Communication course assignement

MAC protocols dedicated to WSN and IoT

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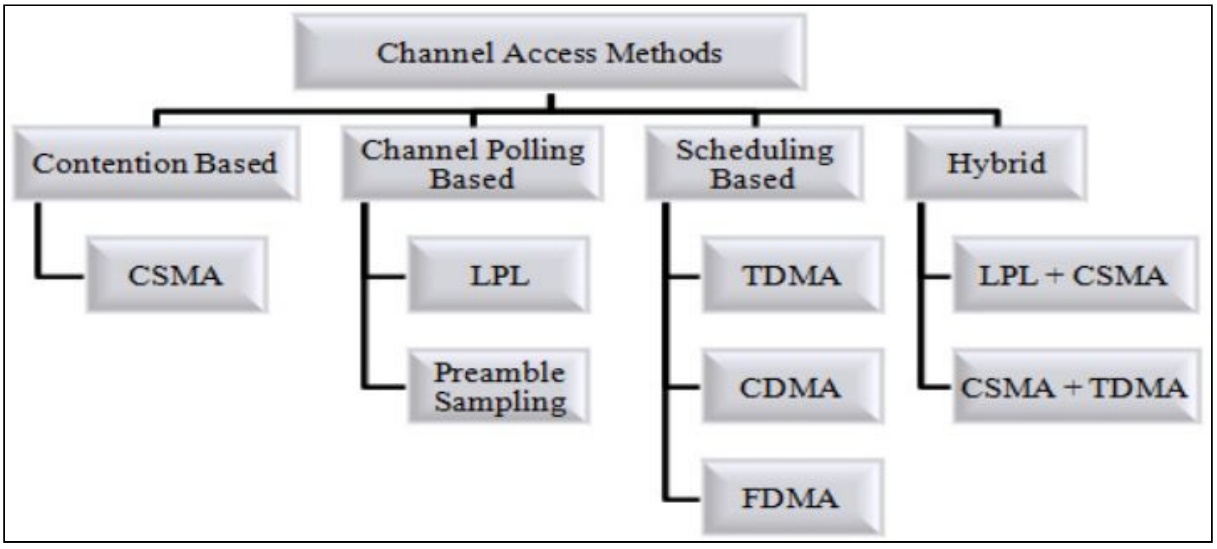
Introduction

As IOT is being part of the future communication systems researches are including different major challenges such as power efficiency.
This document different MAC protocols dedicated to WSN and their specifications.

Different MAC protocols

This following tree shows a type classification of different WSN MAC protocols.



Contention based

In this type of protocols every devices are in competiton to get the channel access.The device act as following: if the carrier is in idle mode it will start the transmission. Otherwisethe device will postpone the transmission for a time defined by an algorithm.
This type has the advantage to not being impacted by network size. It is especially used for event-driven systems in order to reduce the processing energy requirement.
However as each end-nodes decides the contention this type of protocol is easily subjected to different type of loss and throughput flow.

Channel polling based protocols

Using this type of protocol a device will send a premble packet to ensure that the receiver is ready to listen. When the receiver retrieve a preamble it can turn on his radio to receive the payload. A check period is defined in order to put back the receiver in sleep mode until the next preamble.
By this way channel polling based protocols do not need to implement synchronization.
It's now called Berkeley MAC (BMAC) protocol.

Scheduling based protocols

Those type of procotol guarantees nodes communications without collisions by assigning a “link” at the initialization. For complixity reasons WSN usually use a Time Divison Multiplexing (TDM). The medium allocate a time slot for each participant to access resources. On one hand this type of protocol provide a predictable delivering delay.
On the other hand it provide long waiting time as the device has to wait its time slot and it’s also not built for scalabilty as time slot need to be managed each time a device is added to the network

