An Approach to Automate Power Meter Reading & Billing System

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Abstract

The research proposes a solution to implement Automated Power Meter Reading & Billing System for bringing smart governance in power/energy supply departments. The system suggests use of GPRS/IP enabled Power Meters at consumer sites which shall be connected to centralized/distributed database servers. Along with this, Server based remote meter reading and billing algorithms are developed to automate the reading and billing process. Through its n-Tier Architectures based Model, the approach provides real time energy consumption measuring mechanism and more accurate billing procedures. Also it reduces possibilities of human interference in meter reading routines. At one end it provides an intrinsic mechanism of monitoring status of power/energy consumption at client end. While at other end, through the statistics of power consumption based upon database, seasonality of power/energy demands can be analysed. This may help in preparing for future demands and supply schedules. As well as with reduced efforts, more throughput can be achieved in power/energy management.

Keywords: Automated Meter Reading, Remote Meter Reading, IP/GPRS enabled Power Meters, eGovernance.

1. Introduction

In recent years many reforms have brought to improve power sector services nationwide. Still there are some matters in the system, which affect the quality of services and thereby the level of satisfaction of end users or public. Among many
unresolved issues, one of the problem is knowing the exact status of power consumption by consumers zone wise/region wise. Even after installation of more accurate electronic or digital meters, the problem is continued in many areas. In present system the procedure adopted by most of power supply companies/departments for getting reading for electricity consumption is the manual meter reading or some of its variants like photo graphic reading, reading through SMS etc. Some of identified drawbacks of such procedures are:

1. Time consuming
2. Requires more human resource and efforts
3. Possibility of erroneous or intentional manipulated reporting on power consumption data etc.

The presented model removes above mentioned drawbacks of the current procedures and suggests an automated system to remotely collect power/energy meter readings bringing in a capability to real time monitoring of power/energy consumption. The model suggests installation of IP/GPRS enabled powers at consumer end. Such meters have capability to get connected to the network (through wireless or GPRS system). Such network connected meters can be accessed remotely from the server locations and status of reading data as well as other master data stored in the meters local memory can be collected at any time. Along with installation of these network enabled meters the system makes use of scheduled consumer data reading procedures/scripts installed at server end. These scheduled procedures shall periodically perform tasks like:

- Automatically connecting to the specific meters through their unique IP Address/GPRS id
- Getting current reading data from the device
- Updating reading tables at servers
- Preparing list of consumer meters with any connection error or any invalid data.
- Thereby Initiating error reporting and removal routines according to the errors observed.

The reading data collected through remote meters in each schedule, then may be read from the database by the billing programs, most of which are already in used by the power supply departments. As the system does not require much changes in existing billing data/programs, it can be conveniently added to the present partially automated billing centers of power suppliers. The model through its scheduled automated activities, may bring higher performance with state of control in power supply units.

2. System Design

Summery of the system design is expounded here. The overall architecture is divided into two parts (Diagram 3), namely, Client site and Server site. At Client site installation of one of the two type of power meters available in market:
(1) IP enabled Power meters with wireless WiFi connectivity (viz. MK30X256) (Diagram 1)

(2) GPRS enabled power meters like DL/T645 (Diagram 2)

In both the ways the objective is to provide a consumer end meter with unique identity, having connectivity to the power station servers. At Server site a combination of Web application, business logic and database services shall be deployed.

The n Tier Architecture based data processing system (Diagram 3) functions in following ways:

**The Client End Interface** – The consumer end Meters configured with unique id and reading data. Also there is direct reading monitor, through which manual readings can be collected.

**Web Application Server (Presentation Tier)** – The Web Application interface shall be used by system operators, and Administrators to perform routine operations like remote reading and other data collection, billing operations or billing tariffs updating other Administrative operations like user administration, database schema changes, database programming etc.

**Server side routines (Business Tier)** – The Business Tier consists of server side codes like back ground routines for reading collection procedures, selecting applicable tariffs, penalties and other charges, as per consumed units, consumer type and may have scripts for routine reading schedules, reading validations etc.

**Database Storages & Data ware house (Database Tier)** - The reading data collected from consumer meters through remote procedures gets stored in a) Local database at billing centre as well as b) Data ware Houses for long term usages.

**Distributed Logic** - The distributed logic is used to connect with other remote databases servers for advances distributed computing or generating statistics for large scenario like region wise or state wise consumption, or future demand forecasts etc.

**Diagram 1. Option 1**: Connectivity diagram (Showing WiFi connectivity of Consumer end Meters with the Power Station)
Diagram 2. Option 2: Connectivity diagram (Showing GPRS connectivity of Consumer end Meters with the Power Station)

Diagram 3. Architectural diagram of the system.

3. Advantages
The presented automated Power/Reading and Billing system provides following advantages:
1. Real time data collection from consumer ends
2. Convenient Billing system
3. Alarming functionality can be set up for consumer load limitations
4. Good Governance in power supply systems
5. More accurate power/energy consumption statistics
6. Generation of customized statistics for individual consumer, zone wise, or more large geographical location wise
7. Since no human intervention is required, possibilities of human errors can be are overcome
8. The presented model provides a scalable solution to automate meter reading & billing process.

4. Limitations
   1. Installation of IP/GPRS enabled meters at client end can not be once at a time, it requires pilot approach to be followed
   2. Location there may be network coverage issues, which require additional infrastructure to increase coverage.
   3. Installed technical infrastructure shall require additional Maintenance budget
   4. To Maintain services with new technology, technically skilled human resources shall be need
   5. Technology conversion may have resistance from existing workforce, hence policies to be prepared to take them in confidence

5. Conclusion
   The presented model provides an approach to bring good governance in power/energy supply system. However most of the decision makers in the system have opinions of outsourcing services and operations. Following the policy many of the power supply departments countrywide have outsourced meter reading processes, but still there are flaws in the system. The article is concluded with opinion that functionality and design of the presented model is such that, instead of outsourced services, if better in-house development and maintenance technical capabilities are managed, the system will provide a long term stable quality performance to the public.

References
