The "Virtual Electric Utility" via Advanced Energy Control and Communications Systems

Backup Generation Offers a Surprisingly Large, Untapped Resource

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ABSTRACT

Perhaps the most complex application of distributed energy (DE) today, encompassing both distributed generation (DG) and load management (LM), is the aggregation of these resources in real time for sale into wholesale power or ancillary markets. Sometimes referred to as a "virtual utility" or "networked DG," this application is on the frontier of what today's control and communication systems can do and is setting the requirements for future hardware, software and policy developments.

Solutions for "smart" control of multiple DG and LM resources often require the ability to respond to external price signals, starting or stopping equipment as appropriate, selling power or capacity into power exchanges, and diagnosing system problems. They also must have compatible communication interfaces between many types of equipment and the outside world of the power markets. The communication system may require connection via existing control systems such as local supervisory control and data acquisition (SCADA) systems, building control systems, and Internet/intranet systems.

Recent developments in communication options are opening up exciting new possibilities for using distributed energy in real-time applica-

tions as well as making important but mundane processes, like emergency backup testing and reporting, more thorough, more robust, and easier.

The features required for these emerging virtual utility functions forms a DE control and communication puzzle that a number of companies with histories in both hardware and software are trying to solve. Some companies are working on isolated, modular pieces of the puzzle, while others are working toward a broader, big-picture solution.

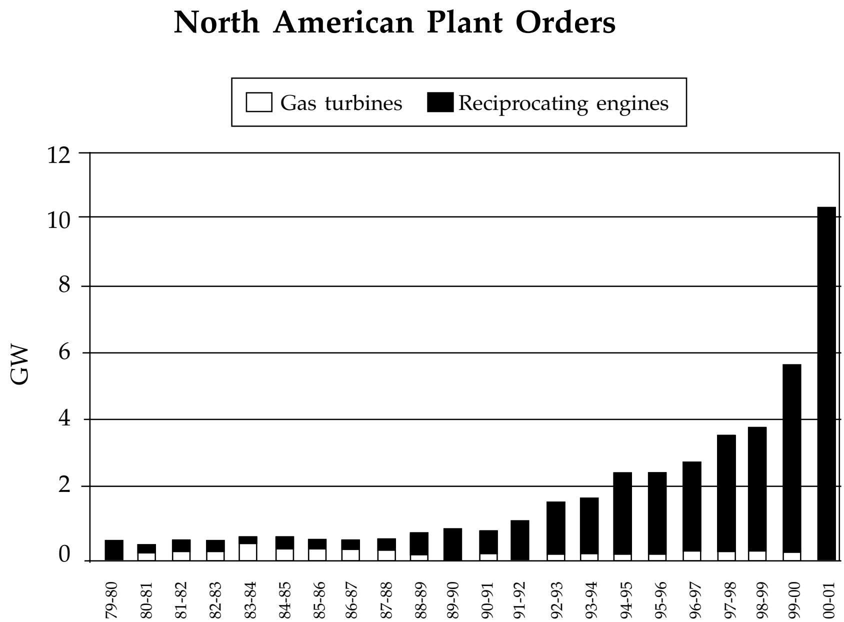
For example, software companies are developing real-time, Web-based, DE management products. These provide economic dispatch capabilities and a communication link between independent system operators (ISOs) and generation aggregators as part of a menu of modules that may include all features needed to support real-time transactions. Others are developing products that begin at the DE resources (generators, storage, loads, or all of the above) and provide monitoring and control of several sites via a Web-based control interface, with varying levels of sophistication.

Utilities have long used SCADA systems to provide this type of control and communication for their own generators. This article focuses on advances in alternatives to SCADA systems that can be used by utilities and non-utilities alike, and how these alternatives are supporting the emergence of "Virtual Utilities."

In the U.S., a number of profitable business models for use of DE resources are emerging, and are being validated in all regions of the nation. One such increasingly popular application for DE resources are the so-called "utility generator programs." In such programs the utility maintains and operates (and may also own or lease) backup generators for their customers, sited on or adjacent to the customer's facilities. End users are often willing to give up care of their generators if the price is reasonable, as this task is typically not in their core business.

