Performance evaluation of LoRa radio solution for PREDNET wildlife animal tracking project

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I. Introduction

The Internet of Things (IoT) has become one of the most important branches of modern telecommunications. There are many fields of application for this new paradigm: smart city, smart home, industry 4.0, precision agriculture. Animal health monitoring and tracking is a growing interest use case. Various academic and industrial projects exist for dairy herd health monitoring [1], [2] and wildlife animal tracking. The Inria FUN[1] project team is collaborating with Stellenbosch University in South Africa in the framework of the project LIRIMA PREDNET[2]. This project aims to develop a Wireless Sensor Network (WSN) that is able to operate in sparsely populated outlying rural and wilderness areas, for efficient monitoring and protection of resources and ecosystems. In particular, the PREDNET project focuses on two specific use cases: 1) Jackal behavior understanding and cattle surveillance; 2) Fight against rhinoceros poaching. The proposed WSN contains wearable devices carried by animals and infrastructure devices (base stations). The key requirements of the system are long range transmissions and low power consumption. Indeed, the animals could be spread over vast areas. Kruger National Park in South Africa (19485 km^2) is the potential zone of implementation of the network. On the other hand, size and weight limitations of wearable devices must be respected, which limits the size and capacity of battery. Moreover, battery replacement is a difficult and expensive process. So, low energy consumption is essential to extend the network lifetime. Some animal tracking projects [3] use GSM to transmit collected data to ensure the coverage over a large area. However, high energy consumption of GSM and lack of coverage in the deployment area do not meet the essential requirements of the application. LoRa technology provides both long range transmissions and low power operation. This technology could be an appropriate solution for PREDNET project.

II. Results

The contributions of this work are multiple: 1) we defined communication parameters of LoRa radio for PREDNET WSN; 2) we performed radio propagation simulation for chosen parameters to estimate the coverage area for both urban and wilderness (rural) scenarios; 3) we confirmed the propagation simulations with range tests; 4) we measured experimentally the Packet Error Rate (PER) of transmissions. The results of mentioned simulation and range tests for urban scenario are presented in Fig. 1. For this scenario, the base station node was installed on the roof of the Engineering Faculty of Stellenbosch University and the mobile node was in a car. In the figure, colored area represents simulation results and colored squares correspond to range test measurement data. As we can see, the simulation results fit with range tests. Thus, used propagation model [4] as well as simulation parameters could be applied for other areas. The rural scenario as well as measured PER values are not presented in this short abstract paper because of page restriction. LoRa can provide an efficient solution for low power communications in harsh areas without telecommunication infrastructures.

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[1]Self-Organizing Future Ubiquitous Networks; https://team.inria.fr/fun/

[2]PREDator preventive ad-hoc NETwork; https://iww.inria.fr/prednet/en/

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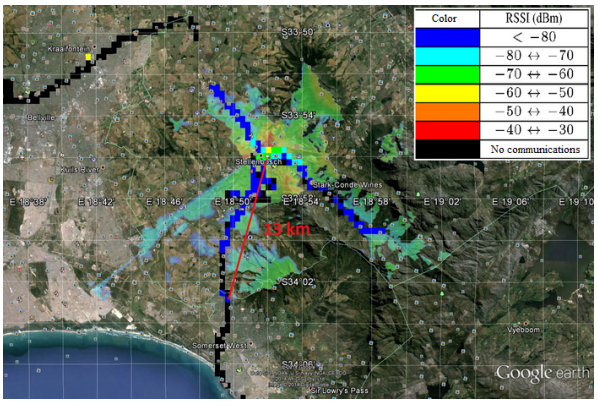

Fig. 1. Simulation and range test results. Urban scenario