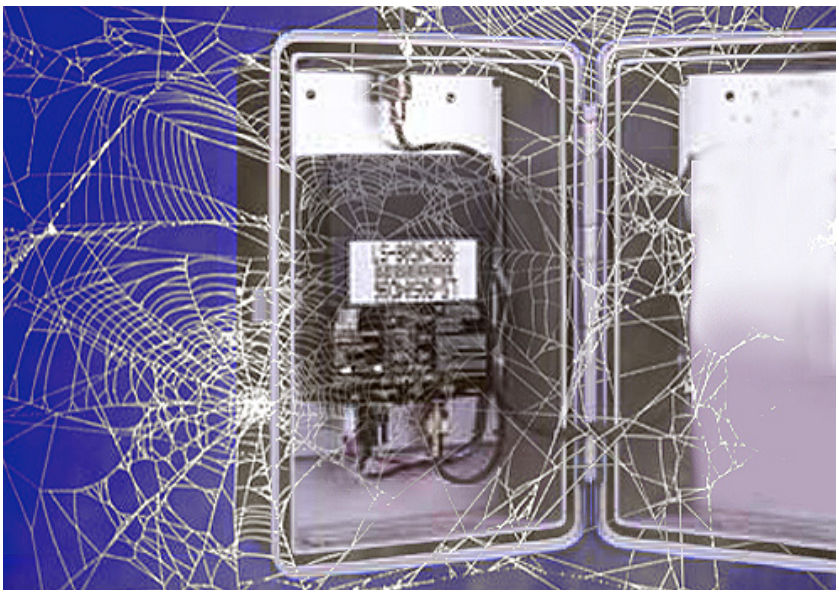
EXECUTIVE SUMMARY

Evaluating complex technology can drive anybody crazy. You must consider dozens of different features to figure out which ones matter most. While simultaneously balancing the needs of IT staff and internal users and consumers. While also juggling compatibility with the past and the present and the expected future. Oh, and by the way... please bring the whole thing in under budget, thank you very much.

Alliant Energy Corporation of Wisconsin recently faced just such a challenge. The distribution feeder monitoring system designed a decade ago was deteriorating. Replacement parts were impossible to find. How could Alliant find a system to work with older gear while also satisfying current needs while also providing for future growth?

The path forward came via the IntelliGrid Technology Assessment Methodology. This process is a "safe-and-sane" way to systematically and scientifically evaluate technology alternatives. Without losing your shirt. Or your mind.

Methodology without Madness



A SMART GRID NEWSLETTER

CASE STUDY

FEBRUARY 2007

THE PROBLEM

For a decade, Alliant Energy had employed a feeder monitoring system from Metricom for gathering and analyzing grid information. The system used wireless transceivers to transmit data to the Alliant WAN. But when Metricom was sold, support and replacement parts became unavailable. The search was on for replacement technology.

Living creatures aren't the only ones to grow old. Technology ages too, and when the age starts to show, it usually spells expense. That was the situation facing Alliant Energy Corporation, headquartered in Madison, Wisconsin.

Through a subsidiary, Alliant serves nearly one million electric customers in Iowa, Wisconsin, Minnesota, and Illinois. For years, Alliant has used a feeder monitoring system to track power distribution for load analysis, fault detection, and other internal purposes. The system employs 975 meters, which communicate via UtiliNet radio transceivers over power line carrier (PLC). Using packet radio technology, the transceivers communicate with one of 27 gateway sites in a 9600-baud peer-to-peer network. From there, the data is sent to the Alliant WAN and eventually finds its way into an Oracle database and other applications.

Gradually, meters began failing and replacement parts were needed.

Unfortunately, the UtiliNet technology had been eaten up in a series of corporate moves. Metricom, the original manufacturer, was acquired by Schlumberger Ltd., which was in turn purchased by Itron. Itron phased out the UtiliNet division, leaving Alliant's system without a clear source of support. Nor was lack of parts the only problem. According to James Teach, lead telecommunications engineer, "The meters are such an integral part of the radio network that replacing one means you almost have to replace them all."

Another confounding factor was the fact that the meters use PLC technology to interface directly with the radio. "Most new meters are serial," explains Teach. That means you cannot just swap in a new meter. You also need a new serial interface or some other way to communicate with the radio transceivers.

