INTEGRATION OF COMPUTER SYSTEMS FOR IMPROVED DISTRIBUTION SYSTEM OPERATION AND CUSTOMER SERVICE.

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SUMMARY

The paper discusses in general the problem of integrating various IT-systems with the distribution utilities in order to reduce costs and to improve customer service. As utilities are facing increased cost reduction demands from their owners, from the authorities and from the customers, it is expected that the utilities will consider a more integrated approach to IT-system acquisition.

The paper gives an example of integration between SCADA, CIS, and NIS illustrating that the NIS system could be used as a tool for implementing more advanced supervision and management at the lower voltage levels in the distribution system. This kind of integration should also be considered when it comes to introducing DA/DSM-schemes at these voltage levels.

Vattenfall evaluates the integrated system in a strategic pilot project called GotCom. Experience from this project is given in the paper.

INTRODUCTION

The overall objective for the distribution utilities is to minimise system costs while maintaining a certain power quality and service level. A general trend in the power industry is an increased cost reduction demand from the customers, from utility owners and from the authorities. At the same time the power quality should improve as well as customer service. Deregulation processes in various countries giving more public focus than in the past amplify this trend.

It is easy to cut costs in the power industry and the short term effects on power quality may not be that large due to the long time constants in the power system infrastructure. Utility customer service could deteriorate more rapidly if staff reductions are exaggerated.

The medium voltage (MV) and low voltage (LV) distribution system is responsible for a large part of the total transmission and distribution costs both when it comes to investment costs, operation costs and maintenance costs. And these voltage levels are also the main connection points for the majority of utility customers - the power quality connection point. In order to improve technical system performance, to reduce costs and to improve customer service, attention should be attracted to the lower voltage levels. The introduction of more advanced technology in medium voltage and low voltage distribution systems offers a large range of opportunities. But as system size increases towards the customer end (number of lines, cables, transformers, breakers, fuses, connection points), real time systems with a detailed distribution system representation will be rather costly to introduce. To renounce real time requirement in order to divide tasks between SCADA/DA/, NIS and CIS-systems is hence a worthwhile option to consider.

Vattenfall anticipates that success in meeting the challenges in the deregulated market is decided by its ability to use modern information technology (IT). The paper describes a pilot project called GotCom, which is Vattenfall's approach to find strategic IT solutions for MV/LV system operation and customer service.

UTILITY IT STRATEGY

Till now the acquisition of information systems have been a decentralised decision process i.e. that different departments within the utility have managed their local needs for information systems. IT-strategies for the utilities have been more based on co-ordinating hardware, operating systems, LAN, database systems, office automation. Links between different information systems have been described on a more functional basis, but how different information systems should collaborate to assist the utility staff in solving different tasks have been indistinct.

Developing a comprehensive IT-strategy has also been hampered by lack of focus from the utility management. The management has permitted decentralised IT-approaches and has evaluated IT-system procurement more from an investment budget point of view. Less focus has been on

- Total economic benefit for the utility
- Provision of adequate resources for commissioning (training, database establishment) and for operation and maintenance of the IT-systems.

Along with this, the development of computer systems has been largely influenced by active users and the creativity of system developers giving an increase in system functionality beyond practical needs for the utility as a whole. Prospective occasional system users find the systems difficult to use due to the overwhelming functionality. The systems have been more a toolbox for many different purposes rather than a workflow oriented support system.

Functionality has also increased as software companies see the possibility to implement new modules into **their** system as new trends and needs emerge, giving overlapping functionality between systems.

The new utility framework as outlined in the introduction, is giving incentives for IT-systems to be evaluated with respect to overall utility productivity giving less room for local decisions.

SYSTEM INTEGRATION

Another scenario with IT-system acquisition is that the utilities will exploit existing systems from different vendors to utilise their respective expertise. To wait for one vendor to develop THE SYSTEM solving all IT-needs for the utility is doubtful both from a resource and competence point of view and from a risk point of view. One large super system that covers everything from finance and debiting to SCADA and network calculations tends to be so complex that it collapses under its own weight.

