MAC LAYER FOR WIRELESS SENSOR NETWORKS

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AN OVERVIEW

INTODUCTION

- A brief reminder on MAC layer
- Importance of MAC layer to WSN

MAC LAYER STRATEGIES

- TDMA
- FDMA
- CSMA
- ALOHA

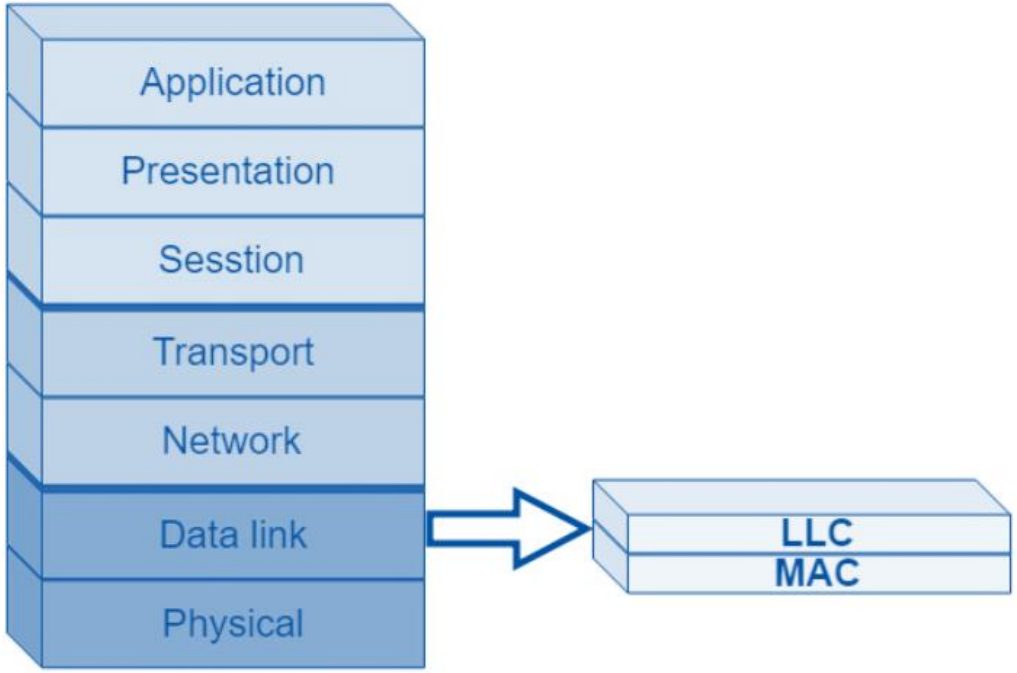
MAC LAYERS FOR WSN

- S-MAC
- T-MAC
- B-MAC
- TRAMA

CONCLUSION

Comparison of the different protocols

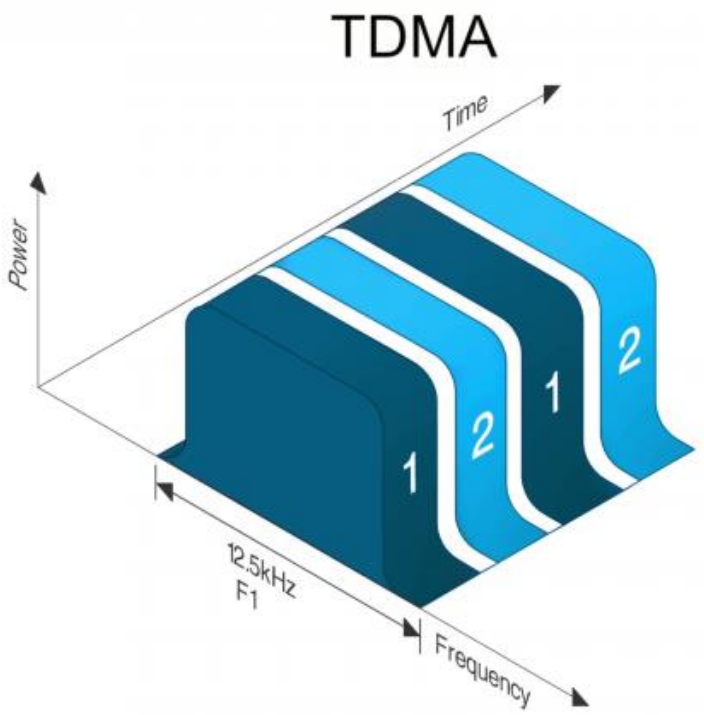
A BRIEF REMINDER ON MAC LAYERS …



- Medium Access Control
- In the OSI model, the MAC layer is a sublayer of the data link layer
- Why MAC layer is important to provide reliability and efficiency to WSN?
  - Assembling/Disassembling frames
  - Encapsulating to upper layers
  - Collision detection

