The Integration Hub Concept: Integrating Electric Utility "Best of Breed" Applications

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Abstract

Integrating new "Best of Breed" applications into existing utility systems can be a daunting task. Expensive custom software development, lengthy implementation time, and the subsequent headaches of supporting modified applications can significantly hamper implementing these applications, and hence, unfortunately, deter users from using such applications, in spite of the significant benefits that they bring. Using an Integration Hub to manage the "Best of Breed" applications can, in fact, eliminate many of the pitfalls traditionally associated with their use.

This paper describes the successful application of an Integration Hub that was installed at XcelEnergy North to integrate a centralized capacitor bank control application with real time feeder and capacitor bank information, as well as with capacitor asset information. The paper describes the concept and implementation of the Integration Hub, and the immediate and long-term benefits achieved by its installation.

Introduction

In January of 2001, XcelEnergy North initiated a project to meet its current and future needs related to controlling capacitors. The application to be chosen would need to fulfill the following requirements.

Business Requirements

- Support of both one-way (legacy) and two-way remote (radio) capacitor controls, since DMS and EMS both support different types of capacitors.
- Need to integrate Capacitor Control to a single platform.
- Need of enhanced control scheme and methodology.
- Accurate and timely reactive control essential.

User Requirements

- Operator selectable Var and Voltage Control at all levels, with automatic voltage override while on Var Control.
- All Alarms, both operational and error, logged in one place.
- Filterable reporting.

- Visual representation of feeders versus text.
- Generate Load Profile reports.
- Data Export Capability.
- Data Archiving.
- Database link between the capacitor system of record and the control system.
- User view (and secured control) outside the control center.

Maintenance (Analyst) Requirements

- Improved Maintenance Tools.
- Remote Access capability (Web) for diagnostic and on-call support.
- Operator notification and logging of field / Server communication failures.

Challenges/Issues

Existing DMS Communications

Communications to all DMS devices is through a SchlumbergerSema CellNet RF Lan. DMS EnergyLine Intelliteam units, capacitors, and switches communicate using the PG&E protocol, via radio at 2400 or 9600 baud to CellNet Cellmasters. The Cellmasters communicate to logical ports called Scadamasters that reside on Cellmanagers. Each field device is associated with a Scadamaster. External users wishing to communicate with a field device must know the address of the device and the Scadamaster used for communications. If the Scadamaster for a device changes, external access of the device fails until the new Scadamaster is known.

To facilitate external access to device data, a naming convention for Scadamasters was developed. The naming convention is

ServerX_nnnn

where X is a letter between A,B,C,D,E and nnnn is a port number. Servers A, B, C, D, and E were established to handle communications to the different Scadamasters: ServerA communicates with ServerA Scadamasters, ServerB communicates with ServerB Scadamasters. etc. Servers communicate with the field devices via PG&E protocol. The DMS accesses the specific server via Inter-Control Center Communications Protocol (ICCP) and the server communicates with the field device via the appropriate port.

CellNet Re-points

Communications with DMS field devices can be lost due to re-points by CellNet. Re-points occur when the Scadamaster used to communicate with a EnergyLine capacitor changes. XcelEnergy receives notification of field device re-points via a daily RTU status e-mail sent from CellNet. When the e-mail is received, servers used to communicate with CellNet need to have their configuration files rebuilt and reloaded. Applications accessing the servers need to have their database updated to reflect the appropriate server.

Motorola Intrac Controlled Capacitors

The EMS system communicated to capacitors using legacy Motorola Intrac 2000 protocol. Communications to these units needed to be supported until hardware in the field fails.

Multiple Interfaces

For the capacitor control application to function correctly, data needs to be aggregated from a variety of sources including: real time loads and voltages from substation telemetry and measurements from down-the-line equipment along feeder circuits.

Initial / Re-population of Application Data Base

Capacitor inventory data has to be gleaned from the capacitor system of record. The Capacitor inventory data is required for initial population of the capacitor database and period re-population.

A New Approach

After careful review of the requirements and the challenges and issues, XcelEnergy North determined that a successful implementation of a centralized capacitor control application would require a new approach. The decision was made to separate the application from the data it had to interface with. Applications were evaluated on how well they met the user and business requirements. The capacitor control application of choice was RCC-2000W (referred to as RCCS throughout the paper), a proprietary software product of RCCS (Radio Control Central Stations, Inc.) of Braintree, Massachusetts. The application met the user and business requirements.

