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Upgrade of SCADA system in remote control centres of Elektra Zagreb and Elektroslavonija Osijek

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SUMMARY

Replacement of the existing SCADA system with a new one has to be performed minimizing the needed works as much as possible allowing complete control and management of the distribution system during these works. This represents a challenging and sensible process. The paper gives a brief description of the phases of the project consisting of an upgrade of the remote control system of the distribution system in Elektra Zagreb and Elektroslavonija Osijek Remote Control Centres with a special emphasis on the implementation of Končar in-house solutions implemented during the so-called migration phase which allow simultaneous operation of both SCADA systems (existing and new).

KEYWORDS

SCADA, Elektra Zagreb, Elektroslavonija Osijek, migration, parallel system operation.

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1. INTRODUCTION

Elektra Zagreb (Distribution System Operator) spans the area of 2 550 square kilometres. In addition to a plant placed in the centre of Zagreb, plants at Sv. Ivan Zelina, Samobor, Velika Gorica, Zaprešić, Dugo Selo and Sveta Klara take care on the supply of the electric energy to buyers. Elektroslavonija Osijek (Distribution System Operator) spans the area of 4152 square kilometres representing the fourth biggest Distribution System Operator of the Croatian Power Authority (HEP ODS). Elektra Zagreb and Elektroslavonija Osijek are distribution system operators (DSOs) belonging to the Croatian Power Authority (HEP) system. Their main aim is safe and reliable operation of the power distribution system in the belonging area and safe delivery of electric power to end buyers. Investments into upgrading of the existing equipment are indispensable to fulfil these basic DSO targets as well as its new roles which have come to light due to the liberalisation of the electric energy market.

The existing SCADA (Supervisory Control and Data Acquisition) Systems intended for control and management of the electric power distribution networks were put into operation in 2007 (at Elektra Zagreb in June, 2007 and at Elektroslavonija Osijek in November, 2007). Within the frames of standard SCADA functions also advanced DMS (Distribution Management System) functions were implemented into the system:

- Load Calibration;
- Power Flow Calculation;
- Short Circuit Calculation;
- Load Forecast.

The upgrade of the existing SCADA system has been initialled due to several reasons:

- The producer of the hardware server equipment seized support for the stated equipment in 2013 [1] and the hardware equipment had to be replaced which automatically meant the replacement of the software equipment;
- The producer of SCADA applications has been abandoning its support to UNIX software platform;
- Implementation of new and enhanced existing SCADA software functionalities.

Replacement of the existing SCADA system with a new one has been performed in such a manner not to disturb the operation of the existing systems and facilities. Communication paths and protocols have not been replaced and all the facilities remained connected to the existing systems at all times. Therefore, the dispatchers could perform their everyday jobs on the existing system without any disturbance. The new system was not put into operation until it was completely tested and implemented and until the dispatchers were well skilled to work with it.

2. HARDWARE AND SOFTWARE UPGRADE

2.1 Hardware

During the project new hardware made by Hewlett Packard was delivered. Figure 1 shows a block diagram of the new SCADA system.