Integration of computer systems is hence not a buzzword, but a meaningful key word for utility IT-strategy development. The development of the computer technology itself also supports the integration point of view with object-oriented system development and the availability of large, robust class libraries, COM-, DCOM-interfaces, ActiveX-controls etc.

To sort out which information systems to integrate, it is important to model how different tasks are being solved by the utility and to what extent different jobs are integrated. In what degree is the work formalised and is the organisation suitable for solving utility tasks using modern information systems? (It is expected that the organisations in the future will be heavily influenced by their information systems.)

Work process and workflow modelling are useful tools to describe and to understand the production process with the utility and evaluate integration between different work processes.

There are a number of systems that are candidates for integration:

- customer information systems (CIS)
- measurement value servers (MVS)
- accounting systems
- transmission and distribution network information systems (NIS) (geographical information systems, GIS, is a part of the NIS system)
- SCADA systems
- EMS systems
- power market trading systems
- DA/DSM systems
- materials management/ inventory systems
- project management systems
- human resources management systems
- office automation systems
- web/intranett services

The challenge is to find a cost-effective division of work tasks/ system functionality between the different type of systems.

THE GOTCOM PROJECT

Vattenfall is running the project through the local utility, GEAB, that supplies electricity and heating to around 36 000 customers on the Gotland island. The number of MV/LV substations is 2500. As Gotland is a sort of miniature Sweden, this location is well suited for such a pilot project.

In principle, the project consists of two sections - making the operations efficient and developing new services for customers, and is divided into three stages until the year 2000.
Stage 1, June 1997 – June 1998 involves the installation and system integration of customer communication systems (CC), distribution automation (DA), mains operation and documentation (i.e. network information system, NIS), customer information (CIS), SCADA, web and business support systems. The customer communication system will affect 5 000 customers in the Visby area.
Stage 2, June 1998 – June 1999, involves the further implementation of specific systems and CC solutions and DA for Northern Gotland.
Stage 3, June 1999 – June 2000, involves further introduction of CC and DA on Southern Gotland. When the project is finished, all of GEAB's customers will be connected to the customer communication system.

Figure 1 gives an overview of the GotCom system elements:

