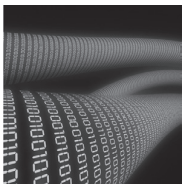

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System of Monitoring, Visualization and Alerting the Safety of CNS Devices for Polish Air Navigation Services Agency

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ABSTRACT
The paper presents a process of development and design for the Polish Air Navigation Services Agency system of monitoring, visualisation and alerting the safety of CNS (Communication, Navigation and Surveillance) equipment located in Radio-Communication Centres (RCC) in Poland. General concept of the transmission network, architecture of the system and key tasks performed by the system are presented. The headquarters is based in the Air Traffic Management Centre in Warsaw, while the other branches are placed in RCC of PANSA in Działoszyce, Konin, Krotoszyn, Przedbórz and Tarnobrzeg. IT System, discussed in the document, is implemented as a distributed system covering above locations. The entire system is designed to operate as a Client - Server - Database. The system has open and scalable architecture that allows to easily adapt to the new and variable requirements in a very short time. The basic purpose of the system is to monitor and control the parameters of technical security devices, power supply, ventilation and air conditioning as well as elements of the digital tele transmission network [1].

KEYWORDS: monitoring system, visualisation, CNS security

1. Introduction

OpenEye SCADA by WASKO S.A. is the fifth-generation system that has been continuously developed since 1999. It is positioned as an "umbrella" system, responsible for monitoring and collecting information from various active systems and devices.

The OpenEye system has a wide range of applications such as SCADA, BMS, SMS or NMS class system. Thanks to openness (open API) it can integrate with industrial controllers, control panels (e.g. IDS, AC, SSP etc.), devices and IT systems [2].

The solution provides flexible management of objects and their connections and also allows for an extensive management of users and their authorizations. The device configuration is simple thanks to the use of mechanisms for creating templates or entire template panels. Thanks to such features, OpenEye is a very attractive tool for user self-customization.

Communication with devices takes place by using dedicated agents that ensure effective data acquisition and control from devices. The agent has an extensive set of translators and plugins that provide support for communication protocols, such as OPC, SNMP, Modbus, EtherNetIP, ICMP, REST, SQL and many others devices or external systems specific to individual groups.

The system has the ability to define automatic actions that are triggered by the state of the monitored infrastructure. As a part of automatic actions, it is possible to control devices or perform interactions between various external systems, which opens up huge integration possibilities for the system user. It also allows to combine process information with business information, which makes it an excellent tool dedicated to both engineers, dispatchers and decision-makers. The OpenEye version 5.0 provides a web interface.

2. Technical solution on RCC

In a single RCC location the designed installation enables to integrate signals and alarms with external IDS (Intrusion Detection System) and Fire Detection System control panels through alarm outputs, and additionally thanks to the ETHM-1 interface via the TCP/IP network.

The BMS installation was designed based on the WASKO's proprietary solution: MZS (cabinet management module). The module is connected to a temperature and humidity sensor module and operates on tested voltages (primary power supply and power supply from a stationary power generator). On the basis of the temperature readings, the module controls shutter, fan and heaters. Status of the fire protection switch will also be read. The expansion module is connected to the MZS module via USB and the MZS module is connected to the TCP / IP network.

The parameters read by the modules are checked in the browser as well as in the OpenEye SCADA application, the application will be able to read information sent by the air conditioning system (ModBus), the Intrusion Detection System, as well as collect information from the UPS and stationary power generator.

The OpenEye system will provide the end user with a modern user interface built in accordance with the UX Design approach and data separation due to the role assigned to users and a number of access rights to monitored objects and data visualization in the form of configurable dashboards. Dashboards allow you to compose views dedicated to the individual needs of the Ordering Party, using ready-made, configurable elements placed on the screens. It is also possible to prepare diagrams of devices and breathe life into them by linking the parameters obtained from end devices and their active visualization, presentation of objects depending on the values of the assumed variables or placing active elements that allow you to control the device. Another noteworthy feature is the ability to drill down into patterns (going from general to detail), dynamic transition between dashboards.

Key functionalities:

- flexible approach to device configuration,
- generation of alarms,
- the ability to control devices,
- visualization in a flexible way through configurable schemes and dashboards,
- visualization on maps,
- support for many communication protocols,
- report generation

Supported communication protocols:

- SNMP
- ModBus TCP
- communication protocol with the MZS controller

Based on the extensive OpenEye platform, the parameters of devices will be controlled in accordance with the Fig. 1.

