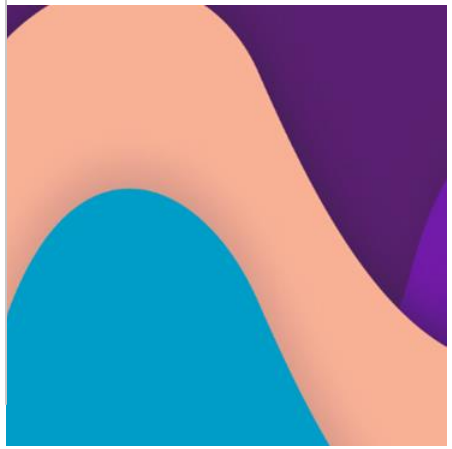
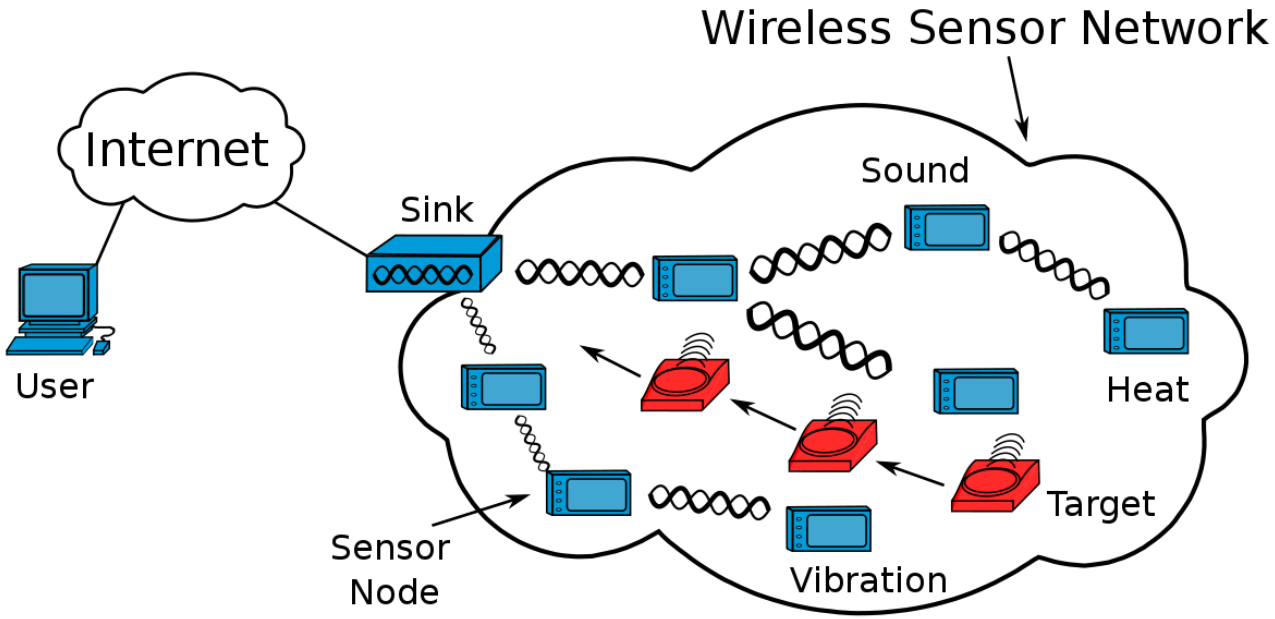
WSN