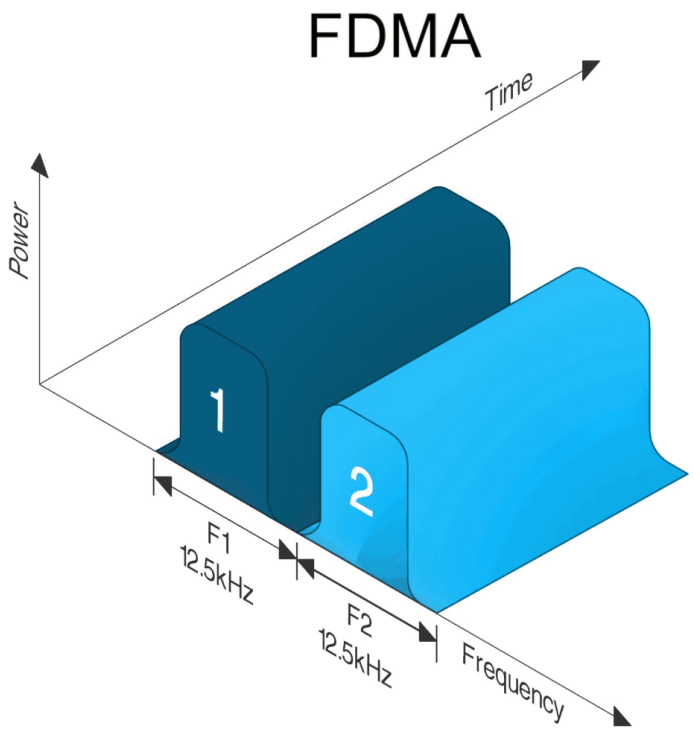
MAC LAYES STRATEGIES

TDMA – TIME DIVISION MULTIPLE ACCESS



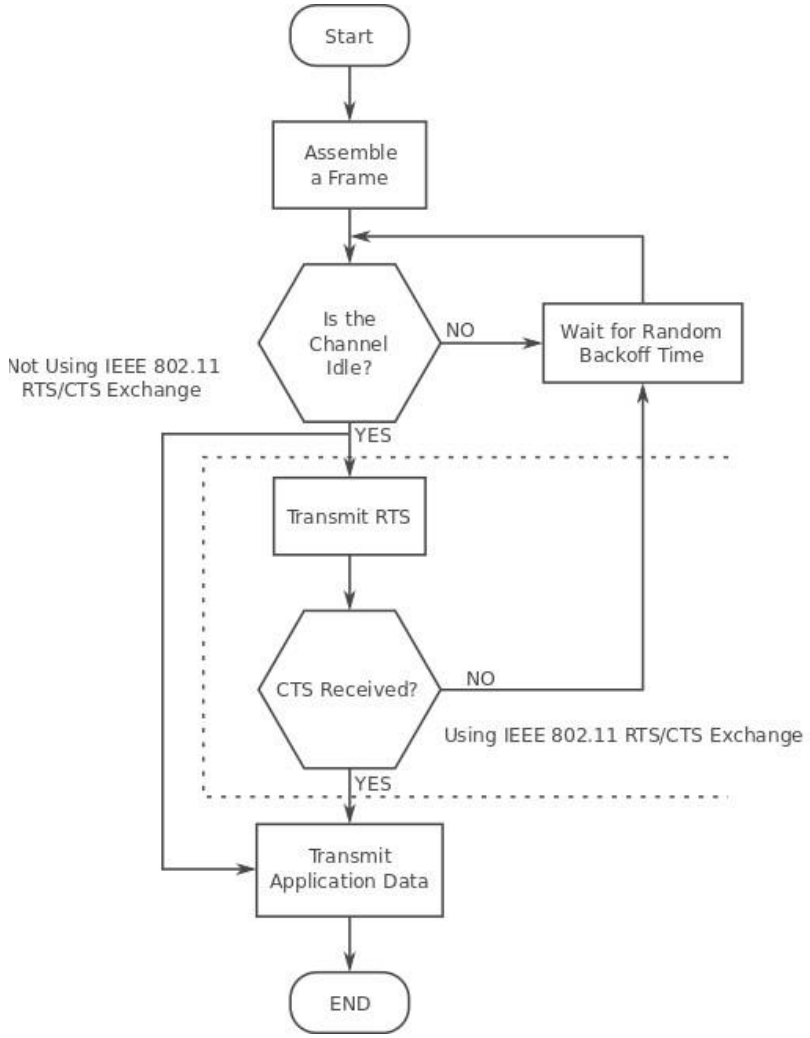
- Multiple nodes share the same frequency channel
- But only use a part of its capacity
- Division in time slots, that nodes access successively to transmit their data
- Can carry 64 kbps to 120 Mbps