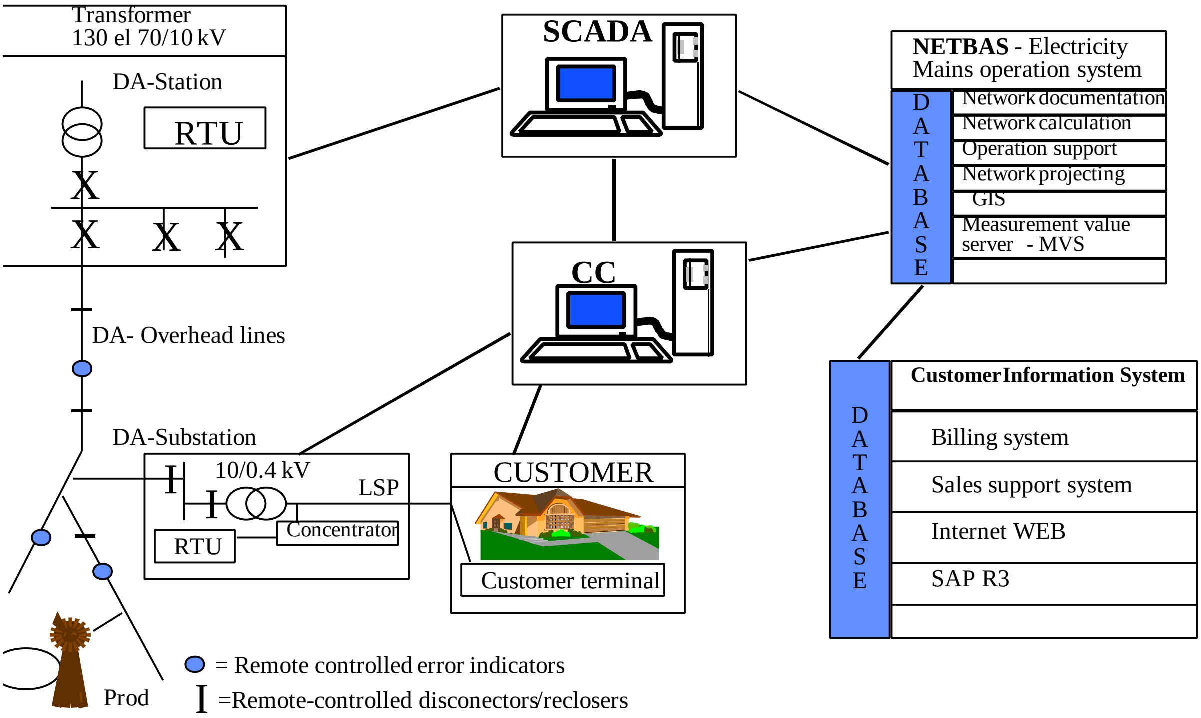

Figure 1: System overview

The SCADA system is connected to the NIS/Netbas Operation support system for the transfer of status of switches and remote-control disconnection switches/reclosers and measurement data. The SCADA system will update the Operation support in the event of status changes in the distribution network so that the Operation Manager (OM) has access to good and relevant information in his operation work. The OM can then analyse the error situation efficiently and take action to restart operations as quickly as possible. The OM will also have greater opportunities of informing customers and personnel in the company of the current error situation.

The SCADA system will be connected to the CC system for monitoring and control in substations at lower voltage levels, 10 – 0.4 kV. The CC system's communications interface will give us the opportunity to control disconnection switches in substations and monitor the temperature, load, etc. of transformers.

The main part of the NIS-system, Netbas, is a calculation and documentation system for the electricity supply industry comprises modules for

- Power system documentation
- Power system planning
- Power system maintenance
- Power system operation planning

For planning purposes a number of tools are available:

- Voltage calculations
- Load flow calculations
- Voltage stability analysis
- Optimum load flow
- Reducing power system losses/optimal switching schemes
- Short circuit calculations
- Reliability analysis
- Outage reports and fault statistics

The system database comprises more than 160 predefined component types, with separate attributes for each component type giving a total of more than 7000 attributes. Network configuration is also stored in database giving the utility the possibility of a comprehensive documentation of the power system (including high and low voltage distribution system). This database together with simulation tools **and integration with SCADA, CIS, GIS and MVS,** are the basis for implementation of and **operation support system**.

THE OPERATION SUPPORT SYSTEM

The module is supporting the task of two main actors during fault events (see figure 2):

Customer contacts
handling messages from customers, updating the database, providing information to customers about outage status

Operation manager
responsible for system restoration, describing events during restoration work (Outages, switching events..) by confirming status information reported from the SCADA system and by manual updating in Netbas database.

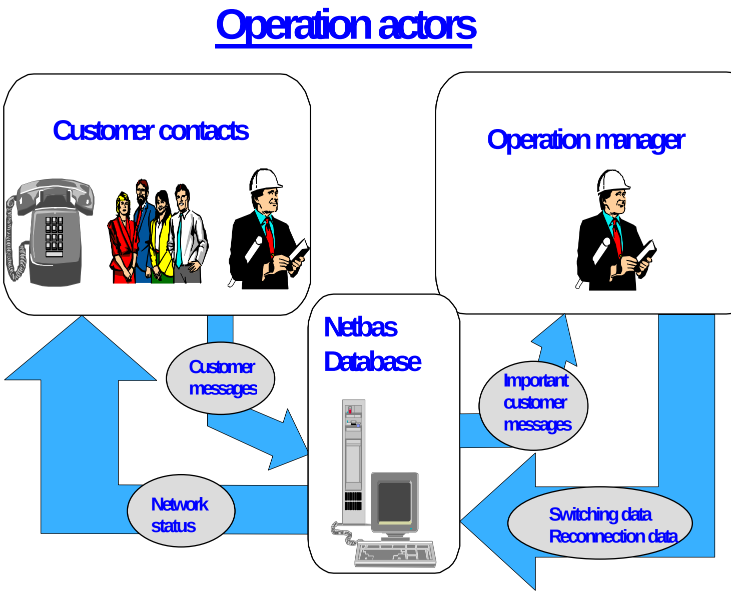

Figure 2 System overview

Customer contacts could be switchboard operators, dedicated personnel or telephone answering machine systems.