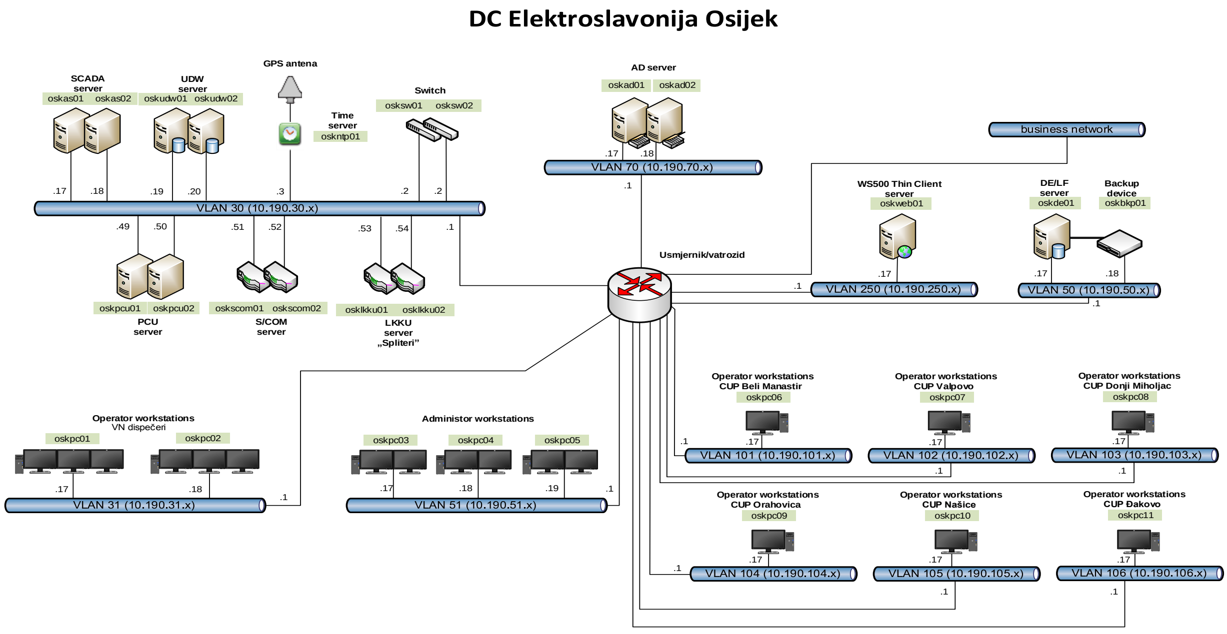

Figure 1 Block diagram of the new SCADA system at Elektroslavonija Osijek

New hardware system components (not existing in their current system configuration) on which part of functionality of the new SCADA software is distributed are the following:

- Active Directory servers – servers intended for user account control; and
- Process Communication Unit (PCU) 400 servers – communication so-called front-end servers.

A device for storing of a failsafe copy of the complete SCADA system is integrated in the system as well. It autonomously takes care of storing the data on magnetic tapes as well as replacement of data storing tapes from the tape internal warehouse.

2.2 Software

Upgrading of the software indispensably comprised implementation of a new appropriate software. Computer Operating Systems in the new SCADA System have been upgraded to new versions in accordance with Table I while the Data Engineering and Utility Data Warehouse data bases are based on the most recent technology of Oracle Data Base.

Table 1 Existing and new SCADA system Operating Systems

Computers	OS (existing system)	OS (new system)
SCADA, UDW	True64 UNIX	Red Hat Enterprise Linux 6.5 64b
PCU400, Web, DE	Windows Server 2003	Windows Server 2008 R2 64b
Operating stations	Windows XP	Windows 7 64b Pro

The new version of SCADA system gives great attention to the failsafe aspect of the system itself. The usage of already stated AD servers is implemented to manage user accounts within the complete system in just one place. The Project has also implemented failsafe technologies such as Kerberos, a network authentication protocol that enables a high security level of authentication for client/server oriented applications using a "secret" key cryptography, and LDAPS - Lightweight Directory Access Protocol over SSL - Secure Sockets Layer, an application protocol for access to directory services also using a cryptographic form of communication, etc.

The existing SCADA system software has been upgraded from version 2.3 to version 6.4 enabling the Employer to work with a whole range of new and enhanced functionalities. Some of them are listed below:

- Counting of events in the alarm list as well as in the event list on the basis of various criteria (priority, etc.);
- User friendly lists – alarms, events, chronology (sorting, filtering, easier creation of own filtered lists, export to Excel files, etc.);
- Dynamic Contour Colouring on the basis of measurement levels: clear and intuitive visualisation of voltage disturbances;
- Advanced Real Time Calculations – user oriented interface for defining complex calculations on real time data and historical data based on the MATLAB software package;
- Tabular presentations – software module that enables users to define complex interfaces based on real time data: list extracts, positioning in a certain queue, defining of the display size, hiding of selected columns, etc.;
- Multilanguage support;
- Numerous "smaller", but important novelties (permitted manual entry without blocking of data collection, possibility to configure an alternative data source for individual indications, etc.);
- The number of characters for EXTERNAL_IDENTITY parameter has been increased to 40, while for the IDENTIFICATION_TEXT it has been increased to 60;
- Redundant DE server functionality, etc.

