

WEB BASED SUBSTATION REMOTE MONITORING AND MAINTENANCE

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INTRODUCTION

The deregulation of energy markets is bringing about major changes in the Utilities, with new players involved in the network and increased quality and profitability requirements. To meet these new needs Schneider proposes web based solutions which provide an efficient and reliable share of the network information between all the players and which increase the quality of their services. This article presents the general architecture of these solutions (including customers advantages), describes the product designed for MV/LV substation monitoring and maintenance and shows the first results of field tests made with Utilities.

THE GENERAL EVOLUTION

The use of new technology and specially web technology in this new system allows it to provide more information, to a wider set of players, more easily, more flexibly, and with lower cost. This meets the new need of the network players facing deregulation and higher profitability constraints .

Indeed the expansion of communication network and the decrease of communication cost via the use of technology such as mobile phone allows to collect information from a larger number of electrical network equipment and so to have a more thorough view of the network. By this way the monitoring of most of the MV/LV substation, for example, becomes feasible at a sensible cost . As we will see later in this text, this is a crucial contribution to customer satisfaction increase, investment, operation and maintenance cost reduction.

In the same time connection to the web has become more and more widespread and cheap for all the network players. So information systems which use web technology are able to provide information to all the network players whatever their location (even for mobile people such as maintenance team during a journey) and whatever the date and time. This meets a new requirement of the electrical network player which can't be met by usual centralized information systems: sharing securely information between multiple persons belonging to several companies and spread out a wide geographical area. Indeed because of deregulation network management has been shared between several

companies which need common information to operate. Moreover higher profitability constraints has led electrical companies to delegate some tasks to sub contractors , these subcontractors who are out of the company site need real time information on the network to meet their contract. It has to be noticed that confidentiality and security constraints on the web are now met by mechanism such as Virtual Private Network (VPN), data encryption....

Furthermore thanks to web technology access to information is easier : standard tool for access by human, data transfer standard for information exchanges (such as XML) for access by application software. Indeed no special tool or software is required to get information from a information system based on web technology : a PC with a web browser to display graphical screen, a mobile phone to receive SMS when there is an alarm... the player use his usual tool without spending time to learn new one's. The same advantage exist for the player application software such as MRO (Maintenance and Repair Operation) software : data coming from the field can directly feed this software by using data transfer standard, there is no need for re capturing them or developing special interface.

All these progress in information access have been accompanied by a decrease of this access cost. As we already said there has been a drop in communication and web connection cost, but using web technology also cancel supervision software licensing cost for all the Human interface (a PC with web browser is enough), supervision software use training cost . Furthermore information system built on web standard modules are less expensive to maintain because of the widespread of these modules and their unceasing improvement.

Another characteristic of this new innovative system is flexibility : network equipment can be instrumented progressively allowing gradual investment and immediate return on investment.

CUSTOMER ADVANTAGES

Placing all this new information at all the actors' disposal allow to optimize significantly quality of service, maintenance efficiency and maintenance cost, network design, asset management and customer service.

Now, it can be offered to all the actors of the substation MV/LV real time data, which allows :

A) to optimize customer service

The operators of utilities have measurements of MV/LV substation cut-off times and voltage drop. It provides them with information about client service quality.

Furthermore voltage measurement makes it possible for them to act to readjust the substation voltage.

B) to increase equipment life duration and to limit on site intervention

The operators of utilities know the load of the transformers: this allow them to avoid overload and so premature aging of the transformer and on site intervention.

C) to optimize intervention time.

. When there is a problem the substation sends an alarm (for example over temperature of the transformer, overload or blowing of a LV fuse or Fault passage indicator) with some information for pre diagnostic. When they receive this alarm people of the maintenance team can have more information about what's happen in the MV/LV substation thanks to real time and historical data available on internet.. By this way they can prepare interventions with the right persons and the right tools.

D) to optimize the maintenance plan from the reliability and economic point of view

All the failures of the different equipment in all the substations are logged, this allows to adjust the preventive maintenance period according to the past observed failures and so to improve the reliability and the maintenance cost.

E) To optimize the investment

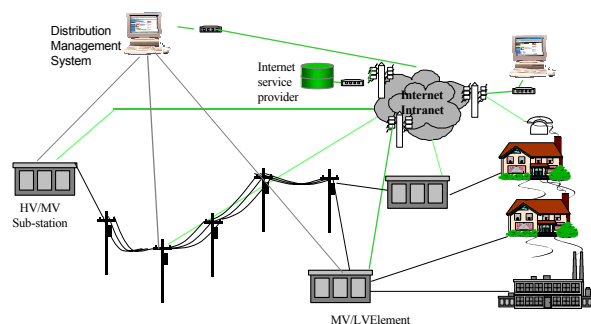
Utility experts, who are in charge of analyzing problems or giving directives for future investments are provided with an overview of the evolution of apparent power, in order to

- have a better understanding of the transformer load and therefore optimize its sizing.
- avoid unnecessary power changes and better adapt transformer power in order to optimize losses.
- determine evolutions in the load of a substation and make forecasts (vision of monthly peaks). This allows to improve network scheduling :plan the addition of new substations and improve wiring.
- identify of non-technical losses (fraud). In certain cases,

F) Optimize the investment and open the utility to new services for other systems like street lighting or fire detection and to edit quality reports on energy availability...