FDMA – FREQUENCY DIVISION MULTIPLE ACCESS



- The bandwidth is divided in different frequencies
- So senders can send at a same moment
- The receiver can “hear” a specific sender by selecting the corresponding frequency

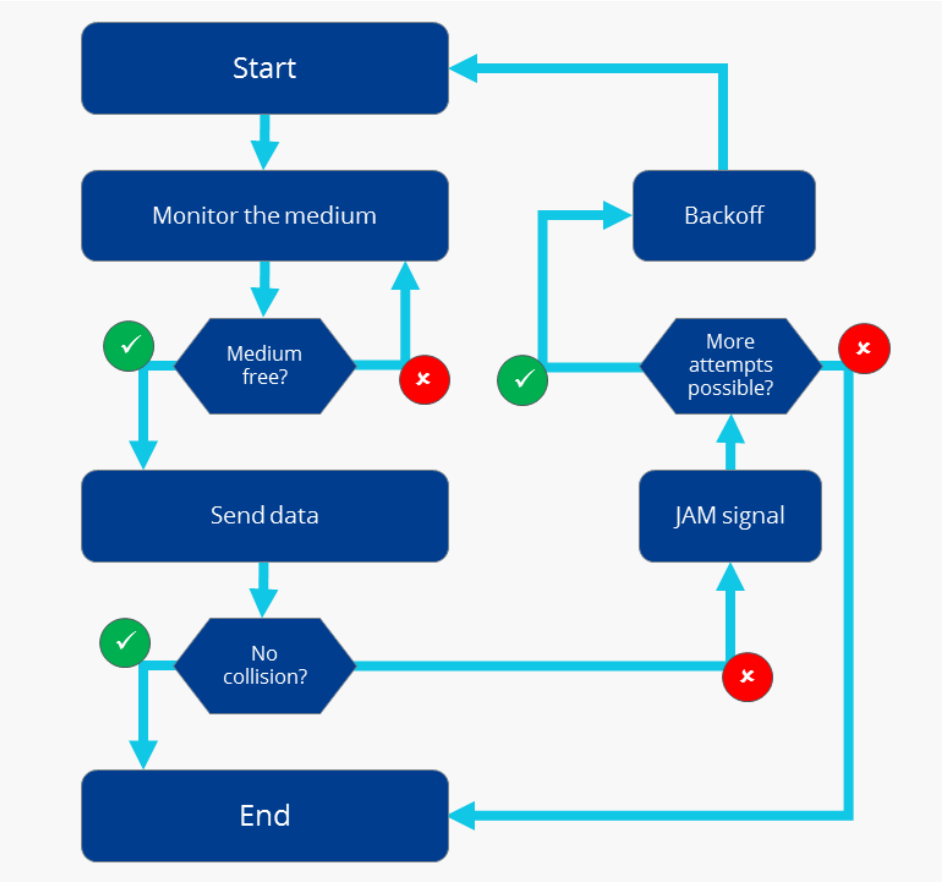
CSMA – CARRIER SENSE MULTIPLE ACCESS



COLLISION AVOIDANCE

- "Listen before talk"
- Before transmitting, the sender node "listens" to the channel to check if another transmission is taking place or not
- To send data, the sender node has to ask permission to the orchestrator and wait for an authorization response

