A NEW OPERATION CENTER IN ELECTRABEL BRUSSELS : A GLOBAL APPROACH FOR OPEN SOLUTIONS, BUILT ON MODERN TECHNOLOGY AND ORIENTED TOWARD THE FUTURE

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SUMMARY

The project to put in place a new control centre was started at the beginning of the decade. The analysis of requirements demonstrated the necessity of adopting a global vision that was not only limited to remote control. Not only was the Distribution Management System aspect envisaged but also links with other projects in the mapping and logistics areas. To bring such a project to fruition, the choice of the Telegyr 8000 system, an open, modern and change-friendly system together with the partnership with the supplier is an appreciable achievement.

INTRODUCTION

In 1992, it became apparent that it was necessary to provide for the replacement of the SCADA (Supervisory Control And Data Acquisition) system at one of the 2 Network Control Centers (NCCs) that cover Brussels. From the outset the attitude taken was to consider this replacement within a global approach instead of concentrating only on the solitary aspect of remote control.

STRATEGIC CONSIDERATIONS

The first consideration was to examine the work of an NCC from the information flow angle. An NCC is a point where incoming information is collected before then being redistributed (dispatched) towards different "receivers" (outgoing information). At the incoming information level we have the information coming from the distribution networks (10 and 6 kV) via the SCADA, together with information from the operators (operations, faults, etc.), and from the transport level (36 KV – 150 KV). You have to add to this the information coming from the customers, from the emergency services, the police etc. These are notices of operations, disconnections, works, maintenance requests, etc.

The outgoing information is sent to operators, the customers, network managers, to the network itself. It includes information about the state of the network, instructions about breakdowns or works, remote control actions, miscellaneous information, etc. It is also necessary to take into account structural and organisational information made available to the operating personnel, i.e. network plans and diagrams, directives and other instructions concerning network switching, lists of personnel, data coming from customers management applications , etc.

It is therefore clear that the SCADA system around which an NCC is built, is in reality only a link in a much larger chain.

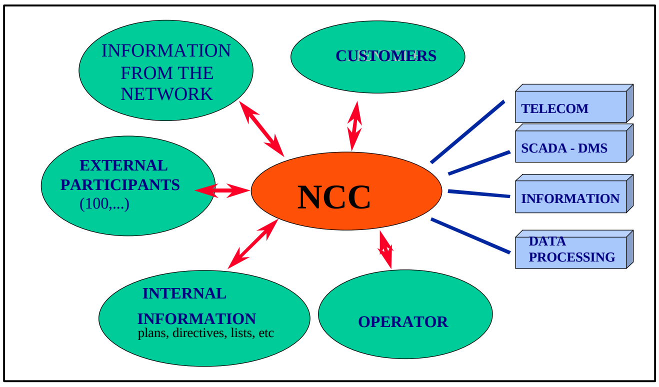


Figure 1 : information flow

During this initial phase it became apparent that, contrary to what goes on in other NCCs in Belgium, this one also has the complementary task of keeping the real condition of the network diagram up to date as events unfold. The people in charge of operations who are on the ground and not at the NCC inform the NCC of the network switching executed. So the people who work with the NCC are able to update the network diagrams in line with events, the state of the different switching elements (open, closed, …),

the state of the networks sections (in service, grounded, working…), etc.
In this way the NCC maintains the reference system for the actual state of the network.

In 1992 this reference system was kept in handwritten form with the aid of a series of diagrams done on Autocad.
A second line of approach allowed us to define a strategic point of view which had to deal with the renewal envisaged: obtaining an optimal quality of service to the customers is essential to ensure a commercial success. An NCC contributes to this by the support it provides to the operation and by controlling the distribution network efficiently. Strategically we came to the conclusion that the requirements had to be defined not only in terms of network, but also with reference to customers and information flow (cf. 1st consideration).

Therefore it became clear that what started out as replacing an NCC had to be extended to all the other activities of the business so as to end up with a consistent whole.

Meanwhile we had to guard against taking on a "mammoth" project which, because of its size, and the human and financial resources necessary, risked never seeing the light of day, losing its way during implementation, or being out of date before we had finished putting it in place.