3. SIMULTANEOUS OPERATION (MIGRATION) OVER LKKU

3.2 Principles

Končar has developed its own in-house solution for the needs of the migration process (the transitional period during which simultaneous operation of the existing and the new SCADA system is required) and to solve the problem of existing remote terminal units that do not have a possibility of a simultaneous communication with more than one supervising center – a so-called splitter device that splits the communication channels enabling the simultaneous provision of process data to the existing and the new SCADA system. A method of process data simulation has also been developed. It can serve as an alternative or supplement to live tests, i.e. to simulate process changes on the remote control equipment or in the process itself.

The advantages of the Končar migration solution are as follows:

- A high safety and availability due to a redundant server configuration;
- Undisturbed monitoring and control of the electric energy distribution system;
- No changes on monitored facilities;
- Testing of visibility of all data from all the facilities in the new centre;
- A time period for getting used to the new SCADA interface/system;
- Savings, shortening of the transitional period: testing of the new system data base with the simulation method.

3.3 Lkku Splitter

The Lkku Splitter is a computer with the function of a channel splitter for the IEC 60870-5-104 protocol (simultaneous providing of the existing and the new centre with the process data collected from the RTUs). It is based on the Linux Debian distribution which is an extremely wide and stable (conservative and largely supported) distribution. The Splitter is made as a Linux *daemon* dependant exclusively on standard Linux libraries and if needed it can be adapted (regarding scripts and integration) to operate on any Linux distribution and architecture. The minimum hardware configurations depend completely on protocols and the number of channels (amount of data), but almost all modern embedded x86 i ARM platforms are usable.

The main user access possibilities are:

- Undisturbed access through a Web interface (e.g. Internet Explorer/Mozila Firefox, etc.);
- Remote ssh access (e.g. PuTTY-em, Xterm/UTF-8) and sftp/samba;
- A local terminal (monitor + keyboard) and transmission of files from portable discs.

Functions accessible from the Web interface are:

- Check of the status of individual channels and LKKU in dual operation;
- Switching on/off of individual communication channels;
- Review of log files;
- Order to reload;
- Order for a temporary interruption of operation and restart;
- Order to lock / unlock of installation partition disc;
- Order to reboot.

