Dynamic power supply path determination of the Point of Consumption (PoC) in the Enea Operator grid

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Introduction

Enea Operator has implemented a project of dynamic determination of the Point of Consumption (PoC) power supply path. The project, which involved the work of all units of the company, now allows for constant monitoring of the normal network operation and the achieved SAIDI and SAIFI indicators.

The common part identifying the customer in the company's IT systems used to implement the project is the Point of Consumption (PoC). Work on the project began with the finalization of the migration process of five billing systems to one - SKOK-D. The project implementation was divided into the following stages: obtaining basic data, standardizing nomenclature, data export, implementation of the service bus and creation of the Customer Service App. The final stage will be the introduction of the target solution, i.e. dynamic determination of the power path for the actual low voltage (LV) grid operation system. It will be possible after the implementation of LV SCADA.

Genesis

Enea Operator is one of the first energy companies in the country to introduce innovative IT solutions. The year 2016 turned out to be a breakthrough for the company, when works related to the project of dynamic mapping of the PoC supply path began. At that time, the process of migrating five billing systems to one, which is the SKOK-D System, was completed. At the same time, the SIS Network Information System (known also as GIS) was implemented, updating the data resulting from the current inventory of low voltage (LV) networks. The next of the six IT systems used in the project are the SCADA System, the Power Outage Management System (OMS), the System for Handling Interruptions Notifications and Information on Planned Outages (Contactis Failures) and the Measurement Data Acquisition System (AMI). Updating data in all systems simultaneously, which was necessary for the purposes of reporting and operation, turned out to be a considerable challenge. Without the automation of the entire process, this task would be difficult to achieve.

Therefore, Enea Operator took up the challenge of automatic updating and verification of data in all systems existing in the Company in the field of PoC. or this purpose, the project: "Methodology and technical solutions for assigning customers to stations from the point of view of quality regulation" was started, the final of which is scheduled for the end of 2020. The obtained data was used to update and determine SAIDI and SAIFI indicators in the company. One of the important elements of this task is determining the number of consumers powered by a given transformer.

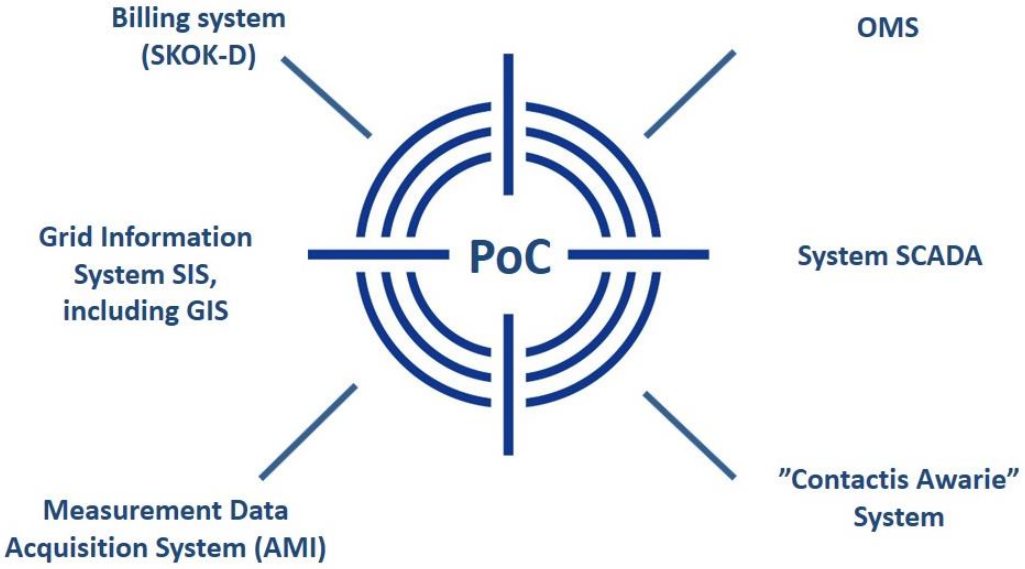

Fig. 1 PoC as a common element connecting IT systems

Basic data acquisition stage

The first stage of the dynamic power path mapping project started with acquiring the geographic coordinates of each PoC. This process was carried out in two steps. In the first - it was done automatically during multiple, scheduled readings of electricity meters. The task was carried out by our field workers using standard tablets.

