An Overview on Advance Metering System

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Abstract— The term "Smart meter" typically refers to an electrical meter, but the term is also starting to be applied to the measurement of natural gas and water consumption. Similar meters, usually referred to as interval or time-of-use meters, have existed for years, but Smart Meters usually involve a different technology mix, such as real-time or near real-time reads, power outage notification, and power quality monitoring. These added features are more than simple automated meter reading (AMR). ADVANCED METERING ultimately, is to reduce costs, even though revenue shouldn't increase, due to regulation. Any account that is not metered at a simple consumption rate including electric gas and water is utility point of view to understand Advanced Metering.

Keywords- Advance metering; SPU; end point; database; GUI.

I. INTRODUCTION (HEADING 1)

The Advanced Metering Communication Server i.e. Central Servers is a Windows (2000, 2003, XP) based server which is responsible for managing all System information and coordinated processing. The perspective is to describe the Central Server from both black box and internal views. Components related to the Central Server (e.g. SPU, end point) are discussed also from a black box perspective, as needed to describe the interfaces between the Central Servers and those components. Keeping utility point of view for Advanced Metering in mind following are types of Advanced Metering Rates:

- Time of use
- Demand
- Time of use plus demand
- Load profile

An advanced meter is one that can measure time of use, demand, and/or load profile. Time of use (TOU) is a billing method in which the customer pays more for energy used during peak hours than for off-peak hours. Time of use is also known to utilities as TOU, time of day, and register reading. Demand is energy used has the same price every day. There is an additional charge based on the highest (peak). Time of use plus demand means energy used has different prices, depending on time of day, plus an additional charge based on pea usage during each time bin. Load profile is information on how much energy was used throughout the day. Load profile is also known as profile, interval data, load research, or LP. Load research is not typically meant for billing.

II. ADVANCE METERING SYSTEM

Cumulative consumption (CUM) is the most basic concept of metering. It is the measurement of total electricity, gas, or water used over a period of time. An example of a simple consumption meter is your residential electric account. Simple consumption means that you pay x amount for each kilowatt-hour (kWh) used during the month − period. To calculate your monthly bill, the utility:

1. Reads the cumulative consumption on your meter on the billing date (C1)
2. Subtracts the equivalent value from last month (C2)
3. The difference (C1 - C2) is the amount of energy you used during the month

For the sample bill:

1. What is the cumulative consumption for the current month?
2. What is the cumulative consumption from last month?
3. How much energy was used during the month?

In Advance Metering on the other hand means:

Any account that is not metered at a simple consumption rate including electric gas, and water. Rate is prime factor of advanced metering and categorized in following types:

- Time of use
- Demand
- Time of use plus demand
- Load profile

III. PROBLEM FORMULATION

Any Advance Metering system is an automated meter reading (AMR) system which uses two way power line carriers (PLC) for communications between end points and substation processing units (SPUs). Each day, an end point can return a single upstream packet to a SPU, which will typically contain usage information needed for billing purposes. Downstream commands can be issued to end points from a SPU for purposes including control of data collection and reconfiguration. There are several issues related to the use of PLC (Power Line Carrier) communications:

- Only one packet (or defined number of bits) can be sent by each end point per day, via ultra narrow band PLC
- A SPU can only transmit 1400 messages downstream per day, via PLC
- PLC communications are lousy, Other issues and requirements which are relevant to the architecture include:
- Web-based GUI, to avoid issues associated with remote access requirements and software installation. Software deployment using an ASP model, with segmentation of models within a common physical database and common server

IV. TECHNICAL TERMS

The following terms and acronyms are relevant to this system specification:

- AMR: Automated Meter Reading
- SPU: Substation Processing Unit
- MSMQ: Microsoft Message Queue
- SQL: Structured Query Language
- Microsoft .Net: A software framework provided by Microsoft
- SPU: Substation Processing Unit
- CS: Central Services
- PPP: Point-to-point protocol, IETF RFC 1661
- SLIP: Serial Line Internet Protocol
- DHCP: Dynamic Host Configuration Protocol
- XML: Extensible markup language
- SOAP: Simple Object Access Protocol
- HTTP: Hypertext transfer protocol, IETF RFC 2616
- SBC: Single board computer, used in the Substation Processing Unit
- VxWorks: Real-time operating system used by the Substation Processing Unit on the SBC, POSIX compliant
- CRC: Cyclical Redundancy Check. There are both configuration CRCs and message CRCs.
- ECD: Error correction data, as is used to permit correction of upstream PLC packets sent by end points.
- NTP: Network Time Protocol
- PLC: Power line carrier
- HHP: Hand held programmer, same as mobile administrator

V. SYSTEM REQUIREMENTS

While it is the focus of this document to describe the Central Server architecture, related TS2 components must be described to establish the necessary context.