MAC Protocols

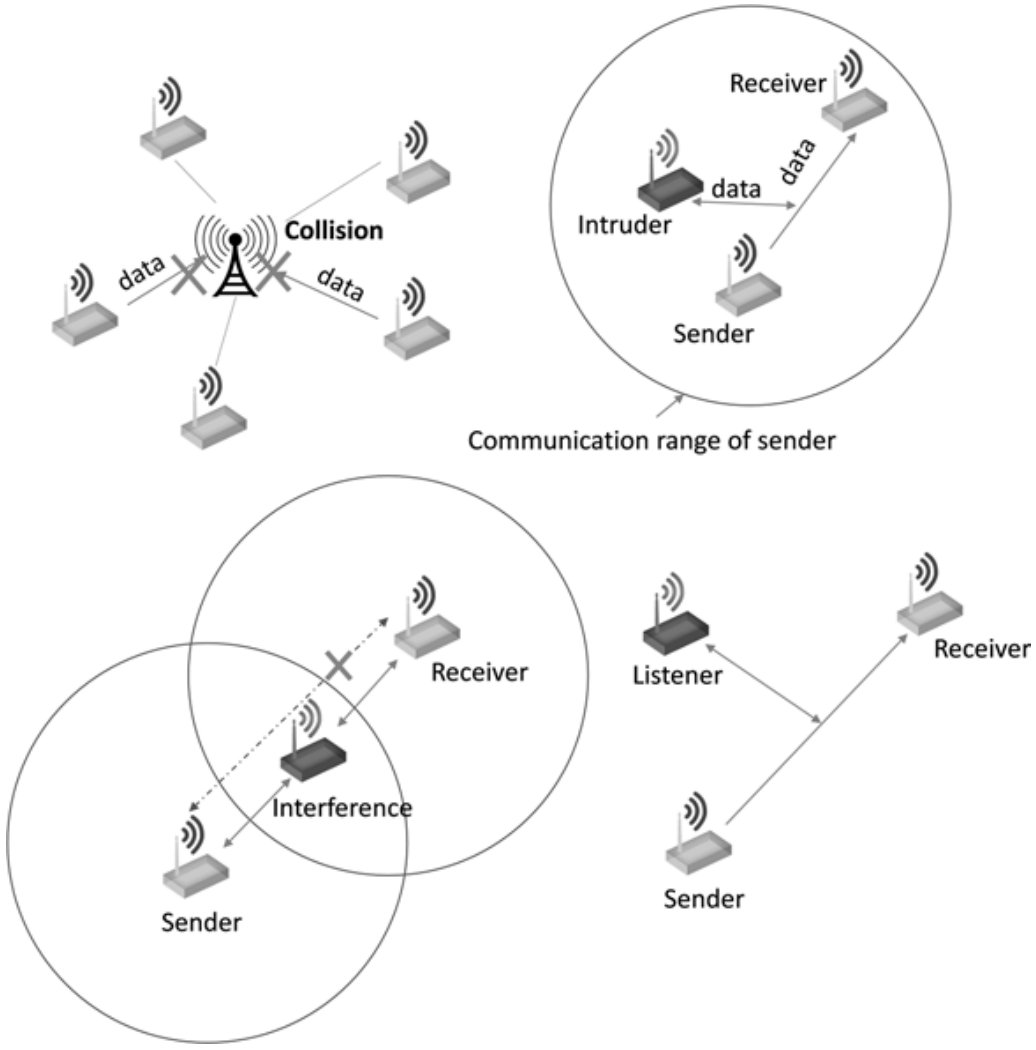


Wireless Sensor Network



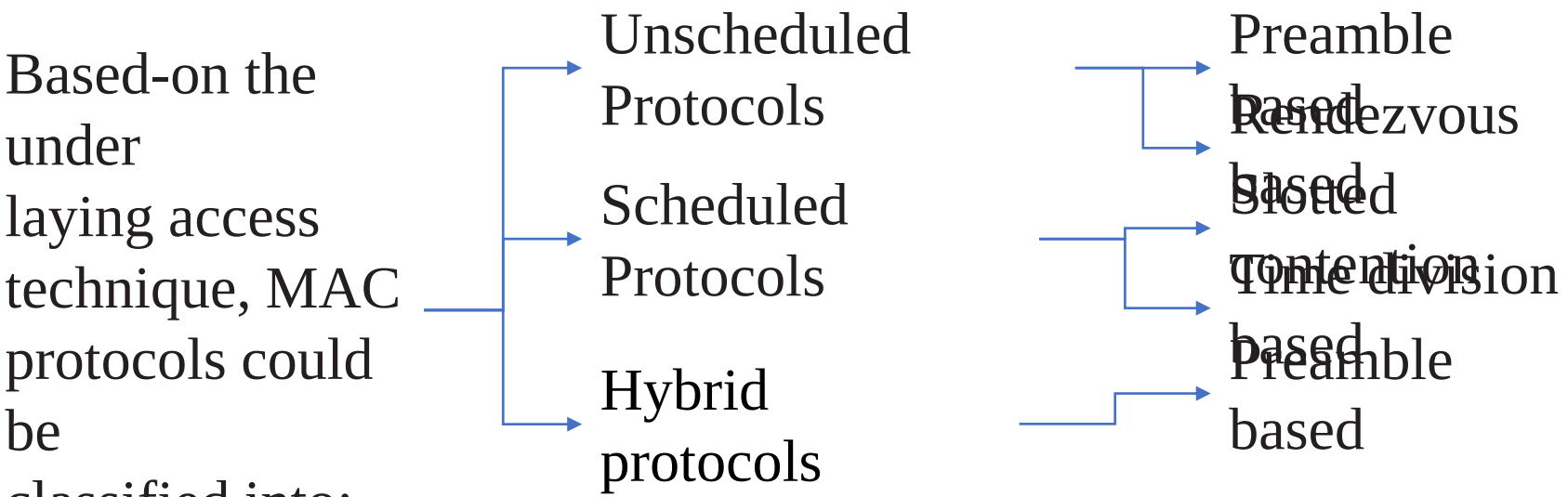
- A typical wireless sensor network consists of a number of sensor devices that collaborate to accomplish a common task
- The Data is collected and reported to the center node (Sink node)
- The sensor nodes organize themselves to form a multi-hop to communicate with the sink nodes

WSN energy issue



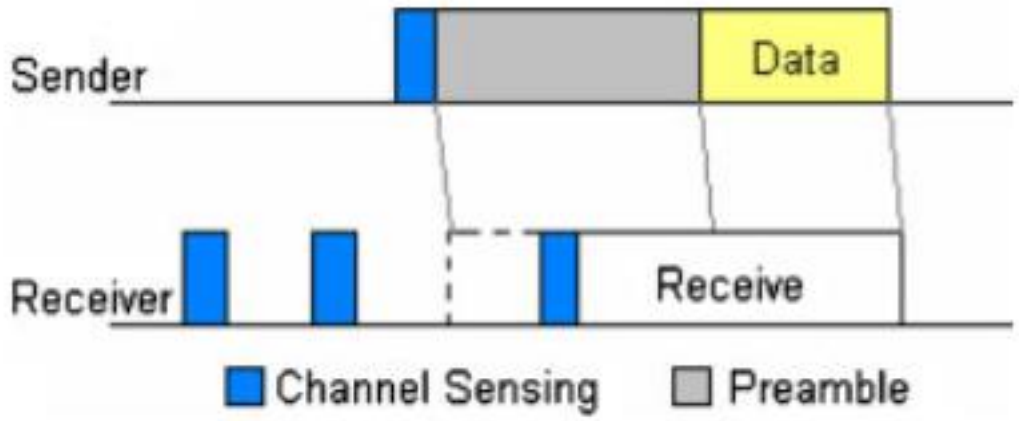
- Idle Listening: Idle listening happens when a node listens for possible reception, but nothing is received, this is due to the low traffic loads typically found in WSNs.
- Collisions: when multiple nodes transmit at the same time the receiver may not be able to decode the payload. Both of the sender and receiver waste energy.
- Overhearing: waste of energy occurs when the listener receive packet that is intended for another destination.
- Overheads: indirect information encapsulated in the packet if it is not treated that represent a waste of energy

