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Narrowband Power Line Communication in Smart Grids

Realisations in UGent Campus Kortrijk

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Contributors to report

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1. The smart grid

In Ghent University a microgrid is available. The grid (Fig. 1) consists of 18 houses (cabinets) interconnected with the standard cable (700 m) used in Flanders. It represents in this way a street. The grid is configurable (TT, TN-C, TN-C-S). The houses can be connected to different phases (f.i. house to phase L1, house 5 to phase L3, house 8 to three phases). All houses have several sockets to connect consumers. The PV on the roof can be connected to different houses. As main source the public grid can be used, or a programmable power source.

Fig. 1. Microgrid

As addition two internal electricity grids of houses were constructed. The houses consist of the precabled electrical cabinet of the house (Fig. 2). Several devices (lighting, washing machines, dryer, …) can be connected.

Fig. 2. Connection box house

2. NB-PLC

The grid gives the possibility to test power line communication under real life circumstances. In this project, both NB-PLC and BB-PLC can be tested. For NB-PLC the developed boxes in WP1 were used. It can be concluded that NB-PLC suffers from interference and is not stable. The reason can be found in two parts:

- The impedance in that frequency range is low, giving low signal levels
- The interference in that frequency range is high

The created boxes were suitable to test PLC itself, but not suitable for signal measurement. This is logical is both sides are transmitting and receiving.

For measuring in that frequency range, a frequency sweeping measurement setup was used. The basic setup can be seen in fig. 3. A signal is injected at point 1 and measured at M1. The signal is received at point M2.

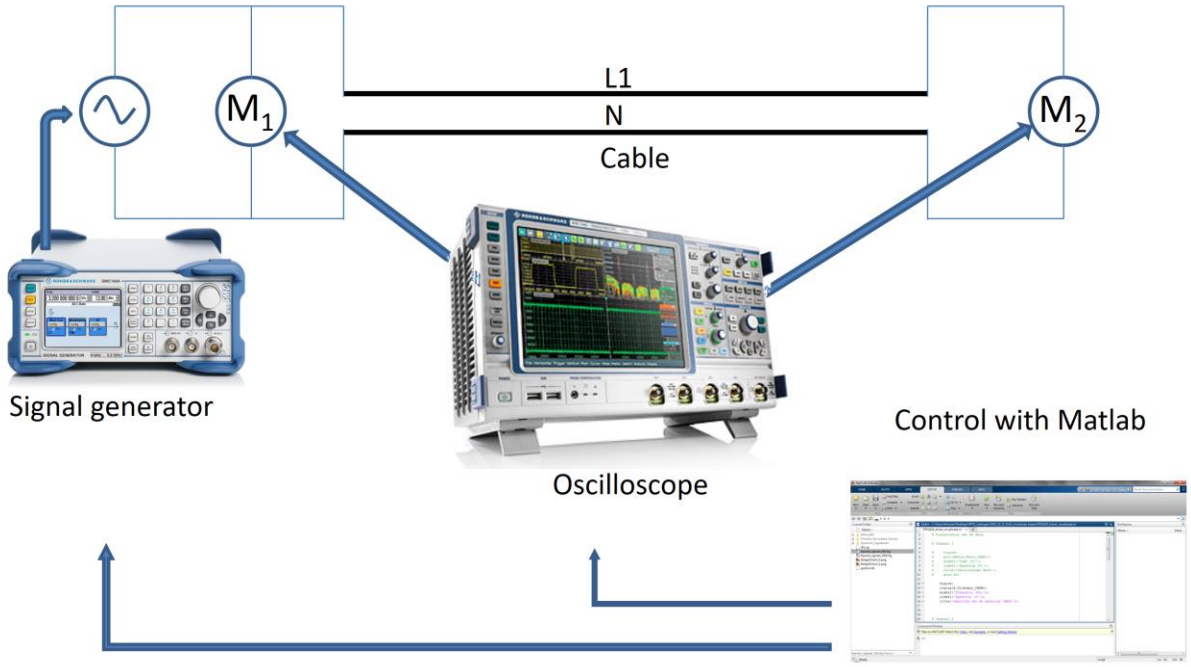

Fig. 3. Measurement setup

The signal was injected in house 1 L1 and received in house 2 L1, L2 and L3. As a result the attenuation can be measured. These measurements were done without grid voltage. The reason is that coupling to a live grid requires a capacitive coupling. This capacitive coupling attenuates heavily the lower frequency signals. By testing offline, the capacitor can be omitted and the test signal is high.

