

What Makes a Smart Meter Smart?

The Transformation of Ratepayers into Customers

by

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May 10, 2011

As a matter of public policy for the last hundred years, electric, gas and water utility users have been referred to as ratepayers by the various utility commissions throughout the United States.

Technical advances in recent years, including advanced semi-conductors electronic components, power sensing techniques, low cost high resolution displays, advanced microprocessors, large inexpensive solid state memories, and the like, now provide the means to change the paradigm and modernize the way utilities charge for their commodity; thereby converting ratepayers into informed customers.

Recently, the State of California mandated that the major Investor Owned Utilities in California deploy an Advanced Metering Infrastructure (AMI). The AMI System has many elements; chief among them an advanced electronic communicating utility meter.

The President of the United States has called for the installation of "Smart Meters" throughout the U.S. as part of the government's efforts to modernize the electrical grid under the economic stimulus plan. Unfortunately, there is no industry definition for the term Smart Meter. One California Electrical Utility has a Trademark on the phrase Smart Meter. Often times these words are silk screened on simple digital electric power meters or older gas meters that are capable of communicating with a roving van containing the appropriate receiving equipment or integrated into a neighborhood fixed network collection system. But does that mean these meters are Smart? The author believes that any new meters installed in the United States and paid for by utility customers or by local or national taxes must:

- Include the ability for customers and the utilities to communicate using a customer interface display and control device.
- Include communications to and from the utility to facilitate customer service, billing data, payment, emergency messages, notification of potential service outages, and the like.
- Include bi-directional communications between the Smart Meter and the utility.
- Include bi-directional communications between the utility customer inside the home or office and the utility customer service department
- Include real-time communications between the meter and the customer to facilitate usage and consumption data converted to dollars and cents, accumulated usage, customer bill to date, power quality information as well as information to be used by communicating appliances in conjunction with home energy efficiency software.

- Serve as the gateway or interface between the Utility Wide Area Network data communication system and the Home Area Network allowing necessary and appropriate data exchanges,
- Use a universal protocol and wireless communications technology thus allowing the customer to implement “plug and play” devices in the home apart from utility company involvement.

To maximize both consumers’ choice and benefits to utilities requires the deployment of a communicating smart utility meter (CSUM) system. One part of the CSUM system is located outdoors, in the traditional utility meter location. The other part, a display & control device, is conveniently located inside the home or office. The two parts of the CSUM system can communicate with each other and with one or more utilities. The display & control device displays, among other things, (1) the billing rate for commodity consumption at various times of the day or days of the week and (2) the real-time up-to-date cost of the utility commodity consumption during the current billing period, allowing customers’ to understand and control their commodity use, budget their financial resources and enable them to conserve resources and money.

CSUM systems can measure, store, calculate and display a great deal of useful information. The following are several examples of how a CSUM system can benefit electric utilities and their customers.

Utility Company Benefits:

- **IMPROVED OPERATIONS:** CSUM systems can collect primary data such as voltage, current, and phase angle. A wealth of additional information, such as power factor, can be derived from the primary data. This information is valuable for both utilities and their customers.

Remote sensing and flagging of power theft and automatic service outage reports are important cost saving benefits to utilities.

- **SUBSCRIBER SIDE BILLIING:** Subscriber side billing is another example of how a CSUM system can reduce costs for both utilities and their customers. Such a meter system is able to (1) calculate and display each customers’ monthly bill, (2) reconcile each bill at the end of the month with taxes, credits and regulatory offsets, (3) display a monthly bill to each customer, and (4) allow customers to pay their bill by interactive electronic means, thereby eliminating the need for the utility to spend money producing printed bills. The implementation of subscriber side billing greatly reduces the overall data network congestion and amount of data needed to be handled and archived by the utility billing operations center.

In addition to these cost savings, subscriber side billing will significantly reduce the amount of paper manufactured from trees and delivered by post thereby saving trees, reducing transportation energy use and reducing associated greenhouse gas emissions.