What's more, what appears desirable is not always achievable in practice because you have to take account of emergencies and of different local requirements. In addition, as the project proceeds it is necessary to be able to integrate new requirements, technological developments that open up new perspectives that could not have been thought of at the outset, etc.
Clearly, it is important to have a sufficiently broad perspective to be able to foresee requirements of the future while remaining firm, realistic and pragmatic in short term actions. This therefore requires open-ended solutions, sustained by a long term strategy.

ANALYSIS OF SCADA AND DMS REQUIREMENTS

Analysis of the requirements was carried out on the basis of the functions that could be expected of a control centre and of the hidden implications in terms of functionality, of what solutions were possible in the light of the technology of the time (1993) and of its possible evolution.

Besides the fundamental function of remote supervision of the networks (SCADA), it appeared that other functions of the Distribution Management System (DMS) type had to be envisaged, such as :

- ➪ managing the network topology
- ➪ managing the network switching
- ➪ calculating the load flows in the network

To these we have to be able to add complementary functions such as :

- ➪ help in locating components in the fields
- ➪ collecting statistics
- ➪ managing the protections
- ➪ simulation
- ➪ managing the energy
- ➪ managing customer calls (outage management)

All this to be done in liaison with applications for the administrative of customers and for the mapping.

It is obvious that the project will have to be carried out in several phases : each of these will have to be implemented in a relatively short time while remaining coherent with one another, and in such a way as to lead rapidly to concrete results. In short, the project has to be manageable in terms of time and human scales.

Due to the urgency for replacing the SCADA system, taking into consideration the time limits imposed by undertaking calls for tender according to European directives, it was decided to bring out as quickly as possible a specification covering the commissioning (in 2 phases) of the SCADA and DMS parts, with the requirements that the solutions proposed be open towards the mapping and logistics areas among others.

Thus it was that the tender specification was published in 1995. This resulted in an order in 1996 with delivery of the SCADA part in 1997. Commissioning of the DMS part is currently under way.

LINKS WITH THE MAPPING AREA

In parallel to commissioning the 2 first phases of the project (SCADA and DMS) global considerations have been pursued and are currently under review again.

In the area of the geographical information systems (GIS) two important elements have come to bear on the thought processes :

- ➪ a detailed study of how the updating of the documents functioned in parallel with requirements demonstrated that it was preferable to divide the area of the geographical information into two sub-areas. The first, that of the detailed maps or positioning plans is designed for positioning the installations exactly on the ground (principally the cables). The time limit for updating is typically several weeks. The second deals with the series of diagrams, the series of general maps[1] and the associated technical data. The time limit for updating documents has to be short. In effect, an installation made available for network operation is obliged to be reproduced on the diagrams at the moment it is taken into service. It is evident that it is this last area that is strongly linked to the DMS in its schematic aspect, while not doing the work twice. In

[1] general maps at 1 / 2,500 with the networks location

effect, the GIS is the definition of the network "as built", while the DMS represents the network "as is".

➪ In addition, because of the evolving technologies, and the possibilities for extension offered by the SCADA-DMS systems chosen, new perspectives have appeared.

OBJECT ORIENTATION

The choice of the SCADA-DMS system fell on the TELEGYR8000 system (of Telegyr Systems Corp.) because, on one hand, the system complied with the specifications and, on the other hand, it offered interesting possibilities for openness towards other systems. Developed in object oriented (OO) technology around a 'CORBA' ("Common Object Request Broker Architecture") message handling system, it consists of a real time data base (DB) (of the OODB type, "Object Oriented DataBase") and of a source DB, both founded on a network model published and largely accepted internationally ('EPRI-CIM' "Electric Power Research Institute" - "Common Information Model").

For the record, here are some of the characteristics of the object oriented approach:

- this technology is applicable throughout the life cycle of a software package or an application : from the specification through to maintenance and support, including all the phases of production and commissioning,
- it brings solutions to extensive and complex problems allowing them to be broken down into small entities that are easier to manage,
- it also offers improved possibilities of changing the software packages to new requirements,
- it also lends itself well to the integration of existing systems, not necessarily written in O-O language.

