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Use of Smart Metering for distribution systems outage location

Implementation of the tool in a DSO's architecture

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Background

As part of the evaluation of Smart Metering's additional benefits, a study was carried out in 2018/19 on the feasibility of creating a tool for locating faults in the LV network. A POC was realized in the REel Demo network of Rolle and the results of the work were used as a basis for the continuation of this project. Generally, the automated detection and location of faults in the different network levels presently end at the MV/LV transformer stations. Downstream of these, the situation is not monitored and any possible outage that may occur are discovered when a customer calls the control centre. Lot of these repairs could be sped up or even avoided, if using a fault location tool.

System integration

The fault location outage tool must be able to be integrated into existing DSO's systems. For that reason, the following "on-demand" procedure has been developed:

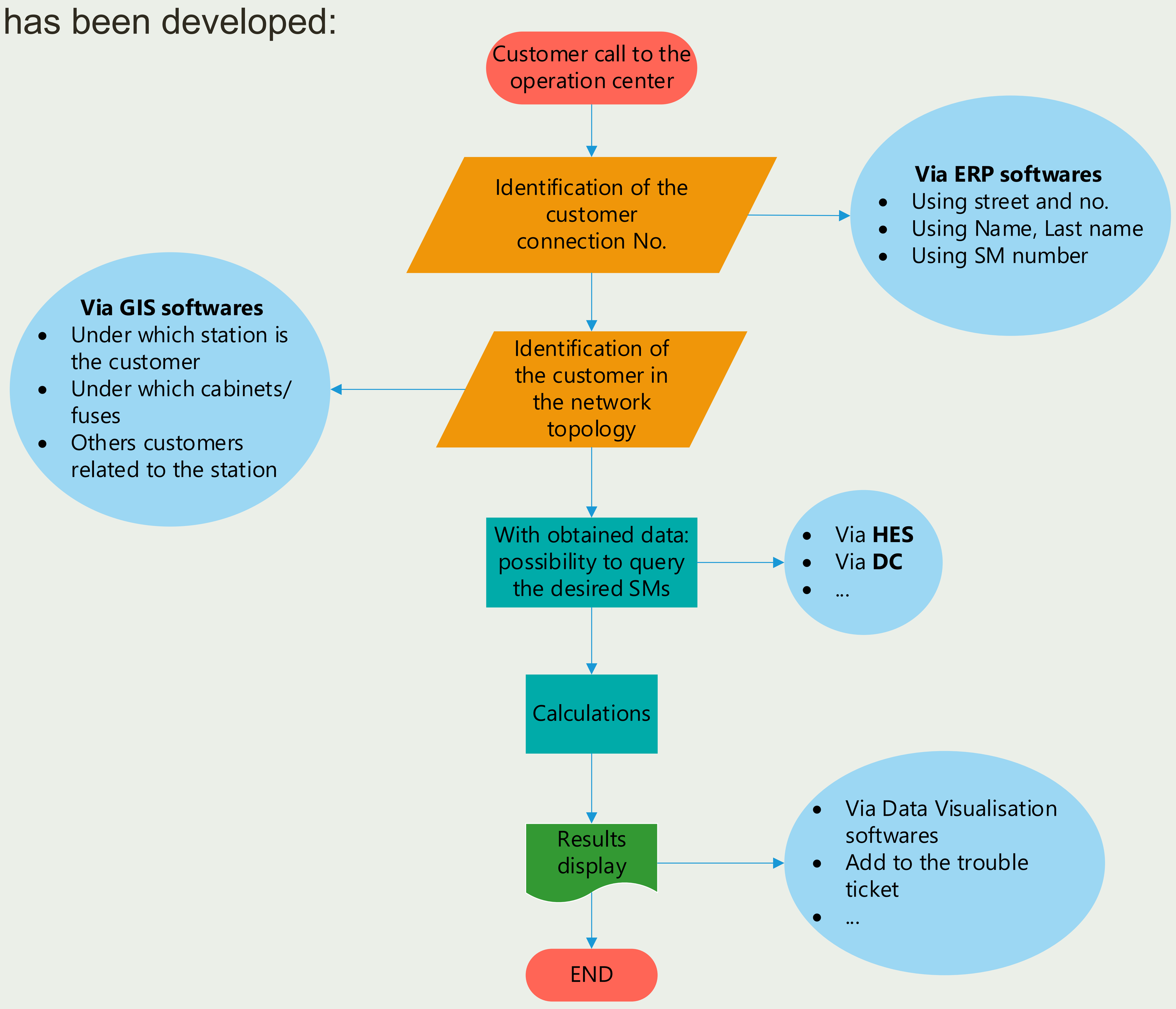

Fig.1 Algorithm integration within DSO's systems

Objectives and Method

The fault location tool is based on the analysis of alarms indicating phase loss as well as the analysis of responses obtained via PLC communication: packets are transmitted from a smart meter to a data concentrator (DC) by bouncing off different smart-meters. The algorithm then combines this information with the electrical topology of the network and locate the actual faulted fuse.

