*e*LAN™ Technology White Paper

The Future of Substation Data Integration

The Tacoma Power SDI Project

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Introduction

As technology has improved, there has been a clear trend towards deploying larger numbers of intelligent devices in substations. In many utilities, these devices have been deployed in a piecemeal fashion, by different departments working to solve specific problems. Often, a unified vision for substation automation and data acquisition and access has been lacking.

With this proliferation of substation IEDs, there has been a dramatic increase in the amount of data available. Currently, much of this data remains isolated in the substation.

At the control center, technology has had a significant impact as well. Traditionally, SCADA and other substation data has been accessed through a hierarchical system, with the EMS at its apex. In this topology, other enterprise level applications that require this data must get it from the EMS. In many utilities, these "other" applications are increasing in both quantity and importance. The EMS is still a critical application for operating the utility, but it is no longer the "center of the universe". Full featured historians such as PI are now playing a key roll in operating the grid, and the use of 3rd party network and maintenance applications is becoming widespread.

These new applications are frequently interested in data produced by the new IEDs, but that is not accessible through the EMS. A solution is needed for communicating this data to the applications that need it. Moving it up the traditional communications channels through the EMS is not only an inefficient use of valuable EMS resources, but the protocols used in many cases cannot handle the newer types of data. Clearly, another approach is required.

At its simplest form, an architecture is needed that allows data from multiple data sources (IEDs, RTUs) to be accessed by multiple hosts (control center or enterprise applications or human users). In other words, a "many-to-many" communications infrastructure is required.

It is also important for this architecture to be flexible to support the ongoing addition of both IEDs, and new applications or queries which require the data. An increasing number of these applications come from an office or IT environment, and have no knowledge of SCADA or IED protocols.

Fortunately, the evolving world of information technology has been addressing many of these issues. The Internet is fundamentally concerned with connecting many data sources to many data consumers, both in a client-server relationship, and in a peer-peer relationship. There is a tremendous wealth of mature, mainstream technology which is available to address the networking, data access, and security issues required by this new utility information infrastructure.

Tacoma Power is very much in the situation described above. It has undertaken a project, called SDI (Substation Data Integration), which is leveraging the strength of this mainstream information technology to address all these issues, as well as providing a framework for future system evolution.

High level objectives for the SDI project

- Provide open, flexible access to all substation and distribution automation devices, from any authorized user or application.
- Leverage mainstream hardware and software technology as much as possible.
- Support current and emerging networking standards, including a full range of security options.
- Reduce complexity of system integration and configuration.
- Provide a simple, secure method of controlling user access.
- Preserve investment in legacy field devices and control center applications.
- Scalability, so that the benefits of SDI could be realized by small vault and pole-top installations as well as major substations.

Specific functional objectives for the SDI

- Provide all desired SCADA data to the EMS.
- Provide all desired IED data to the PI historian. This will be the primary repository for field data, for user queries and reports.
- Provide intelligent management of event data from IEDs (filter duplicate events)
- Provided automated management of fault records.
- Provide remote maintenance access to all field devices.