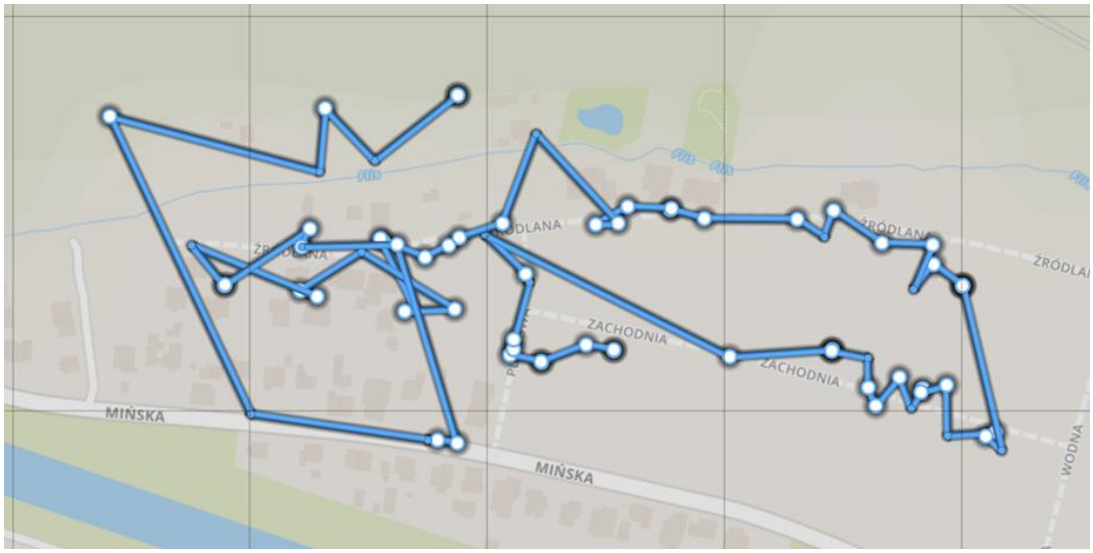

Fig. 2 A map showing the process of acquiring geographic coordinates by the field worker

The collected data, specific to each PoC, was subject to automatic verification. For this purpose, the DBSCAN algorithm was used to determine the average PoC location, for which the PoC address was specified and confronted with the address in the billing system. Appearing discrepancies were rejected and subjected to further verification. In the second step, the field workers had to approve or correct the designated PoC position during the implementation of subsequent readings or technical orders, but only within the selected area.