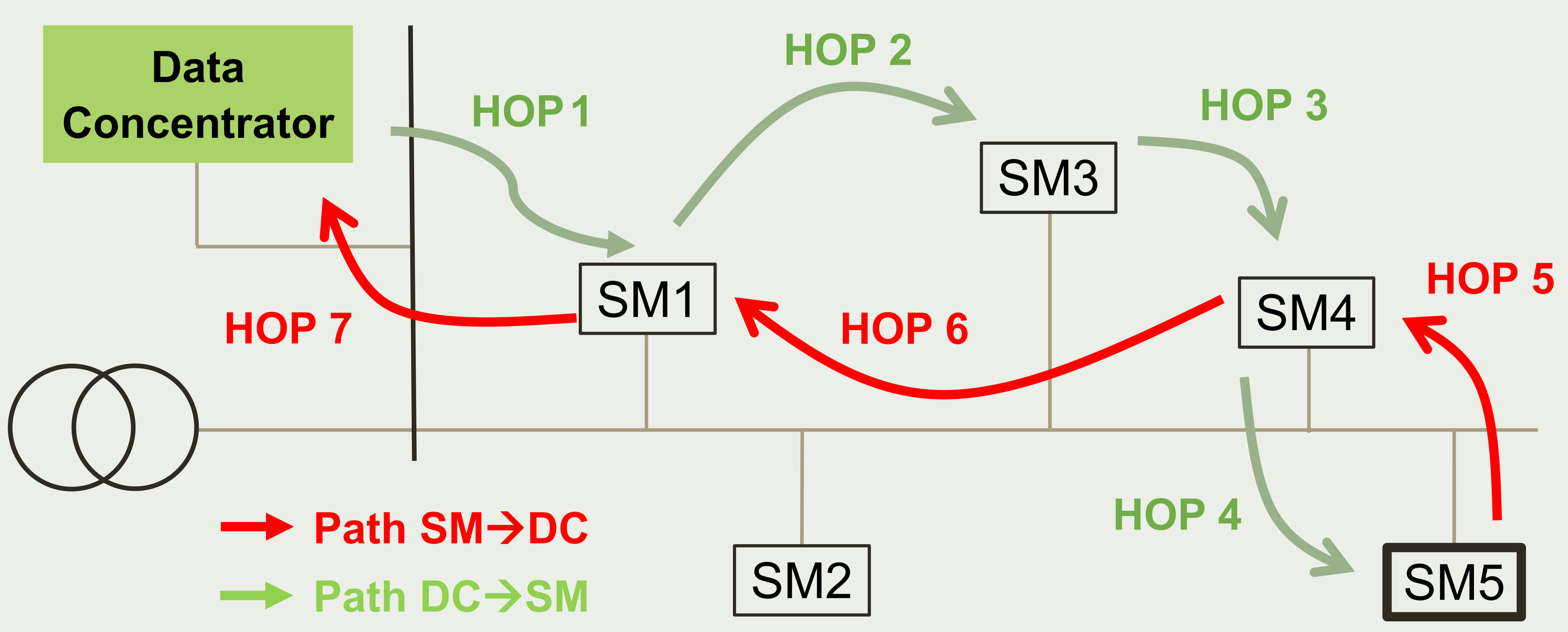

Fig.2 PLC communication principle

Results

The algorithm has been developed on the basis of real fault cases. This allowed to increase the accuracy of the algorithm's responses to 96.5% of the studied cases. The example below shows a real case of failure on a derivation.

