Itron White Paper
OpenWay® by Itron

What makes a smart meter smart?

Itron

Introduction

At the start of the 21st, we hold smart phones to our ears, wave smart cards at point-of-purchase terminals, and drive smart cars. In the electricity industry, we have smart meters and the Smart Grid. What exactly do we mean by describing a device or machine as "smart"? "Smart" is in peril of becoming vague through frequent and indiscriminate use. Dictionaries are having difficulty keeping up with this area of technology. The online version of the Oxford English Dictionary doesn't list a definition of "smart that comes close to conveying this meaning. The American Heritage Collegiate lists its fifth meaning of "smart" as "Of, relating to, or being a highly automated device, especially one that imitates human intelligence." Even that seems like a cop-out of a definition.

Let's break down smart or intelligent into observable qualities or actions, to see if we can reach a better definition. Three general classes of behaviors seem to combine into something close to intelligence:

- Environmental interaction: Animate and inanimate objects that can measure or sense the world around them strike us has having a measure of intelligence. Intelligence appears to increase if the object can sense or monitor its own condition, such as location, power levels, or operating status. We can call this capability sensing.
- Data interaction: Animate and inanimate objects that can interact with data strike us as having at least limited intelligence. This can be a simple level of if-then logic regarding a single piece of data, or more sophisticated operations of combining multiple data points and multiple type of logic. We can call this capability computing.
- Peer interaction: Animate and inanimate objects that can interact with other objects strike us as having a type of intelligence. This can range from a simple binary status indicator (Full/Empty, On/Off) to robotics that perform tasks alongside humans, such as pharmacy robots that now traverse many hospital corridors. We can call this capability communicating.

When sensing, computing, and communicating combine in a single device, that device can become highly automated and possibly imitate human intelligence. Today, we can affordably combine global positioning system (GPS), mobile computing chips, and radio communications in mobile devices like cellular phones and portable navigation devices.

This is certainly true with today's electricity meters. The electricity meter was originally developed more than 100 years ago to sensing current flowing through a wire. Now, that sensing capability can be enhanced and combined with computing and communication capabilities to create a truly smart device for managing an increasingly valuable, volatile, and perishable commodity: electricity.

Smart Meter: Sensing

A meter must measure. That is meaning of the word *meter*. For many decades, electricity meters simply measured the current that ran through them, one simple and continuous measurement. Utilities subtracted last month's reading from the most recent reading to compute the unbilled energy from a meter.

That simple level of measurement is no longer sufficient for operating the complex electricity deliver system we have today. A smart meter today must sense or measure a wider range of quantities or conditions:

- Interval metering: Much of our electricity distribution issues arise from *when* customers use energy, not just how much they use over time. To be smart, an electricity meter needs to be able to measure how much energy is used within a certain time period. This is known as interval metering. Price or rebate programs can be tied to time periods as a way to change consumer behavior about when they use energy. As a result, a smart meter must also be able to sense time through an internal clock that is synchronized with the entire network it resides on.

- Bi-directional measurement: Alternative, renewable energy technology is and will continue to become more widespread and affordable. A smart meter needs to measure energy a house or building receives from the distribution network plus any energy the house or building generates and returns to the network. This is known as bi-directional metering or net metering.
- Amperage measurement: To help manage the distribution of a finite commodity, it helps to know how much of that commodity is flowing through various points of the distribution network. Smart meters need to know how much amperage is flowing through to the home or building. This type of measurement has many applications, but one obvious one involves an imbalance of supply and demand. If not enough supply exists to meet demand, it is helpful to ration distribution rather than fully supply some customers and cut others off completely. This can be done with a variable, load-limiting service switch.
- Voltage measurement: Many devices in today's digital economy require high quality power, power that falls within a certain range of voltage. The farther a device is from a substation or generator, the more voltage can tend to dip below acceptable quality levels. Conversely, voltage can also swell above accepted quality levels. A smart meter needs to measure and report on voltage as a way meet customer's need for quality power.
- Tamper sensing: For various reasons, some customers will try to tamper or modify their meter to reduce or eliminate the cost of electricity. Also, at times a meter may not be installed properly. In these cases, a smart meter should be able to sense the error condition.
- Outage and restoration sensing: Outages and the work to restore them can cost utilities a large amount. Utilities are measured on their up-time performance through various indices, and some utilities receive bonuses or penalties based on those indices. In competitive markets, fewer outages of shorter duration can be a competitive advantage. A smart meter should be able to report that it is out of power and when power flow has been restored.

