World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:17, No:07, 2023

An Analysis of LoRa Networks for Rainforest Monitoring

Authors : Rafael Castilho Carvalho, Edjair de Souza Mota

Abstract : As the largest contributor to the biogeochemical functioning of the Earth system, the Amazon Rainforest has the greatest biodiversity on the planet, harboring about 15% of all the world's flora. Recognition and preservation are the focus of research that seeks to mitigate drastic changes, especially anthropic ones, which irreversibly affect this biome. Functional and low-cost monitoring alternatives to reduce these impacts are a priority, such as those using technologies such as Low Power Wide Area Networks (LPWAN). Promising, reliable, secure and with low energy consumption, LPWAN can connect thousands of IoT devices, and in particular, LoRa is considered one of the most successful solutions to facilitate forest monitoring applications. Despite this, the forest environment, in particular the Amazon Rainforest, is a challenge for these technologies, requiring work to identify and validate the use of technology in a real environment. To investigate the feasibility of deploying LPWAN in remote water quality monitoring of rivers in the Amazon Region, a LoRa-based test bed consisting of a Lora transmitter and a LoRa receiver was set up, both parts were implemented with Arduino and the LoRa chip SX1276. The experiment was carried out at the Federal University of Amazonas, which contains one of the largest urban forests in Brazil. There are several springs inside the forest, and the main goal is to collect water quality parameters and transmit the data through the forest in real time to the gateway at the uni. In all, there are nine water quality parameters of interest. Even with a high collection frequency, the amount of information that must be sent to the gateway is small. However, for this application, the battery of the transmitter device is a concern since, in the real application, the device must run without maintenance for long periods of time. With these constraints in mind, parameters such as Spreading Factor (SF) and Coding Rate (CR), different antenna heights, and distances were tuned to better the connectivity quality, measured with RSSI and loss rate. A handheld spectrum analyzer RF Explorer was used to get the RSSI values. Distances exceeding 200 m have soon proven difficult to establish communication due to the dense foliage and high humidity. The optimal combinations of SF-CR values were 8-5 and 9-5, showing the lowest packet loss rates, 5% and 17%, respectively, with a signal strength of approximately -120 dBm, these being the best settings for this study so far. The rains and climate changes imposed limitations on the equipment, and more tests are already being conducted. Subsequently, the range of the LoRa configuration must be extended using a mesh topology, especially because at least three different collection points in the same water body are required.

Keywords : IoT, LPWAN, LoRa, coverage, loss rate, forest
Conference Title : ICWCS 2023 : International Conference on Wireless Communication Systems
Conference Location : Helsinki, Finland
Conference Dates : July 06-07, 2023