

WIRELESS COMMUNICATION BASED REVENUE MANAGEMENT SYSTEM

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Abstract

The liberalization of the operation environment for Utilities are putting unprecedented pressure to them forcing them to urgently rethink and seek for more innovative means of doing their businesses. This means changes in customer relationships as well as investment in new technologies to enhance customer satisfactions Automatic Revenue Management System is such innovative means a Utility can employ to boost customer satisfaction and also increase the Revenue Base of a Utility. The System is based on the application of Wireless technology in Automatic Meter Reading System. This Paper therefore takes a look at the application of the wireless technology in the management of NEPA revenue and propose an efficient model for such operation in the distribution Sector of the Establishment.

Keywords

Wireless, Radio LANs (RLANs), WANS, Automatic Revenue Management System (ARMS)

1. Introduction

Higher customer satisfaction and expectations, increased competitions, regulatory demands and improvement of revenue base are some of the challenges Utilities have to face and manage. To remain relevant and maintain a competitive edge, a Utility has to respond to these changes by investing in new technologies, staff skills and know how.

The explosion in new technologies in Wireless Communications System has resulted in its use in both Utilities and private utilizing all the resources of the radio technology. Wireless offers high-capacity services direct to the customers premises. Its potential advantages are:

- Rapid deployment at low cost to the customer premises no digging and laying of cables with its attendant costs and time.
- No technical restriction on the bit rates.
- No huge upfront investment in infrastructures on the customers premises. The investment is made a customers sign on [1].

Despite these advantages, certain challenges are presented by this System, viz:

- Limited radio spectrum useable. This results in frequency reuse, which are done only at a distance. The reuse distance is a function of such factors as the local propagation environment and the acceptable signal-to-noise and interference ratio [2].

The introduction of wireless based revenue management system in NEPA Nigeria for revenue cycle management (RCM) had been made more urgent because of the failure of the old manual method, which has some inherent disadvantages such as:

- Delayed delivery of energy bills to customers
- Bills are mostly based on estimates
- Customer dissatisfaction
- Loss of revenue because of non payment of bills
- Fraudulent Meters Readers connive with unscrupulous customers to defraud the Establishment
- Lack of adequate staff to carry out the job

The concept of Automatic Revenue Management based on the philosophies of the Automatic Meter Reading operations with special application of the wireless technology is the focus of the paper.

There are other media that can be used to realize this; such as: Power Line Carrier (PLC) Communication, Leased PSTN Lines, Optic fibre System, etc. The advantages of the wireless in this particular application however outweigh the advantages of the alternative technologies.

This paper whose scope covers the Distribution Sector of the Organization is structured such that Section 2 highlights the concept of

Automatic Revenue Management System (ARMS), the overview and the concept of the wireless band ARMS Section 3 treats the proposed model for the ARMS in the Distribution Sector implementation of the various functional levels and integrated network for the model. The benefits of the System are handled in Section 4. Finally Section 5 concludes the paper.

2. Concept Of Automatic Revenue Management System.

The philosophy of the operational concept of the ARMS is based on the following (fig 1)

- Automatic collections of energy meter data.

This involves remote telemetry and establishment of 2-way functional communication.

- Automatic Load Management.

This makes use of Information Technology (IT) to realize the functional requirements.

- Introduction of IP-based wireless connectivity for internet connected customers for some value-added services.

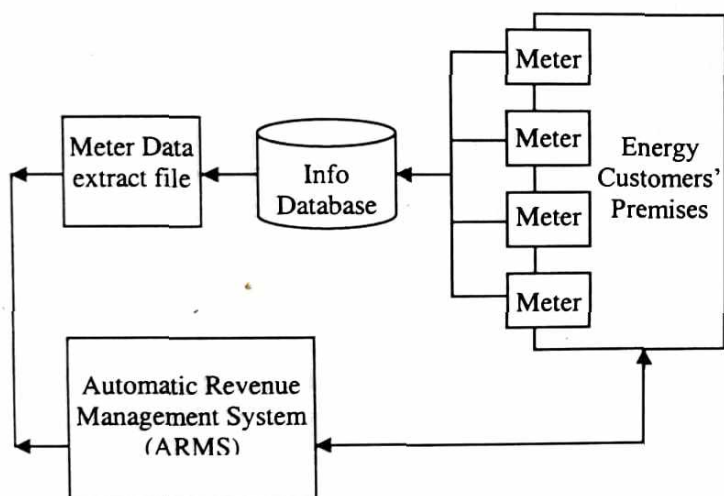


Fig.1.: Concept of the ARMS

2.1 Overview Of Wireless Revenue Management System (Wrms)

The introduction of wireless (radio) technology in NEPA Distribution Sector will undoubtedly put in place an efficient and reliable revenue collection and management mechanism in the revenue management cycle to [3], [4].

- Provide a 2-way energy data communication
- Detect illegal use of electricity
- Provide accurate, reliable, timely and proper billing system
- Provide for real-time billing
- To automatically disconnect the faulty submits under emergency
- Provide for prepayment of energy bills
- Provide for detection of outages

- Provision of on-line energy transactions such as time of use, demands, web access to data, customized rates and services.

In rural area, wireless systems of automatic meter reading will offer the best solution because of the remedies and inaccessible terrains.

2.2 Concept Of Wireless Based Revenue Management System

The system is built on 4-tier communication architectural levels, viz:

The Consumers' energy metering System, which reads the energy information and transmits them via wireless device

The Pole-top Base Station Transceiver System which collects the various customer energy meter data in the form of Radio LANs of the various meters connected to it, also functions as data switches into future networks. TCP/IP – gateways are provided for internet-based energy service. The RLANS for different locations now transmit their data to a Wide Area Network (WAN) System.