The present functions of the module are:

- Handling messages from customers concerning interruptions of supply
- Handling other information from customers related to interruptions of supply
- Providing information to customers concerning interruptions of supply
- Provide internal information to utility staff during fault situations
- Generation of data to fault and interruption statistic module
- Generation of various reports concerning de-energised customers (as basis for prospective customer notification)
- Providing switching orders

The integration of different systems are shown in figure 3:

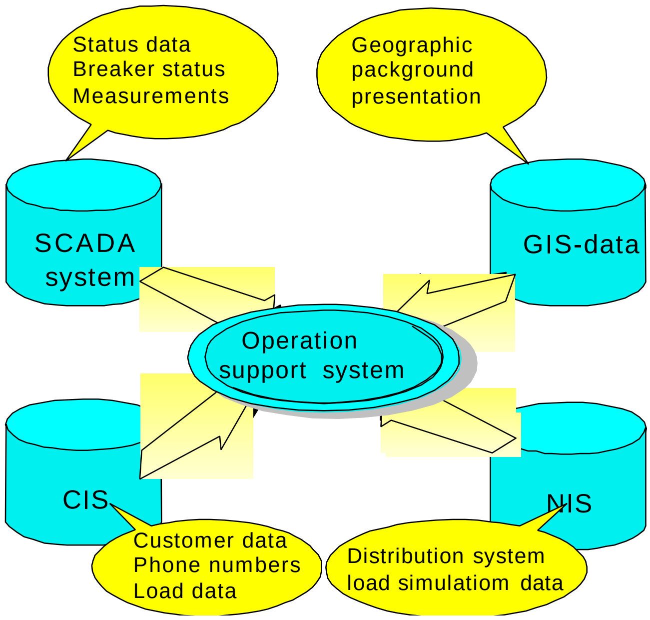

Figure 3 System integration

USER EXPERIENCE

16 weeks of operation experience of the system was available when this paper was written. During this period the distribution system has experienced 289 disturbances due to power system faults or planned outages. For each disturbance an interruption report is generated by the system for each MV/LV substation affected by the disturbance a part of the fault statistics reporting system of the utility. During the 16 weeks, 2532 substation interruption reports have been generated.

The experience so far has been positive both from a utility and a customer point of view. The difference in having the telephone answering machine system in or out of operation is substantial. The need for giving information to the customers manually is drastically reduced especially when the system continuously is updated with information concerning expected power reconnection. The operation manager is experiencing more time to focus on distribution system restoration and this was one of the main objectives for system acquisition. The improved customer service objective also seems to be fulfilled, but only a limited sample of customers has yet been interviewed.

CONCLUSION

It seems that it is now time to establish the basic requirements and architecture for the next generation of utility information and control systems. The view given in the paper is that a successful integration of different information systems both exploits investments already done and the expertise/specialities of different system suppliers, and hence is a fruitful strategy to consider.

Both utility and customer experience is encouraging. The paper is given to promote discussion concerning these questions; all the answers are not yet worked out.

REFERENCES

[1] T.Ingvarsson, T.Nilsson, G.Petterson, J.Söderbom, L.Gustafsson, L.Sandberg "Gotcom – Infrastructure for service development and network operation", in Proceedings Nordac 98 Nordic Distribution Automation Conference

[2] K.Sand "Integration of computer systems for SCADA/DA – The role of network information systems", in Proceedings Nordac 98 Nordic Distribution Automation Conference.