SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECE402- WIRELESS ADHOC AND SENSOR NETWORKS

IV ECE / VII SEMESTER

UNIT 4 WIRELESS SENSOR NETWORKS

Topic 7- Energy Efficient, Synchronization issues.

Energy-Efficient Design

In node level :

- Dynamic power management (DMP)
  - One of the basic DMP is to shut down several component of the sensor node when no events take place.
- Dynamic voltage scaling (DVS)
  - The processor has a tome-varying computational load, hence the voltage supplied to it can be scaled to meet only the instantaneous processing requirement.
  - The real-time task scheduler should actively support DVS by predicting the computation and communication loads.
- Sensor applications can also be trade-off between energy and accuracy.

In network level :

- The computation-communication trade-off determines how much local computation is to be performed at each node and what level of aggregated data should be communicated to neighbor node or BSs.

- Traffic distribution and topology management algorithms use the redundancy in the number of sensor nodes to use alternate routes so that energy consumption all over the network is nearly uniform.

Synchronization

- Two major kinds of synchronization algorithms :
  - Long-lasting global synchronization , (for entire network lifetime)
  - Short-lived synchronization, (only for an instant)

- Synchronization protocols typically involve delay measurements of control packets. The delay experienced during a packet transmission can be split into four major components :
  - Send time : sender to construct message
  - Access time : taken by the MAC layer to access the medium
  - Propagation time : taken by the bit to be physically transmitted through the medium over the distance separating the sender and receiver
  - Receive time : receiver receive the message from the channel

- The information of time obtained by GPS
  - Depend on the number of satellites observed by the GPS receiver
  - Not accuracy, 1μs (worst case)
  - Not suitable for building, basements, underwater, satellite-unreachable environment

post factor

- A low-power synchronization scheme
- The clocks of the nodes are normally unsynchronized
- When event is observed, a synchronization pulse(脈衝) is broadcast by a beacon node
- Offer short-lived synchronization, creating only an “instant” of synchronization among the nodes which are within transmission range of the beacon node.
- The propagation delay of the synchronization pulse is assumed to be the same for all nodes.

Global synchronization protocol

- Based on exchange of control signals between neighbor nodes.
- A node becomes a leader by election
- The leader periodically send synchronization messages to its neighbor, and these message are broadcast in turn to all nodes of network
- Fault-tolerance techniques have been added to account for errors on the synchronization message

Long-lasting synchronization protocol

- Ensure global synchronization of a connect network or within connected partitions of a network
- Each node maintain its own local clock (real clock) and a virtual clock to keep track of its leader's clock
- A unique leader is elected for each partition in the network, and virtual clocks are updated to match the leader's real clock
- The leader election :
  - A small probability (random number) be a leader
  - Broadcast Leader Announcement (claim) packet, which include the random number, node ID, time of the real clock
  - A node which receives this packet applies a correction for the propagation delay, and update its virtual clock
  - If two nodes stake a leadership, compare the random number and node ID, and resynchronizes to the small one

post factor

- Resynchronization
  - Dynamic network
  - Take place in situations such as the merging of two partition due to mobility, where all clock in a partition may need to be updated to match the leader of the other partition.