The platform has been configured to enable full automation of processes of acquiring and processing measurement data from the new measurement modules mentioned above, with particular emphasis on alerting and notifying.

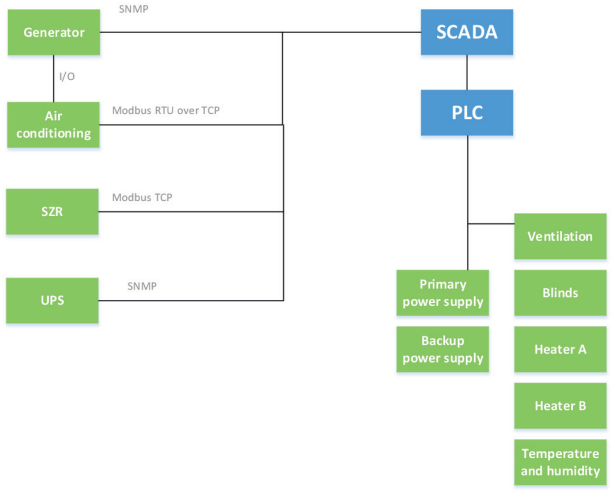

Fig. 1. Communication protocols to monitored devices [own study]

3. System architecture

The monitoring system was implemented as a distributed system consisting of nodes situated on the level of RCC (OR) PANSA and the central node in the Air Traffic Management Centre (CZRL) in Warsaw. The overall system architecture is presented in the Fig. 2.

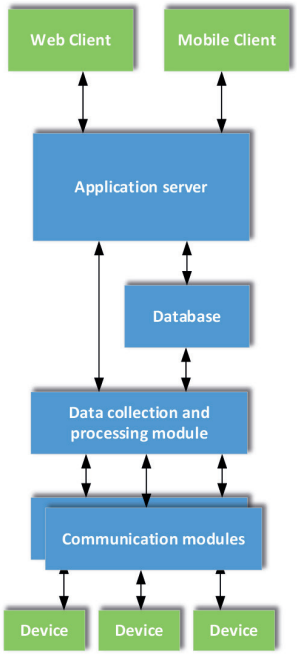

Fig. 2. The scheme of system architecture [own study]

The software architecture of the monitoring system allows to re-configure the network nodes system in no demurrage (hot swap), during production of the system. Such a mechanism will cause

that activation and deactivation functions of selected elements of the system in order to carry out the work, will service without stopping the operation of the whole system. This means that the exclusion of the application server or database will not cause polling and monitoring facilities via a communication module. In this case, the module will operate as an autonomous unit, implementing pre-configured tasks. After re-establishing communication with the application server or a database, the data collected will be completed in the database. In case of the absence of communication with the server, the data collected by the communication module will be stored in a specific time in the configuration module (min. 3 days).

The field locations also placed Workstations running the GUI client monitoring application (Fig. 3).

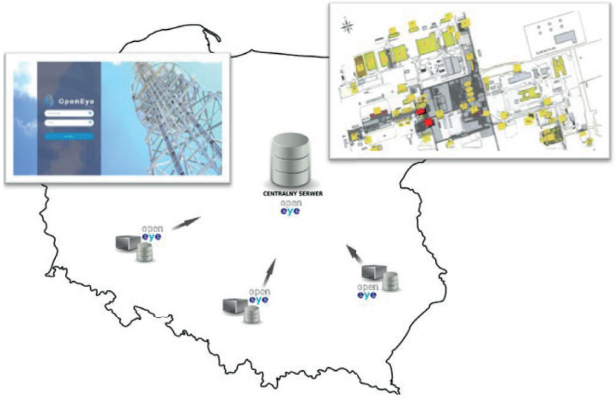

Fig. 3. A map presenting central monitoring system [own study]

Due to the operation of the system in the environment PANSA surveillance and monitoring system is equipped with mechanisms to ensure protection against unauthorized access and data loss prevention. The system is also equipped with a mechanism for the reporting of individual service or technical support or irregularities observed failure of the maintenance data. This mechanism indicates the occurrence of important system events to coordinate activities, review the case and conduct corrective action using the built-in tools to determine and automatically send encased event notifications or SMS notifications [3].

4. Graphical User Interface

The system is equipped with a Graphical User Interface, which allows to perform all operations related to both the operation of the system from the system operator and system administration (in accordance with their permission) – Fig. 4.

