INTEGRATION OF IT AND OT SYSTEMS: AN EFFICIENT DATA SHARING BETWEEN SCADA_DMS, GIS AND ENTERPRISE APPLICATIONS

ABSTRACT
The proposed paper takes place in the frame of the CIRED 2015 conferences and addresses especially the topics dealing with “techniques to improve operation efficiency” and “data management”. It addresses the benefits of System Integration for Utilities.

Reducing outage time and controlling costs are essential for Utilities in order to be highly competitive. Reliable and sufficient detailed data is mandatory for facilitating decision making.

As data are stored, retrieved and used by different people, at different locations, the data can be modified or destroyed easily. So, system integration techniques are required for exchanging data between different systems and furthermore the elaboration of data exchange models and a time based synchronization between SCADA_DMS, GIS and Enterprise systems allows a better reliability, saving a significant time in data feeding activity.

The proposed paper develops the advanced approach that has been put in place by Romande Energie for the integration of IT and OT systems and for sharing data efficiently between the SCADA DMS, the GIS – Geographical Information System and the Enterprise systems.

INTRODUCTION
Romande Energie Group is the leading electricity distributor in Western Switzerland. Through its subsidiary Romande Energie Commerce, it supplies more than 300,000 end-customers directly in approximately 300 municipalities in the cantons of Vaud, Valais, Fribourg and Geneva. Its core business lines are the generation, distribution and marketing of power, alongside energy services.

Priorities are liaising with customers to ensure high-quality services in line with expectations: guaranteeing a reliable, sustainable and competitive supply of energy; developing proprietary power generation through priority investments in renewable energy; promoting innovative energy-efficiency solutions.

Romande Energie’s corporate social responsibility policy systematically guides its approach to business.

Romande Energie has implemented a new generation of SCADA including DMS functions in 2011, based on Lynx solution.

The GIS – Geographical Information System is based on the Autocad MAP 3D software which version has been up-dated in 2013.

The ERP of Romande Energie is based on SAP software, including the maintenance management module PM.

Up to a recent past, these applications where operated as independent silos, but as they are sharing the same data, for consistency and time optimization reasons, it made sense to design a new integrated architecture.

Historically, in Utilities, the GIS is usually the master repository for static network data, the DMS for dynamic states of the network elements and the ERP for the customers data and the maintenance information of network elements.

PROJECT CONTEXT
In 2012, Romande Energie has decided to develop an interface between the GIS and the SCADA_DMS Lynx in order to coordinate connectivity changes of the single line diagram of the Medium Voltage network in both systems due to daily works.

In 2014, Romande Energie has decided to develop an interface between the SCADA_DMS Lynx and the Enterprise software SAP to inform easier maintenance teams about actions to be performed at site in case of outage.

The benefits are effective and numerous. They are illustrated in the different Use Cases developed below, with the benefits drawn from the return on experience, especially regarding productivity, maintenance cost, ...
ARCHITECTURE
Thanks to the open software platforms selected for each application, the architecture has been built using Web Services, with XML files exchanges between SCADA DMS and GIS. One of the challenges has been the mapping of the Data Models of each system.

Then, the GIS operator prepares the modifications of topology and schedules the publication of each step.

Concerning the SCADA DMS, import of data from GIS is done in two complementary steps:

- From Sunday to Friday, new substations and switches needed for manoeuvring orders are imported and automatically appeared in SCADA DMS. Addition or withdraw of power lines is done by SCADA Operators through Lynx tools: temporary links, forced state... In addition, temporary symbols are available in SCADA DMS Lynx to underline stations ready to be in service but not connected yet.
- Every Saturday, a complete import is done, with definitive upgrades of all projects done the past week and new permanent power lines appear in SCADA DMS. The SCADA DMS operator has to check new lines and then erase temporary power lines used during the field works.

USE CASE 1: UPDATE OF THE MV NETWORK REPRESENTATION WITH DATA EXCHANGES BETWEEN SCADA DMS AND GIS
Specific tools are needed to correctly manage evolution of the topology for the Medium Voltage network. These tools have to insure a permanent safety and security for the power network and people working on it. A connection between SCADA DMS and GIS is relevant to achieve these safety and security targets: through data exchange between GIS and SCADA DMS, the system control operator has always an up to date picture of the power network (switching status, connectivity...) with a perfect consistency with the real state of the power grid.

The following description deals with the implementation performed by Romande Energie and Atos Worldgrid, interfacing the GIS MAP 3D 2013 and the SCADA DMS Lynx.

