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Energy Management Application
Using JMatos™, CMatos and Jini™ Networking Technology

Introduction

Generators, transmitters and distributors of utility services aim to provide businesses and consumers with cost-effective, energy-smart, environmentally sound and reliable energy services.

An on-going challenge for these companies is managing peak loads and lowering operating ratios by controlling increases in infrastructure and service delivery costs, while still meeting the growing demands by businesses and consumers for electricity.

The challenge for consumers is to manage their ever increasing cost of energy! Consumers can control and lower their consumption but they are still vulnerable to being charged by their utility provider for higher infrastructure and operational costs.

Traditionally, generators, transmitters and distributors operate centrally controlled systems structured around large servers that run controls and application software for operational management. The grid and systems are designed and built to handle peak load periods.

Solutions to manage peak periods and reduce outages are still being architected to be centrally controlled. These methods are prohibitively expensive for distributors looking to control devices in consumers' homes and businesses. Key reasons centrally controlled solutions are not being deployed on any scale are:

- They require significant capital and operating investment for hardware, software, and manpower to maintain and support. They are very costly to deploy.
- They require centralized controls, processing and dedicated, proprietary, time critical communication systems which are rigid, brittle, costly, and complex.
- There are many single points of failure: if a server fails or communications fails, it impacts the entire system, affecting customer satisfaction and forcing utility companies to invest in expensive backup systems.
- They are not easily scalable and difficult to keep up to date, as new applications are developed and new customers are added. Whenever a new meter or end appliance is introduced to the system, new software interfaces must be written, installed and maintained, to allow these meters or appliances to participate on the network. Typically, these higher costs are passed to the consumers.
- Controlling millions of customers and devices at each customers premise is a huge management, communications and control problem.
- Customers are reluctant to give control of their devices to an outside party.

One way for the distributor and the consumer to mitigate these costs, is to introduce an autonomous solution that is based on a distributed computing framework. At the heart of the system is a self deploying intelligent meter that connects automatically with both the distributor and smart appliances in the home. The advantages of a distributed system are primarily:

- Does not require costly addition of centralized servers to control and maintain the system; meters can be deployed gradually, reducing the need for high up-front capital investment required when launching a centralized system.
- Increases the robustness and reliability of the system; a meter can continue controlling appliances in the home even if the central system or communications is down.
- Increases customer satisfaction; consumers can benefit from lower energy bills by operating appliances at low load periods, and by taking full advantage of (off-peak) lower energy rates.
- Excellent investment; fully scalable and future proof, appliances can be added to the system ad-hoc, without technical expertise or time required. Since the system is open, consumers can chose from a wide array of appliances. These appliances will not be prone to obsolescence or interoperability issues.
- By streamlining power consumption such that peak periods are avoided, utility companies can operate their grid systems more efficiently, lower their capital investments and reduce service failures.
- With the advent of next generation internet connected utility meters, automatic meter reading will be a clear benefit.
- It offers a very simple and cost effective deployment strategy.
- The user can always override the autonomous behavior and turn a device on to maintain control.

Technology

PsiNaptic software products, JMatos and CMatos provide the autonomous solution for streamlining power consumption. Based on a distributed computing framework, PsiNaptic solution does not require utility companies to add a costly centralized system to their infrastructure to manage this improved service delivery. Business and consumers operating machines and appliances will quickly recognize the benefits of having “intelligent” devices negotiate best rates with an intelligent meter on a continuous basis. Aside from this software solution being cost effective and operating reliably, it is self deploying and self managing.

JMatos and CMatos, based on Jini Networking Technology is IP based network architecture for the construction of distributed systems where scale, rate of change and complexity of interactions within and between networks are extremely important and cannot be satisfactorily addressed by existing technologies. Jini technology provides a flexible infrastructure for delivering services in a network and for creating spontaneous interactions between clients that use these services regardless of their hardware or software implementations.

Jini network technology is an open architecture that enables developers to create network-centric services -- whether implemented in hardware or software -- that are highly adaptive to change. Jini technology can be used to build adaptive networks that are scalable, evolvable and flexible as typically required in dynamic computing environments.