Alliant needed to evaluate its technology alternatives.

Alliant Energy is faced with an aging distribution feeder monitoring system with no replacement parts in sight.

THE SOLUTION

Alliant turned to EPRI's IntelliGrid program for help developing requirements and reviewing technology. One result was a detailed and systematic Telecommunications Assessment document. This document evaluated technologies against Alliant's needs while also judging their adherence to IntelliGrid's "future-proof" architecture.

The dilemma: UtiliNet radio transceivers are no longer available from the manufacturer.

As Alliant formed a team to address the issue, John Weyer, Alliant manager of Technology Development, suggested the project could benefit from the principles of the IntelliGrid Architecture. That architecture is part of an international industry initiative to develop frameworks for the next generation of energy delivery (see the sidebar "Snapshot: IntelliGrid"). An early member of the IntelliGrid consortium, Alliant contracted with IntelliGrid consultants for help and training.

The Technology Assessment Method

The three pillars of the IntelliGrid approach are:

1. **Use cases**, which capture the requirements;
2. **Technology assessment methodology**, which maps those requirements to available technology; and
3. **Systems engineering**, which translates the findings from the first two steps into a design for the entire system.

(For more insight into the first principle, see the SGN case study "The Case for Use Cases," which tells how it was applied by Salt River Project. For a real-life application of systems engineering, see the SGN case study "Designing the Future," which documents the experiences of Southern California Edison. Both are available for free download at www.smartgridnews.com/cases.)

As it has done for other utilities, the IntelliGrid team coached Alliant in the creation of uses cases to develop clear system requirements. Next, they helped them create a document that accomplished two purposes: (1) it defined the IntelliGrid Technology Assessment Methodology and (2) it applied that process to the telecommunications technologies that could potentially serve Alliant's needs. (See the sidebar, "The Technology Assessment Methodology in Action.")

"We helped Alliant objectively assess available technologies across 10 key categories," recalls IntelliGrid Program Manager Don Von Dollen. The resulting Telecommunications Assessment document scores various wireless technologies against a systematic matrix. (See Table 1.) To start, it summarizes technical attributes, such as range. "We also designed the report to consider engineering needs that mapped to the requirements turned up by the use case process," Von Dollen explains. "For example, if the use cases showed

The Technology Assessment Methodology in Action

Alliant received a 69-page document that used IntelliGrid's Technology Assessment Methodology to evaluate communications technologies (not products or vendors). It also included references and links to specifications and other information. The report was specifically designed to address replacement of Alliant's distribution feeder monitoring system. It measured technologies against criteria defined by the IntelliGrid Architecture, including:

Level of standardization (how well-defined it is and how well accepted by the user community).

Level of openness (ease of obtaining, using, and servicing the technology versus proprietary systems under the control of one or a few vendors).

Level of adoption (how widely used).

Level of users' group support (whether groups exist to help maintain it).

Security (ease of securing the system).

Manageability (ease of remotely managing and upgrading).

Scalability (a "ceiling" on the number of units, the ability to manage, or the ability to keep secure).

Use of Object Modeling (does it organize data into logical, hierarchical groupings).

Use of Self-Description and Metadata (can it store data about itself and describe itself to a client).

Applicability to the Power Industry (is it too generic or too specific to another sector, such as industrial automation).

Table 1 nearby shows a matrix that resulted from applying these criteria to various telecommunications technologies.

The criteria were not weighted for importance and the resulting ratings were not intended as recommendations. The scores merely represent how well each technology matches up against each criterion. By design, the document did not address the following three issues:

1. **Cost**: Differences such as functional purpose, licensing, and life cycle were too different to make comparisons possible.
2. **Maintainability**: Statistics over multiple years were not available
3. **Functionality**: How well a technology does its job is subjective and depends on customer expectation.

The assessment was organized by service groups, as shown in the diagram below. Inner rings represent generic, shared or common applications (core networking, security, network management, data structuring and presentation). Outer rings represent project- or application- specific technologies (wide area network, local area network, power system operations, and consumer applications). ■

a need for equipment that covered a certain frequency range, you could go through the tables to find evaluations based on that criteria."

Meeting requirements. The Technology Assessment Methodology also addresses requirements not usually covered by use case scenarios. "It provided a framework to show which technologies matched up with functional and non-functional requirements," says Jim Teach, one of two team members responsible for analyzing replacements for the feeder monitoring system. "The goal was to decide where to go when we replace the existing system."

