INNOVATIVE DISPATCHING SYSTEM BASED ON TCPIP FOR INDUSTRIAL AND UTILITY APPLICATION

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ABSTRACT

Modern industrial chemical processes require reliable electrical grids to assure in the end stable product quality, to minimize production losses and to avoid any environmental impact, even during power down of public grids. To assure the correct operation and monitoring of these grids a future orientated and flexible dispatching system project was realized, focusing now a second step.

The context

SOLVAY group is a worldwide operating chemical and pharmaceutical group with worldwide 30.000 people and spending for energy round about 630mio€. Inside SOLVAY's chemical sector, energy, either in form of steam or electricity, has an important role. Several of our plants have a total consumption and auto-production largely above hundreds of Megawatt. Most SOLVAY plants poses electrolysis rectifiers with power consumption in between of 100 – 200MW and are connecting power stations within several generator blocks, each up to 125 MW per machine. Those generation units are often constructed and operated in partner ship with electrical companies, wherein SOLVAY consumes mainly steam and a minor part of the produced electricity, whereas the electrical company feeds an important quote part of produced electricity into the public grid, mainly on high voltage level. These power plants comply very well with the spirit of green energy. Like the energy generation, the chemical production itself requires a reliable industrial grid. These grids are constructed for 24h over 24h use all over the year without any total shutdown option. The site internal transport grid is mainly based on a redundant 30kV level connecting several 6kV substations by a double radial structure. These strong 6kV substations feed big motors up to 10MW and –via transformer groups- low voltage motor grids. Similar to the continuously operated chemical process, the electrical grids feed their consumers (mostly principal + reserve engine) in a redundant way. This design is made in such way that the continuity of supply is granted whether in case of interventions or faults events. In particular cases a triple redundancy by emergency diesel groups is established to assure in any case a safe shutdown of production units. A protection philosophy with fast tripping times and backup strategy is mandatory to assure a good reliability, to immunize against major incidents and, if a once an electrical fault would happen, to limit destruction. This protection philosophy is realized by digital protection relays with integrated logical controls using hardwired busses for breaker failure control and blocking functions. The engineering quality of the concept is assured by modern engineering methods and tools.

Although these electrical grids transports and distributes an enormous amount of power, their extension is often rather small at 1-2km². Even strong switchboard materiel is used nearly up to the rated parameters.

Classical starting point

Foresaid industrial grids were in the past controlled by a "hardwire telemetered" mosaic control rooms or in few cases, by individually parameterized, manufacturer bound substation controllers. In spite of the protections relays, the other instrumentations were quite pure whereas automatisms existed. The one or other site tried over the year to install a manufacturer bound dispatching system. Often after few years the supplier explained us: *your system ran out off lifetime* …stressing important upgrade costs.

Our strategy

In the context of three network renovation projects SOLVAY decided to review his strategy of plant internal dispatching systems for energy distribution. Modern protection relays with integrated bay controllers should be connected to a dispatching system, naturally without forgetting the already installed "past".

We decided to use optical fiber grids and TCP/IP as platform for the telemetry communication by integrating a bundle of different telemetry protocols without further data compressors or nodes. Information reaches directly from the bay-level over the communication grid the servers of the dispatching system. Elder serial ports are integrated by local serial port servers and virtual com ports. The system was designed to be modular and scalable with integrated relational database. We removed the "classical" substation controller completely out off our scope, keeping only few hardwired "horizontal" logical links in between the bays and communicating bottom top directly with the dispatching. We saw that modern relays behave like data servers; consequently we parameterized those servers in such a way that they send only the required information to the control centre. The substation controllers of the past were removed and -surprise- safety wasl be increased by a better overview. The new design allows the use of mobile operator stations (laptops) on substation level giving during operation the same view as inside the control room; not only on the dedicated substation but even all around (topic: jumpers, cats and grounds).

The flexible system architecture was thought to support the integration of wide variety of different generations of field devices and RTU's. The open database structure should be usable for accounting- and energy management and allow interconnecting different SOLVAY sites by ICCP.

Having actually three systems in service, recently three systems were again ordered. In a third step a middleware solution is focused to realize savings by energy forecast, risks management and contracting.

Key-expectations for a new system platform

High availability and stability was the key objective. We decided to use redundant server architecture and to monitor consequently the whole system platform getting enough detailed information. The system software should allow doing all configuration work on our own in a well structured way and should support a central database.

Once having a dispatching system well tested running, the configuration data (telemetry data points, images, energy archive) of the whole grid represents a higher value then whole hardware and software licenses. For this reason we decided to use a standard database product, supporting complete and transparent data import and export. Main idea was to keep in future the database content and to upgrade when required one day parts like control centre software or database product.

On our own we developed a tool which permits us to set up a system even off line or to integrate routine engineering support by external partners. This tool uses the export files of configuration tools of the "intelligent" periphery and bundles the information content ready to import by XML into the main system. It supports flexible exchange of hardware components. The database setup is consequently typified. A once generated library supports fast setup, avoids a lot of setup errors and saves a lot of money on testing efforts.