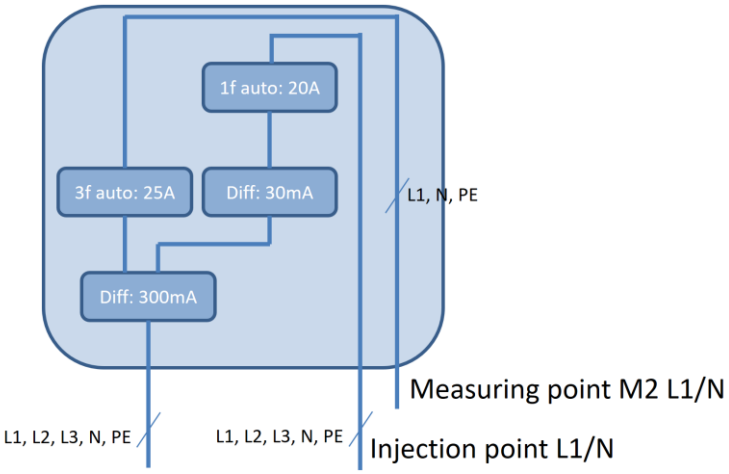

Fig. 4. Measurement with connection box

The results can be seen in the following figures. Fig. 5 shows the attenuation between two houses, on the same phase. The attenuation is low as can be expected. There is a slight increase when the frequency increases. Fig. 6 shows the measurement when the injection is at phase 1 and the receiving end is at phase 2. The attenuation is 60 dB and increases with frequency. This is normal due to the capacitive behavior of the cables. Fig. 7 shows the influence of the cable length. The cable length increases with 12 and 23 m. The attenuation decreases with 10 dB (12m) and 4 dB (23m).