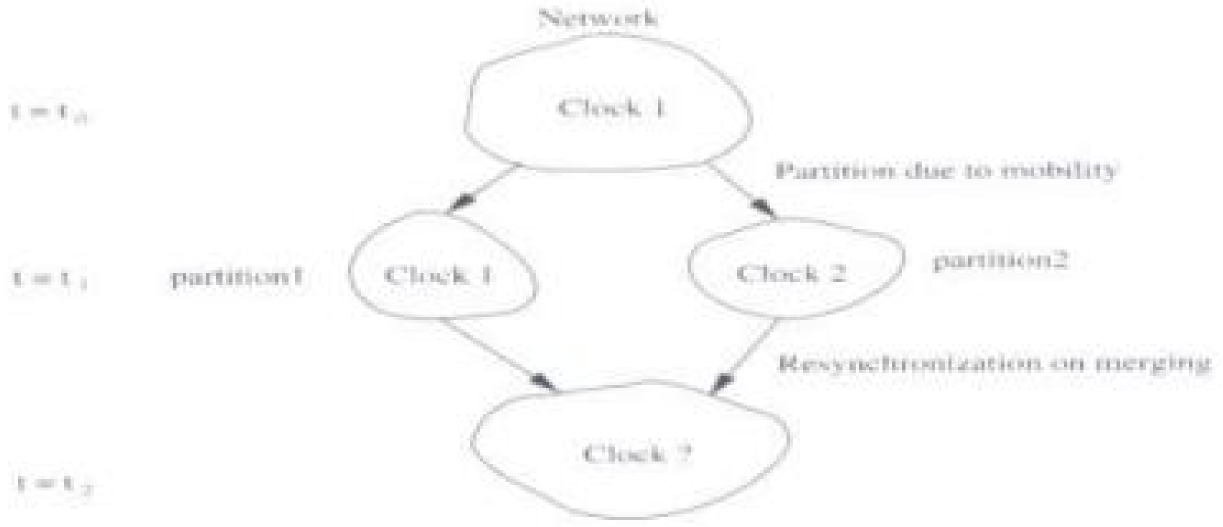
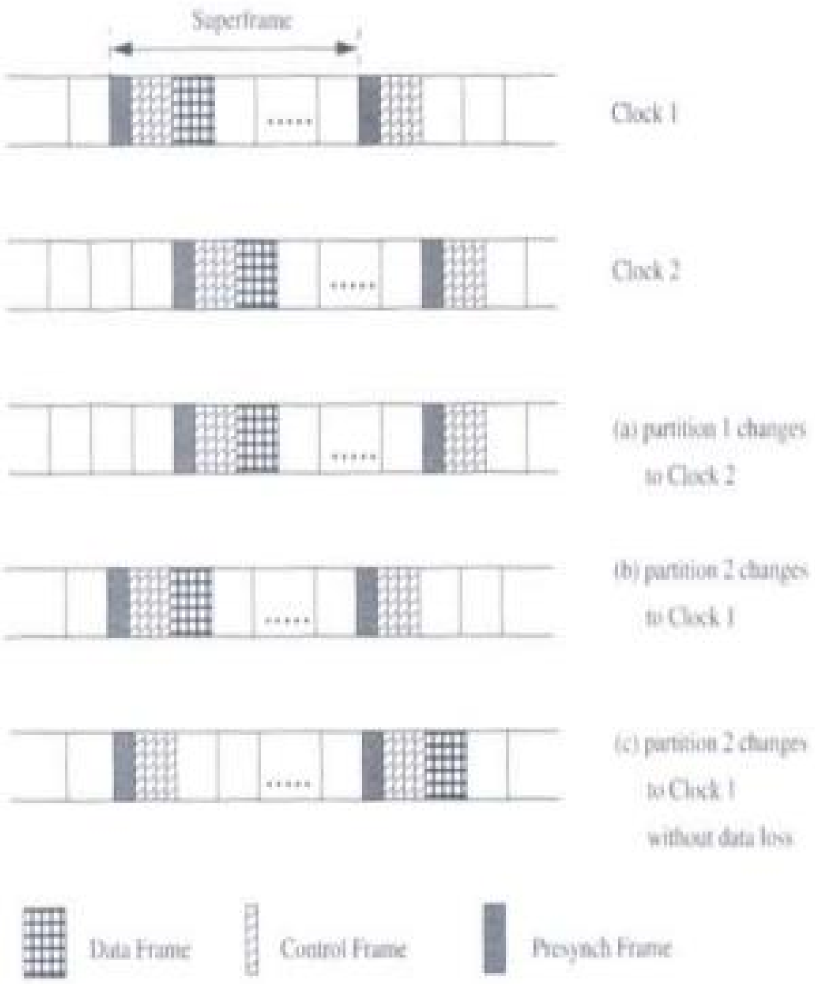


Figure 12.19. Resynchronization.

shifting of frame on resynchronization



- TDMA superframe
- Presynch frame
  - Start and end of superframe
- Control frame
  - Transmit control information
- Data frame
  - TDMA time slots contain data

shifting of frame on resynchronization

- A positive shift is defined as the transmission of a data packet at an absolute time later than slot in the current frame structure.
- A negative shift is defined as advancing the start of a superframe to transmit the data packet earlier than the start of transmission in the current frame structure.
  - Some data frame will be lost
  - Buffer
- But neighboring links may suffer collision when they follow different clock. Hence, as the resynchronization proceeds radially from the new leader, there is data loss along the head of the resynchronization wave.