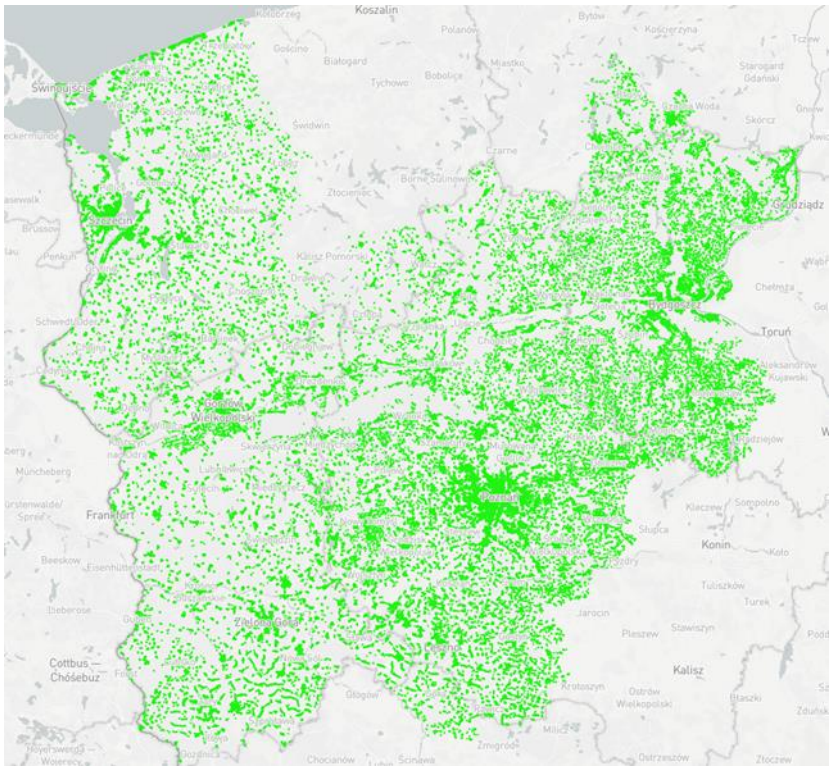

Fig. 3 Location of PoC at the area of Enea Operator operations

After analyzing the collected data, PoC addresses were re-generated, this time in compliance with the TERYT database (National Official Register of the Territorial Division of the Country) and the PoC address database was updated in the SKOK-D billing system. This action was necessary to perform reporting and proper supervision of the processes in the company. Data verification covered both the existing and new PoC.

Stage of nomenclature unification

The second stage was the unification of nomenclature in system databases - SIS (GIS), OMS-SCADA, AMI and physically, in the field. Collecting data to the central system for each of the above-mentioned groups, which were obtained over the years, allowed to identify differences in the way of naming individual network elements. This was the result of a different approach in each of the areas of the company's operations. An additional element that could, and still can, cause differences is the way of entering new data to the SIS and SCADA systems, by manual drawing of diagrams and individual elements. Here, human error can become another cause of data inconsistency. Without full synchronization in each of the systems and in the

field of all common elements, the company would not be able to dynamically determine the supply path and update the number of consumers supplied from a specific station. Therefore, an external mechanism was created to carry out this task, to which data from individual systems were imported for the purpose of comparison. The generated reports of discrepancies were forwarded to the appropriate territorial units, where they were verified and conflicts were removed. This is a long-term task of constantly analyzing and updating data in order not to lead to desynchronization again.

Data exporting stage

The third stage is a prelude to the dynamic determination of the PPE power supply path in the normal operation scheme of the low voltage grid. For this purpose, after the completion of both previous stages, exports were prepared in the form of flat files of aggregated PoC data from the SKOK-D billing system (PoC number, address, location data, technical conditions) and imported to the SIS Network Information System (GIS) - startup. In the SIS system, Distribution Points (PD - electrical model of the physical place of energy consumption, e.g. a single-family building, staircase of a multi-family building, GSM telephony pole) were generated, to which PoC was assigned based on the provided location data. The nesting of the PoC in the structure of the SIS system made it possible to generate the starting power path along with the indication of the circuit and the station. The aggregated data prepared in this way along with the PoC status were exported to the OMS system. Based on the above data, the number of consumers (PoC) supplied from a given circuit in a transformer station was updated. It took place once a month, taking into account the new PPE and the current status of the existing ones.