BACKUP GENERATION: A MAJOR DISTRIBUTED ENERGY RESOURCE

1. Following trends for the last decade (See Figure 1), businesses will continue to invest in backup generation for reliability and security reasons. While the largest number of purchases will be in small



Compiled by E Source from data published in *Diesel & Gas Turbine Worldwide* magazine, each October.

Figure 1. Orders for 1-10 MW Capacity Range Reciprocating Engines and Gas Turbines.

systems (<100 kW) that at first will not be worthwhile to network, a significant number of much larger systems, (representing the greatest portion of net US backup generation capacity), will be installed, and utilities will network some of these.

2. As prices of control and communications hardware and software continue to drop and as interconnection is standardized, smaller and smaller DE and LM resources will be cost-effectively networked.

3. Utilities will assist in expanding these markets, as they recognize the values of dispatchable generation and peak load management resources, and as a part of their suite of energy services to enhance customer retention.

As is visible in Figure 1, the large (1-10 MW) reciprocating engine market is growing robustly, having averaged 27% annual growth in sales over the last 10 years, although this has varied widely year-to-year. 80% of the equipment represented by these data are purchased for backup generation.

Although the sales growth profiles for all sizes of DG are not represented here, E SOURCE has found that this strong sales growth is a representative trend across a broad range of backup generation equipment sizes.

A 1999 survey of 754 principal decision-makers at U.S. and Canadian commercial and industrial companies measured customer interest in backup generation. In this study, representative businesses from seven major customer segments were interviewed. The segments interviewed were: Health care, Financial services, Retail, Food stores, Agriculture, Continuous-process manufacturing, and Finished-product manufacturing. These user segments were asked about their interest in purchasing backup generation, and indicated their likelihood to do so as probabilities.

Data from the survey were used to develop a market basis estimate of backup generation DE applications, indicating the expected distribution of capacity by plant sizes (Table 1). The gross totals are consistent with independent estimates that backup generation capacity in the US is roughly 80,000-100,000 MW.

Several DG industry leaders were consulted as to their opinions on the expected rate of conversions of backup generation systems for non-emergency dispatch in the next 5 years. Their average response clustered closely around 10%, and this was used as a penetration estimate for networked DE.

The distribution of networked DE likely among the 7 different end-user types was then estimated by applying their probability of purchase of DE to the networked DE estimate, as shown in Table 2.

TECHNOLOGY ADVANCES

While DE applications drive the requirements for their controls and communications, recent developments in the larger computer and telecommunications industries are enabling the increasing sophistication of these systems. Developments focus on digital, wireless, and Internet

Table 1: Estimate of Current Backup Generator Population Distribution in the U.S.

Population of end-user businesses represented in survey:	232,660
Q # 89 Does your organization have backup gen capability?:	46%
Population of end-user businesses with Backup gen:	107,024

Disaggregation of US DE capacity from Multi-client survey:

(Q. #90 How large is your organization's backup gen, in kW	Percentage respondents in this range	Assumed kW Backup Capacity	Estimated Net U.S. Capacity (MW)
>20,000 kW	2%	20,000	42,809
2000-20,000 kW	6%	5,000	32,107
100-1999 kW	10%	500	5,351
<100 kW	4%	50	214
Don't Know	78%	20	1,670
			82,151 MW
10% Estimated Penetration of Networked DE In this population:			**8,215 MW**

Table 2: Estimated Distribution of networked DE among 7 Energy End-User Types

Networked DE Estimated Capacity by Sector *(from Reliability in the Emerging Electricity marketplace: The End User Perspective)*			
Sector	Probability of purchase of Backup Genset	Weighting of sector	Likely Distribution of networked DG (MW)
Health Care	0.30	25%	2,088
Food Stores	0.24	20%	1,670
Financial	0.20	17%	1,392
Agriculture	0.17	14%	1,183
Continuous process Mfg.	0.12	10%	835
Retail	0.09	8%	626
Finished Prod Mfg.	0.06	5%	417
		100%	**8,215 MW**

technologies. This section presents an overview of those advances to enable understanding of what features are available and important when choosing a DE control and communication system.

