Software Development and Engineering the Future

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1 KES Company

KES was established to provide high quality software solutions to its clients. As a dynamic and independent company, we are committed solely to the success of our customers and can react quickly and flexibly. Today, high-quality is considered the main problem clients are facing with software providers and KES is committed to help in solving this major problem. KES is dedicated to the assessment, consultation, design, and implementation services in all areas of software solutions. As a technology-neutral professional services company, KES assists clients in selecting best of breed services and tools for customized solutions across various industry sectors.

We put the requirement and needs of our customers first. We orientate ourselves to meet their requirements regarding project implementation, aiming to achieve optimality and efficiency. We help our customers reduce time-to-market and save time and costs on R&D by helping them integrate advances in technology (or emerging communication standards) into their existing products, thus extending their product's reach and application scope.

We act independently of external financiers and stock markets. We invest extensively in research and development in several areas including power systems engineering, energy engineering, control theory and communication and information technology to build cutting edge standards based communication and optimization solutions and products for the development of Smart Grid and energy efficiency technologies. Our commitment to independence is evident in our products, which enable the greatest possible freedom when selecting hardware and software.

We embrace challenges and set the pace for modern, contemporary automation. We naturally meet standards, but spend just as much time and energy creating software that enables the free development of individual working methods and individual customer solutions.

Our customers are much more than business partners for us. They inspire us, their trust strengthens us and their feedback enables us to think in new ways and meet diverse requirements. We collaborate with leading utilities, OEMs and system integrators in the generation, transmission, distribution and renewable energy sectors to provide technology leading solutions, products and services. With

strong partner networks across the globe, and customers focusing on energy markets, KES understands the regional challenges better and offers solutions that are flexible, scalable and secure.

What we offer…

We offer to improve the network operation, and the data management throughout the software and hardware implementation of a low cost high technological SCADA System and its applications, as well as providing expert advice.

We offer consulting, comprehensive training and workshops or you have a specific technical question you would like to ask us.

We offer solutions that address the challenging issues facing our utility clients as they strive to maximize the reliability, security, and economics of the power system including generation, markets, transmission and distribution. Our target companies are TSO's, DSO's as well as industrial companies with strong consumption of electrical energy like mining companies.

2 Single-user SCADA-System for substation use

The SCADA System uses the latest technology, supports main communication protocols (including the new standard protocol IEC 61850) and is independent from the operating system. It can work under Windows, Linux as well as other devices such as raspberry PI. This feature is of major importance for incorporating low cost solutions that are also compatible with the existing data. Another important feature is that the SCADA-System includes an interface to the real-time database, which enables the incorporation of further applications independent from the ones we offer. These features enable to reduce significantly the installation costs, especially when targeting a distributed model in the distribution network, for example by using Raspberry PI devices.

The SCADA-Systems supports a wide possibilities of databases such as Firebird, Oracle, SQL, MySQL, Postgres, etc. For real-time database we suggest using SQL-Lite, since is fast and completely independent from the operating system and it's portable and compatible with most of them (Windows, Linux, etc.). For historical database use we suggest Firebird due to its low costs. The SCADA-System is also component based, so any type of improvements or additional features are easy to implement.

Our SCADA-System can be used as primary SCADA for main online-system supervision and control, as secondary SCADA for online-system supervision, working parallel to the main SCADA, and as tertiary SCADA to manage historical data and perform reports.

SCADA Applications

All applications are based on our development connected with open-source solutions, which enables a significant cost reduction. Nevertheless the software also provides the assembly for commercial solutions, in case a proven package such as WSMP from IBM, CPLEX, etc., wants to be used. Requirement for real-time applications is access to the real-time database.

1. **State Estimation:** Our high performance real-time state estimation package is based on the latest research on the field and gives much more accuracy compared to the standard solutions. Main characteristics are:

a) Use of different probability distributions to account for the error of pseudo measurement. For example, log-normal distribution for office load and shopping centers, beta distribution for industrial and commercial load, etc
b) Each measurement (generation injection, load and even the current) are part of the solution vector, which enables to treat them independently in each node (not aggregated), as well as to detect the true value.
c) Optimization procedure includes tolerance in the network parameters, which increases the convergence and enables to detect wrong data by giving a confidence level of each parameter.
d) Operating limits of network data are considered, which increases the quality of the estimation and impedes the obtainment of unrealistic solutions (such as negative load).
e) The correlation of the injection of generating units based on renewable resources are considered, which gives a much more accurate model (compared to uncorrelated generation injection) and therefore much better results.
f) Underline model supports different solvers, from open-source to commercial ones, which enables to reduce costs and adjust to the project budget.

2. Real-time load flow calculations: We offer not only three-phase load flow calculation, but also single phase, which is especially important in networks prone to high asymmetrical operation. Our load low calculation module can also be extended in order to analyze the dynamic response of the network in case of disturbances or events.

3. Contingency Analysis: Our tool for contingency analysis can run in real-time (every 5 or 10 minutes) and helps to detect hazard situation that may compromise the safety of the network. It includes not only the failure simulation of each network element (line, cables, generating units, etc.), but also performs a cascading contingency analysis.