A. End Points

End points are used to electronically track usage recorded by a meter, where the meter usually records usage though mechanical means. Information captured includes:

- Total consumption (KWH)
- Time of use (TOU) based consumption
- Time and amount of peak demand
- Sustained and momentary interruption counts
- Sustained and momentary interruption durations

The end point will return a single data packet to a SPU each day using the power line carrier. The end point is a two way device, in that it can accept downstream commands from a SPU over the power line. Commands that can be sent to end points include the following:

- Asynchronous packet requests
- Reconfiguration commands
- Configuration confirmation requests

B. SPUs

The Substation Processing Unit (SPU) is a device which is located within a utility substation. The SPU is effectively a router which manages communications between an IP-based communications network and the power line carrier (PLC) communications to and from end points. The SPU consists of several hardware components:

1. Single board computer, which uses the VxWorks operating system on an industrial Pentium-based processor, which includes a network interface.
2. A digital signal processor (DSP), which collects ultra narrow band (UNB) signals on up to 9000 channels in parallel from the power line.
3. A downstream amplifier and coupler, which are used to send downstream high frequency PLC signals to end points.

A key requirement related to SPU hardware is that the SPU must operate in extreme environmental conditions as would typically exist at a distribution substation. Functionally, the SPU is very similar to a router.

C. Database, Centarl Server and Held Held Programmer

The database is built upon any relational database. The Central Server should connect to the database using a connection string specified in the configuration file. The purpose of the Central Server is to coordinate the management of information and processing between all Advance Metering components. The Central Server is a proposed set of software implemented using the Microsoft .Net framework, SQL Server 2000 and MSMQ. The hand held programmer is used to directly communicate with an end point through an optical interface. The hand help programmer interacts with the end point using optical communications. The hand held programmer interacts with the Central Server database using web methods.

D. GUI Application Centre

There will be a web-based GUI which is used to view and enter information that is managed by the CentralServer. The GUI application uses CentralServer web-based interfaces and direct database access.

VI. PROBLEM DOMAIN

Metering in simple terms is consumption of Energy without energy management. By adding word Advanced to Metering i.e. Advanced Metering makes it more significant. Prescribed domain of problem in metering is not only to restrict it with advanced meters by also move to Smart Grids and equipment required for setting up Smart Grid(s).

Simply put, Smart Grid is the application of communications and Information Technology (IT) to the electric power transmission and distribution networks themselves. Smart grid is more than smart meters, which entails replacing analog mechanical meters with digital meters. Smart meters are transformed when connected to a real-time, broadband and Internet-enabled Smart Grid that extends from the generation plants to each electrical outlet (smart sockets) or device attached to the grid.

VII. COMPARATIVE STUDY

There is an important difference between advanced meters and advanced metering. Polyphase is not the same as advanced metering. Polyphase meters are used to measure two-phase and three-phase electrical service. However, that service can still be charged as simple consumption. Conversely, a customer who uses a lot of energy may be put on an advanced billing rate, such as time of use or demand, even though they only have single-phase electrical service. The beauty of the Advance Metering system is that any meter can be used on an advanced metering account. This is because all of the advanced metering calculations are done at the MicroCell Controller (MCC), not within the meter itself.

VIII. ADVANCE METERING SECURITY MODEL

The security model is based on securing the application level protocols between the AMI head end and the devices in the system. The application in the head end communicates with applications at the endpoints using encryption and authentication. In advanced metering systems there is often a need for a group of endpoints to communicate amongst themselves. The confidentiality goals for this group-based encryption are managed through the use of team keys. The command and control system generates and distributes team keys to collective teams. The teams can also exchange signed messages which requires commissioning of signing keys.

IX. CONCLUSION

Metering is directly related to energy. The energy management is serious concern today and effective energy management is considerable if consumption or demand is high. There are several components established over the network to customize the energy consumption on basis of need. Advance Metering and its operating components are majorly viewed for following prospective:

- Utility prospective
- Consumer prospective
- Network prospective

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