Classification of MAC Protocols



Unscheduled protocol

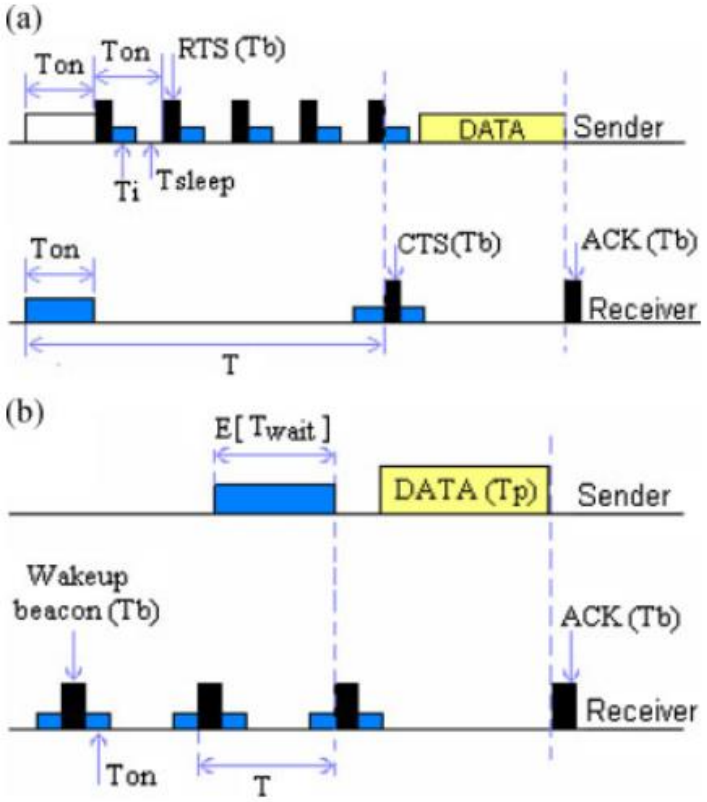
Preamble based MAC Protocol: **Berkeley MAC (B-MAC)**



- In the B-MAC protocol, sensor nodes independently follow a sleep schedule based on the target duty cycle for the sensor network.
- The source sensor node transmits a beacon long enough that the destination, which periodically senses the channel, has enough time to wake up and sense activity
- Sensor nodes that sense activity on the channel remain awake to receive the message following the beacon or return to sleep if they do not detect activity on the channel

Unscheduled protocol

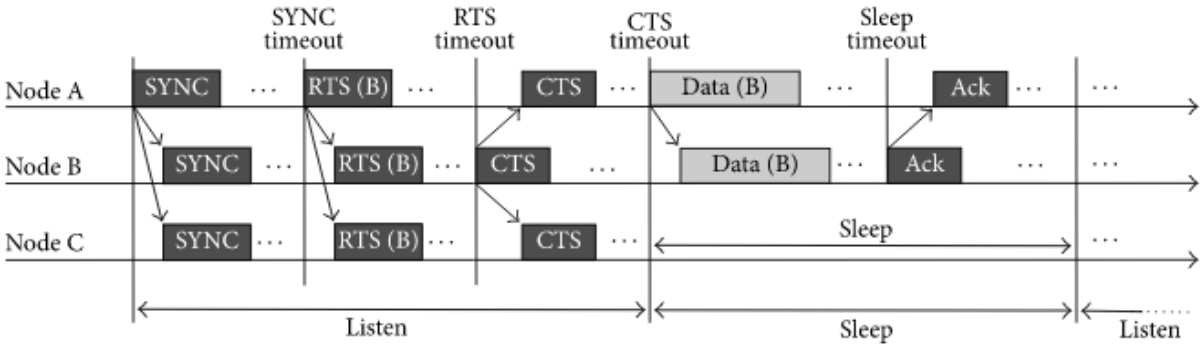
Rendezvous based MAC Protocol: **TICER and RICER MAC**