GENERAL ARCHITECTURE

This new monitoring system operates in parallel with existing information system (Distribution Management System) and rely on the following generic architecture:



The generic hardware architecture consists in :

- devices for data collection in the network equipment
- communication infrastructure between the network equipment and the server
- the server available from the web for authorized players : human or players application software.

Hardware architecture for MV/LV substation

The system comprises a remote unit called W200 in each distribution substation and a WEB server, called W500, situated on the user's intranet which concentrates information access. The Web server and the remote units are linked via the global system for mobile communication (GSM,GPRS) network.. This architecture allows access to data in the client Intranet.

Moreover, it allows access to data from internet for all the authorized users by hosting the W500 by a service provider on the Internet.

The W500 is a personal computer (PC), which is exclusively used as a data concentrator. The server is connected to the Intranet network via a standard Ethernet link. The maximum number of W200 used with a single W500 is 8,000.

The system, thanks to new Web and GSM, GPRS technologies, which are becoming less and less expensive, makes it possible to:

- inform the right persons when there is an alarm in a substation via an e mail or an SMS
- Display on the web through a PC with a web browser
 - Real time information from the substation
 - Historical information (capacity to show curves)

- Substation equipment characteristic
- Feed the utility application software (Maintenance and Repair Operation software) with data from the field thanks to data transfer in XML format.

Visualization of relevant data

The substation carries a W200 unit (in the LV switchgear) that includes three analog inputs for current measurement (three phase neutral is the summation), one analog input for voltage measurement, one analog input for transformer temperature measurement, six digital inputs (for alarms and events), three relay outputs, and a connector for local interface.

The archived information is adapted to substation supervision, and it includes:

- Power records covering 1 year (RMS and active power)
- Service cut-off (outage) alarms
- Alarms for temperature thresholds of distribution transformer
- Alarms for power thresholds
- Miscellaneous substation information (equipment, interventions, etc.)
- Records of input/output status changes
- Records outages and voltage drops.

For each substation, it is possible to display the following pages:

- Substation information page, which shows physical location of substation, type of equipment, maintenance operations, etc.
- Substation status page, which shows the status of the substation on the date of the last connection with the substation
- Event history page, which shows any change of status of one of the digital inputs and any exceeding of thresholds
- File loading page, used to download files contained in the remote management unit to the PC, using file transfer protocol (FTP).
- Configuration page, used to configure the remote unit.

In local mode, a connector providing a link to a laptop PC is sufficient, and the local display is the same as the remote one.

Simplicity of installation

Fitted into a small enclosure (250x160x65), W200 unit provides all function: MODEM, transducer, 240 AC supply, connectors, AC fuse and battery.

Easy to plug, the W200 can be installed quickly :

- The current sensors are split core CT connected directly on the bus bar.
- The voltage measurement is done on the same connector as the AC supply
- The temperature is a standard PT100 sensor

A progressive investment can be done by installing the W200 without GSM MODEM. The MODEM will be added gradually in the substations which require more attention.

The W500 is a software to install with a CD Rom on a standard PC (Windows 98, NT, 2000, XP). The PC requires an Ethernet card and a phone modem.

FIRST RESULTS OF FIELD TESTS

Results of field test have proved a strong interest to the MV/LV substation monitoring.

Field test have been recently started. It is too early to have comprehensive results. The first conclusion are the following concerning the customer analysis:

- The substations where the transformer is used at its limit needs a permanent monitoring. Transformers can exceed the current limit without any problem, but a long overload time in a high temperature can damage rapidly the transformer with a premature aging. This remote unit is a real improvement to secure the network. The first result of field test have proved that the W200 should be the right product to control transformers : no need to change the old transformer with a preventive maintenance policy.
- Facilitates substation maintenance operations and manages the equipment inventory without site visits
- Optimizes intervention time: the cause of the problem and its location are known; the relay dates and records outages so as to quantify their number and duration
- Offers the possibility to connect input/output for remote alarms adapted to client needs: fault indicator, door sensor, etc.
- Besides traditional distribution substation control methods, it provides the operator (in a simple and economical manner) with all information concerning the installations on his network (substation equipment, installation status, load curves, FPI) and in this way it notably contributes in the improvement of the quality of services.
- Simple installation is very appreciate : no need to get separate devices like power meter, transducer, modem, battery ...all that is embedded into one closure easy to plug.

The architecture evaluation has shown the following advantages compared with an architecture where a server is integrated into the remote management unit of each substation:

- Rapid connection: Data access is faster with an intermediate server, because the pages have been saved. In addition, the server takes care of the telephone connection.
- No security problems: Access is secured by the client's Intranet.
- Simpler configuration: The configuration of parameters common to all remote management units is undertaken by the server in a transparent manner, i.e., the e-mail configured to receive alarms does not have to be updated in each remote management unit.

□ WEB technology is high-tech but needs frequent upgrades : browsers of today will be not compatible with those of the future. It is why the remote unit with a web server embedded could be rapidly obsolete.

At a conclusion, this remote unit is a relevant tool to make network planning, to control the transformers, and to communicate with the Fault Passage Indicators. Besides traditional distribution substation control, it provides the monitoring of the MV/LV substations at a sensible cost with the WEB technology.