Given the wide variety of interfaces, XcelEnergy North decided to handle all application interfaces via an Integration Hub.

Integration Hub Concept

Utility Operations uniquely must manage a diverse set of hardware and software assets acquired over a long period of time. The sheer mass of the variety of systems (all still within their useful lifespans) creates a challenging source of inertia when undertaking new initiatives. Each new initiative designed to increase efficiency can become so burdened with the risks and costs of re-integration with the rest of Operations, that many valid initiatives never get off the ground. The result is that potential efficiencies--with savings of anywhere from 5% to 30%--are **never** implemented. Clearly, it is worth analyzing the source of these high risks and costs.

Utility Operations managers and Systems Integrators have found that one of the major cost and risk factors involves real-time data management. Beyond the well-understood challenges of normalizing and translating data schemas and formats from disparate systems, real-time data management introduces an entirely new level of complexity. Not only are there disparate data formats, but also there are sources of data that come and go--both by accident and by design. Real-time data is not neatly stacked within the glass-house of IT.

Grid-wide data networking is still not reliably deployed--perhaps a surprising fact, given the widespread deployment of Web technology, but true nonetheless. Wireless technology such as CDPD is starting to gain attention in the Utility space, while the Wireless industry moves onto next generation wireless. Thus, the industry finds itself with "last-year's" technology based on many technology and pricing models. This is one burden placed on real-time data management that traditional data management, with well-understood and maintained office networks and mature DBMS products, rarely faces.

Even given reasonably reliable wide-area Utility Operations networking, the industry is saddled with actual equipment in the field dating back to the 1940's in some cases. This means that the access methods, interfaces, languages, and protocols used to interrogate, monitor, and control field equipment are manifold. Additionally, even within a stable set of these wireless connectivity schemes and recent equipment, the overall system design makes significant demands on applications that need access.

In summary, Utility Operations' real-time data is hard to access due to a variety of historic factors. Compounding this problem is the lack of robustly implemented application interoperability standards. The industry has seen various efforts to standardize using a variety of technologies. UNIX was supposed to help, but then everyone deployed NT. RPC mechanisms gave way to CORBA, but then JAVA and COM took off. Meanwhile, XML and its eco-system have arrived under a variety of guises and flavors. It is no wonder that efficiency initiatives are often stalled at the gate.

The Integration Hub is an **architectural** answer to the problem (Figure 1). Rather than attempt to painstakingly and bilaterally connect every application to every system on the grid, the Integration Hub creates a logical center, dramatically reducing the risks and costs associated with Utility Operations Integration. By offering industry-standard APIs or interfaces, the Integration Hub can often look and behave exactly the way each application demands. The Integration Hub can present a real-time instance of data in tables, called "virtual tables," that conform exactly to the application's requirements.

Implementation of an Integration Hub

Given that the Integration Hub is an architectural solution to integrating an application (in this case RCCS) with a utilities' existing real time and corporate data, the function and design of the hub will vary from utility to utility. XcelEnergy North implemented the PersonalView Integration Hub, supplied by LiveData, Inc., of Cambridge, Massachusetts.

Challenges Resolved with Integration Hub

Application Integration

For the RCCS application to function correctly, data needed to be aggregated from a variety of sources including; real time loads and voltages from substation telemetry and measurements from down-the-line equipment along feeder circuits. Also, capacitor inventory data had to be gleaned from the capacitor system of record. The approach decided upon was that RCCS would interface with the external world via the Integration Hub and the Integration Hub aggregate data (Figure 2). The RCCS application would also handle communications to capacitors using legacy Motorola Intrac 2000 protocol.

A meeting between all parties at the start of the project defined a comprehensive data acquisition and control model that addressed all relevant data resources and control requirements of the RCCS expert application. Within a week of model definition, a test-data exhibit of the model, with all data acquisition and control functions fully operational, was made available on the Integration Hub. RCCS was able to connect over the web to the Integration Hub and develop and test the cap control application without need to visit the customer site.