It is recognised on the international scene as being the informatics technology currently appropriate to the solution of complex problems.

The TELEGYR8000 takes advantage of this technology, among other things, to facilitate the integration of new applications, linking with foreign information systems and managing evolutions in the system; and it does this without loss of performance or availability of the system, qualities indispensable for running electrical networks in real time.
The system offers a topological 'motor' powerful enough to respond to the demands of the users in general and to the network operators in particular, as well as providing an interface to external programs API ("Application Programming Interface") written in IDL ("Interface Definition Language").

The DB source of the TELEGYR8000, access to it and the services of data configuration are part of the tools of a modern GIS from Smallworld Ltd; they offer, among other things, coherent management of modifications to the DB ("Version Managed Data Store"), a flexible language for defining dialogues and functions ("Magik"), numerous gateways to information systems (GIS or others), efficient access to spatial information and a distributed and modulisable architecture.

It opens up interesting perspectives for linking to existing Electrabel systems (a large part of the series of diagrams is found on a GIS system of type GPG from IBM). The interfacing can be envisaged not only as a gateway between applications, but above all as better integration and a greater transparency of the system in the working practices of the business.

A OBJECT ORIENTED BASE MAP

The interest is again reinforced by the fact that since the beginning of 1999 Brussels region has had available the basis of a regional land registration plan that it has developed itself using an object oriented architecture. This enables it in effect to envisage putting in place new functions like locating calls more easily, locating vehicles (via a GPS system) etc.

If you think of the potential links between a call managing system (TCS – Trouble Call System) and the SCADA-DMS-GIS systems, this would enable you to respond rapidly to a client who telephones in with a breakdown. If you have his address, via the land registry information, it is possible to trace it back to a cable possibly affected by high voltage tripping, which would have been picked up by the SCADA and passed to the DMS which in turn is linked to the GIS.

LINK WITH THE LOGISTICS

On the 1st January 1999, Electrabel transferred all its logistics applications to a new business management system: R/3 (from SAP AG). If at first sight it is possible of dissociate the logistics part from the DMS part, the fact of having chosen an open DMS and on the other hand a modern system for managing logistics (jobs, maintenance, stock etc.) opens up interesting perspectives.

Indeed there are high powered gateways between SAP and Smallworld, which the DMS can put to good use. Even if this opens up interesting perspectives at the GIS level rather than with the DMS. Actually, because of the way SAP works, allowing us to easily create a data bank of the technical characteristics, characteristics necessary for managing maintenance in SAP, the technical data bank for the equipment was implemented in SAP.

However it has been decided to define the technical data about the cable sections and the associated conductors together with their technical data in the GIS (with links to the DMS), because they are more oriented towards geography. It is evident that the two information systems have to be linked together sinds they are describing one and the same network as it has been built.

Regarding the data banks, it must be noted that each area needs information, sometimes different information, sometimes the same, about a certain element of the network. For example, for an electrical cabin, the SAP area will need administrative information and the constituents so they can connect with the jobs whether they be construction, preventative maintenance or repair work. The GIS area will need information so it can locate things. When it comes to the DMS area, it will need elements for connectivity and operational state. It is important to take care on the one hand to avoid any double data entry and on the other hand to create a link between data that are essentially the same. It is also necessary to be careful to put in place updating procedures that will guarantee the quality of the data.