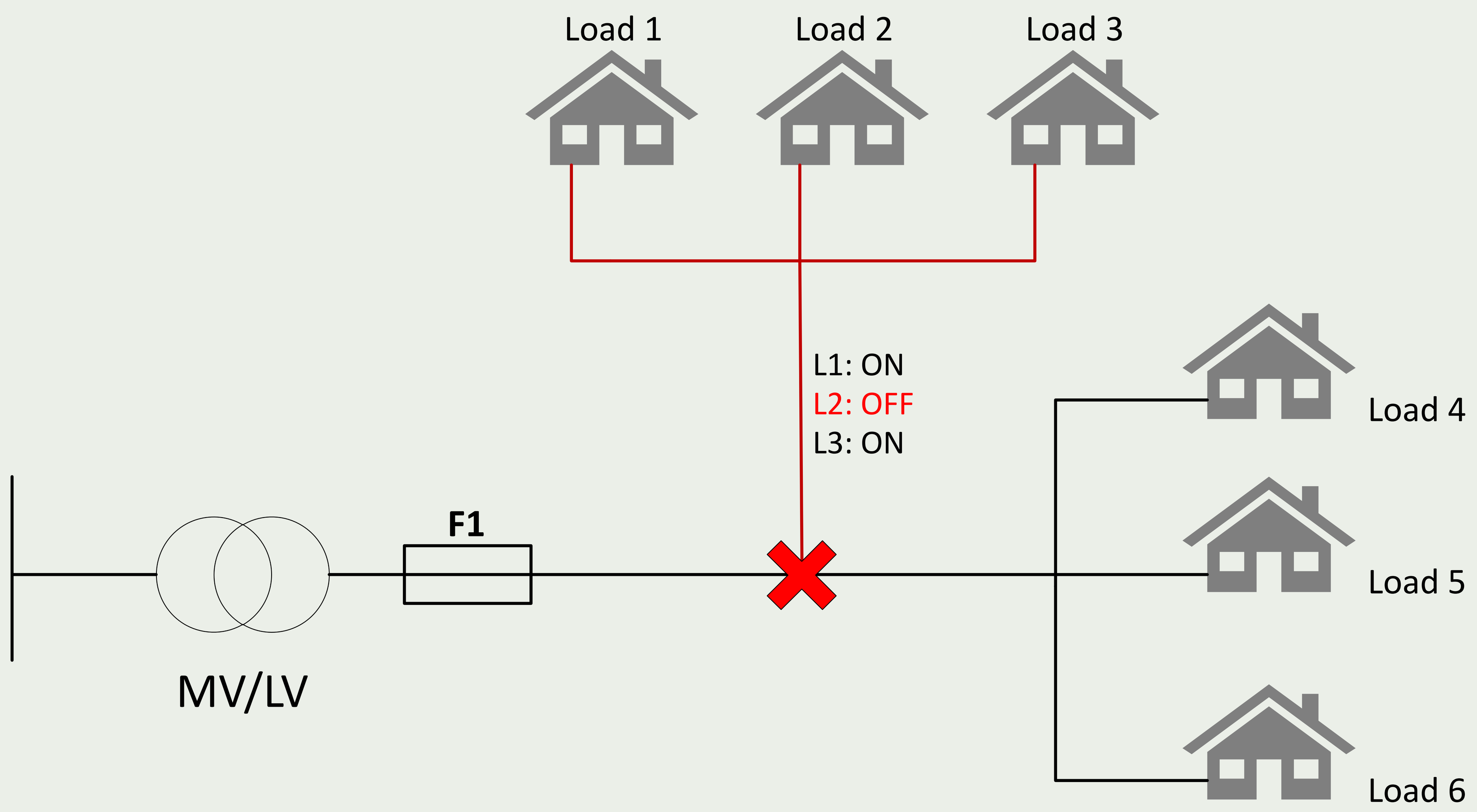

Fig.3 Example of real fault

At a connection point of an underground cable with anoverhead line, the wire of the L2 phase span was unhooked from the pole. Since this came off on the load side and not from the transformer, no fuse could have tripped. The 2 types of analysis gave the following results, with each one giving its own answer:

Type of information	Affected phase	Affected customers	Possible problem
Alarm	L2	3	F1
Lost of communication	L2	1	-
Final algorithm result	**No faulted fuses detected. There might be a derivation problem.**		

Indeed, failures like the one in Fig.3 make detection much more difficult. But the combination of two systems (alarm and communication) allows the algorithm to exclude wrong answers and increase accuracy.

Conclusion and Perspectives

This work has made it possible to refine the algorithm while keeping the very good bases already established during the POC. In particular, the reliability has been increased, with an excellent fault detection in 96.5% of the cases analyzed. Ambiguous situations such as the detection of chained fuses, or the detection of bypass failures are all assets that have been brought to this new version of the algorithm.
Once deployed, the DSO's control center will be able to evaluate its operation in the field and test it with even more fault cases.
The next step, once the "on-demand" operation has been validated, will be the development of a pro-active operation: in this way failures will be detected before the customer calls.

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