DE Communication

For years, the standard communication methods for power systems at energy users' sites had been local access via serial communications and remote access via telephone lines. Serial communication is reliable but expensive, as it requires dedicated hardwiring to each component.

For controlling multiple generators at a single site or campus, in addition to serial and telephone communications capability, most new systems offer local area network (LAN) options. These usually use standard control protocols such as LonTalk or Modbus or, more recently, the family of Internet and Ethernet protocols known as TCP/IP. A goal (not yet in sight) is interoperability independent of the physical communication media or manufacturer, from generator controllers to building automation systems, and from the sensor level to the Internet.

To monitor and control multiple generators dispersed at multiple sites across a wide area like a county or state, users need a communication system that isn't constrained by physical proximity. As a result, systems that provide monitoring and control across a wide area tend to be either wide-area network (WAN) Internet-based, or use wireless technologies such as paging or cellular technologies, or employ a combination of both. The result is a system that uses distributed computing and distributed intelligence to provide real-time control and communication among a host of users, applications, and devices. An example of one such system is ENCORP's Virtual Power Plant, shown in Figure 2.

Wireless technologies are a significant departure from WAN-based ones, using paging or small-packet cellular technologies. Wireless systems are best at sending simple messages such as "deploy now" to many distributed generators at a very low per-point cost. The signal can be sent fast enough for utility peaking capacity or for selling power into quick-response markets.

Speed requirements for communications are important factors in selecting the appropriate system. In its research on using distributed energy for ancillary services, Oak Ridge National Labs (ORNL) found that understanding the differences in speed requirements for each direction can significantly affect the cost of the system. ORNL found that