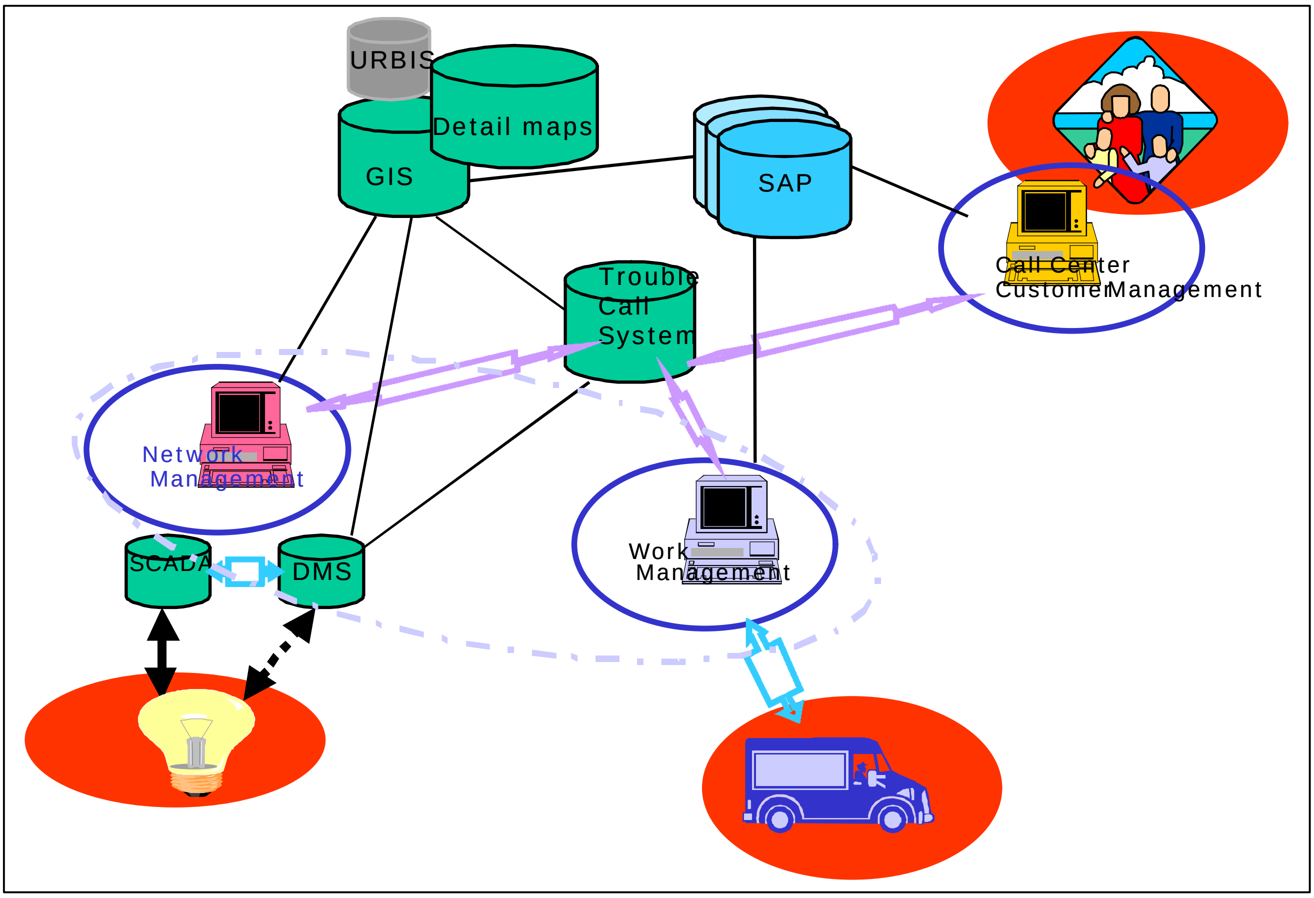
EXTENDED DATA BANKS

It is no longer necessary to consider GIS as software that is strictly associated with a data bank. The two can be separated. You have to consider a data bank like a coherent collection of graphical and not graphical information . The same data bank must be able to be used for different tasks to assist different applications in different environments. The same graphical information, a cable for example, can be visualised and modified in different environments (and therefore with possibly specific applications) : to study networks, positioning projects, preparations for operations or in the context of a Call Center.

