Evaluation of new Electricity Meters

Communication Protocol

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March 2012

Abstract

Due to the new ways of energy generation and energy consumption developed, the introduction of improvements at electricity networks is necessary. Nowadays, European legislation is promoting changes at electricity networks of member states. These changes include new technologies to facilitate the introduction of renewable energy sources to the grid and have a more efficient use of energy. All these improvements need of a better communication between the electricity market participants (electricity producers, grid operators, suppliers and consumers). Smart grids are able to achieve these objectives. One of the important issues at smart grids is the requirement of having good measures (to be able to control the power grid) and good communication between all the electricity market participants. Smart meters are part of the smart grid technologies able to solve these tasks.

Smart meters have a lot of features, but the most important is the two-way communication. This Master Thesis is going to study deeply this communication to understand how it works, by developing an own program able to read the measurements taken by the meter. The limitations caused by the transfer rate will be also identified.

Laboratory work

Before developing the program that communicates with the smart meters, the communication protocol has to be known. To do that, the software provided by the manufacturer (EMH) has been used. The set of instructions needed have been taken from the data flow between the EMH software and the meter. Once the instructions are classified as the ones that the meter has to receive and the other ones that the meter has to send, the communication protocol to read measures is known.

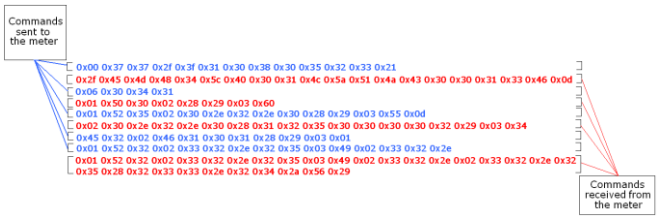

Figure 1: Instructions of the communication protocol

The first command includes the identifier of the meter. Once this commands is sent, the meter replies with one instruction that verifies that the meter is connected. After that two more commands have to be sent and received to follow the communication protocol, which ends with the instruction that contains the measure that is going to be read. The value of this measure is

included in the last command received. Finally, one more instruction has to be sent to end the communication. The meter has different options to read measures; the one commented is the one followed to read by single commands.
There is another option to read measures that has been used in this Master Thesis. Tables can be configured to include the values that the user wants to read. In this case the protocol is easier and faster. The communication starts sending the meter ID and receiving the verification from the meter, after that the instruction to read the table is sent.

Once the communication protocol is known, the program can be written. In this Master Thesis three different options have been developed:

1. - Communication with one meter by RS232.

Figure 2: Communication with one meter by RS232

The code to read values from one smart meter connected to the computer by using the serial communication port (RS232) has been written. This program permits to read the values that user wants to know and save them in a file. An interface is used to interact with the user.

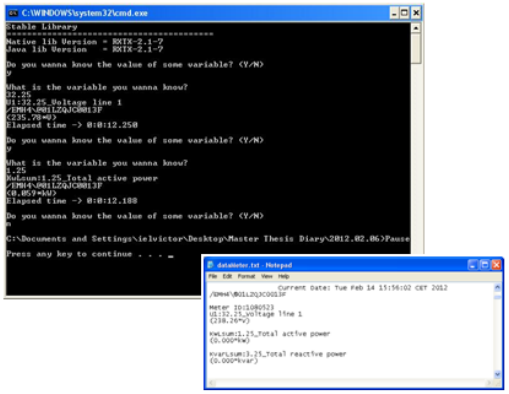

Figure 3: Program interface and data file

2. - Communication with three meters by RS232.

Figure 4: Communication with three meters by RS232

In this stage it is possible to read measures from three meters connected at the same time. Some modifications on the code have been needed. The most important change is a physical change: the necessity of adding pull-down resistances. If these resistances are not added, when one of the meters starts to communicate, the computer is not going to receive the information because the rest of the meters connected are keeping the signal received by the computer like if none of the meters is communicating.

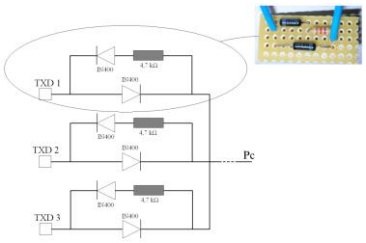

Figure 5: Pull-down resistance

This pull-down resistance has to be added at the transmission terminal of each meter.

3. - Communication with three meters by GSM.


Figure 6: Communication with three meters by GSM

GSM communication is a wireless communication. That allows having a long distance between the meter and the computer. In this case the computer is connected by USB to a modem that sends the information to another modem that is connected to the meters by RS232. The communication between the modems is wireless. To achieve that AT-commands have been used to start and hang-up the communication between the modems.

Evaluation of the time needed for reading measures

The faster way to read the values is by using the tables. By reading the tables the time needed is less than by reading single commands. Also RS232 communication is faster than GSM communication. The program developed in this Master Thesis needs less time than the software provided by the manufacturer.

RS232 (4800 Bd)		
	Single Command	Table
Master Thesis program	**4:360 sec**	**2:281 sec**
	4:281 sec	**1:969 sec**
EMH software	6:724 sec	4:380 sec
	6:846 sec	4:730 sec

Single Command		
RS232	EMH software	**6** seconds
	Master Thesis program	**4** seconds
GSM	EMH software	**13** seconds
	Master Thesis program	**11** seconds

Conclusions

The communication protocol to read single commands follows the next steps:

1. - Send the meter ID
2. - Receive confirmation from the meter
3. - Commands between to follow the communication
4. - Send the desired variable
5. - Receive the value of the measure
6. - End the communication with the meter

· The only command that changes between all the single commands is the last instruction sent to read the desired measure.

· To connect more than a meter the only change needed in the progarm code is the first instruction that includes the meter ID.

The communication protocol to read the tables defined in the meter is easier and faster than the one used to read by single commands.

It is possible to connect more than a meter with RS232, but it is necessary to add pull-down resistances.

GSM communication has some advantages (wireless communication, long distances between the meter and the user…) but more time is needed to read the meter.

TABLE OF FIGURES