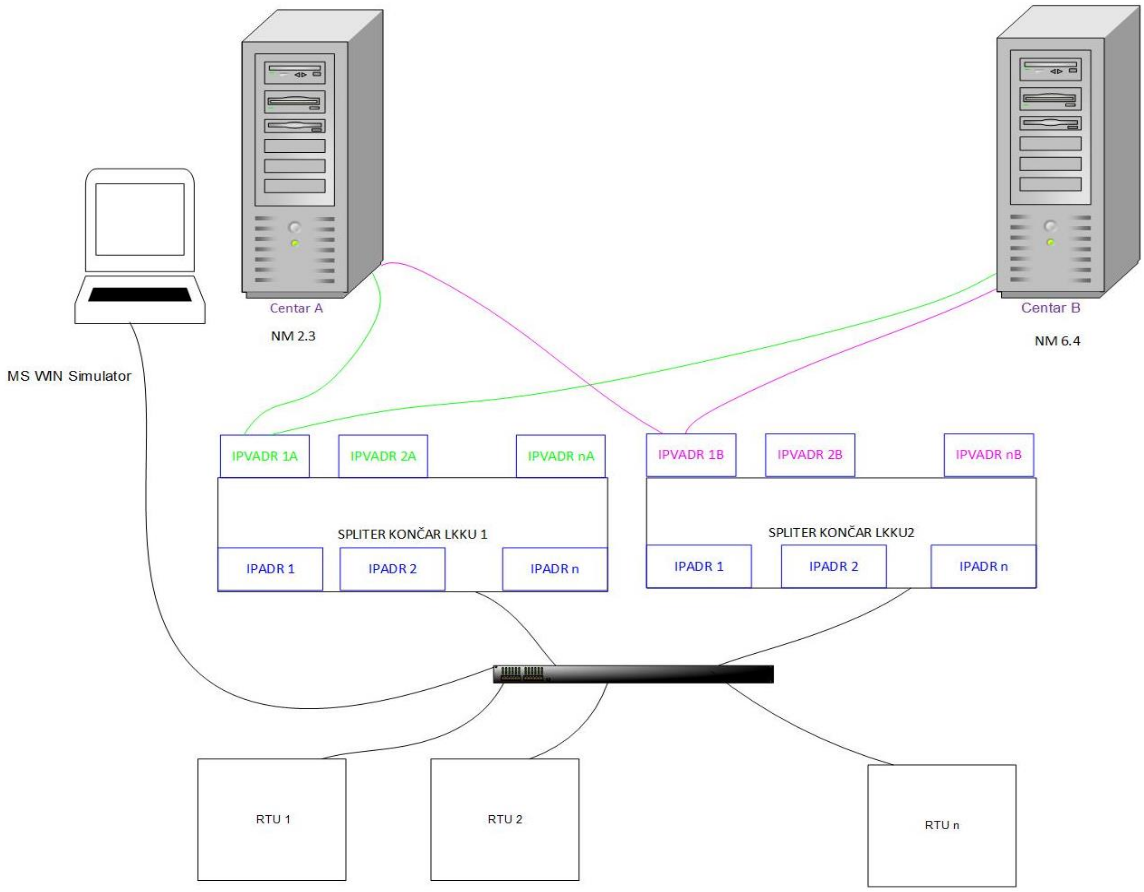

Figure 2 Lkku Splitter logical operating scheme

3.3 Processing data simulation possibilities

When the simulation is requested by the user, a message for a defined data point is generated and directed automatically to be processed to Lkku computer. It then forwards the data to the supervising centres. In that way the simulated data is shown simultaneously on single line diagrams and in lists not only in the existing system, but also in the new SCADA system. In this manner also the reports, calculations and alarm handling groups can verified. By comparing the data processing the data base entered into the new SCADA system is tested which includes the quality of all process elements such as indications, measurements and counters.

The preconditions for simulating process data are as follows:

- Data base print out (of a required segment, e.g. station) is used as a source of the existing SCADA system data and it is entered into the software for table calculations and adjusted for testing;
- A simulator computer with MS Windows operating system that communicates with the Lkku computer over a LAN segment.

4. CONCLUSION

The Paper presents a description of the project of upgrading of SCADA software or Elektra Zagreb and Elektroslavonija Osijek electric power provider remote control with a special emphasis on Končar in-house hardware and software solutions.

During the project the SCADA system database was migrated from the old to the new SCADA system which resulted in significantly reduced data engineering efforts with the most time being spent on the data engineering needed for the functionality that didn't exist in the old SCADA system.

The parallel system operation (which today is one of the basic requirements in projects like this one) was implemented using Končars in-house device and software (LKKU) which enabled simultaneous provision of process data to both centres. This method of working greatly reduced the efforts needed to perform the point to point tests especially since most RTUs could be tested using the simulation software option on the LKKU with only commands being tested from point (SCADA) to point (if not possible to do send commands directly on the supervised equipment then to the output module of the RTU).

5. BIBLIOGRAPHY

[1] ABB: „NM Rel 6“, 2015.

[2] ABB: „1KSE401716D5_en_Koncar_HEP_DMS x4 Upg_Implementation Specification“, 2015.

[3] Končar-KET d.d.: „Nadgradnja SCADA sustava u DCV Elektra Zagreb i Elektroslavonija Osijek“, Izjava o radovima, (Upgrading of SCADA system in Elektra Zagreb and Elektroslavonija Osijek power provider remote control centres, Work Statement) 8360-53-15-0045, 2015.

[4] KONČAR: „LKKU korisnički priručnik“, 2015 (LKKU User Manual)