a queue of requests and allocates six variable length slots



PDAMA

- Four types of slots; a leader control slot, a gaurd slot, a reservation minislots and data slots
- The leader control slot is used by the master station to communicate acknowledgements
- Gaurd slot help other stations to hear the leader control slot and prepare further reservation, can also be used for ranging
- The reservation minislots for reservation requests using S-ALOHA
- The data subframe is used for variable length data



Thanks!