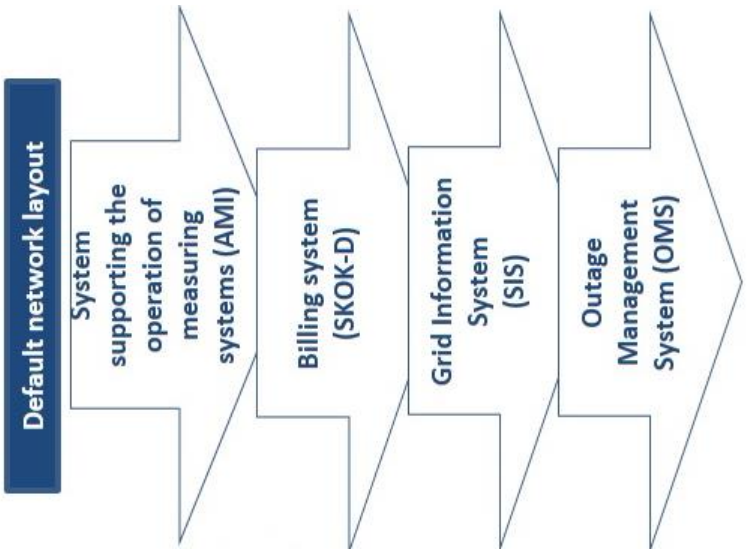

Fig. 4 PoC data flow in the transient solution - data update monthly

Enterprise Service Bus implementation stage

The fourth stage is the target solution in which flat file imports have been replaced by launching communication in the form of the Enterprise Service Bus. In accordance with the adopted assumptions, the entire process of determining the power path for each new PoC and changing the existing ones is carried out automatically, in all systems connected to the service bus. Each change of the PoC status in the SKOK-D billing system is immediately reflected in all systems, causing, among others, updating the supply path in the SIS system, and a change in the number of consumers supplied from a given transformer station in the OMS system. In the case of creating a new PoC, the power path is automatically determined in the SIS and delivered to the other systems at the current stage on the next day. Updating the number of customers in the OMS system takes place dynamically, therefore the determination of SAIDI and SAIFI indicators is made on the basis of constantly updated data.

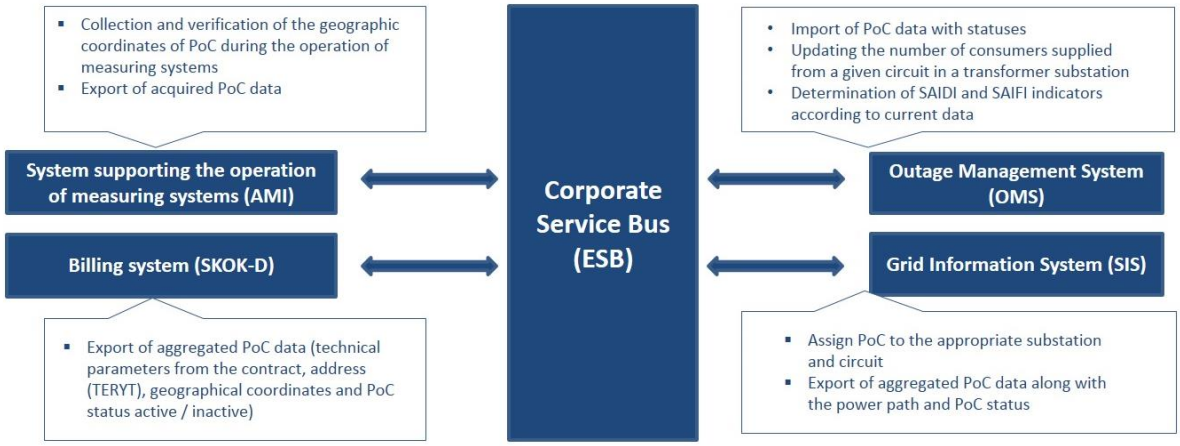

Fig 5. PoC data flow in the target solution - dynamic data update

The messages exchanged on the service bus are based on the CIM model so that other systems can also use them in the future.

The stage of creating the Customer Service Application

Distribution System Operators have many possibilities to locate failures of their own power grid. They include, among others SCADA systems with telemechanics, which keep the supervision services informed of any irregularities in the network. However, at the present stage, we are not able to locate all faults, especially at the low voltage level. Therefore, as part of this task, as the fifth stage, the project of creating a smartphone application for each customer was carried out in parallel with the fourth stage. The main goal was to enable customers to report power failures in their households with feedback on the failure / scheduled outages status. For a DSO, it facilitates the location of damage and helps in its faster removal. Another advantage of this solution is the ability to handle a very large number of notifications at the same time in the event of mass failures, e.g. as a result of weather anomalies. In such a situation, the Customer Service Application seems to be the perfect solution.

The launch of another grid information channel helps not only in current operation, but also significantly influences the dynamic updating of the status of each PoC along with the impact on the determination of SAIDI and SAIFI indicators.

