Section D. Leaflet

FLoRa: Control and Adaptation of LoRa in the WiSHFUL Infrastructure

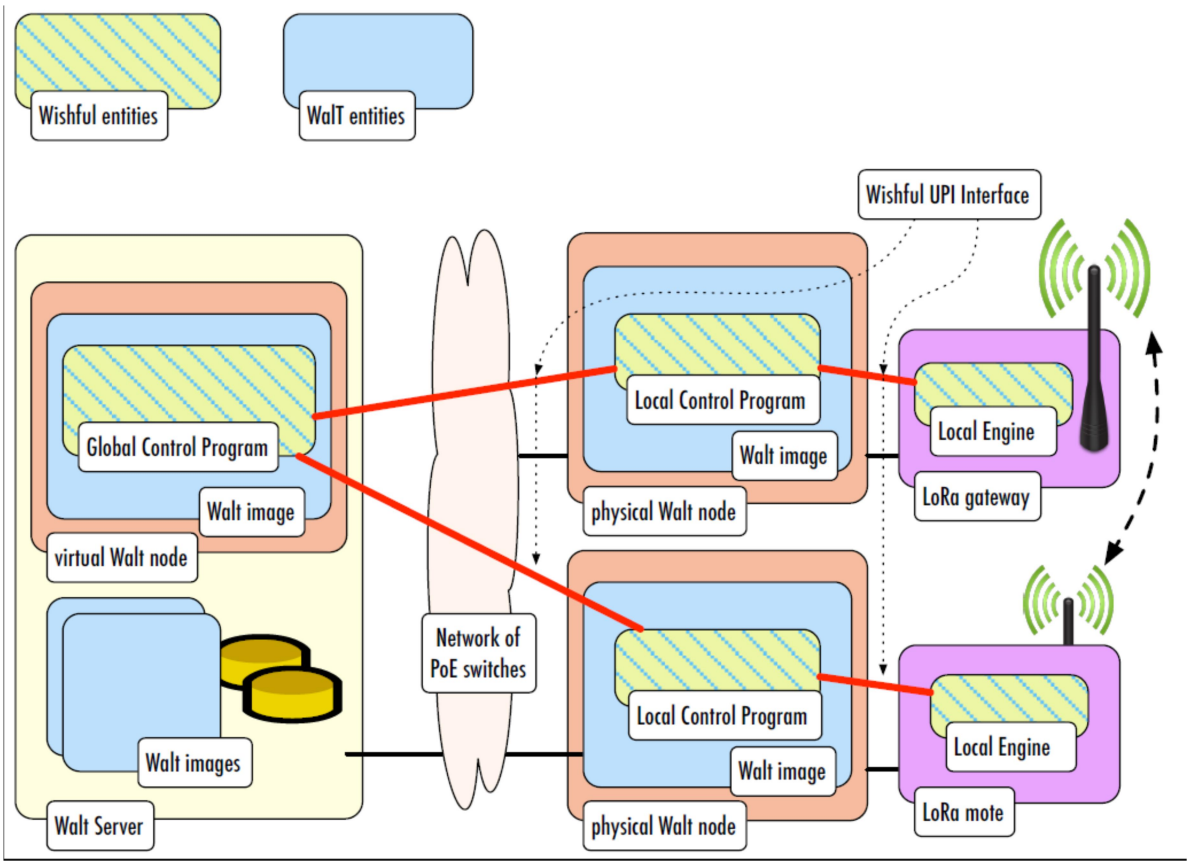
Grenoble Institute of Technology, LIG Lab

The goal of the experiment was to develop the Global and Local Control Program for controlling and adapting the LoRa parameters to given conditions and required energy consumption by configuring transmission power, spreading factor, bandwidth, and error coding rate. Based on the developed support for LoRa motes, we proposed to set up and perform measurement experiments to measure the quality of communications (throughput, loss rate, collision ratio, capture ratio).

The main challenges were related to the development effort of the WiSHFUL Local Controller on LoRa motes and debugging its operation for correct communication within the portable testbed. The difficulty of the development was related to the STM motes and their modes of operation. Another challenge is related to running experimentation sessions – as the ETSI regulations on the use of 868 MHz channels restrict the time between possible transmissions, measurements take a lot of time.

