Smart Lora parameters selection

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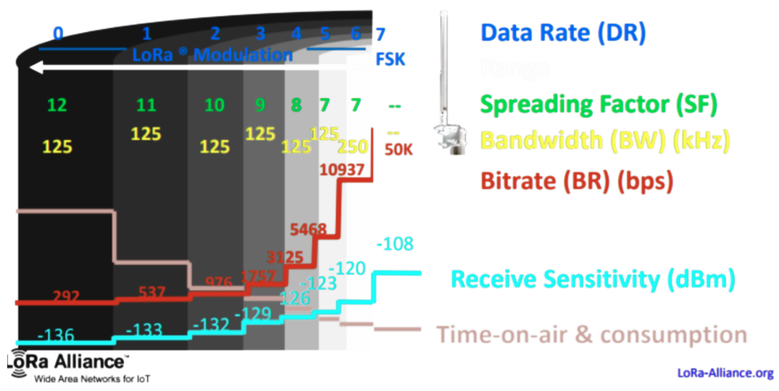
1. Introduction

The need of new kind of wireless communication that could send data far away with limited resource constraints emerged recently to support IoT application like smart building smart environment monitoring. **LoraWan** is one of this emerging wireless communication [1], it allows sensors 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.

3. Parameters selection problem

The physicla layer of Lora thecgnology (Semtech SX1276) hase 4 parameters which make 6720 possible settings [2]:

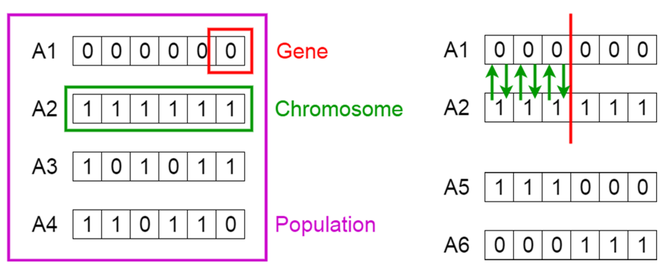
- **SF:** Spreading factor [SF7 - SF12]
- **CR:** Coding rate [4/5 - 4/8]
- **BW:** Bandwidth [7.8Khz - 500Khz]
- **Tx:** Transmition power [-4dBm +20dBm]