Hybrid protocol

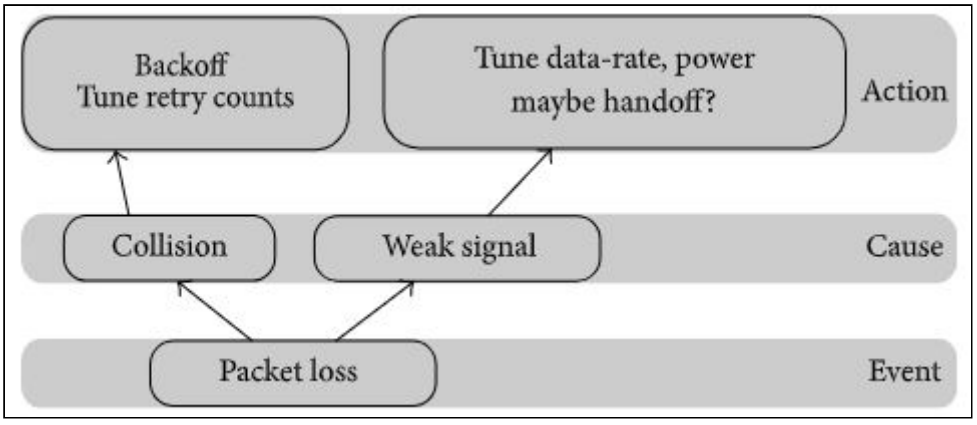
Hybrid protocol combine different MAC technology in order to be strongest and more flexible. Most of the time it user synchronized and asynchronous methods. By using different mode it can handle network scalability. Z-MAC and SCP-MAC are two exemple of those protocols.

Source:
Medium Access Control Protocols for Wireless Sensor Networks Classifications and Cross-Layering

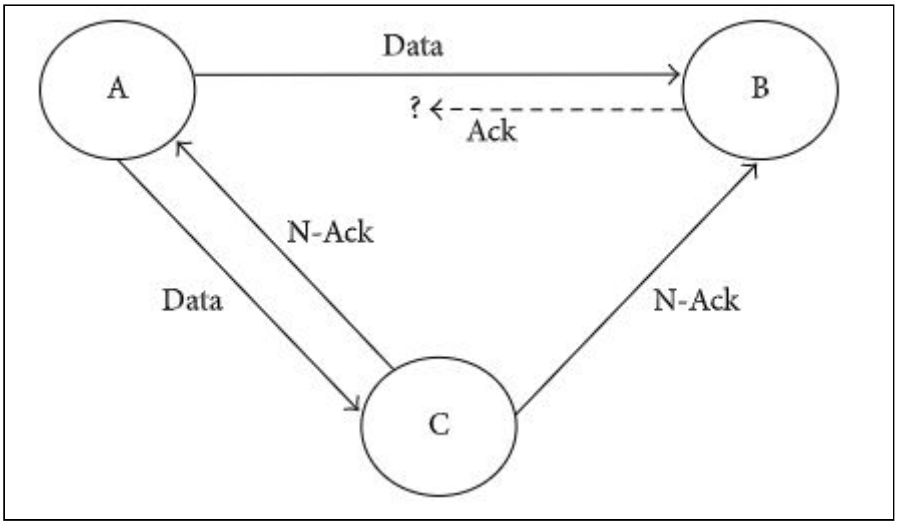
CSMA/WSD Protocol

This protocol is an evolution of CSMA protocol and implement a Weak Signal Detection (WSD) to analyze message collisions and manage decision in order to reduce power consumption.