Applications

The Utility Meter:
At the center of the system is an intelligent electrical utility meter containing services such as: time of day, consumption rate and a table of differential cost of electricity. The meter, using a TCP/IP communications protocol, can advertise its presence and its services to a home network, connecting various appliances, using standard wired or wireless protocols solution such as Bluetooth.

Appliances:
Intelligent appliances connected to the home network can autonomously search the network for the services offered by the utility meter or each other. The appliances can use this information to determine when to turn on and off, consistent with its function. For example: a dishwasher can continuously interact with the utility meter to determine the optimal time period to turn on. Two appliances can cooperate with each other, not to turn on at the same time. This co-operation amongst the appliances happens autonomously without the user having to set it up or manage.

Of particular importance are HVAC systems and their thermostats. These too can be intelligent and co-operate to manage peak loads and costs while maintaining comfort. The user can opt to override this setting and turn on their appliances. However, if the system is allowed to operate as designed, it will:

- continuously minimize the cost of energy, by avoiding peak load periods
- eliminate the need for centrally controlled system either locally or remotely through a utility network. The system is self deploying, robust and autonomous.

Due to the open nature of the system, appliances of any manufacturer type, model, make or year, purchased at any local outlet, when installed by a non-technical user, can autonomously join and participate on the network.

Distributors:
Central office operators only need to make available the time and peak differential cost of electricity over an IP network. Because of the distributed nature of the system (where the devices are intelligent and autonomous to make decisions when to turn on and off), there is no need for a centrally controlled system or dedicated communications network.

Energy management applications on a distributed computing framework are therefore cost effective, future proof, robust and efficient.

Security:
Security is a requirement that must be implemented in any deployed network system, independent of protocol, or whether the system is architected to function centrally or in a distributed manner. There are many methods, implementations and levels of authentication and encryption available depending on the information, user, application or device capability.

Distributed intelligence is by nature more secure than centrally controlled methods since each home or LAN or pair of devices can act as an independent system.

Connectivity:

Connectivity between the meter and the distributor can be done using standard methods and equipment such as internet modems, phone modems, or even cell-phones.

The distributor can interact with the remotely connected IP meter providing it with updated cost tables, actual usage (peak, off-peak by appliance) and accumulated cost to date. Conversely, the remote meter can offer its services to the distributor, enabling remote reading at all times.

Each time the meter is updated, it will provide the appliances with the new information. For consumers, current up-to-date information is available through their PC, PDA, cell-phone or any number of other devices.

Benefits:

- An intelligent utility meter as described above can be inexpensive. It can be built with a single chip Bluetooth device that provides all the connectivity, the processor and even a DSP for metering.
- Distributors can offer their customers a better rate as an incentive to switch to an intelligent meter. Even without the availability of intelligent appliances, an intelligent meter can accurately track on a time or peak usage basis, providing the distributors with more accurate billing.
- Informing customers of these rates and opportunities to lower their energy cost can further encourage customers to switch to an intelligent metering system. An intelligent meter can inform a consumer what times of day rates are high and low. Consumers can reduce their energy consumption costs by manually turning devices on and off to avoid peak periods.
- Consumers will be able to benefit even more from the cost savings of the system, as intelligent appliances are capable of automatically joining the network, and autonomously make decisions on when to turn on/off. Distributors will further benefit from better load management.
- Legacy non-intelligent appliances can be retrofitted with inexpensive intelligent after market modules in order to enable them to partake in the system.
- A distributed based system allows for new appliances to be networked without adding complexity to the controls consumers are familiar with, and at the same time enable utility companies to achieve superior capital and operational results.
- Homes that are not IP connected can have their meter tables' updated monthly by the individual who routinely reads the meter.

Conclusion:

Significant cost savings from energy management can be realized by both distributors and consumers with intelligent appliances and meters operating on a distributed computing framework. PsiNaptic software technology running on appliances and meters is standards based, independent of hardware and operating systems, and is available for all complexity of devices. The technology uses a service offering and service consuming software model at the application level, making the definition of an application very simple and fast to implement. It also provides an extremely high level of interoperability. It is future proof. For these reasons, all meter, appliance and other manufacturers and suppliers will be able to participate easily, freely and openly. This will produce a large selection of products with differentiation and competitiveness.

Most importantly, there will be little to no capital outlay required by the utilities or governments. The system will be self deploying and self financed. The technology is standard and available.

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