- **CREDIT LIMIT AND PREPAID SERVICE:** In addition to its ability to calculate monthly bills, a CSUM system with subscriber side billing will make it easy for utilities to establish a credit limit for each customer and also to offer a prepaid service. In either case, a useable balance would be displayed along with a projected date on which the credit limit or prepaid amount will be fully consumed, based on the current rate of consumption. If the useable balance is fully consumed, the class of service can be changed automatically, reducing or turning off the utility commodity available to the customer depending on the utility policy and local regulations.
- **SECURE COMMUNICATION AND HACKING DETECTION:** A CSUM system will (1) securely encrypt all communications to prevent unauthorized access to private information, (2) detect any cyberspace hacking attempt by those seeking to do harm to the nation's transmission and distribution system, (3) provide an additional firewall and (4) report the occurrence of such discoveries to the utility and/or other appropriate authorities.
- **NEW TARIFF OPORTUNITIES:** A CSUM system will also support the future use of a variety of new rate tariff structures. These can be *time of use*, *peak demand*, and *critical peak demand* tariffs currently in use or proposed for use by the various state Public Utilities Commissions, the Department of Energy and the Federal Energy Regulatory Commission. Further, more innovative tariff structures can be deployed in the future such as *real-time pricing* and *class of service pricing*.
- **CLASS OF SERVICE:** Examples of Class of Service include: (1) maximum current in amperes, (2) guaranteed maximum period of service interruption, (3) guaranteed minimum and maximum over and under voltage and (4) guaranteed levels of power factor deviation and harmonic content.

These Classes of Service alternatives have implications for the operation and maintenance of the utility service and user owned electrical devices such as computers and the efficiency of power used, hence the bottom line charges for electricity.

- **REMOTE CONNECT, DISCONNECT AND CLASS OF SERVICE CHANGE:** A CSUM system can remotely connect, disconnect and change the class of service saving the utility money. This feature is especially helpful when people move into and out of residences. It is also important when enforcing collections.
- **SUPPORTS ELECTRICITY RETAILERS:** A CSUM greatly enhances the effective operations of electricity retailers in deregulated markets by directing meter data to a specific retailer.
- **REMOTE UPDATE:** Lastly, any embodiment of a CSUM system must provide for the remote download of updates and improvements of the software/firmware operating system. This will insure that hardware paid for today will not become obsolete in a few short years due to a lack of functionality. Once the basic meter internal hardware components are in place, new features and upgrades can be remotely installed.

Customer Benefits:

Manage electricity usage by:

- Display of electricity cost information; i.e. cost per kWh in real time.
- Real time consumption and accumulated cost to date based on actual electrical load.
- Establish, monitor, and control customer established budget.
- Integration with Home Area Network and communicating “Smart Appliances” fully automates the lowest monthly electricity cost consistent with customer selected comfort and convenience parameters.
- Offers payment choices such as traditional monthly billing with automatic funds transfer after customer approval, prepaid, pay as you go, and other to be designed plans for the customer’s convenience.
- Allows display of all information on a remote computer or PDA while the customer is away from the premise.
- Monitors the “health” and efficiency of major electricity consuming appliances and alerts the customer of maintenance issues such as filter replacement or predicted failure of a device such as a fan or air conditioning compressor.
- Allows the implementation of local data archiving for customer review.
- Allows the customer to analyze and make cost effective choices for new appliances based on manufacturers’ ratings and historical use within the premise.
- Provides the customer with a real time interactive link to the utility customer service department.
- Provides for the down load of energy related or other media content.
- Allows for the simple operation of Electricity Retailers in deregulated environments thereby offering the customer a choice of electricity companies, plans and programs.
- Provides solar power generation and cost & credit information in real time to the consumer in the case of net power generation at the customer’s site and utilities offering “feed in tariffs.”

Many of the features described in this paper are the subject of USCL USPTO patent no. 7,379,791, USPTO publication number, US 2009/0109065 A1, EU rights granted for 7,379,791, and additional patents pending in the U.S., Europe, China & Israel.