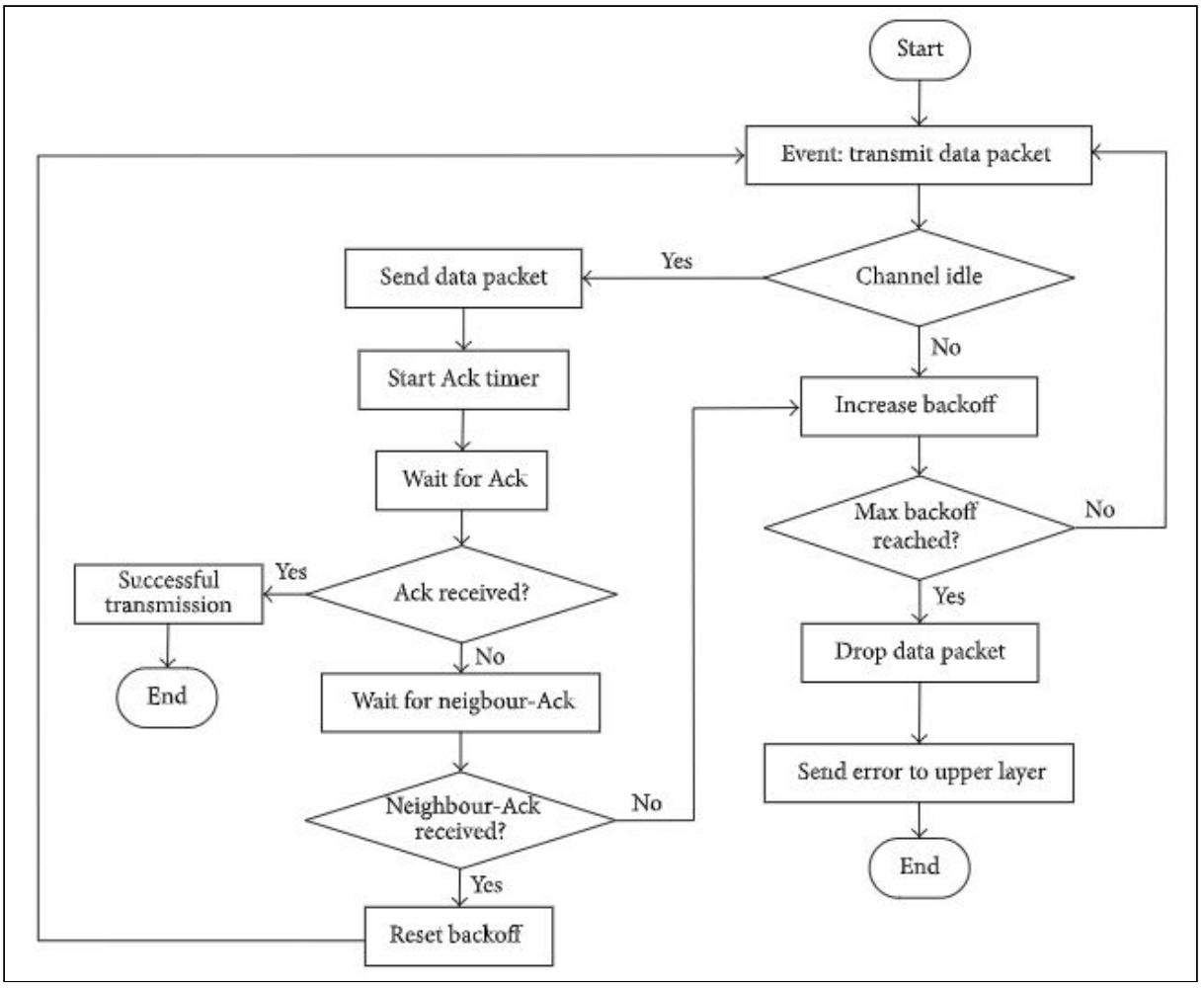
The idea of WSD is to diagnosis a packet loss to adapt the node behavior in order to send again the packet. The following image represent a diagnosis exemple :