- The transmitted initiated cycled receiver(TICER) and Receiver initiated cycled receiver (RICER)
- TICER protocol make sensor nodes with data to periodically transmit RTS control packet followed by a sensing period, if the Receivers detect the request an RTS message, reply with a CTS message. The sensor nodes can then transfer the data message
- RICER reverses the operation, so receivers periodically transmit beacons when they awake, The Sender hears awake up beacon from the intended destination and starts transmitting the DATA
- The session ends with an acknowledgment (ACK) signal transmitted from the destination node to the source node, after receiving the data packet.

scheduled protocol

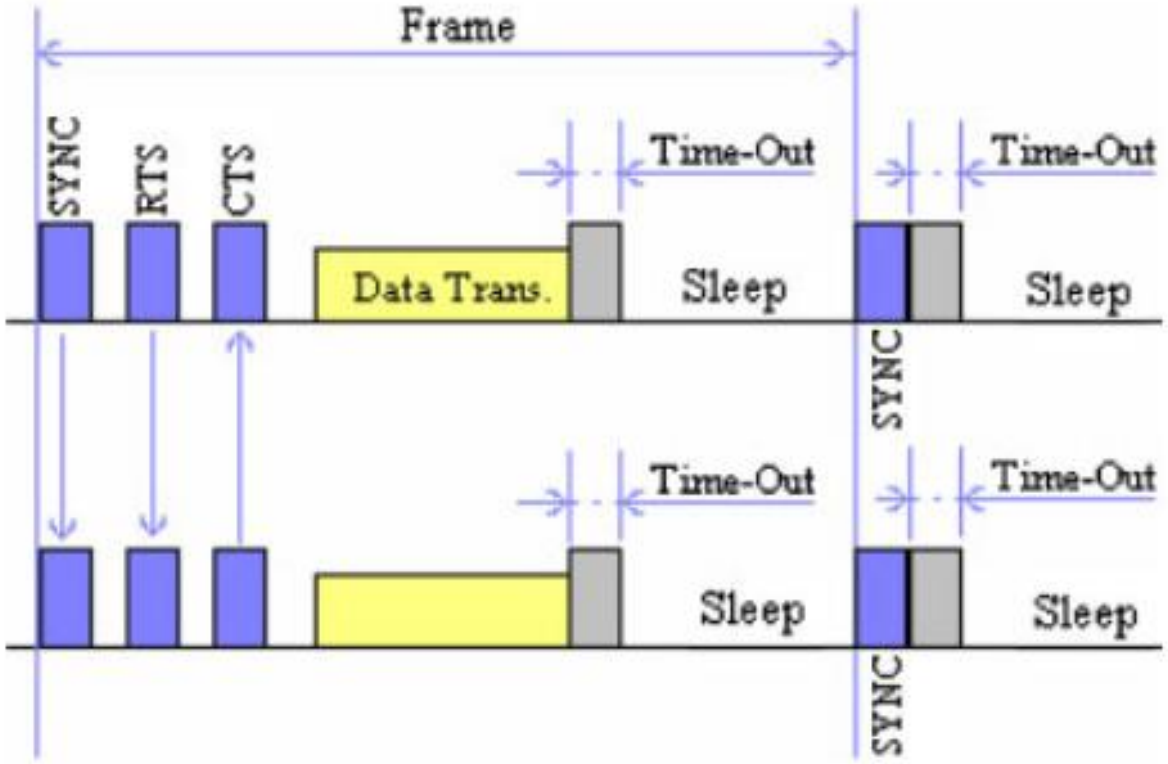
Slotted contention based MAC Protocol: **Sensor MAC (S-MAC)**