The data bank must therefore be a coherent whole in which each element is identified by a reference.
In addition, the object-oriented nature of a graphical information data bank and the processing that can be associated with it, at the level of queries amongst other things, enables some very useful functionality: which part is fed by a cable or sub-station, along which cable is the client situated, …

COMMAND AND CONTROL STRATEGY

THE implementation of a new NCC must also be the occasion on which to reassess the command and control strategy.
In 1992, for the region of Brussels, all the primary stations and MT main cabins (MC) of the network were operated by remote control, the old system had however reached saturation and no further chance of extending it was possible.
An enquiry was held to define a development strategy suitable for the supervisory control system, not so that it could operate remotly "at any price", but with the goal of satisfying the criteria of optimal quality of service to the customers, more particularly in acting on the time taken to reinstate power in the event of a breakdown. It was evidently necessary to direct the strategy towards improving the re-supply when power was interrupted. The aim is to be able to "re-supply 80% of the load that was cut within 5 to 10 minutes".
Efforts to accomplish this strategy are being made in several directions : the design of the electrical network and the search for suitable RTUs and appropriate network equipment.



In the area of electrical network design, after the sub-station or MC (main cabins), there is provision for branching sections with a limited number of cabins (4 to 8) and equipped at each end with means of detection and appropriate remote control supply restoration.

On the ground this strategy translates as installation in some cases of DCs (with circuit breakers) allowing selectivity in case of a fault, with the remaining nodes being equipped with fault-current indicators and motorized interrupters.

In the end this led to an appreciable increase of the number of motorized nodes, hence the interest in an in-depth examination of the technology used for the motorization in order to obtain an acceptable cost/performance ratio. This analysis rapidly led to the following recommendations:

- the abandonment of the 110 V technology used in the primary stations and MCs in favour of a lower voltage (48 V)
- we have to search for small RTUs that have a good quality, price and performance profile
- to launch an investigation into the standard media of transmission that should be brought into operation to collect the information from a large number of geographically dispersed nodes
- to investigate the possibility of integrating customers cabins
- a measure of independence with regard to problems of ownership.

The principal characteristics required of the RTUs are the following : easy to install, possibility of checking 4 motorized interrupting units with fault passing indicators, 8 supplementary alarms, self regulating energy facility for supplying RTUs and interrupters and accessible to several media of transmission.

As regards the remote control transmission network, as a result of the current market, the choice falls for the present on switched networks with the Modbus protocol. Studies are under way to establish an extended information network (WAN) based on the "LON" technology with information concentrators linked to the control centre via a TCPIP network. Supporting the concentrators a second network using LON technology enables remote control to link with all the cabins using different media of communications, among others for example radio transmissions.

The LON technology comes in the form of a "chip" produced by the company "Echelon". All the modules that use this "chip" can communicate easily together using a coherent addressing system that allows them to consider the network as a single area.

It has to be noted in this area that the suppliers of remote control equipment still come up with proposals using traditional means of transmission (telegraphic cables, etc.), which nevertheless perform well. They are generally very suitable for nodes that carry a lot of information but less effective for smaller nodes. A little more innovation in this area on the part of the suppliers would be welcomed.

Another of the sensitive points for the implementation of a new NCC is the question of renewing existing protocols that are usually proprietary and of the difficulty of arriving at a sufficiently broad “universal” protocol. When renewing one part of the network, it was judged preferable to install a code converter in each existing RTU. This choice has the advantage of leading to a more coherent network (a single transmission protocol instead of 3 : 2 old ones and 1 new one) and of simplifying the necessary connections. For another part of the network, in contrast, it was decided to carry out conversion centrally. In short, for each network the solution that was the most suitable overall was chosen.
Using a more universal protocol avoids these problems of conversion and adaptation.

The experience gained with small RTUs, and the use of the Modbus protocol is proving quite positive. Several manufacturers are now using this protocol, which is opening up the market and more possibilities. The best thing would be to adopt a common, well defined protocol (870-5) which has a minimum of latitude for adaptation.

CONCLUSION

The approach followed, which was based in the beginning on an in-depth analysis of requirements, extended to the neighbouring areas of geographical and logistical requirements, led to a system that possesses an internal coherence that draws all the elements together in an interdependent way , resulting in a co-ordinated and unified performance. In such a system the integration and the interaction of the different elements is leading to new functions appearing that are proving interesting in the possibilities they raise for client-network links.

The approach of staggering the project, insisting on open, modern, adaptable systems while adhering to the concept of a global strategy, is enabling us to manage the introduction of the new systems within realistic time schedules and on a humanly envisigeable scale, at the same time maintaining an overall coherence and keeping our options open for the future.