Genetic Algorithm For LoRa Transmission Parameter Selection

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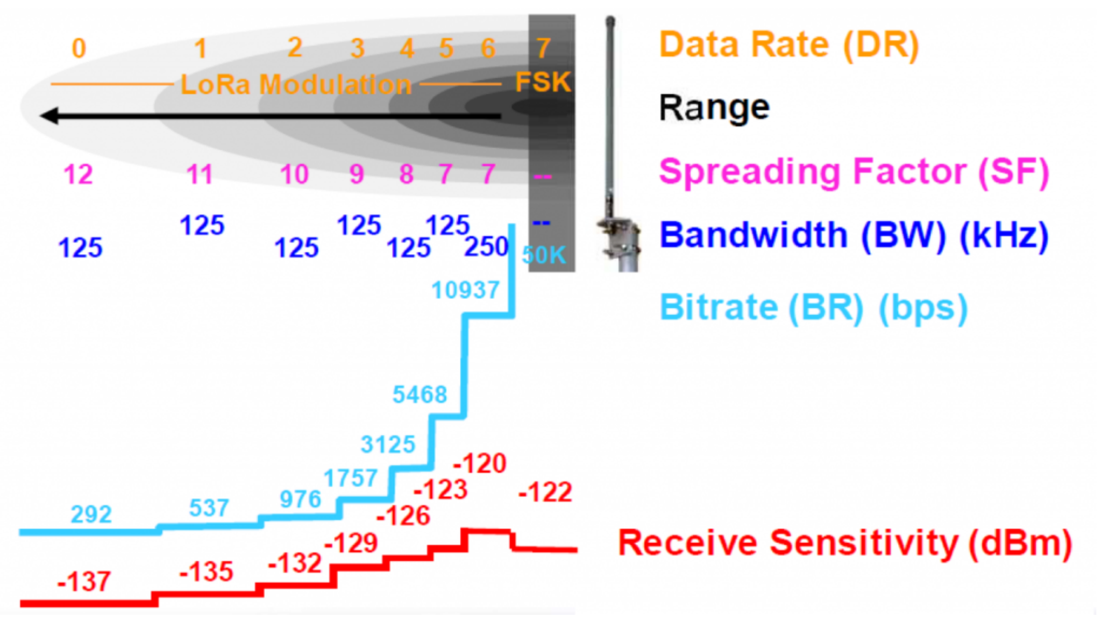
1. Introduction

The need of a new kind of wireless communication that could send data far away with limited resource constraints emerged recently to support IoT applications like smart building and smart environment monitoring. **LoRaWan** is one of this emerging wireless networks [1], it allows end-devices to reach the gateway in a range up to 5Km, Unlike other technologies LoRaWan is the best versatile solution to deploy IoT application in both urban and rural area where there is no communication infrastructure.

2. Parameter selection problem

The physical layer of LoRa technology (Semtech SX1276) has 4 parameters which make 6720 possible settings [2]:

- **SF:** Spreading factor [SF7 - SF12]
- **CR:** Coding rate [4/5 - 4/8]
- **BW:** Bandwidth [7.8Khz - 500Khz]
- **Tx:** Transmission power [-4dBm +20dBm]