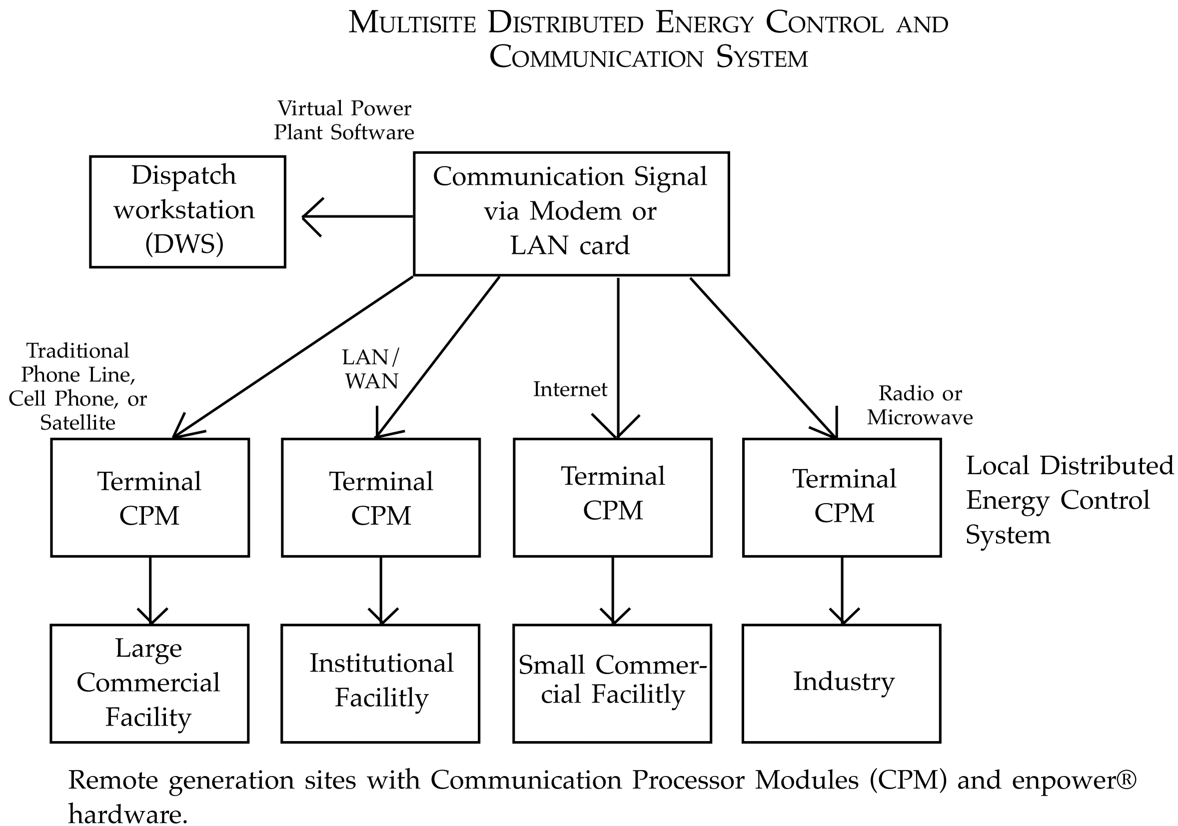


Figure 2: Communication Options

pagers are useful for low-cost communication with large numbers of distributed resources, because they provide individually addressable communications for a $20 capital cost plus $5 per month per device. Pager speed appears to be adequate, or nearly so, for aggregation and other applications, with messages typically getting to pagers within about two minutes.

DE Controls

Trends in controls advances include the use of software in place of hardware to provide lower costs and more flexibility, and the development of mass-customizable packages of equipment in lieu of individual hardware components.

Controls that were previously entirely electromechanical or electronic are now being rapidly replaced by devices based on microprocessors and microcontrollers, with control algorithms in software and firmware. Switchgear and equipment controls manufacturers can now manufacture a single model with characteristics modifiable as required by customers and easily upgraded as requirements or equipment changes. This is particularly helpful for aggregators or others working to deploy standard equipment across many different utility territories.

In traditional electrical equipment markets such as protective relaying, that have been dominated by electromechanical solutions, digital options are gaining ground. The electromechanical signal from the device, say a current transformer or position sensor, is digitized as close to the source as possible, reducing both costs and signal error. In spite of these advantages, even well accepted manufacturers like ASCO Power Technologies have had difficulty getting electronic protective relays accepted, although they report that the reliability of electronic devices is equivalent to or better than that of electromechanical devices.

A growing trend in controls is to move away from individual hardware components to a complete switchgear, automatic transfer switch, and communication package. An example is the ENCORP Solution: ENCORP's all-in-one-box approach replaces a dozen or two dozen individual devices such as protective relays and control modules that would be used in a traditional approach. ASCO and Woodward Governor offer similar products. The benefit is that such a system reduces the size and cost of the controls equipment and enables application engineering to be done in software.

DE control and communication systems can communicate with generator control panels if the generators are "communication-enabled," that is if the generator panel supports an open protocol that encourages communication with other manufacturers' systems. For generators that are not communication-enabled, discrete and analog input/output points can be connected to control and monitor the generator. In this approach, a relay output is used in parallel with a physical start button to start the generator, and analog inputs are used to monitor such engine parameters as temperature, speed, or other variables. An example of a communication-enabled setup is how Caterpillar allows ASCO's multisite control systems to communicate directly with Caterpillar's generator control panels. Though many manufacturers advertise that their systems are based on open protocols and open access, the reality is that getting devices and systems of different manufacturers talking with each other is often a major obstacle.

Newer prime movers, such as microturbines and fuel cells present minimal differences as far as control is concerned. DE control and communication systems interact with any generating technology in basically the same way, sending start/stop, power level, and other signals to a control panel or to relays controlling the device directly. As with other devices, a simple software interface must be developed to allow the central system to talk to the specific microturbine or fuel cell controller.

DE PRODUCT ADVANCES

This section presents various products and example applications that highlight recent advances in control and communication systems for distributed energy and load management.

Automatic Economic Dispatch Products

Aggregators and others need quick access to real-time market prices, status and operating costs of dispersed generators, and information processing that monitors these factors and presents the necessary information for dispatch decisions. Today, decisions are usually made and implemented by human operators, but fully automatic dispatch is the goal of many of the products, ultimately.