Fig. 4. GUI of monitoring system [own study]

In all locations, both local and centre which placed Workstations running the GUI client monitoring application. The console GUI application allows to configure and monitor the work of all application modules and components of the system.

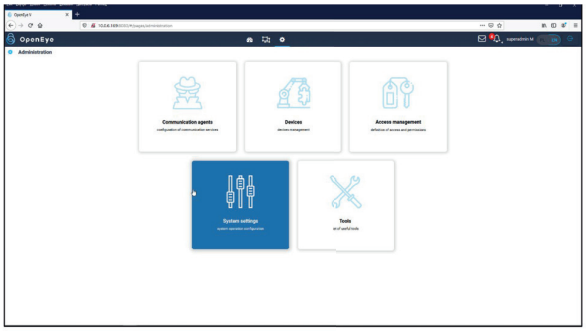

Fig. 5. Administration of monitoring system [own study]

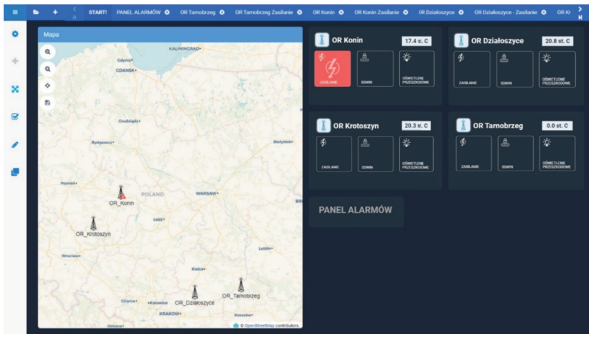

Fig. 6. Map view of monitoring system [own study]

Meeting the requirements of the PANSA system has been equipped the opportunity to present and create patterns defined and developed IT infrastructure for the entire area.

The system allows for the presentation of graphs that characterize the state of the size of monitored infrastructure objects in the form of:

- Numeric values,
- Charts,
- Tables of values,
- Animation dependent the parameter values,
- Indicators (bar, wheels),
- Maps,
- Alarms and Events panels.

5. System functionalities

To meet the basic purpose of the system (monitoring and controlling the parameters of technical security devices, power supply, ventilation and air conditioning) WASKO developed and implemented dashboards, panels and system tools of OpenEye SCADA.

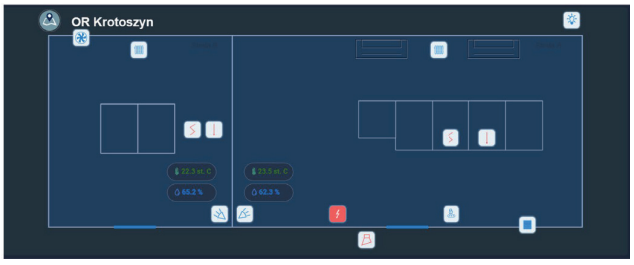

Fig. 7. Main technical view of RCC [own study]

SCADA system monitors different types of objects/devices of Radio-Communication Centres.

Intruder and burglary alarm system (I&BAS):

- the status of alarm zones is monitored in terms of: alarm, tamper and disarm / arm,
- the system enables remote arming / disarming of a zone after entering a pin number.

Fig. 9. I&BAS [own study]

UPS guarantee power supply system:

- device operation mode is monitored,
- input / output / bypass / battery parameters are monitored.

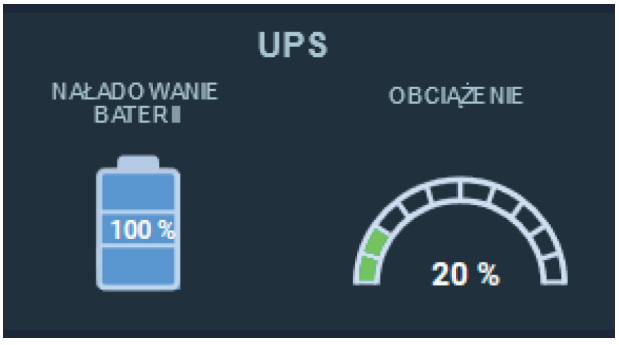

Fig. 10. UPS [own study]

Power monitoring:

- device operation mode is monitored,
- input / output / bypass / battery parameters are monitored.