Smart Meter: Computing

Computing powers the transformation of meter data into information, which in turn drives the knowledge to operate a smarter utility. Clearly utility data centers provide a large and growing amount of computing power to operate the business. But smart meters need to perform their own set of computations to provide quality information to all utility processes.

- Smart meters must be able to perform all relevant calculations related to the qualities and quantities measured: kilowatts, kilowatt hours, voltage, amperage, time. Rate calculations can be done at the meter. This would make it easier for individual consumers to know the financial impact of their consumption behavior. However, maintaining and updating rate schedules at meters could be an unnecessary burden on the communications network. Rate calculations could also be performed at the utility and communicated back to the meter, to avoid the burden of communicating rates.
- Meter must perform the calculations, and not rely on an associated communications module or the communications network itself. One reason for this is permitting measurement and calculation to continue even if the communication network is not available do to outage.
- Meters must support future computing needs as well. Utilities expect meters to last 20 years or longer. Algorithms are bound to change within that meter lifespan. A utility does not want the cost of physically visiting meters in the field to update their computing capabilities. Therefore, meters need the ability to download and install new programming or configuration remotely, over the communications network. Ideally, this would also include the ability to download programming or configuration to other devices that communicate with the smart meter, such as natural gas meters, water meters, and home-area network devices. The meter also needs sufficient computing processing power and memory to download and run future applications without degrading meter performance.

Smart Meter: Communicating

As technology continues to advance, utilities find themselves operating a network of networks. Automated meter reading, SCADA, workforce management, distribution operations and other systems have their own network of devices and information. All of these must come together with customer service, billing, human resources, and other business applications to enable smarter utility operations. The smart meter must fit into this network through communications.

The smart meter must have two-way communications between the meter and the utility. This usually starts as a local-area network covering a neighborhood, and joins with a wide-area network connection neighborhoods with the utility. The smart meter must also have two-way communications into the home, to support new customer service and energy management programs. Communications into the home can reach thermostats, in-home displays, load-control devices, and major appliances. Because the electricity meter has access to power, it also serves as a logical communications point for smart water and natural gas meters that must usually rely on battery power.

Communications needs to be structured in standardized formats to aid with transport over different types of networks and sharing with different types of business systems and applications. To further aid in the movement and sharing of data, the smart meter should support industry-standard communication protocols. The smart meter must contain enough memory to retain relatively large amounts of data. If the communication network is not function, the utility should not lose data because it was stored in the communication network or could not be stored in the meter for lack of storage space.

Communications to and from the smart meter needs to be secure. The smart meter needs to support security from the point and moment of measurement at the metrology level all the way through to communications. As security needs evolve, so to must the smart meter's protection schemes. The smart meter needs to be built with enough computing power and memory to support evolving security algorithms that can be updated over the communications network.

OpenWay CENTRON: The smart meter

The Itron OpenWay® CENTRON® embodies the sensing, computing, and communications characteristics of a smart meter. It's at the heart of OpenWay by Itron, the industry-leading advanced metering solution that serves as the foundation for the smart utility. We encourage you to compare the OpenWay CENTRON, and any other meter you're considering purchasing, against the criteria put forth in the paper, and judge for yourself what makes a smart meter.

Itron Inc.

Itron Inc. is a leading technology provider to the global energy and water industries. Itron Inc. consists of Itron in North America and Actaris outside of North America. Our company is the world's leading provider of metering, data collection and utility software solutions, with nearly 8,000 utilities worldwide relying on our technology to optimize the delivery and use of energy and water. Our products include electricity, gas and water meters, data collection and communication systems, including automated meter reading (AMR) and advanced metering infrastructure (AMI); meter data management and related software applications; as well as project management, installation, and consulting services.

To know more, start here: www.itron.com

Itron Inc.
Corporate Headquarters
2111 North Molter Road
Liberty Lake, Washington 99019
U.S.A.
Tel.: 1.800.635.5461
Fax: 1.509.891.3355

Publication 100XXXWP-01
03/09