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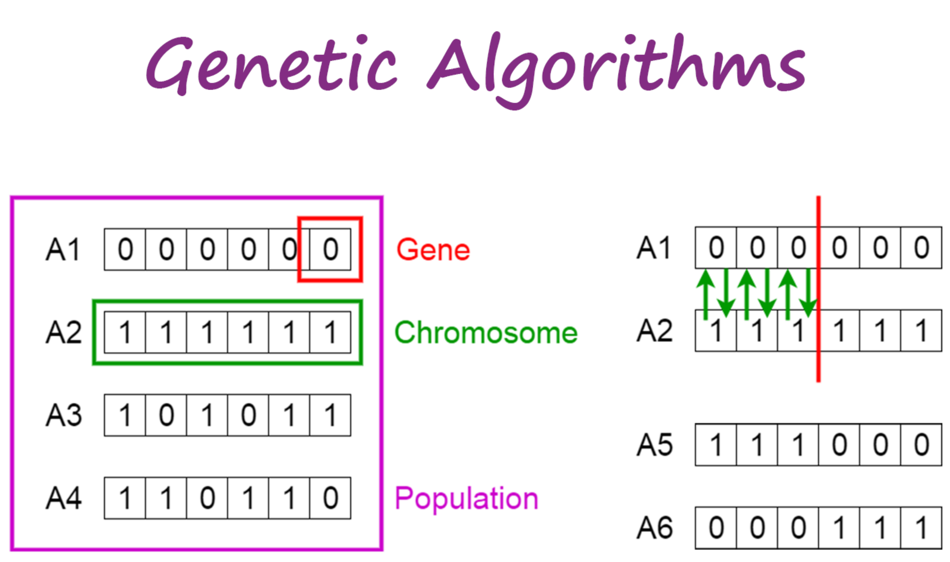
3. Genetic Algorithm

A genetic algorithm is a heuristic search that is used to deal with selection and ranking problems [3]. This algorithm reflects the process of natural selection where the fittest configurations are selected for