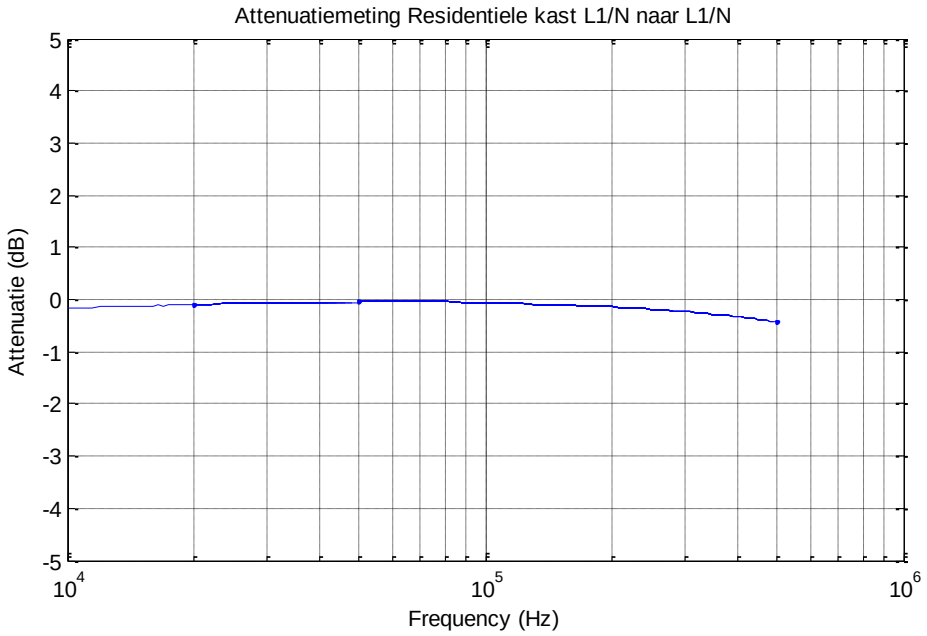

Fig. 5 – L1/L1

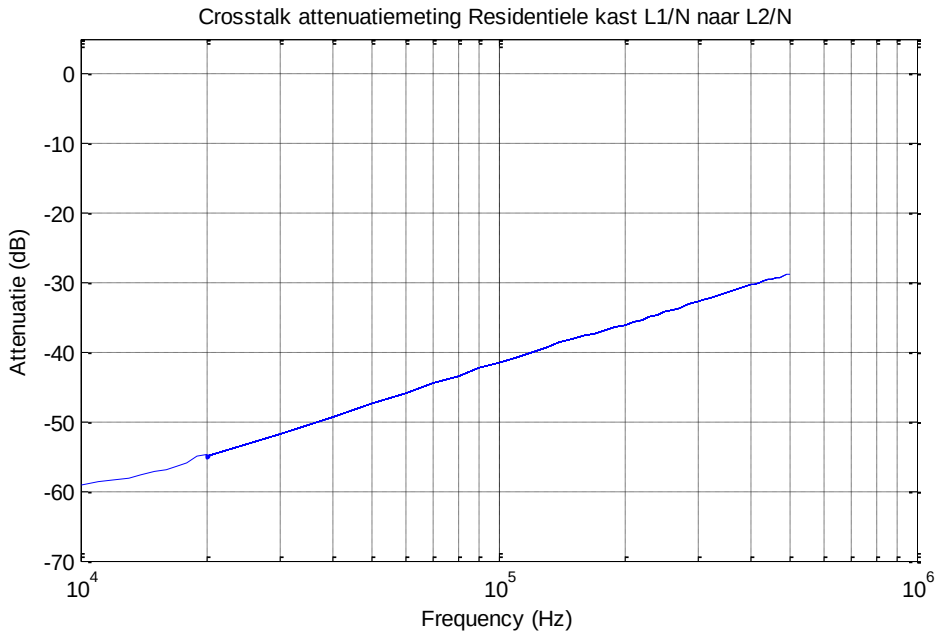

Fig. 6 – L1/L2

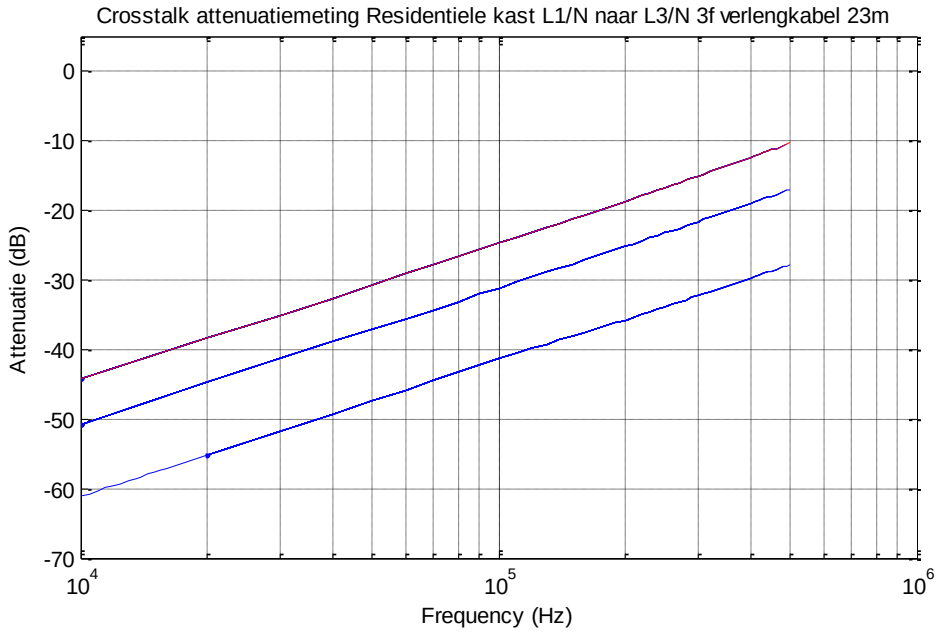

Fig. 7 L1/L3 – different cable lengths