Access points self-configuration in

embedded Wi-Fi networks

# Objective

Given a wireless sensor network based on embedded Wi-Fi modules with limited capabilities, the object is to study a multi agent system architecture that autonomously decides the optimal Access Point nodes number and distribution according to the following metrics:

* Energy consumption
* Received signal strength and hidden nodes problem
* Self-recovery
* Traffic congestion

The network configuration can follow a plan or change dynamically depending on the environment state.

## Energy consumption

The access point (AP node) typically consumes more energy than the station nodes (STA nodes) because it has to act as router for the messages it receives and as gateway towards external networks.  
It also has to send the Wi-Fi beacon at fixed time intervals to keep the connection up and running. There may be the need to share the burden of being the AP node to assure a fair use of the energy resources.

## Received Signal Strength (RSS) and hidden nodes problem

Depending on their location, speed and on external interference the nodes receive signal from each other with different strength. If the signal strength is too low, the link between two radio stations is open. The idea is to select the node that guarantees the best reception to all the nodes. To have optimal communication, it is possible that more than one AP node must be selected. In case for example of hidden nodes, they can select one of their neighbours as a local access point that bridges the gap between the hidden subnetwork and the main AP.

## Self-Recovery

AP nodes can disappear for different reasons like empty battery, accidental damage or because they move away (vehicular networks). In case the AP nodes disappear, the nodes should select a new configuration as quickly as possible to minimize the communication disruption.

## Traffic congestion

The sensor nodes have very limited processing power; to guarantee a good throughput and avoid congestion within the network, it is possible that more than one AP node is required. Having an access point routing all the traffic also affects its energy consumption in contrast to the fairness statement.

## Assumptions

* The network has a star topology, with the access point as central node of the star.
* All the nodes have the same capability and can become stations, access point or both at the same time.
* No external technology (LoRa, Bluetooth, etc.) used for communication between the nodes.
* The nodes have limited capabilities and processing power compared to a PC with a Wi-Fi card.
* All the nodes can communicate at least with one other node belonging to the network.
* Self-containment / no gateway: for the purpose of this study the constraints given by an external network connection are not taken into account

# Research questions

* What are the best agent architectures in case of moving nodes vs static nodes configuration?
* How do the nodes coordinate to avoid conflicts? (e.g. same SSID name for more than one AP)
* How much information (and which kind of information) do the nodes need to coordinate their behaviour?
* Can the coordination be done only with local communication or every node needs to know the full state of the network?
* Can the network adapt locally if the environment influence only affect part of it?

# Simulation software

AgentNode

Messages:

sender={sender addr} ;receiver={receiver addr}; type={type};params=({list of parameters separated by comma})

type: request, response