reproduction in order to produce offspring of the next generation.

- **Gene:** QoS metric.
- **Chromosome:** QoS of one configuration.
- **Population:** QoS of all configurations.



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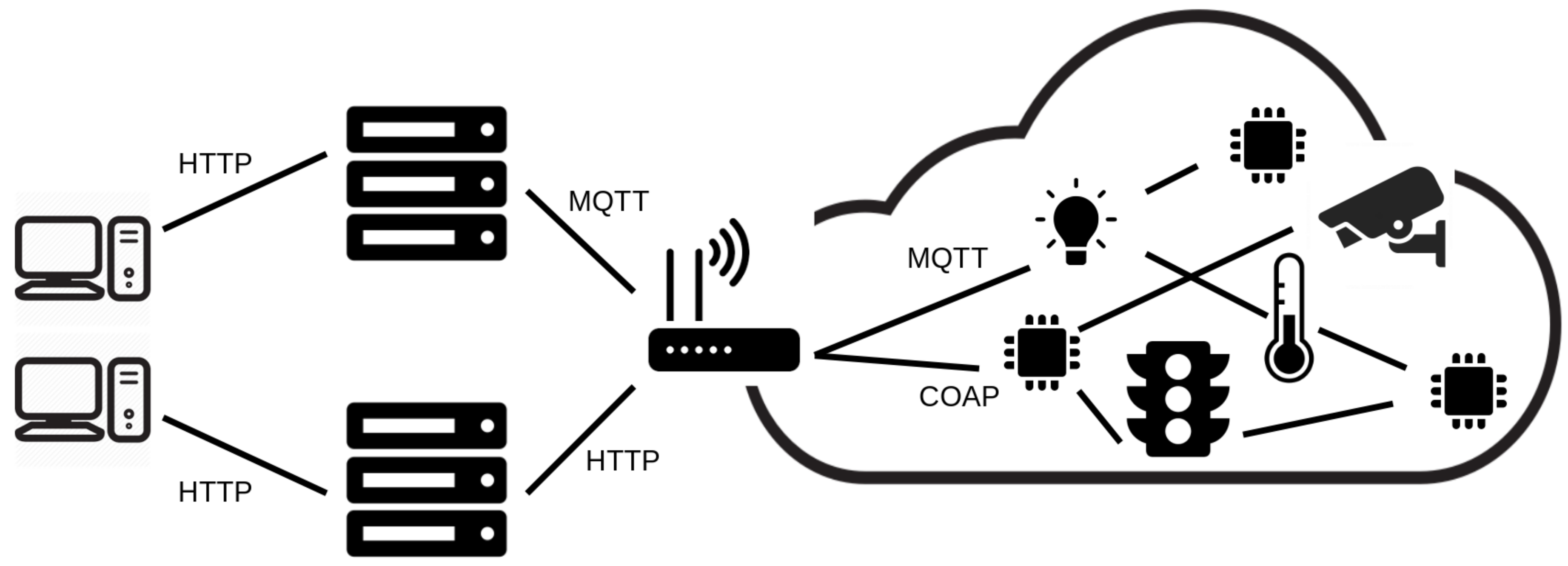
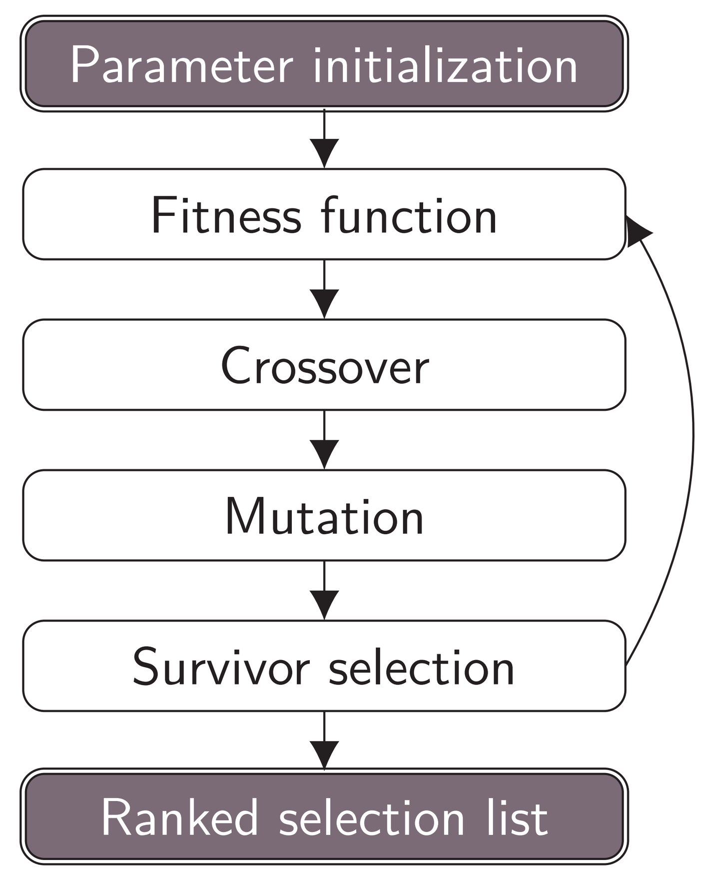
4. LoRaWan network