Manufacturers of these automatic economic dispatch products include new e-business companies like Engage Networks, Powerweb, Sixth Dimension, and Silicon Energy. In addition, other companies are entering the field as a way to expand or redefine their business. These include ABB, Electrotek, ENCORP, and Siemens. Table 3 lists some of the economic dispatch products now available. Following is a brief description of the products studied.

ENCORP (Windsor, Colorado, USA) demonstrated the financial dispatch feature of its Virtual Power Plant in a project with the Tennessee Valley Authority in 2001. The Virtual Power Plant has been designed

Table 3: Internet-Based Automatic Dispatch Product Developments

Company	**Product**	**Experience**
Encorp	Virtual Power Plant	Field tests under way at Tennessee Valley Authority, Tennessee
Engage Networks	DGen	Feld-tested at Dgen investor partners eLutions and Duke Solutions.
Powerweb Technologies	Omni-Link Internet Energy Platform	In use by a variety of clients, including regulated utilities, unregulated suppliers, Fortune 100 clients, and ISOs.
Siemens AG	DEMS	Field tests underway in Karlsruhe, Germany, and Minnesota.
Silicon Energy	Distributed Energy Manager	Field tests underway at Pleasanton Power Park, CA.
Sixth Dimension	6DiNet, PowerPak	Field tested and verified in California ISO Ancillary Services Program in 2000. Commercial installation for a 25-MW aggregation in Albuquerque, NM, by Celerity Energy.

to aggregate thousands of DE assets and roll them up through the utility distribution system onto a power exchange or ISO, and arbitrage the spark spread between the Btu/hr. and the kilowatts (kW), or hedge physical supply and demand in response to spot/futures market price signals. ENCORP's goal is to provide a solution that is technology neutral, meaning that it will communicate with all types and brands of generation technology, including reciprocating engines, microturbines, fuel cells, and energy storage.

ENCORP estimates that the cost of an all-in-one retrofit/upgrade of existing generators to a Virtual Power Plant solution is approximately $100/kW. This includes hardware for monitoring and control of the generators, the on-site computer and hardware, a master dispatch computer, and the Virtual Power Plant software.

Engage Networks (Milwaukee, Wisconsin, USA.) offers the DGen software system for the economic dispatch of distributed generation equipment. DGen uses the Internet to both collect site data and dispatch DG assets depending on the spread between generation cost and fuel cost, both relative to the value of electricity in real time on the grid. Environmental factors including air temperature and emissions are also included in the dispatch decision, as well as the ability to pick the most cost-effective DG resources in real time.

DGen is able to dispatch many generators of various types—microturbines, fuel cells, photovoltaics, and wind—in real time either automatically or manually. The usual decision parameters including fuel cost, power price, operations and maintenance charges, and others can be custom weighted when making the dispatch decision.

Powerweb's (Media, Pennsylvania, USA), Omni-Link Internet Energy Platform allows control of DE resources based on the real-time price of electricity, monitors loads and operations, and processes energy transactions back to the energy market from a single Internet portal. An ESP can automatically start up customers' DG equipment and implement preplanned demand-side management strategies when spot market prices warrant doing so. Powerweb reports that Omni-Link is in use by a variety of clients, including regulated utilities, unregulated suppliers, Fortune 100 clients, and ISOs.

Siemens AG (Erlangen, Germany) has developed the decentralized energy management system (DEMS) for planning, simulation, and optimized dispatch of a variety of dispersed DE technologies. The DEMS has two parts: an "off-line" part that provides pre-project planning and optimization of the design and configuration of a DE project and an "on-line" part that provides the strategies and control for real-time optimal dispatch. The DEMS uses forecast, planning, and on-line dispatch algorithms running under Windows NT.

The pre-project off-line optimization and design is done using the DEMS' simulation mode, which models the performance of various generation sources, storage units, loads, operating characteristics, and possible additions or further expansion. The optimization can be based on economic benefits or other parameters, such as emissions. This is an important feature, because it provides financial feasibility analysis of DE projects.

For on-line optimized dispatch and load control strategies, DEMS combines a variety of features from data gathering, forecasting, and planning. The system includes daily and weekly planning capabilities as well as the ability to respond to real-time information. DEMS predicts the overall situation with all sources of generation, storage, and load, basing its forecast on weather and other variables. From this assessment, an assignment plan is derived, and optimization is then communicated via a LAN, ISDN telephone line, or Internet to the distributed generators and load configurations. All system data is stored and can be addressed on-line via the graphical user interface.