4. Short Circuit Localization: Our tool for short circuit localization is based on the standard IEC 60909-0 and simulates three-phase grounded faults, two-phase grounded and ungrounded faults, and single-phase faults. It gives as a result all relevant information for planning studies such as initial symmetrical short circuit level, peak values, thermal equivalent short circuit current, etc.

5. **Loss Minimization:** This package can run periodically (every 5 or 10 minutes, depending on the operator), and gives proposal for the network operation such as topology changes (switches and feeders), tap changes in the transformers, optimal operation of reactive power units (capacitors and reactors), in order to minimize the network losses.

6. **Voltage VAR Control:** Automated voltage and VAR control requires coordinated operation of reactive power resources such as capacitor banks, voltage regulators, transformer load-tap changers, and distributed generation (DG) with sensors, controls, and communications systems. These devices could operate autonomously in response to local events or in response to signals from a central control system.

7. **Optimal Power Flow:** The goal of an optimal power flow (OPF) is to determine the “best” way to instantaneously operate a power system. Usually “best” is equal to minimizing of operating cost.

8. **Optimal Feeder:** Reconfiguration in distribution networks is used to reduce losses or improve the voltage profile of the network.

3 Expert Advice

We offer expert advice in the network modelling field of data cleaning and collecting, helping utilities to acquire and organize their data, cleaning it, as well as training operators to maintain a reliable database for the practical use of the applications. Data cleaning and collecting is a crucial task for the optimal operation of a transmission and distribution network. Since commonly the control center department is different than the study, planning and maintenance departments, many utilities do not have a sound information regarding important network parameters, which difficult the achievement of a proper network operation.

Transmission System Operators

Transmission System Operators often face the problem of not being able to fully use their applications such as estate estimation, load flow calculations, etc. Specifically for Transmission System Operators we offer SCADA Applications such as State Estimation, Load Flow Calculation, Optimal Power Flow, Contingency Analysis and Short Circuit Analysis.

We also offer expert advice in network modelling data cleaning and collecting, as well as operator training.

Distribution System Operators

Distribution System Operators face the problem of:

1. Not having all relevant information (from sensors) at the control
2. Slow and error prone data acquisition at the substation level
3. Eventually not an optimal network operation (critical for loss minimization)

A SCADA System connected at key places in the substations can bring many benefits for the network operation and for the data management.

Regarding data management, the reality of many distribution networks is that operators must maintain the log files manually, reading the data from the feeders and writing them in the register (for example every hour). This manual process is slow, inefficient (regarding man power) and prone to errors. Furthermore, loads of information related to the network operation is lost, because not every signal coming from the RTU is forwarded to the control center.

A small SCADA System at the substation level can improve the data management by automatizing the information intake and significantly reduce the errors (only possible hardware errors would remain). Also, if numerical relays are directly connected to the SCADA at the substation level all information can be saved, enabling a much deeper and accurate knowledge of the network. This information can later on be used for planning and operating purposes. For instance, historical and reliable information regarding the feeder's loading can help with the planning process of the network. Also, a much more accurate post-fault analysis can be done if information from all sensors was saved.

A small SCADA System at the substation level would not only help the data acquisition and management process, but also to improve the network operation. Nowadays the distribution network model is pyramidal: All decisions are taken centralized at the control center, where substations are passive and not able to make any decisions on their own. The disadvantage of a pyramidal model is the high dependency on the control center: if any problem appear it would affect the whole distribution network. Also, network healing in pyramidal model is not possible if dedicated master (control center) fails (complete system will be unreachable).

The future of distribution networks is rather the distributed architecture, where decentralized decisions at the substation level are taken. In the future, SCADA-Systems will be multi-agent active devices, and connected at the substation levels. They will be connected to each other (peer-to-peer) and take decisions decentralized. Depending on authority and the configuration, few small SCADA can automatically take over control as virtual center if the real control center is not available. Throughout a distributed model a better and safer operation can be achieved. These concepts are the key for achieving smart grids in the future.

Mining Industry

Mining industry are very intense consumers of electrical energy, which must be supply overcoming large distances. As a consequence, the transmission network faces important losses, which derive in the additional supply of power energy with more costs involved. The optimal operation of the transmission network can help to minimize the losses, as well as improve the network operation to achieve a higher reliability.

Another difficulty faced by the mining industry, most part of the electrical energy must be supplied using grounded cables, in which excessive heating and irradiation can be a big problematic. Excessive heating can decrease the lifetime of the cable, or even damage it completely. High levels of irradiation can produce interference and thus affecting the proper function of other electrical devices, as well as health damages to people exposed to it. In order to keep the heating and the irradiation at low levels, a compensated loading of the cables is essential. Nowadays all available tools for state estimation, load flow calculations, etc., are based on a single-phase model. This makes the assessment of line loading a difficult task. The implementation of a software where all DMS applications are based on single-phase calculations can help to improve the line loading by determining the optimal feeder configuration, thus reducing the risk of single phase overloading.

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