CSMA – CARRIER SENSE MULTIPLE ACCESS



COLLISION DIVISION

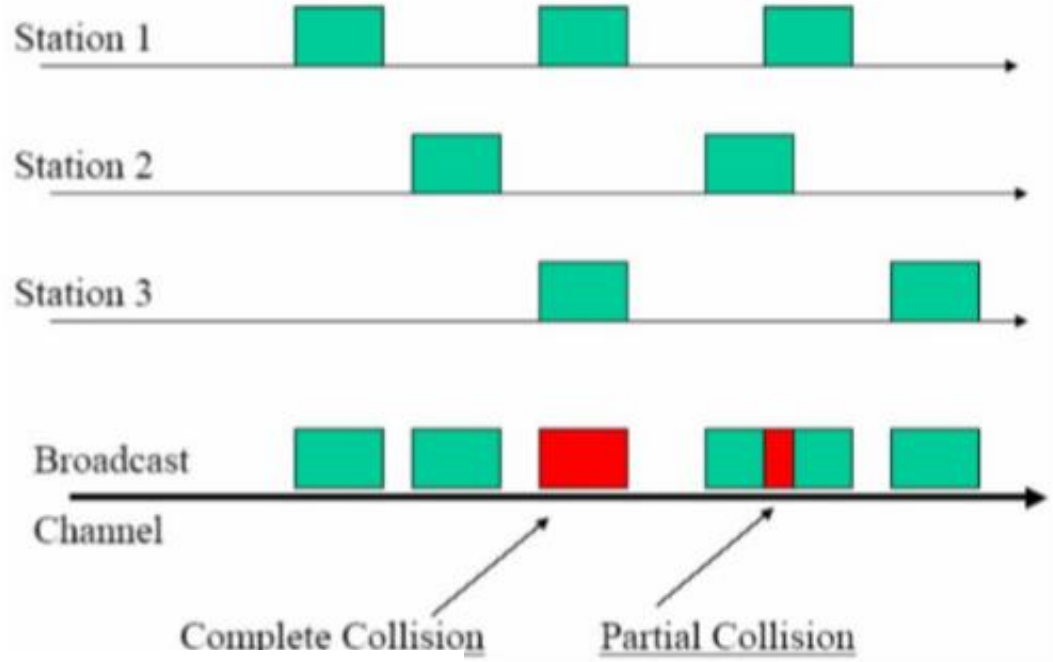
- "Listen while talk"

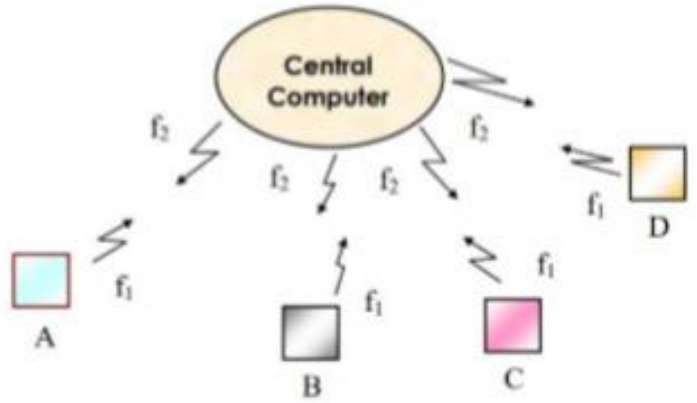
- When a sender is transmitting data and detects a collision it:
  - Stops transmitting
  - Sends jamming signal to warn other nodes
  - Waits random delay to retransmit

ALOHA

PURE ALOHA

- Nodes are given access randomly to a central computer via common frequency band f1
- The computer centre broadcasts the received signal via f2
- Can reduce duration of collision