Silicon Energy (Alameda, California, USA) is testing its new Distributed Energy Manager system in the Pleasanton Power Park in California. Silicon Energy is using its Enterprise Energy Management (EEM Suite) software to provide real-time software and communications infrastructure for the project in conjunction with the new DE resources' dispatch software system.

Sixth Dimension (Ft. Collins, Colorado, USA) offers a hosted service that allows energy companies to remotely aggregate, schedule, dispatch, and monitor large numbers of DE units. As part of the service, Sixth Dimension also provides and manages the necessary Internet-based network to implement the functionality. This includes a secure "Tier 1" data center, where the application and database are located, and a round-the-clock staffed network operations center. In the summer of

2000, the system was certified for the California ISO Ancillary Services Program. It is now being used for a few projects in the U.S., including a 25-MW aggregation of standby generators in Albuquerque, New Mexico, that's being delivered by independent energy service provider Celerity Energy. Sixth Dimension estimates that its system takes 4 seconds to send a signal and receive verification that either the signal was or was not received.

Multisite Control and Communication Systems

Several companies offer networked multisite control and communication systems for distributed energy. These server-based systems can control multiple sites and be accessed via the Internet or other communications options. The products are briefly compared on Table 4.

Below are brief descriptions of the products researched:

ASCO (Florham Park, New Jersey, USA), provides an Internet-based multisite system, SiteWeb. SiteWeb communicates with ASCO devices and the outside world through a thin-client Web server, known as TWS. This server houses the communication software and interacts via an Ethernet port, serial communication port, or modem. The software communicates using open protocols including Modbus. Each TWS can control on-site generation of up to six generators (such as reciprocating engines, microturbines, or fuel cells) and provide load control of up to 64 automatic transfer switches from multiple manufacturers supporting open protocols. Multiple Thin Web Servers can be daisy-chained together to control more generating and transfer devices.

ASCO estimates that the cost of installing all controls and SiteWeb software for upgrading and retrofitting existing generators is about $60 to $75/kW. (However, if the local utility requirements for interconnection are more stringent than normal, or if expensive studies or lengthy processes are required, the costs can increase to as much as $200/kW.)

Capstone Microturbine's (Chatsworth, California, USA) first control systems offering was the Remote Monitoring System, a PC-based system that could control and monitor up to 40 Capstone microturbines simultaneously via serial communication or modem. Recently, Capstone announced development of a new multisite system, the Capstone Power Server. It's an Internet-based system that can control up to 100 Capstone

Table 4: Multisite Control and Communication Systems.

Company	Product	Description	Product Status	Experience
ASCO Power Technologies	SiteWeb, PowerQuest	PC-based and Intemet-based systems for control of any type of generator via Ethernet, communications port, or modem.	Commercial product	PowerQuest was introduced in 1991. The SiteWeb system was introduced in 2000 and is installed at seven sites. The financial dispatch module is in development.
Cannon Technologies	LCR 5000 and Yukon software	Paging load control receiver for the control and dispatch of multiple gensets, with real-time data for the generators and pricing available via the Internet.	Commercial product—2001	Used for load control for years at several sites. Installed for generator dispatch by a number of utilities and cooperatives, such as Dakota Electric and Xcel Energy.
Capstone Turbine Corp.	Remote Monitoring System, Power Server	The Remote Monitoring System is a PC-based system that can control up to 40 Capstone microturbines at once. The Capstone Power Server enables control of up to 100 Capstone microturbines via the Internet or an intranet.	Beta tests 2001	The Remote Monitoring System has been installed at 90 sites for single microturbines and 35 sites for multiple generator applications. The Power Server was tested in a 10-unit microturbine system at Capstone's headquarters before being shipped to the first customer, a plastics manufacturer.
Cummins Onan	Power Command Network	Cummins Onan is developing a wide area network version of its existing PC-based system.	Commercial product — 2001	Field tests of the wide area network version are underway. The PC version has been installed in hundreds of locations worldwide.
ENCORP	Virtual Maintenance Monitor (VMM), Virtual Power Plant (VPP)	VMM is a PC-based system for single sites. VPP is an Internet-based system for multiple sites that is able to dispatch a variety of distributed generation technologies.	Commercial product	VMM is installed in sites including Ft. Bragg, North Carolina. VPP was installed at the Tennessee Valley Authority (TVA) in 1999. Field tests of economic dispatch are under way at the TVA.
OmniMetrix	G-Series wireless monitors, Cellemetry and other supporting software products	Intemet-based system using cellular technology for wireless control and communication, with a GPS option.	Commercial product	Installed at 500 sites, including Zilwaukee, Michigan, where CMS Energy uses it to control portable Caterpillar generators.