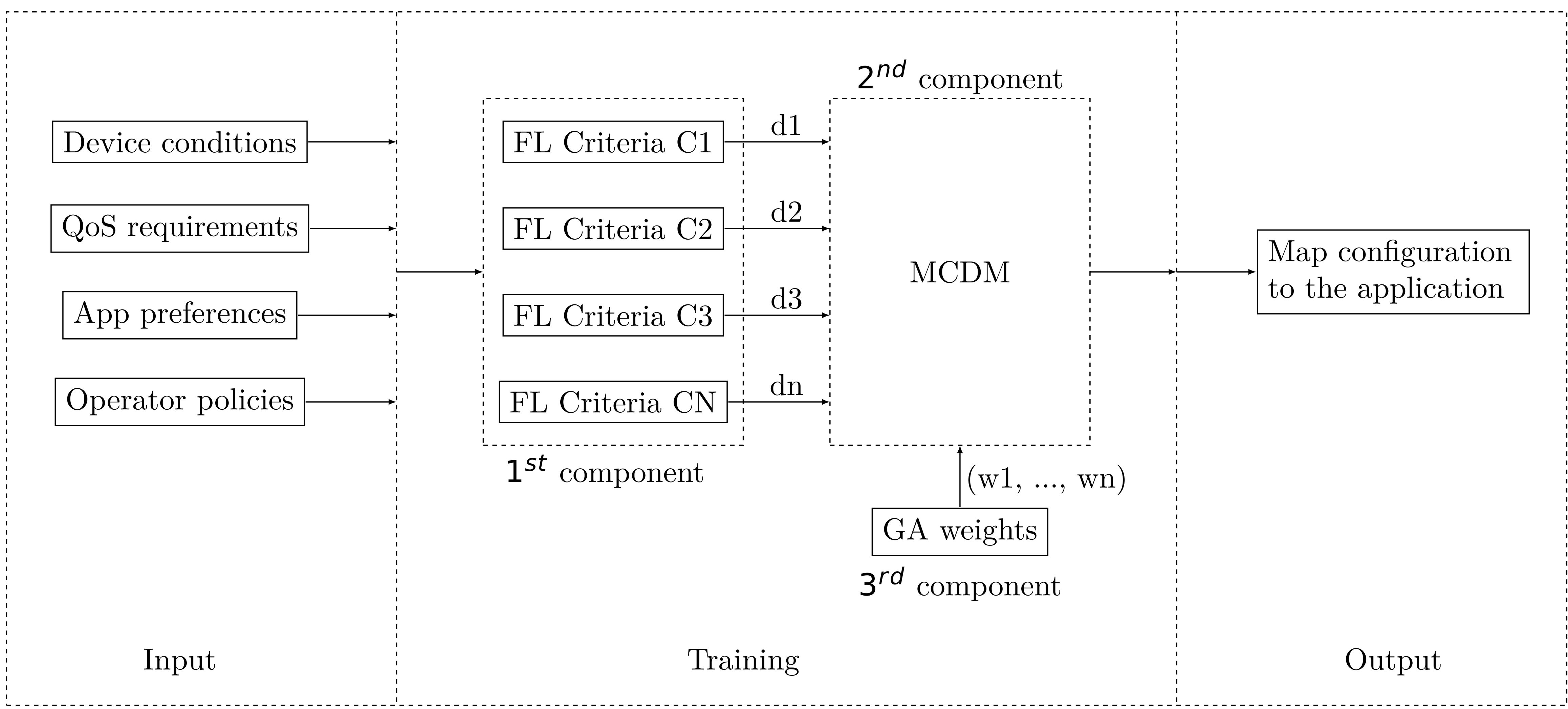


5. Algorithm

Definition: stopping criteria, population size P, and mutation probability p_m
Generate randomly the initial configurations
repeat:
. . . **for** each configuration do
. . . . . . Train a model & compute configuration's fitness
. . . **end**
. . . **for** each reproduction 1 ... P/2 do
. . . . . . **Select:** 2 configurations based on fitness
. . . . . . **Crossover:** Produce 2 child configurations
. . . . . . **Mutate:** child configurations with p_m
. . . **end**
until stopping criterion are met



6. Framework



The proposed scheme for LoRa transmission parameters selection based on GA, FL and Multi-Criteria Decision Making MCDM .

- **Ongoing:** In order to generate all the required metrics of each LoRa configuration, we use ns3 simulator with 2 nodes and one gateway. The distance between nodes and the gateway is 1km.

7. Discussion

➠ **Advantages:** Genetic algorithms can manage data sets with many features. They don't need additional knowledge about the problem under study. In fact, such iterative algorithms require only the result of the last fitness value of the previous generation,
➠ **Conclusion:** LoRa transmission parameter selection problem by nature is a selection problem, thus, in our work we use genetic algorithm with a selection process to get the optimal subset of parameters that match better required QoS. Knowing the impact of each LoRa parameter on the output configuration still a big issue in research area. Our first results show that the transmission delay is more impacted by the SF and BW but less impacted by the CR.

7. References

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[3] E. I. Vlahogianni, M. G. Karlaftis, and J. C. Golias, " Optimized and Meta-Optimized Neural Networks for Short-Term Traffic Flow Prediction: A Genetic Approach ", *Transportation Research Part C: Emerging Technologies*, vol. 13, no. 3, pp. 211–234, Jun. 2005, 00506.