Initial / Re-population of RCCS Data Base

Capacitor Asset information from the system of record required by RCCS was identified and a view of the information made available through the Integration Hub The Integration Hub reads the view and populates a table accessed by RCCS. RCCS periodically reads the Asset Table View in the Integration Hub and repopulates its internal database.

Real Time Feeder Data

Real Time Feeder data required by the Capacitor Control System resides on the EMS. Feeder Data was made available by adding a server that retrieves that data from the EMS via an ICCP link. The Feeder Data is made accessible to the RCCS application via the Integration Hub.

CellNet Re-Points

The timely processing of CellNet re-points was resolved by adding a FTP directory to the Integration Hub. Copying the CellNet RTU Status e-mail to the FTP directory causes the Integration Hub to store the re-point information in a Oracle table and schedule an Oracle procedure. The procedure generates new configuration files for the servers handling communications with CellNet. Analysts can view the output of the configuration procedures and restart servers as required.

Benefits of Integration Hub

- The use of an Integration Hub allowed the project to meet an ambitious schedule for implementing a centralized capacitor control application:

1/3/01		Project Start
1/3/01	3/30/01	RCCS (Capacitor Control) Development Integration Hub Developement
3/30/2001	5/15/2001	RCCS Initial install / checkout on site
5/15/2001	6/12/2001	User Acceptance

- Proven application interface. Methodology used for Capacitor Control program can be applied to other applications.
- Limited modifications to third party software.
- Capacitor updates performed on system of record. No need to maintain data in more than on place.
- Enhanced maintenance capability, web view of RCCS data allows for easier problem resolution (see Figures 3-5 for user views of the data).