microturbines as one seamless system, providing redundant and scalable power. The Power Server allows for communication to each individual microturbine through high-speed, digital communications via the Internet to coordinate and dispatch individual units based on load demand. The system can be programmed to start, stop, or deliver power based on a time-of-day or day-of-week schedule. It uses intelligent algorithms to account for changes in ambient conditions as well as predictive load capabilities. Capstone is actively teaming with third-party companies to develop browser-based, remote monitoring and dispatch applications.

Paging/Cellular Communication

Of the multisite products listed in Table 4, two are based on wireless technologies: paging and small-packet cellular. These technologies provide a simple, relatively inexpensive way of controlling large numbers of dispersed resources. They claim to reduce the per-unit cost of implementation by reducing communication system equipment requirements. This technology is being used to monitor, aggregate, and curtail loads from multiple sites simultaneously. Brief product descriptions follow:

Cannon Technologies (Wayzata, Minnesota, USA) offers its LCR 5000, a load control receiver that allows utilities to send start/stop commands relatively quickly (typically in about two minutes, which is adequate for most ancillary services) and reliably to thousands of generators from a remote location. The LCR 5000 receives pages from any 900-megahertz (MHz)-band paging system that supports the Motorola FLEX paging protocol. Units can be addressed individually or en masse. The cost of the LCR 5000 and associated master software is $100 or less per point. Dial-up access can be used for verification and metering using Cannon's software, which allows real-time data for the generators and pricing to be collected and then made available via the Internet.

The Cannon products have been used for years for load control and are now being used by Dakota Electric of Eagan, Minnesota, and Xcel Energy (formerly Northern States Power) to control on-site generators at some customers' sites.

OmniMetrix (Norcross, Georgia, USA) also supports remote start/stop commands and monitoring of distributed resources with its wireless system. The G-Series wireless monitors attach to remote generators or loads, and instead of paging, the OmniMetrix system employs the Cellemetry Data Service to route monitoring signals over the cellular network. This system can include a satellite-based system for monitoring and control, as well as GPS-enabled equipment tracking. Real-time status of all generators is posted on the customer's assigned Web site. The system also has the capability to automatically choose units to dispatch based on a variety of parameters, including location, engine size, substation, or neighborhood. The cost of the OmniMetrix system starts at around $500 and depends on a range of options as well as on the quantity of generators. The OmniMetrix system was chosen by CMS Distributed Power, a new technology unit of CMS Energy, for a project in Zilwaukee, Michigan. CMS installed 32 truck-mounted Caterpillar diesel generators. When remotely operated by CMS, using the OmniMetrix system, a total of 40 MW could be generated for export into the local grid at times of 32 peak demand in a project that began in summer 2000.

A Peak Shaving Case History: Fort Bragg Army Base

Fort Bragg Army base near Fayetteville, North Carolina, is using ENCORP's Virtual Maintenance Monitor (VMM) single-site control and communication system to control its electricity demand for peak shaving as part of a shared savings project. Fort Bragg is one of the largest army bases in the U.S. and is staffed by 45,000 servicemen and servicewomen. Fort Bragg has a contract with Carolina Power & Light for a maximum demand of 78 MW that can be imported without penalty. As Fort Bragg's mission has grown, so has its use of electric and electronic equipment and its peak electric demand. To avoid penalty charges, Fort Bragg embarked on an aggressive plan of supply-and demand-side measures aimed at keeping demand below its contracted level.

