Project description

The project is part of a smart metering application. Smart metering is one of the challenges of deploying a smart grid that can respond effectively to the demand for electricity. To maintain the balance between supply and demand, the Distribution System Operator(DSO) need a bidirectional communication system to firstly know what is real-time demand for electricity to adapt its production and secondly to offer their customers the means to adapt their consumption according to supply, for example by starting the devices consuming large amounts of electricity when the electricity is cheapest.

Several means of communications are possible among which the Power Line Communication (PLC). The latter has the advantage of using an already existing infrastructure which, moreover, belongs to the DSO, namely the power grid itself. However, it is not designed to carry high frequency signals, we had to create standards to adapt to the characteristics of the network. The G3-PLC is one of this standard.

The G3-PLC is a standard that provides solutions to characteristics related communication problems from the power grid especially high attenuation and the existence of several disruptors which generates noise [REF à quelques un des nos articles]. The solution recommended by the G3-PLC standard is to use all the Smart Meter(SM) as a relay. Therefore, the standard defined a routing protocol, the LOADng, which routes data from the various SM through a mesh network to a Concentrator. However, studies show us that the operation of this network is dependent on the density SM [REF à quelques un des nos articles]. The problem arises especially in a rural environment where the distances between the various counters are important. What happens if a meter or a set of meter can not join the mesh network?

One solution would be to use a wireless communication. There is a plethora of wireless communication system: GPRS, 3G, LTE, WiMAX, etc. All these solutions are also serious alternatives to the PLC because they are based on existing standards and infrastructures and are easy to deploy. However, they make the DSO dependent on telecommunications operators. In addition to financial problems, the strategies of telecom operators, including trying to stay competitive by always offering the latest technology to its customers do not always match those of the DSO. However, with the emergence of open wireless solutions such as LoRa / LoRaWAN, wireless solutions become again an option for smart metering applications. The LoRa enables a reliable and long range (up to 10 km) wireless communication and low cost. However, this communication has a very modest rate of a few kilobits per second. For our project, we plan to use Lora as a backup for the G3-PLC.

The project idea is to create a hybrid modem G3-PLC / LoRa for smart metering. The concentrator and the smart meter will have the ability to use both communications. They would use default G3-PLC, as it provides better throughput (up to more than 200 kbps). When using PLC is not possible or is difficult they use LoRa link. Long range communication of LoRa will compensate the weakness of PLC due to High attenuation and high noise in power grid. Two scenarios are possible:

1. a single SM, the solution is simple a priori, it would use the LoRa link directly communicate with the concentrator.
2. or a set of SM isolated and between which there is still a mesh network. The project will have to define the strategy:
   1. either repatriate G3-PLC data to a single SM and the latter undertakes to send them to the concentrator via its LoRa link.
   2. Or let each smart meter would use his LoRa link to send data directly to the hub.

In both scenarios, the project will define:

1. The parameters to be considered to take decision to use LoRa link and the G3-PLC link: PER, LQI, data rate etc.
2. Interactions between upper layers and lower layers to take this decision;
3. interactions between concentrator and SM, including how the concentrator uses its neighborhood or routing table to make the choice between the G3-PLC and LoRa link.
4. In the second case (set of SM) how to make the choice of the SM that retrieves data to the concentrator.

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