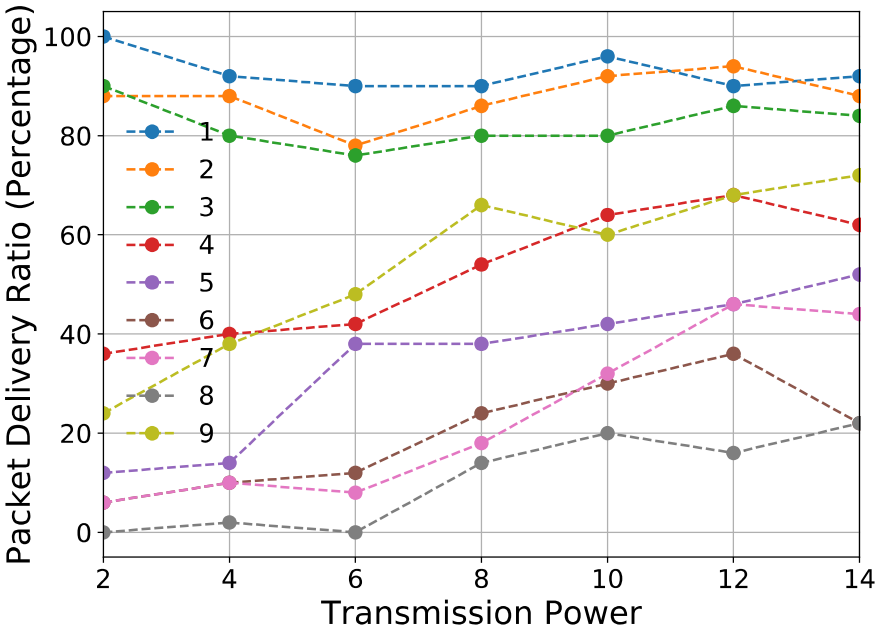
We have developed WiSH-WalT, an integrated framework for LoRa experiments based on the implementation of the WiSHFUL unified interface on LoRa STMicroelectronics boards and its integration within WalT, which results in a framework offering the best functionalities of both systems.

We have set up a series of experiments with a LoRa mote sending packets to 9 public TTN gateways placed at different distances and altitude. We have evaluated the quality of communications mainly with the Packet Delivery Ratio.

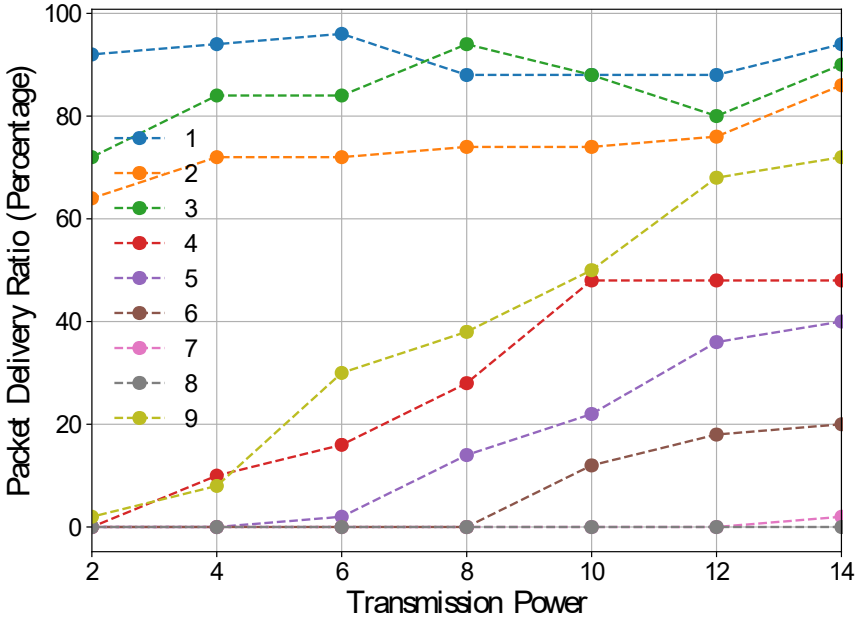


The measurements confirm that the performance behavior of LoRa motes follows a complex pattern based on multiple parameters. The presented results also show that we need to perform more experiments to understand better all performance aspects. WiSH-WalT provides a suitable platform for doing this kind of research.

Figures below show PDR (Packet Delivery Ratio) in function of TP for CR of 4/5 and BW of 125 kHz (each point is the average of measured values for 50 packets). We can observe that a good level of PDR (greater or equal to 80%) is only achieved for Gateways 1, 2, and 3 almost independently of SF and TP. For other gateways, the impact of TP is as expected: PDR increases with TP. Gateway 9 obtains good PDR for TP of 14 dBm even for the long distance of 13 km because of its high position. Interestingly, other data gathered during a day for Gateway 9 show high variability of PDR between 10% to 95% without any sound explanation except for the varying weather. The data speak in favor of densification of gateways—placing them at high positions at relatively short distances can result in good performance.



PDR in function of TP (SF 12)



PDR in function of TP (SF 7)

The WiSH-WalT platform developed within the project enables researchers and network architects to test their setup under real world conditions before final deployment and optimize the operation of LoRa motes with suitable parameters.

Measurements with WiSH-WalT can provide an insight on whether it is beneficial to use Adaptive Data Rate (ADR) or disable it, which can reduce downlink traffic from gateways as well as save energy of motes.

The learning curve of the WiSHFUL framework and UPIs is fast. The documentation on the interfaces is good and sufficient for developing new instantiation for LoRa. WiSHFUL concepts align very well with the reproducibility support provided by WalT to obtain a new added value in the form of the joint platform WiSH-WalT.

Thanks to the software tools and hardware provided to me by WiSHFUL I was able to develop the code for parameter configuration on LoRa motes in a well structured way and integrate WiSHFUL functions with WalT support. The final platform enables us to perform meaningful experiments on the quality of communications in the LoRa network.