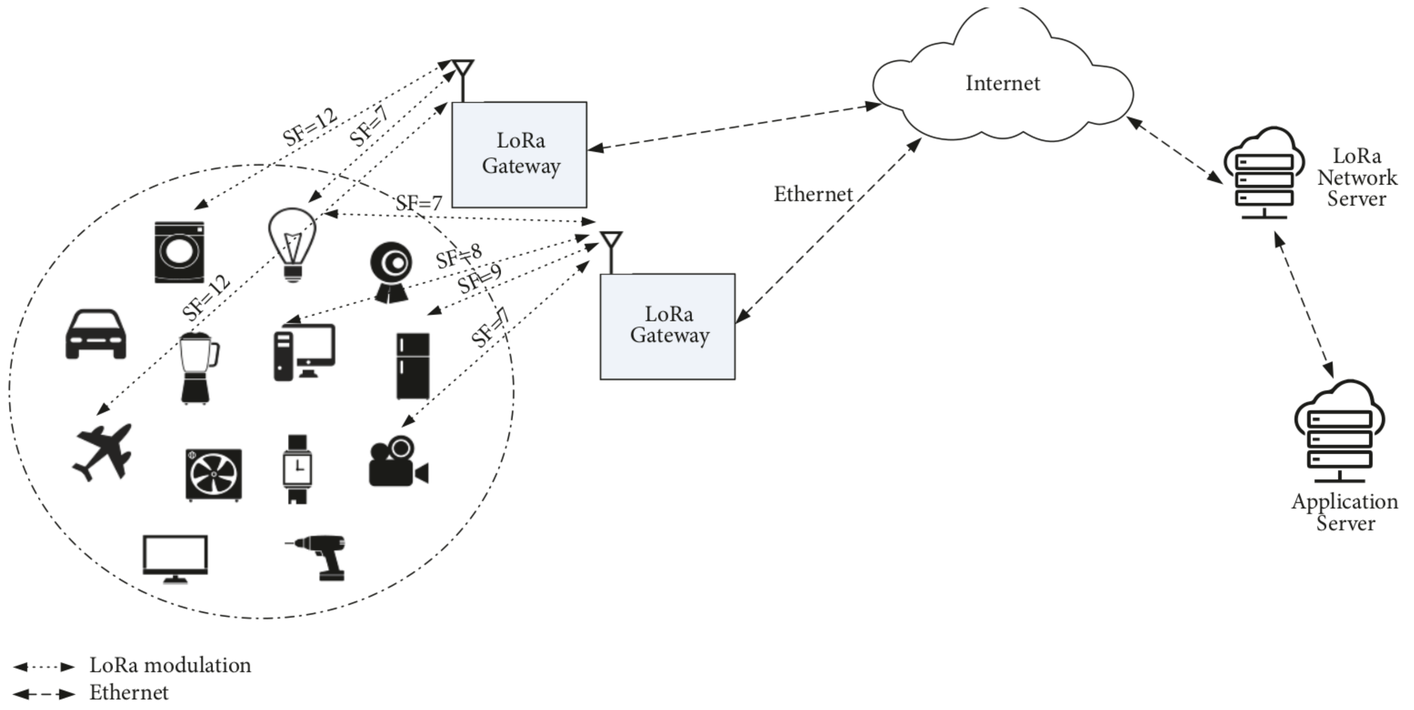
2. Genetic Algorithm

A genetic algorithm is a search heuristic that is inspired by [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.

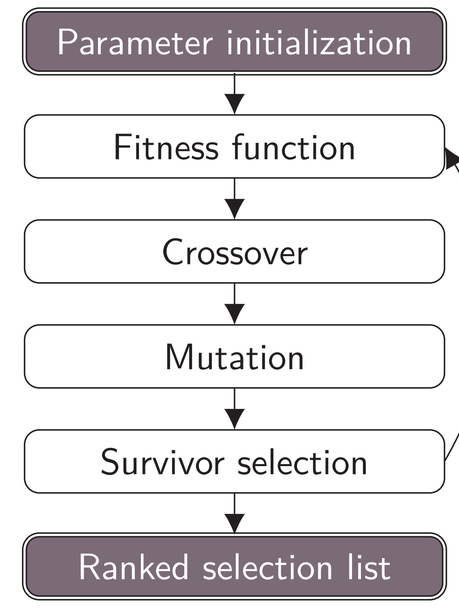


4. LoraWan communication



5. Algorithm

Definition: stopping criteria, population size P, and mutation probability pm
Generate randomly an 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 configuration
. . . . . . **Mutate:** child configurations with pm
. . . **end**
until stopping criterion are met



6. Simulation & Results

In order to generate all the required metrics of each Lora configuration we use both simulation and real enviroment. We use ns3 simulator with 2 nodes and one gateway, the distance between each node and the gateway is set to 1km.

Setup	Selection error	Rank	Fitness
1	0.9	1	1.5
2	0.5	3	4.5
3	0.7	2	3
n	0.5	4	6

Results show that genetic algorithm select the configuration that match beter the requiered QoS by the application.

7. Discussion

- **Advantages:**

They usually perform better than traditional feature selection techniques. Genetic algorithms can manage data sets with many features. They don't need specific knowledge about the problem under study. These algorithms can be easily parallelized in computer clusters.

- **Drawbacks:**

Genetic Algorithms might be very expensive in computational terms, since evaluation of each configuration requires building a predictive model. These algorithms can take a long time to converge, since they have a stochastic nature.

7. References

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[3] Eleni I. Vlahogianni, Matthew G. Karlaftis, and John C. Golias. Optimized and meta-optimized neural networks for short-term traffic flow prediction: A genetic approach. 13(3):211–234. 00506.