On the supply side, Honeywell Home and Building Control Division converted the existing standby engine-driven generators for peak shaving as part of a shared savings contract with Fort Bragg. Honeywell modified the electrical switchgear for 11 generators (a total of 3.85 MW) to allow closed transition, grid-parallel operation using software and hardware from ENCORP.

ENCORP's VMM software is used to monitor and control the generators. VMM interfaces with ENCORP's Automatic Parallel Switches and Generator Power Controllers. Previously, the generators could only operate isolated from the grid, thus causing brief but problematic outages when facility load was switched from the grid to generator power. With the modifications, the generators can seamlessly transfer load from the grid to the generators and back. VMM software allows a single user to manage the control units stationed at each generator through a LonWorks network.

Using forecasting and a DE optimization program that uses real-time information regarding fuel costs, maintenance costs, electricity prices, and so on, the ENCORP system determines when it is economically favorable to operate the generators. Now the system alerts the operator when it is economical, but it may soon be used to automatically dispatch the generators—if the operators choose to allow it to do so. A maximum demand level and generator operating strategy is specified, and the generators are operated to keep overall demand below the set point. The system can also monitor the environmental or permit hours that the generators have been run. The plan calls for each generator to operate for only about 200 hours, which is the limit set for backup generators under the state's air quality permits.

The systems were first proven in February 2000 during the winter peak when the real-time price of electricity soared above normal levels and made operation of the generators cost-effective. Honeywell estimates that the project will have a simple payback of four years. Honeywell assumed all equipment procurement and installation costs as well as maintenance and service costs as part of the shared savings contract, so Fort Bragg experienced an operating cost reduction with no out-of-pocket expenses. As well as delivering cost savings, the control system improved reliability at Fort Bragg: In case of grid power interruption, the generators are dispatched automatically, saving time, whereas previously, someone had to operate the generators manually during outages and for maintenance checks.

NEEDED: A STANDARD SPECIFICATION

A control and communication protocol standard is urgently needed to support the growth of networked DE. Such a standard would lead DG equipment manufacturers to make products that can be easily integrated by utilities and third party aggregators into their DE resource portfolios. Celerity Energy of Portland, Oregon is attempting to lead this development by offering publicly what it calls a "functional specification" to communicate with and control distributed generators.

The specification that Celerity is developing will include requirements for the following characteristics:

- Latency—the length of time required for performing a query and getting a response from a remote DE unit.

- Packet size—the maximum volume in bytes of a communication packet at the source.

- Bandwidth—total volume of data necessary to operate the DE units.

- Remote intelligence—computational ability necessary to make decisions at the DE units.

In the process of determining what parameters are required for each of these aspects, Celerity is weighing the trade-offs between performance and initial capital cost and operating costs. For example, large bandwidths are available in a totally Internet-based system but will require significant ongoing costs. Other options provide smaller bandwidths, along with probably larger initial costs and lower ongoing costs. Efforts like Celerity's will assist with market growth.

Similarly, issues surrounding control and communication needed to enable networked DE, LM and the "virtual utility" are just now making their way to the forefront of public policy and will surely gain more attention in the future, especially as large markets like California and New York are being forced to try new approaches to solving their critical generating capacity problems. For example, the U.S. Department of Energy's Office of Distributed Energy Resources is beginning to address DE control and communication systems and plan what the office's role should be in formal R&D policy development for these systems.

CONCLUSION

There are overwhelming motivations for the rapid development of networked DE and LM:

1. **A large untapped market that will value dispatchable DE and LM at certain times and places;**

2. **An estimated market of 8 gigawatts of backup generating capacity in the US likely to be communication and control networked;**

3. **Business models that offer prospects of profit to utilities, and ESPs regardless of relative fuel and electricity costs; and,**

4. **Manufacturers aggressively developing products to enable real-time communications and control.**

While this article may not be entirely accurate in predicting the rate or particular market segments that will enable the virtual utility, it seems that in some form, its robust emergence and growth is a virtual certainty.

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