- Schedule exchanges are accomplished by periodical SYNC packet broadcasts to immediate neighbors
- Collision avoidance is achieved by a carrier sense
- RTS/CTS packet exchanges are used for unicast type data packets

scheduled protocol

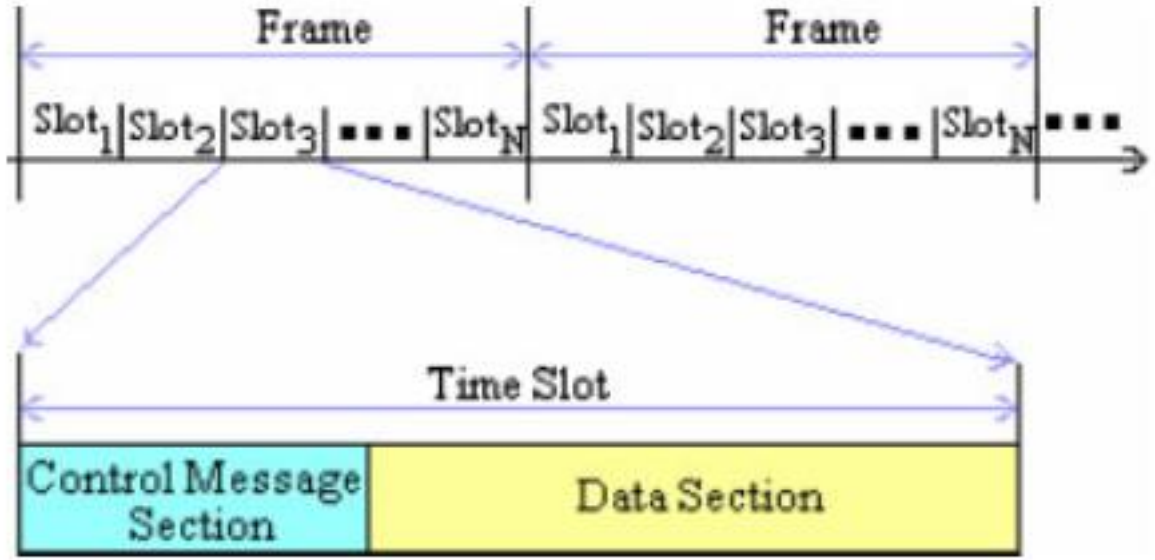
Slotted contention based MAC Protocol: **Time out MAC (T-MAC)**



- T-MAC is based on S-MAC protocol SYNC/RTS/CTS, and tries to eliminate idle energy further by adaptively setting the length of the active portion of the frames
- If no activation event has occurred after an interval of time, the sensor nodes put their radios into sleep mode until the next scheduled active frame.

scheduled protocol

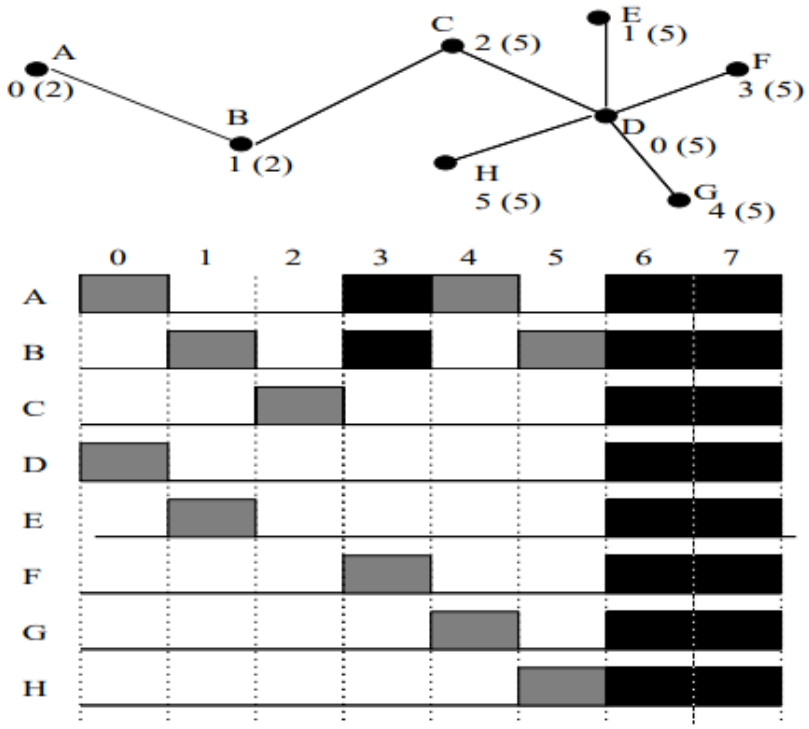
Time division based MAC Protocol: **Light MAC (L-MAC)**