Operation processes in Romande Energie
At least ten days before field works, the project manager has to fill two forms:

- **Notice for modification**, which describes the reason of the modification, details the impacted substations, gives the date of the modification and gives a diagram of the target architecture.
- **Switching orders**, which details all planned switching operations during the work, with associated time of execution.

Technical aspects
All exchanges between GIS and SCADA DMS described above are done using XML files.

Benefits
The main benefits of data exchanges between GIS and SCADA DMS are:

- The MV single line diagram is only drawn once, by the GIS operator.
- The SCADA DMS gives in live the exact representation of the site situation for the whole duration of the works.
- Safety and security are maximized: SCADA DMS pictures are always up to date.

Example
An example of automatic upgrade of stations and switches in SCADA DMS is given in figure 5.

Figure 2 shows the first step of the process with the “notice for modification” form transmitted to the GIS operator; Figure 3 shows the network representation after modification drawn by the GIS operator; Figure 4 is the Lynx display of the network state before modification; Figure 5 shows in bold blue the temporary lines drawn by the SCADA operator.
USE CASE 2: FIELD TROUBLESHOOTING MANAGEMENT WITH DATA EXCHANGES BETWEEN SCADA DMS AND ERP

In case of events hitting distribution power grids, data exchange between SCADA DMS and ERP can optimize the troubleshooting process. Thanks to exploiting and crossing the complementary data from both SCADA DMS and ERP, more efficiency and more safety during troubleshooting process are possible.

The following description deals with the implementation performed by Romande Energie and Atos Worldgrid interfacing SAP PM with the SCADA DMS Lynx.

Operation processes in Romande Energie

When an event occurs within the distribution power network, the SCADA DMS Lynx proposes a troubleshooting form. In this form, some blanks are filled automatically and others manually. Then, the troubleshooting form edited in the SCADA DMS Lynx is sent to SAP for troubleshooting management, i.e.:

- Time for solving the event,
- Management of the Maintenance actions

Technical aspects

Information from SCADA DMS is sent to SAP through web services.

Benefits

The main benefits of data exchanges between SCADA DMS and ERP are:

- The process starts on alarm occurrence raised by the SCADA DMS.
- SAP PM troubleshooting actions are based on real time data coming from the SCADA DMS.
Examples
The 4 following examples are those currently under implementation in Romande Energie, using the Lynx – SAP PM data exchanges described above:
Event Reported Form Lynx is a form which is automatically created in case of specific state modification concerning distribution power grid. Lynx operator can manually fill in some parts of the form, using drop-down menus or blanks. The events leading to a form creation are selected during the data configuration phase. When the form is fully filled, it can be saved, printed or sent. For troubleshooting management, the form is sent to SAP PM.

Event Reported Form Key Account is a form concerning large customers connected to the network. This form is created in the SCADA DMS, it can be created through two different ways:
- Automatically, when a large customers loose power after an opening of a circuit breaker;
- Manually, when large customers call the operator to signal power cut.

“ERF Key Account” uses the SCADA DMS data base to give maximum information.

Event Reported Form LV is a form which is manually created by SCADA Operator. When a customer calls to signal a power cut, SCADA operator asks the questions indicated in FD BT. Thanks to these questions and associated answers given by the customer, SCADA operators determines if the power cut is due to LV or MV outage, or if it is due to internal event. Only in the first case, Romande Energie is concerned.

Luminis Form is a form used to take notes when some people call about public lightning power cut.

NEXT STEP: RELIABILITY METRICS COMPUTATION
A new connection between SCADA DMS and GIS is going to be implemented by Romande Energie and Atos Worldgrid: the SCADA DMS Lynx will send information stored in the “Qualitension” module of Lynx to the GIS. This information is about MV power cuts, number of customers cut, duration of power cut for each MV/LV station. Using this information, the GIS will be able to compute all reliability metrics and the non-distributed energy.

CONCLUSION
Staff productivity has been improved: these new services help operators in their job, and the global process is optimized:
- Thanks to a more accurate representation of temporary connections and devices, network operators have a permanent exact reproduction of the state of the network at any point, on both SCADA DMS and GIS,
- Troubleshooting management is optimized with field data transmitted from the SCADA DMS to SAP PM.

Manual tasks are now automated, improving the service reliability.

One additional benefit is the ability to support the implementation of other applications in the future, thanks to the openness of the architecture.