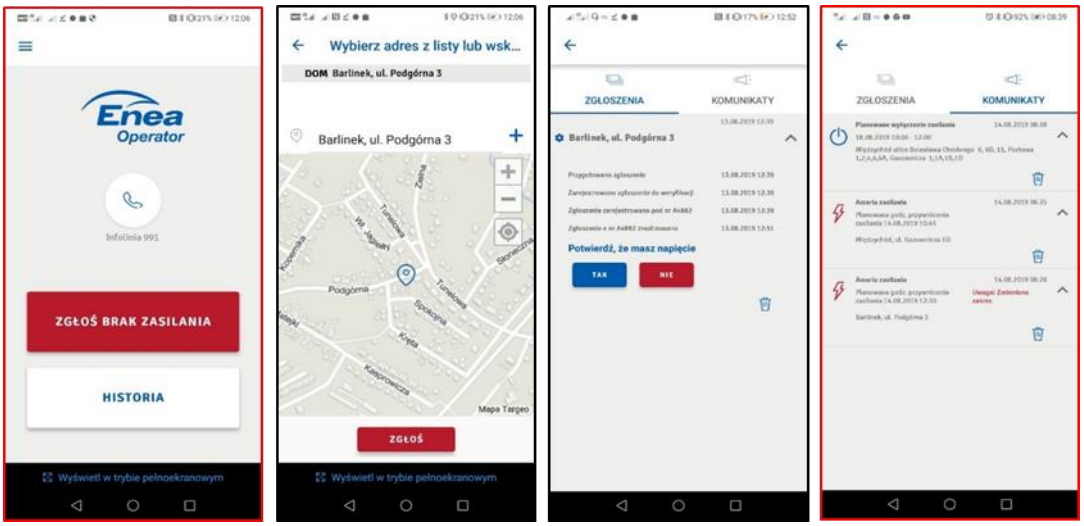

Fig. 6 Customer Service App

The principle of operation of the Customer Service Application was based, like many other applications of this type, on the interaction of the customer with the Contactis Awarie System, which is used to handle notifications about failures and informing about planned outages.

By installing the application on his smartphone, after going through the registration process, the user specifies his personal data along with the PoC address data. After completing the configuration, he can report a power failure and receive feedback – for example the planned date of ending the power failure or the confirmation of the removal of power failure.

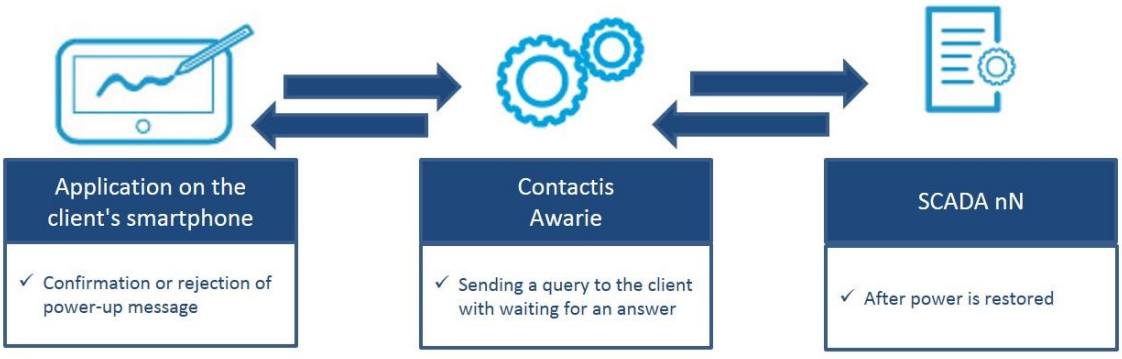

Fig. 7 *Customer Service Application - flow of information about the lack of power*

Development plans

The sixth stage is the development of the implemented solution. After carrying out the analyzes based on the normal operation scheme of grid operation, it is planned to switch to the real-time operation scheme for low voltage (LV). It will be possible only after the implementation of LV SCADA.

The use of the capabilities of all correlated, available IT systems allowed for the creation of one effective tool for modern service to our customers.