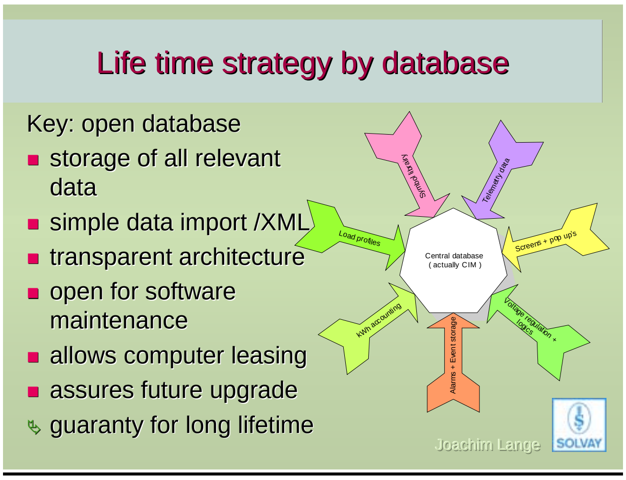

table 1: life time strategy by database

The system architecture is typified and based on standard, but reliable components. Central servers, raid disks, central switches and time server, as well as local power supply and UPS for the RAID are all together mounted inside two standard cubicles (delivered pre-tested and ready for energetization).
Mandatory for future components was the use of Standard Communication Protocols as there are IEC 61850, IEC 60870-5- family 104,103,101 as well as IEC CIM database model and Modbus.
Protocol 103 and 101 allowed connecting a lot of existing hardware, only in few cases it was required to use data converter (ILSA, SPABUS).

To immunize the system against electromagnetically field and induced voltages during fault events, optical fibre cables were consequently used.

The overall bus concept is very flat, redundant by fast spanning tree transfer and extremely fast.

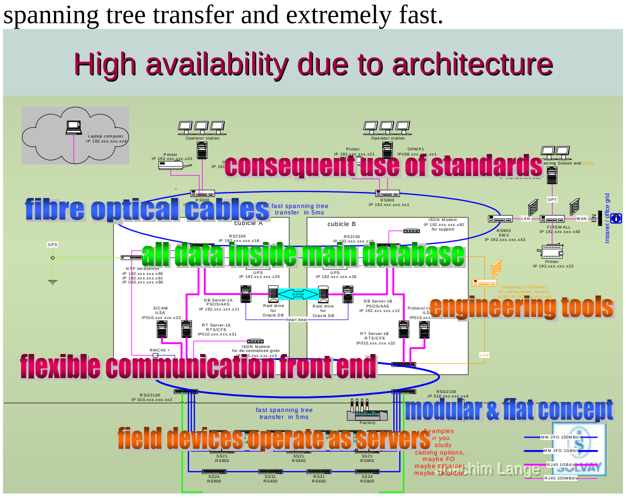

table 2 standard system architecture

Control centre main innovations

Consequent we used data sourcing out off the process-database (actually IEC CIM Model). The system architecture was designed consequently flat motivated by IEC 61850 and supports a very good time synchronisation of event lists by NTP central clock (fed by GPS). All serial communication is redirected over TCP/IP. The Communication grid supervision is monitored by SNMP.

Information network up to company intranet level is equipped with several safety precautions. For external alarming a SMS alarm server was integrated as well as a Web User-Interface.

TCPIP down to field device level (Bay controller with Protection) is consequently used. A fast spanning tree function of the switches assures as well as scaling of the port performance assures a redundant network.

Connecting a substation

Below you find an example of the TCPIP grid going down directly into the switchboards and connecting the intelligent bay controllers. Inside the substation switches with good EMF specification and DC supply out off substation battery are used, typically one switch per busbar.

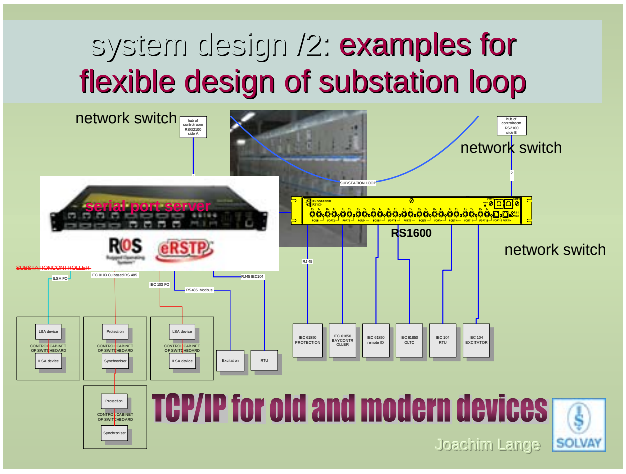

table 3 TCPIP grid down to baylevel

Telemetry data processing

The concepts allow the use of a large variety of different devices. To minimise testing efforts the communication port list of the periphery devices is exported and management by a tool we called the “device list”. This tool adds to the port information all additional required tags like alarm levels, switching behaviour, comments, and supports multiple reuse of typical once generated. Particularly this features allows us today to recopy a lot of once done work setting up a new system for another plant: series production!