Personal View Integration Hub

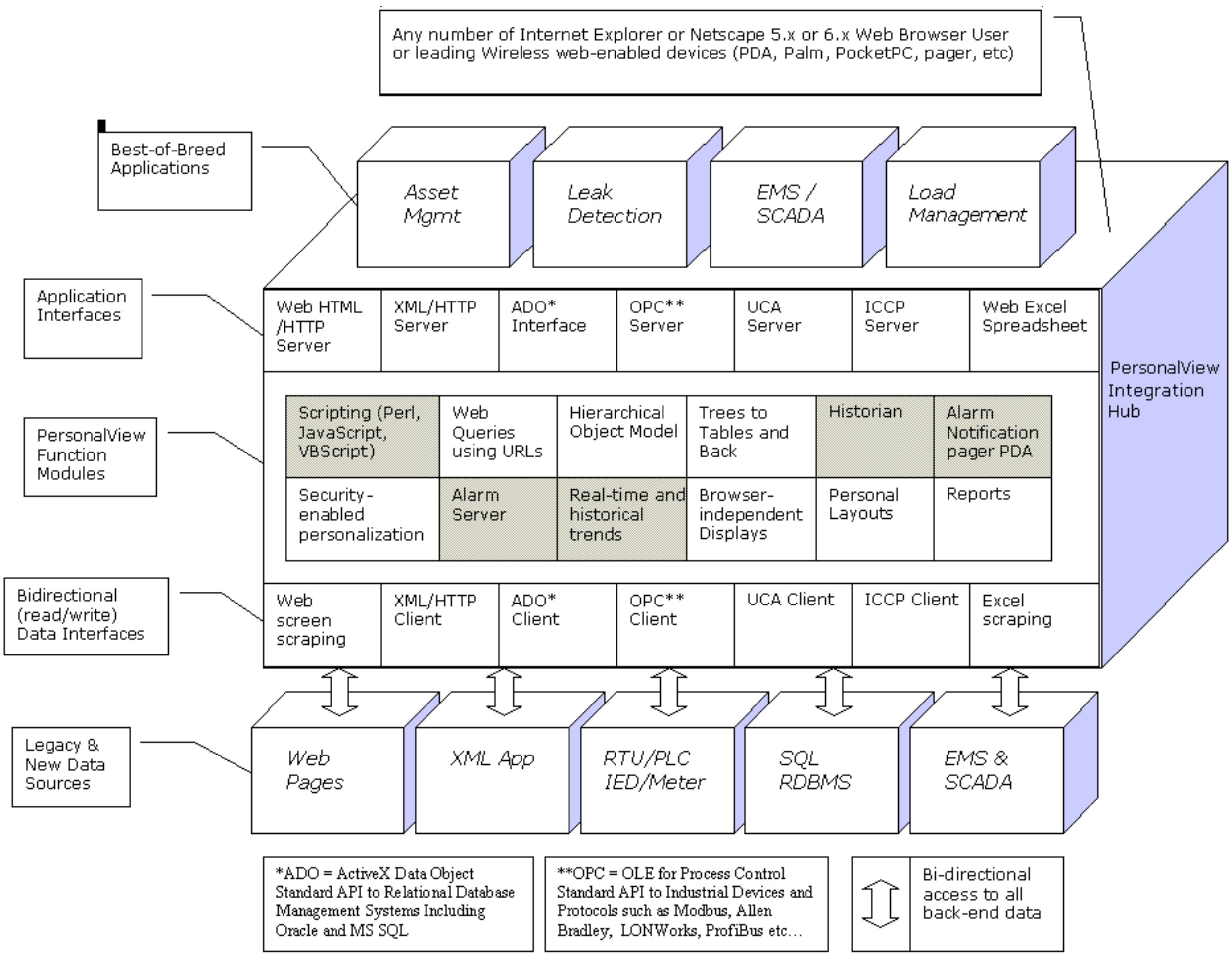


Figure 1

XcelEnergy North Capacitor Control--Overview

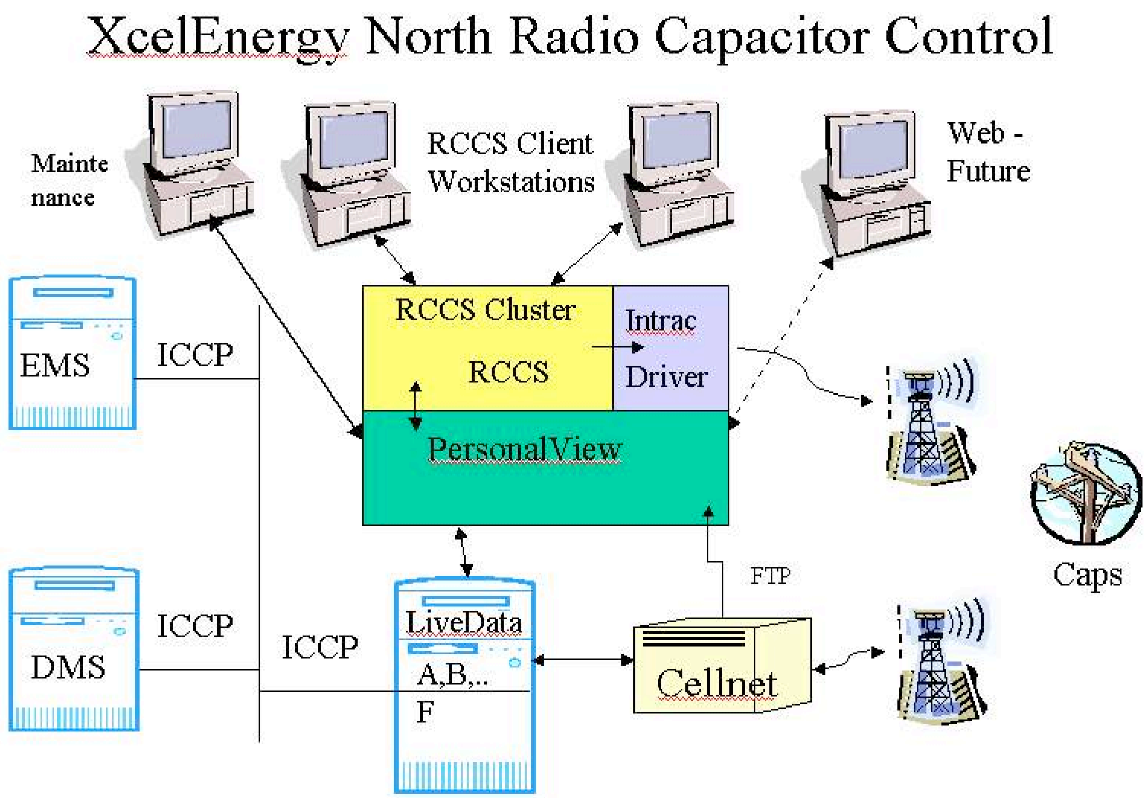


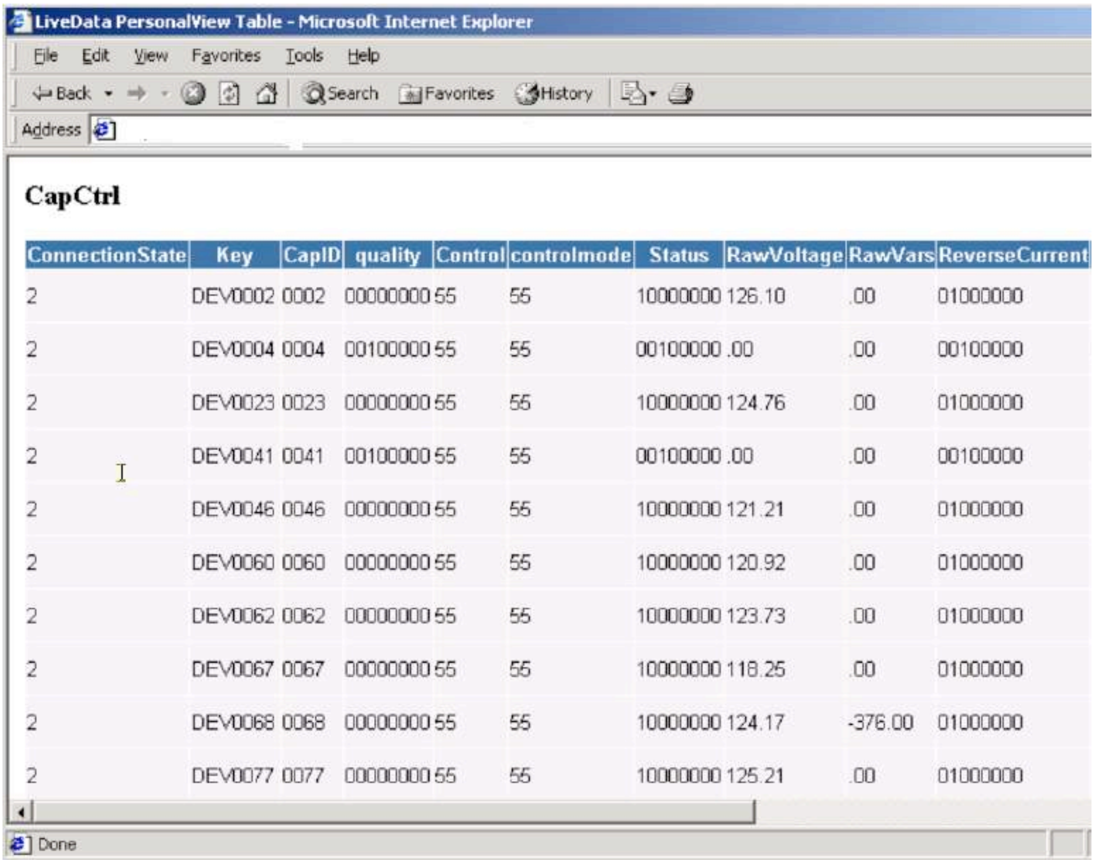
Figure 2

Graphic View

	Raw Voltage	Raw VARs	Raw Neutral Current	Reverse Current
Values	125.95	.00		Normal
	Comm Quality	Last Ctl	Sftw Ctl Mode	
Values	Good	55	55	
	Face Plate	Cap ID	Timestamp	
Values	Remote	4050	2001-10-29T13:41:15.757	

Figure 3

Tabular View



CapCtrl

ConnectionState	Key	CapID	quality	Control	controlmode	Status	RawVoltage	RawVars	ReverseCurrent
2	DEV0002	0002	00000000	55	55	10000000	126.10	.00	01000000
2	DEV0004	0004	00100000	55	55	00100000	.00	.00	00100000
2	DEV0023	0023	00000000	55	55	10000000	124.76	.00	01000000
2	DEV0041	0041	00100000	55	55	00100000	.00	.00	00100000
2	DEV0046	0046	00000000	55	55	10000000	121.21	.00	01000000
2	DEV0060	0060	00000000	55	55	10000000	120.92	.00	01000000
2	DEV0062	0062	00000000	55	55	10000000	123.73	.00	01000000
2	DEV0067	0067	00000000	55	55	10000000	118.25	.00	01000000
2	DEV0068	0068	00000000	55	55	10000000	124.17	-376.00	01000000
2	DEV0077	0077	00000000	55	55	10000000	125.21	.00	01000000