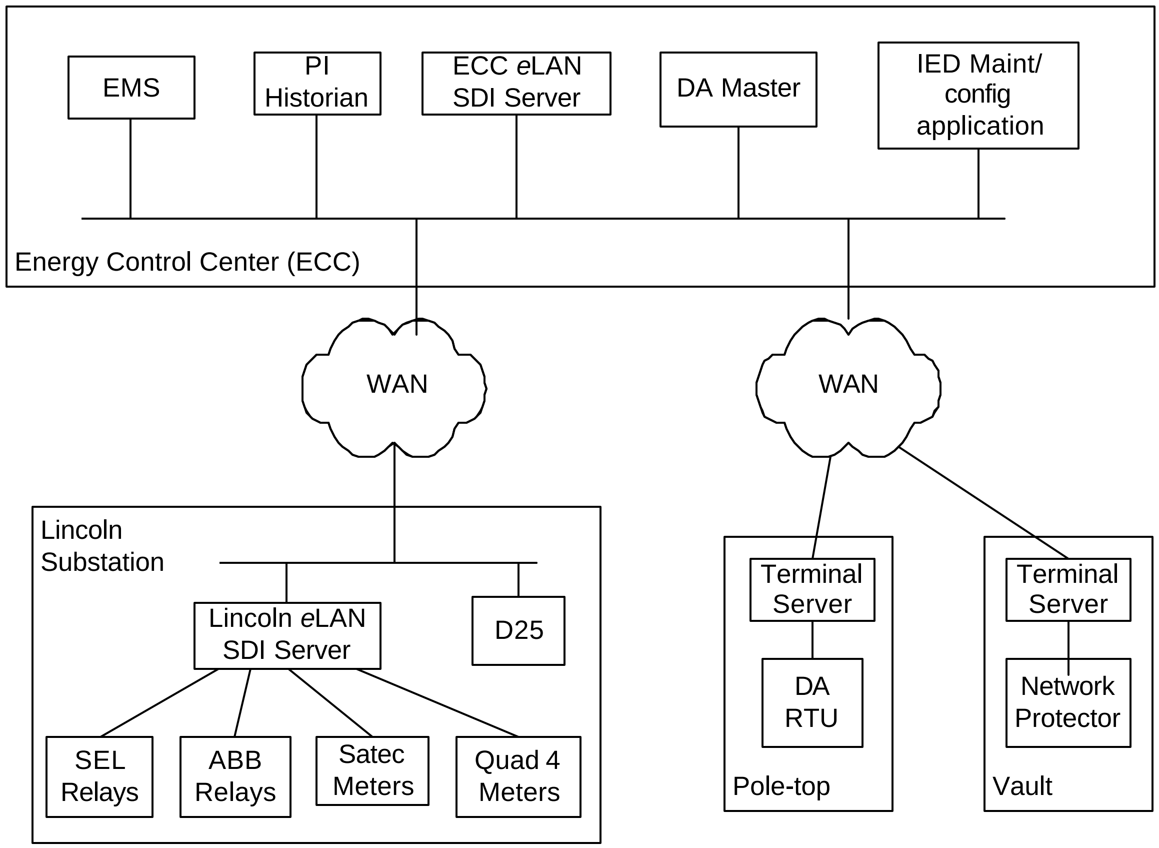
Project details

Tacoma Power had a strong preference for the Linux operating system, due to its robustness in a networked environment. Additionally, there was a preference for products based on commercial, off-the-shelf (COTS) hardware, to ensure flexibility, and to allow future technological advancements to be easily accommodated.

The *e*LAN substation server from Bow Networks was selected as the platform for SDI. It is based on Linux, running on a diskless, substation hardened Pentium III platform, based on industrial PC hardware.

The initial project scope includes one major substation (Lincoln) and 17 distribution automation sites (vaults and pole-tops).

The following diagram shows a (greatly) simplified version of the SDI architecture. Networking components such as routers, switches, and firewalls have not been shown, nor has the overall corporate network topology.



Note that there are 2 SDI servers. Each performs roughly the same functions, for a different set of field devices. Lincoln substation has many IEDs, which justifies a dedicated SDI server in the substation. Connections to the SDI server from the IEDs are either direct serial connections, or over the station LAN.

The second SDI server is located at the control center. It provides access to data in a number of IEDs and RTUs scattered throughout multiple smaller sites, such as pole top DA RTUs, and distribution vaults. A small hardened terminal server provides a remote serial port at the field device, with all associated software located in the control center SDI server. A key feature of the *e*LAN solution is that as a network-based architecture, distributed implementations such as this are possible, resulting in a much lower system cost.

As previously stated, a primary objective of the system is to provide multiple, simultaneous host applications accessing each IED. The following are the primary applications deployed. Note that in many cases, a single data point is served to more than one of these applications.

EMS System Interface

The EMS polls for data from each of the SDI servers. The server provides a single, virtual RTU for each physical device. Because of the processing power of the SDI server, and the bandwidth available on the WAN, there is no need to concentrate multiple physical devices into a single virtual device. Maintaining a one-one relationship between physical and virtual devices allows point maps to be maintained from end to end through the system, resulting is an easy-to-understand system, and considerably reduced configuration effort.

Note that even though the network-based RTUs could be polled directly from the EMS, they are mirrored through the SDI server as well. This is to take advantage of the much lower poll latency of the SDI server. See http://www.bowsoft.com/downloads/dnp_poll_perf.pdf for further details.

Only a small subset of the available data is reported to the EMS. This traffic has priority over all other data.

PI Historian Interface

The PI historian is the repository for all IED data which is believed to be of interest, either now or in the future. The SDI servers maintain a separate connection with PI, based on the OPC standard.

TPWR intends to deploy the necessary desktop application that will allow all interested staff to query the historical database for specific information, mine data, and build their own custom displays.

DA Master Interface

The DA master interface functions similarly to the EMS interface. The ECC SDI Server collects data from the various DA RTUs and network protectors, and creates virtual RTUs for each, which the DA master polls for.

Fault record management

The SDI server is responsible for extracting fault records from IEDs as they are captured, and archiving them on a central file server at the control center. Interested staff may receive notification of record capture via email. This central repository for all fault records provides a consistent access point for all staff that needs them.

Remote Maintenance Access

Another goal of the SDI project was to create an easy to use mechanism for remotely accessing maintenance ports on all remote devices, from the vendor's configuration /maintenance application. The *e*LAN IED Anywhere application provides this functionality, and provides a central administrative tool for this.

The IED Anywhere Administrator allows the creation of *sessions*, which are one-one associations between a *specific* IED, and its maintenance application. The session is given a unique, unambiguous name, so there is no confusion as to which device is being connected to. The Administrator also allows individual users to be defined, and specifies which users may access which sessions.

Security

Network and application security is a broad issue, which should be addressed in a holistic manner across the utility. A unified vision of security must exist that accommodates all networking, from SCADA data to remote e-mail access for corporate executives, to Internet access for employees..

Tacoma Power has viewed the security requirements of the SDI project as an extension of their existing, multi-tiered network architecture. The *e*LAN family offers a number of security options, compatible with the existing technology, and allows the system to follow the NSC recommended security practices.

Consistent with these practices, and with Tacoma Power policy, specific architectural details remain confidential.

Summary

Tacoma's SDI project has illustrated the benefits of building a data communications infrastructure on powerful, mainstream technology.

About Bow Networks

Bow Networks has been creating and deploying communications solutions for electric utilities since 1986. In serving many of the world's leading utilities and vendors, Bow has built a strong organization extending from product development through field commissioning and training. Bow has invested heavily in what is now the industry's most advanced platform for substation communication and data management, *e*LAN.

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