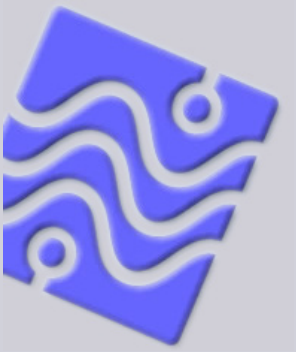
Solutions, not endorsements. The report was designed to examine technologies, not vendors. For example, "it considered WiMAX and 900 MHz packet radio," notes Von Dollen. "It also looked at management protocols such as SNMP (simple network management protocol)." The technologies were ranked according to compatibility with IntelliGrid principles.

Vendor resource. Although the assessment is vendor neutral, it does provide resources for finding vendors that support the technologies. "The assessment includes a list of vendors and technologies associated with them," reports Teach. "It has a table of vendors, a table of products, and the key characteristics of that technology."

Limitations. The IntelliGrid Technology Assessment Methodology does not create a catalog of solutions. For example, notes Von Dollen, "this evaluation did not take cost into consideration. Nor did it consider how well a technology does its job." The report also omits maintainability (although some related information is provided in a section called Manageability). Those areas were outside the document's scope.

What is IntelliGrid?

The IntelliGrid consortium was created by the Electric Power Research Institute (EPRI), an independent nonprofit association for energy and environmental research.



Currently, power systems devices such as electronic protective relays and sophisticated protection schemes already provide local intelligence. But IntelliGrid envisions a grid that links these systems together with the latest communications technology (and with distributed computing), resulting in optimized, self-healing systems that are flexible, extensible, interactive, and secure. A major achievement of the program is the IntelliGrid Architecture. It provides an open, standards-based architecture for integrating data communications networks and equipment —in other words, the framework to start creating the smart grid today. The IntelliGrid Architecture provides the methods, tools and best practices for specifying "intelligent" systems that will not have to be abandoned or re-engineered later.

For more information, see www.epri-intelligrid.com. ■

BENEFITS

The Technology Assessment Methodology clarifies complex choices. It also creates documents that become useful tools for designing the system, for uncovering the best vendors, and for negotiating the best possible feature set.

In the past, utilities have leaned heavily on vendor fact sheets and informal, subjective opinions to choose their technology path. There was no established, rigorous method to evaluate the options. IntelliGrid's Technology Assessment Methodology steps into that gap. First, it takes the confusion out of the process. Second, the resulting evaluations become valuable in many ways.

Alliant's feeder monitoring upgrade still awaits budget approval. Despite the delay, the process of developing requirements and conducting a technology review has served useful purposes. "Now that we have this information, we use the report to find out who is out there," says Teach. "Some of the vendors we had heard of, others not. So it was helpful from that perspective."

Project engineer Teach feels the time and money were well spent. "Had the project gone ahead immediately, we would have used the document to generate a vendor list," he notes. The IntelliGrid Technology Assessment Methodology also helps when developing a "nice to have list" with which to approach vendors. "You ask for what you want, you find what vendors have, and then the list changes, either up or down," says Teach. "It's an iterative process."

The assessment had other unforeseen advantages. "We've had some spot applications, other SCADA applications that have come up since then," reports Teach. "The document has helped us assess vendors that might have products we need." Teach also occasionally forwards the document to other engineers in the company who may need the information it contains.

Case studies at Smart Grid News

This article is one of a series of case studies created as part of a cost-shared, public-private initiative with support from the Office of Electricity Delivery and Energy Reliability and U.S. Department of Energy and produced by Smart Grid Newsletter and Global Smart Energy. You'll find a growing library of position papers, case studies, and third-party reports of pilot installations at www.smartgridnews.com\cases. Contact us for a quote on your needs. ■