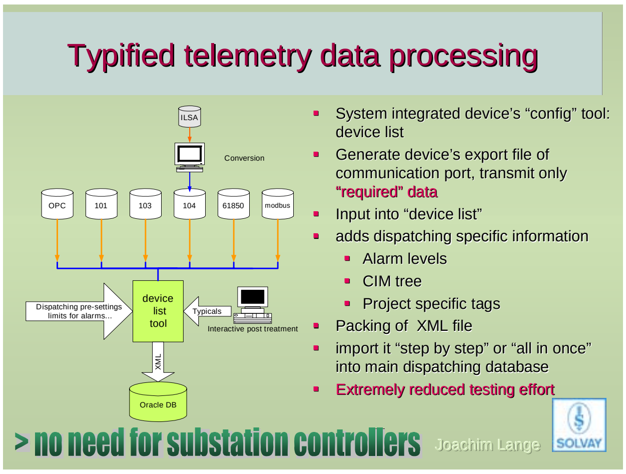

table4: telemetry data processing

Long lasting quality of the solution

On one hand side the SOLVAY concept assures an important autonomy from only one supplier. On the other hand side the new system is now a standard product with a design allowing an easy upgrade, either on computer level either on software evolution. Consequently we prepared an evergreen - contract within long-term software upgrade combined (inside Europe) with a computer hardware-leasing contract.

This won’t be possible without the essential lifetime key which is the relational central database based on a standard product. We had understood that inside larger systems the once spend engineering hours to generate the data is more expensive then the system itself.

Integrated energy tools

Actually the SOLVAY database integrates all data for load management and accounting. Each site system contains a load management and an accounting tool as well as a connection to the intranet.

Already in actual energy contracts the processing of reliable forecast data and the follow up of peak consumption plays a significant cost role:

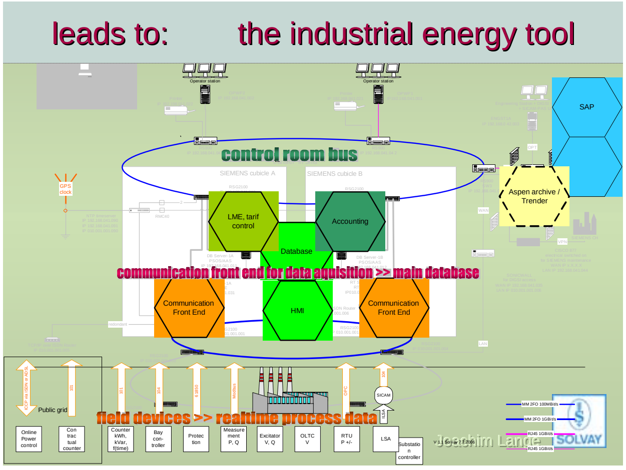

table 5: integration of load management and accounting

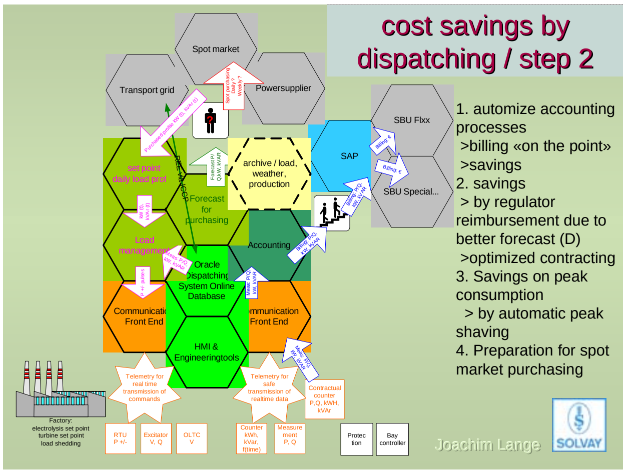

table 5: integration of load management and accounting

This concept is open to connect several sites dispatching systems to one central group system and to exchange in between the site systems some contract relevant parameters online via ICCP as well as data exchange with the public grid operator.

Applications

Running applications

- Torrelavega Spain (1rst, once updated after 3rd)
- Deven & SODI Bulgarie
- Martorell Spain

2006 Started projects: « production in series »

- Jemeppe Belgium
- Santo André Bresil
- Dombasle France

2007 4 international projects are in discussion

Perspectives

Having reached our dispatching target, we defined a second step to create our industrial energy tool, which shall monitor at once several sites in Europe. SOLVAY focuses a centralized energy management on European level in same way like an energy distribution company manages its regional grids.

The required intranet is already established.

This second step focuses connecting to a middleware solution with centralized programs like trending tools, long-term archives and links to SAP for energy purchasing. Required is a flexibility to realise online data exchange with an external power supplier or power consumer, as well as opting on energy spot markets. It is needed to manage forecasts, consumption, risks, peaks as well as “non consumption” and load shedding.