- TDMA divides the channel access time into a repeated frames each frame is subdivided into N time slots, as shown. In each slot, only one node is allowed to transmit.
- LMAC protocol messages consists of two parts: control message and a data unit
- The control message has a fixed size . It carries the ID of the time slot controller, it indicates the distance of the node to the gateway in hops for simple routing to a gateway in the network, and it addresses the intended receiver and reports the length of the data unit.
- The control data is used also to maintain synchronization between the nodes and therefore the nodes also transmit the sequence number of their time slot in the frame.

hybrid protocol

Preamble based MAC Protocol: **Zebra MAC (Z-MAC)**

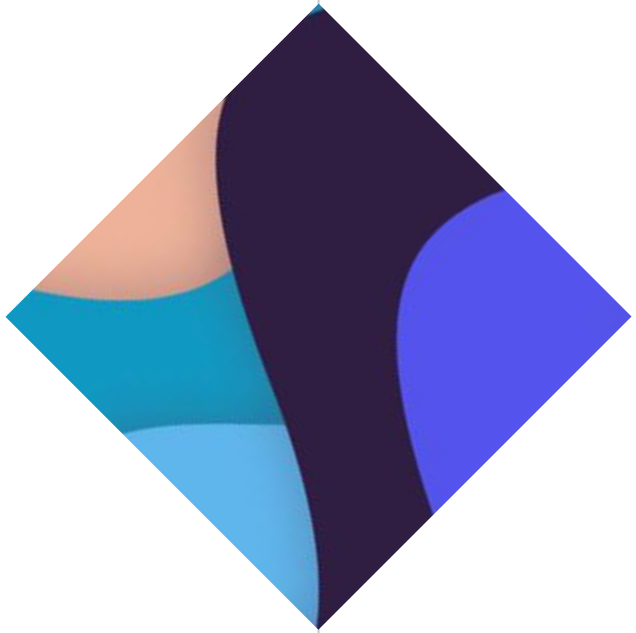


- Z-MAC uses CSMA as the baseline MAC scheme, but uses a TDMA schedule as a hint to enhance contention resolution
- The Z-MAC uses DRAND to order channels. Any node assigned to a time slot is called an owner of that slot and the others the non-owners of that slot
- There can be more than one owner per slot because DRAND allows any two nodes beyond their two-hop neighborhoods to own the same time slot
- Unlike TDMA, a node may transmit during any time slot in Z-MAC. Before a node transmits during a slot, it always performs carrier sensing and transmits a packet when the channel is clear. an owner of that slot always has higher priority over its non-owners in accessing the channels,

Summary

Summary of general classes of MAC protocols for wireless sensor networks

General classification	Specific classification	Advantages	Disadvantages
Unscheduled protocols	Preamble based	The energy savings provided by preamble technique	Long preambles may cause performance degradation in terms of latency
Scheduled protocols	Slotted contention based	Sleeping schedules is the reduction on idle listening time	sleep and listen periods are predefined and constant, which decreases the efficiency of the algorithm under variable traffic load
	Time division based	Scalable Collision free Reduce idle listening Energy Conservative protocols	Control overhead is high Limited scalability and adaptability to node changes
Hybrid Protocols	Preamble based	mixing CSMA and TDMA, Z-MAC becomes more robust	Protocol complexity is high



Thank You