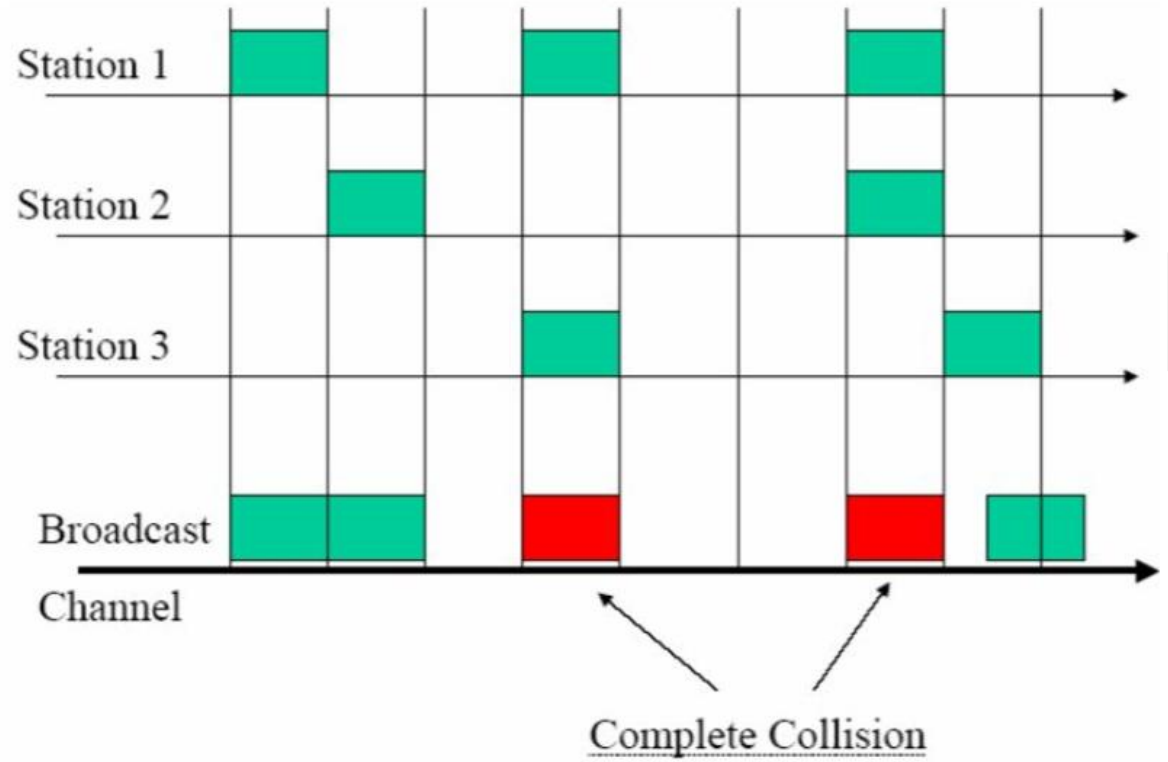




ALOHA

SLOTTED ALOHA

- Improvement of the pure Aloha
- Division of time in slots
- Only one frame is sent per slot



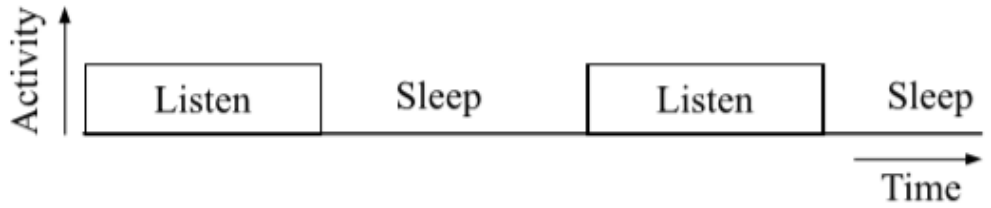
- Nodes are only allowed to send one frame at a time and at the beginning of the slot

MAC LAYERS FOR WSN

In the following slides, some of the most well-known MAC layers for WSN will presented...

S- MAC: SENSOR MAC

- Nodes are put into sleep mode and listening mode periodically: when a timer expires, the node is woken up and go into listening mode to decide where they transmit data or go back to sleep



- Works in a synchronised way using a time division-like (TDMA) strategy

- Divides long messages, being more adaptable to different topologies

- *Advantages:* More efficient in terms of energy, protocol is simple to implement

T- MAC: TIME OUT MAC

- Uses sleep/active duty cycles like S-MAC but in a more dynamic way, no fixed schedule
- During an active period of a node (sending/receiving data), if no action is detected during a certain period of time, a timeout is activated and the node goes to sleep mode
- *Avantages:* T-MAC can easily handle variable load due to dynamic sleeping schedule, more energy efficient (because more dynamic cycle)
- *Disadvantages:* cannot support high data rate applications and has a lower sensitivity to latency

B- MAC: BERKELEY MAC

- Very low power and offers a high throughput
- The node is woken up every check interval. If there's an activity during this period, it stays on for receiving data but if there is no data the time out forces the node to sleep
- Uses CSMA/CA technique
- It supports reconfiguration to improve latency and network performance

TRAMA: TRAFFIC ADAPTED MAC

- Uses random access periods to get and signalize information

- It's a more complex algorithm, using:
  - information about neighbors through a Neighbour Protocol (NP)
  - a schedule exchange protocol (SEP)
  - adaptive election algorithm (AEA)

- According to its current traffic and propagated to the neighbours, it decides whether to transmit or not

CONCLUSION & COMPARISON

COMPARISON BETWEEN THE MAC LAYERS

PROTOCOL	THROUGHTPUT	ENERGY CONSUMPTION	LATENCY	SCALABILITY
S-MAC	Low	Low	High	High
T-MAC	Low	High	High	Low
B-MAC	High	Moderate	Moderate	Low
TRAMA	High	Low	High	High

- There are many MAC layer protocols proposed for sensor networks
- There is not one protocol which is accepted as a standard and one of the reasons behind this is because the MAC protocol is really application-specific

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THANK YOU!

ANY QUESTIONS?