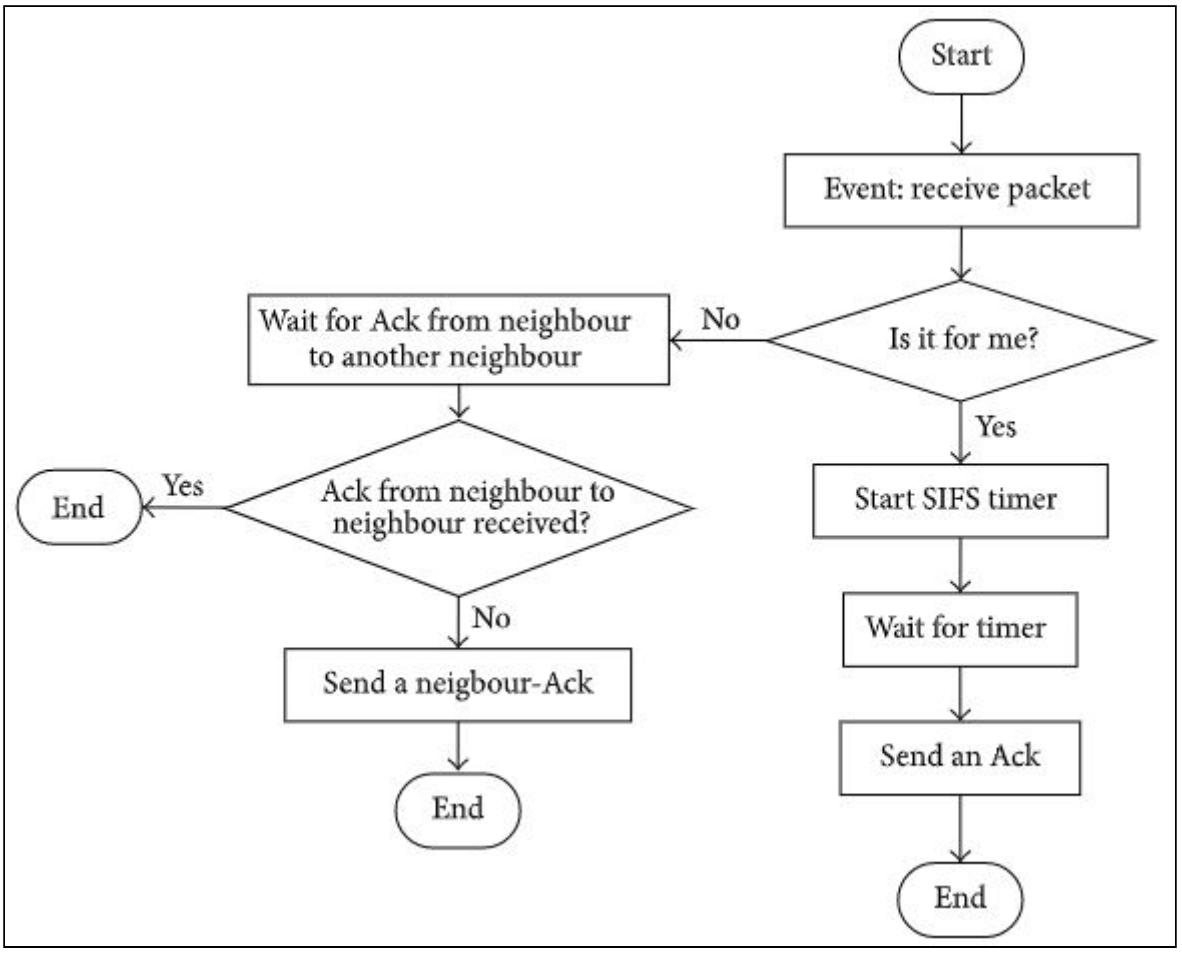
In the following figure A wants to send data to B. A send packet to B and to his neighbour C. A is not receiving the B ack because of weak signal. As C received the data it assumed that B non-Ack is not due to collision. C send a N-Ack in order to permit A to understand that B non-Ack is due to weak signal.
Due to this A we will be able to adapt communication method (frequency, data-rate) and might resend the data.
This operation permit to not use power consumption by avoiding resending data the same way each time the ack timer time out.



The following flowchart represent the packet transmission over the CSMA/WSD protocol :



The receiving operation is represented on the following image :



Source:
Implementation of a Modified Wireless Sensor Network MAC Protocol for Critical Environments