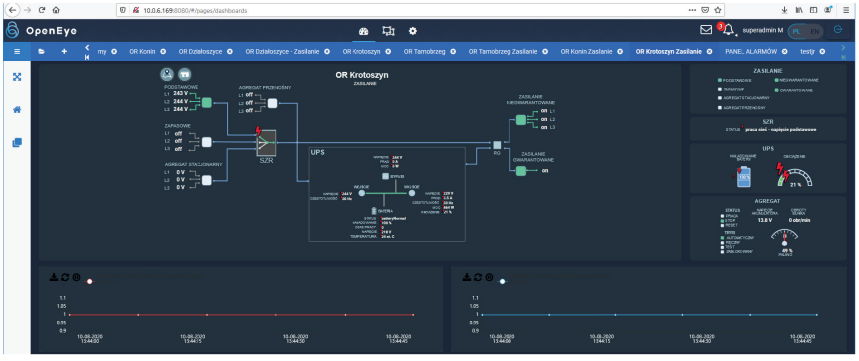

Fig. 8. Power supply view of RCC [own study]

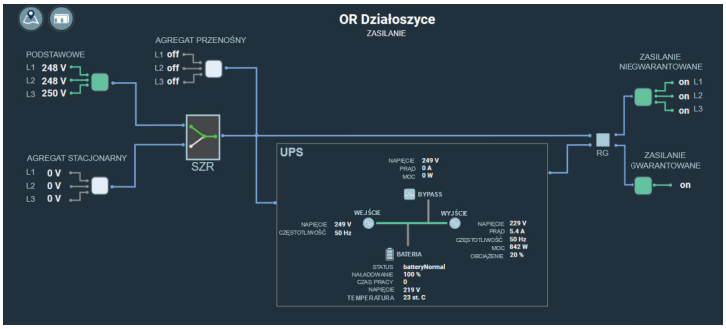

Fig. 11. Power monitoring [own study]

Monitoring HVAC (Heating, Ventilation and Air Conditioning):
- device status (on/off/alarm)
- Set/Actual Temperature

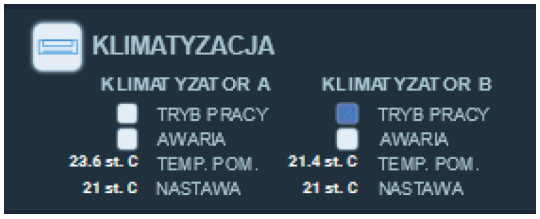

Fig. 12. HVAC- Air Conditioning [own study]

Obstruction lighting operation monitoring:
- device status (on/off/alarm)
- type of power supply (AC/Battery)

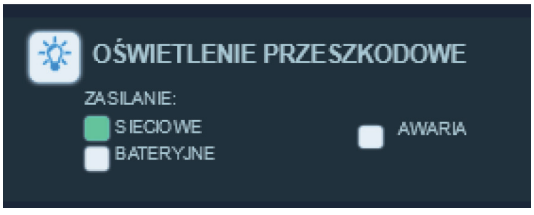

Fig. 13. Lighting operation [own study]

Generator set monitoring:
- device status (on/off/alarm)
- Battery voltage
- Amount of fuel
- Engine speed

Fig. 14. Generator [own study]

Automatic ATS reserve switching on:
- type of work

Fig. 15. ATS [own study]

6. Conclusion

The WASKO Supervisory Control and Data Acquisition System, called OpenEye, was created to protect and secure industrial installations that require the highest level of security.

Operators can monitor distant Radio-Communication Centres behind the monitor of the computer, tablet or smartphone. All they need is a device with a web browser.

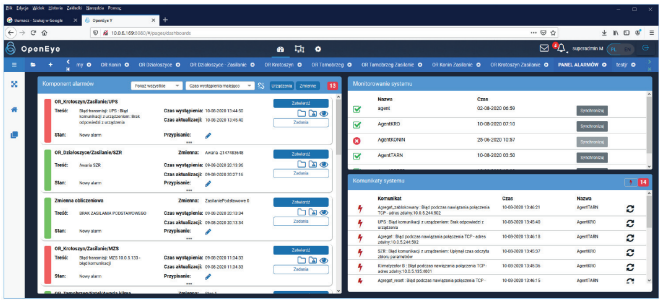

Fig. 16. Alarms and Events panel [own study]

Ability to remotely arm / disarm intrusion and robbery systems. Archiving of collected measurement data. Full log of operations.

The main advantage of the OpenEye system is the monitoring of extensive architecture in one place, without the need of traveling to locations [4]. User will know about the failures even if he is not at the location – the sooner the problem information will be known, the faster it can be fixed. Improvement of air traffic safety in the area supervised by PANSA has been achieved.

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