Table 1: Alliant's telecommunications assessment matrix

	Standardization	Openness	Adoption	User's Group	Security	Manageability	Scaleability	Object Modeling	Self-Description	Power Industry	TOTAL
Core Networking											
IPv4	3	5	5	4	2	4	4	1	2	3	**33**
IPv6	3	5	2	4	4	4	5	1	5	2	**35**
TCP	3	5	5	4	2	4	4	1	2	3	**33**
Security											
TLS	3	5	5	4	5	3	4	1	3	3	**36**
IPSec	3	5	5	5	5	3	5	1	3	3	**38**
X.509	5	4	4	1	5	5	3	1	4	3	**35**
b	5	3	2	5	5	4	2	1	2	2	**31**
ASCE	5	3	2	5	3	1	3	4	5	5	**36**
Management											
Basic IP	3	5	5	4	1	5	4	1	3	3	**34**
SNMP	3	5	5	4	2	5	3	4	2	2	**35**
NTP/SNTP	3	5	5	4	1	5	4	1	2	3	**33**
IEEE 1588 (PTP)	5	3	2	4	1	5	3	1	2	4	**30**
Presentation											
XML	3	5	5	4	2	5	5	5	4	2	**40**
ASN.1	5	5	5	1	1	1	5	5	3	3	**34**
DNP/60870-5-3,4	5	4	5	5	2	1	3	2	3	4	**34**
LANs											
Ethernet	5	5	5	1	3	4	3	1	5	3	**35**
Wi-Fi	5	4	4	5	3	4	2	1	5	2	**35**
WANs											
DSL	5	4	5	5	4	4	4	3	3	2	**39**
Cable	5	5	5	5	4	4	4	3	3	2	**40**
WiMax IEEE 802.16	5	4	2	5	4	3	3	3	5	1	**35**
Dense WiFi IEEE 802.11	5	4	2	5	3	4	2	1	5	2	**33**
900MHz ISM FHSS	3	4	3	2	3	4	2	1	3	3	**28**
Paging	3	2	5	1	1	2	4	1	5	3	**27**
Satellite	2	2	2	1	4	4	3	1	1	3	**23**
Cellular	5	1	2	2	3	4	4	3	5	3	**32**
Power System Operations											
DNP3	5	4	5	5	2	1	3	2	3	4	**34**
IEC-61850	5	3	2	5	3	1	3	4	5	5	**36**
IEC 61968/61970	5	3	2	4	2	1	2	5	5	5	**34**

This matrix shows one example of results from the IntelliGrid Technology Assessment Methodology. It was created with help from IntelliGrid consultants and scored by Alliant staff. Any such assessment is a "snapshot" of one point in time. Results would change if repeated later, as technologies mature and new ones appear. See the sidebar "The Technology Assessment Methodology in Action " for an explanation of the criteria in the columns at the top.

LESSONS LEARNED

Evaluating complex technologies does not have to be subjective, informal or haphazard. It can be done with precision, using objective, forward-looking criteria. The resulting assessments are more fair and less subject to the appearance of favoring one vendor over another.

With the feeder monitoring project waiting for budget to free up, another Alliant team is currently holding meetings to find a stopgap solution. "If we have to a retrofit an existing substation, we'll put in a new communications path, and use the old meters as spare parts for the other systems," Teach predicts "It's cost effective, but it's not the best solution."

And if they had to do it again? "I wish we had moved a little faster," says Teach. "The uses-case process requires you get a fair number of people together at the same time. We needed to move very quickly, plan ahead, and get people to put the process on their calendars." As for the future of the project, Teach is philosophical. "Sometimes you have to put a project in the budget for several years before you get approval. It's a prioritization thing. There is only so much money to go around."

Utilities in Alliant's position might also consider conducting use cases and using the Technology Assessment Methodology as early as possible, so they will be on hand when money is available.

Either way, when building for the future, it is important to have a comprehensive, objective method to assess needs and evaluate options. Utilities need no longer rely on haphazard, partial reviews. Nor do they have to be at the mercy of vendors' self-serving comparison charts. With the Technology Assessment Methodology, they can scientifically map alternatives against their own needs and against IntelliGrid's "future-proof" architecture. ■

What is Alliant Energy?

With headquarters in Madison, Wisconsin, Alliant Energy provides customers in the Midwestern United States with both electricity and natural gas. Alliant Energy Corporation itself is a regulated public utility holding company with two utility subsidiaries, Interstate Power and Light Company and Wisconsin Power and Light Company. A Fortune 1000 company traded on the New York Stock Exchange (symbol: LNT), Alliant had operating revenues of $3.5 in 2005 and assets of more than $7.7 billion.

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