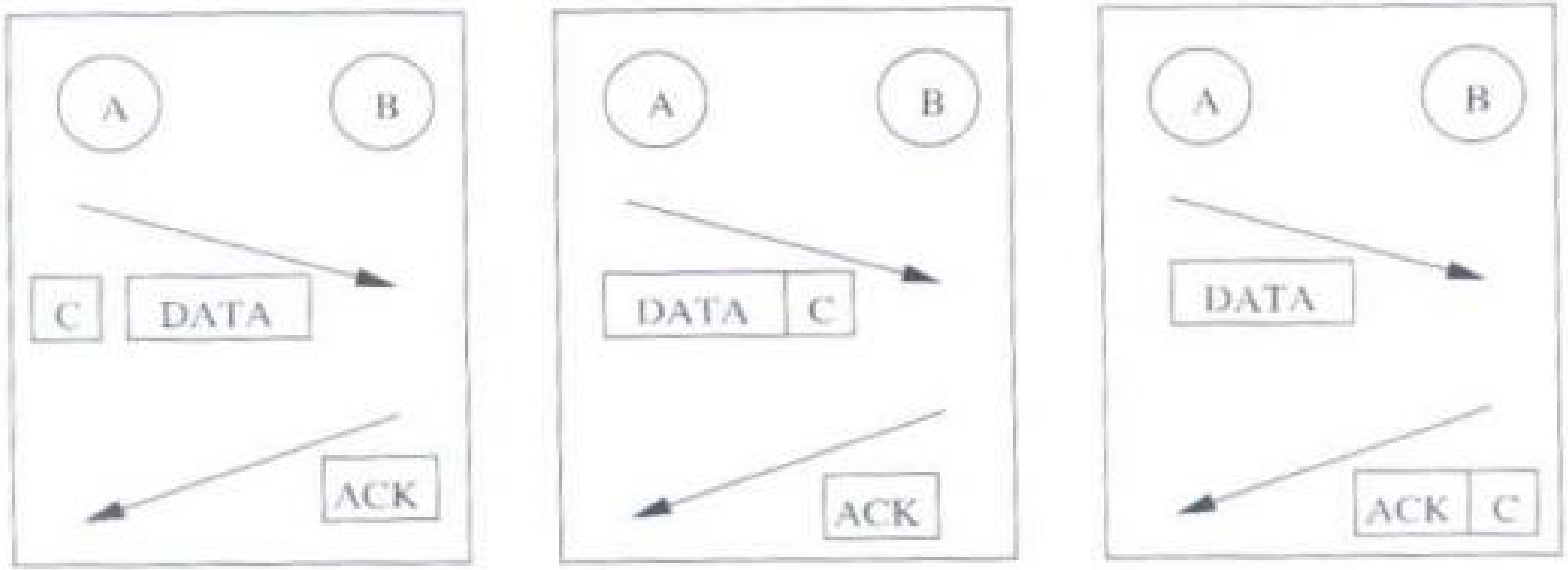
Out-of-band synchronization

- Separate control channel for sending claim and beacon packets
- Collision are reduced but the available bandwidth for data transmission is reduced
- The cost of the mobile nodes increase because of the need for an additional radio interface

In-band synchronization

- Figure 12.21 (a)
  - Control information for synchronization shares the same channel with data packet
  - A greater number of collision, but avoids an additional channel or bandwidth reservation
- Figure 12.21 (b) piggy-backed on data
  - Control information is piggy-backed onto outgoing data packet
  - Very low overhead and bandwidth saving.
- Figure 12.21 (c) piggy-backed on ack
  - In data gathering, each sensor send the data to BS, the control information piggy-backed on ack, and move from BS to each node.

Figure 12.21 In-band signaling



(a) In–band signaling with explicit control packet

(b) Control information piggy–backed on data

(c) Control information piggy–backed on acknowledgment

C Control packet