Figure 4

XML View

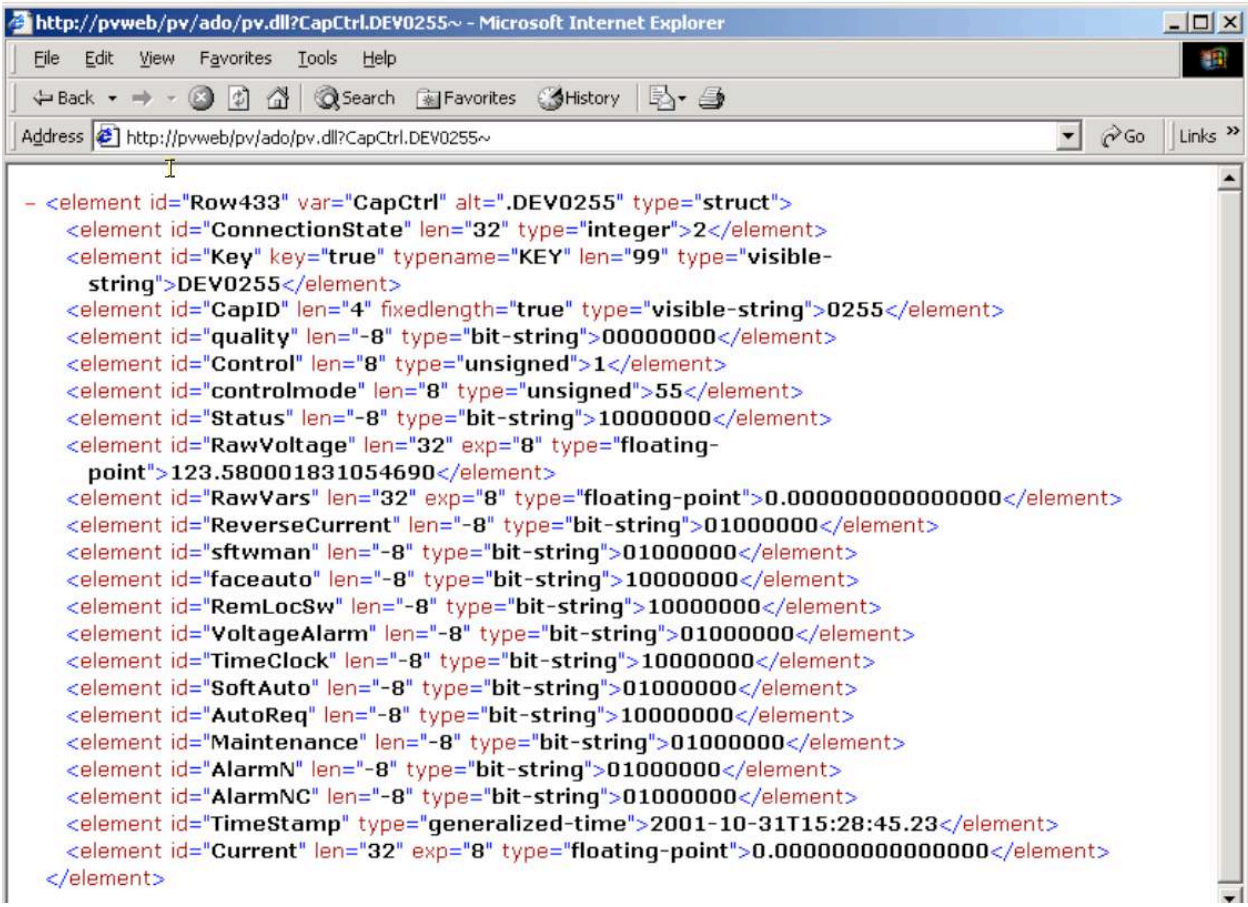


Figure 5