The WAN System pulls these meter data from the Base Stations, which forms RLANS and sends them to the Central Revenue Management Base. The WAN Control Units are cluster of computer Workstations with open data base connectivity options of future expansions.

The Revenue Management Base. This is a data based management system, which processes the meter data and produces customer energy bills among other functions [5].

The customers energy locations form the Base Station quantified in terms of the meter density must fall within the radii of the operating radio frequency. This is because the spatial distribution of the radio propagated the Transmitter is generally a direct function of the Square Law of the form $1/d^2$ for distances of 5m to infinity [6]. In the case of frequency for the continuous-wave signal transmission, the statistics of the received signal envelope are of Rayleigh distribution. If the line-of-sight (LOS) path or strong reflected path does not exist between the transmitter and the receiver. However if it does exist, the distribution is Rician [7]. These factors are taken into consideration in the location of the Base Station form the customers' premises. For wireless systems, the Transmission of data in the form of packets or short bursts are preferred so that in the even to error, the overload in retransmission will be low. Also short bursts enable efficient sharing of common data channel resulting in high spectral efficiency. The millions of these are packets of data collected within a given tight frequency band of 928-952 MHz. Some other frequencies can be used. The frequency spectrum is

subdivided into sub-channels of 25kHz band, which can be reused in a similar manner to that of Cellular Phone Systems.

3. The Proposed Model

There are some considerations to be made before putting in place automation and communications solutions in Utilities for their operational use, such as [8]:

- The best system available to be deployed.
- Level of return in investment
- Capital outlay
- Specific future upgrades achievable

The System is expected to fulfil all the function of Utility's revenue cycle management and other Energy Information Service (EIS) to customers [9]. The Wireless based Revenue Management System proposed for NEPA Distribution Sector is the integrated system as shown in fig 2.

It is made up of:

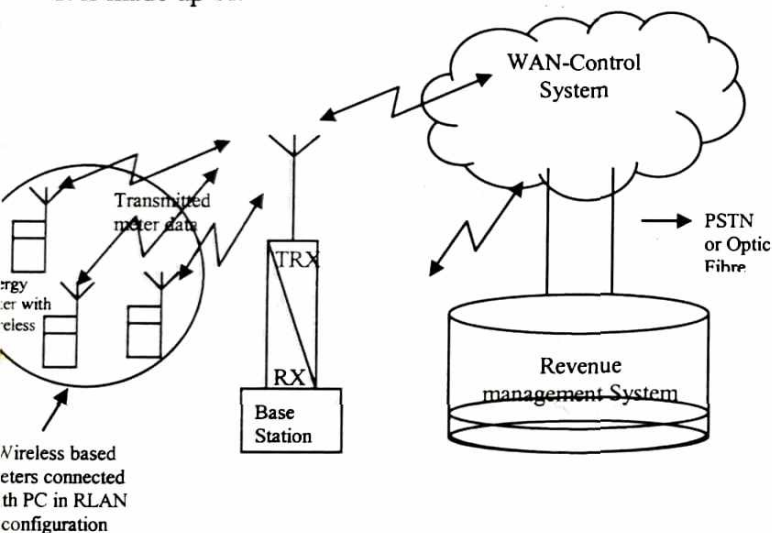


Fig 2: Integrated Wireless Based Revenue Management System

- Intelligent energy meters which are attached to radio transceivers and are capable of eavesdropping on the pulses from energy consumptions, transmitting to a Local Based Station.
- Pole-top Local Base Stations: All the data from the customers' energy meters are collected by the Base Stations which pulls them in the form of RLAN system and later transmits the data collected to a WAN Control system.
- Wide Area Network (WAN) Control System. This handles the information from the different RLANs and transmitting them to the Central Processing Center or the

Revenue Management System for final processing.

3.1 Implementation Of The Metering System

The present energy meters installed in customers' premises by NEPA are mainly analog type capable of measuring the real, active and reactive power component. However the energy meter proposed in this paper is the digital energy meter module like the Thaler meter module – RDM800 and the Mark –V type. These metering modules present advanced metering platform providing energy usage profiles, quality of service information to customer wireless telemetry applications etc. The range of installation environment. The Thaler module – RDM800 – can cover a range of about 300meters and are capable of transmitting their energy data on demand or regular intervals.

3.2 Implementation Of The Pole-Top Base Station

The System is a digital radio similar to the Base Station in Cellular Phone System. All the Radio system installation planning considerations such as the terrain of the location, clutter data, demographic data (which will help in determining the meter density) are put into use [10]. The Base Station connects the individual meters in form of Radio Local Area Network (RLAN) and transmits the information from them to a WAN System. The distributed WANs transmit the energy information to the Operational Revenue Management Centre (ORMC).

3.3 Implementation Of The Operation Revenue Management Centre (Ormc)

The provision of Centralized Management System for the network is very fundamental to the realization of the objective of the System. The ORMC monitors and controls all aspects of the communication nodes, which is the System's backbone.

The WAN, which supports data communication for the Management System is also managed from the ORMC. The System has gateways which are TCP/IP-enabled and they give access to the System's Operations Centre database internet, etc. CMIP or CMIS is the communication protocol. The management interface to the wireless is based on the X700 principles. The CMIP & CMIS are Network Management Standards that support any OSI-Compliant System [11]. The Service Management subsystem (SMS) supports accounting and billing.

3.4 Functional Hierarchy Of The System & Its Expandability

The system proposed is structured in a multilevel functional hierarchy made up as follows (fig. 3)

- Operational Revenue Management Centre
- WAN Control System
- Pole-top Base Station/Meter data Collector
- Customer radio energy Meters

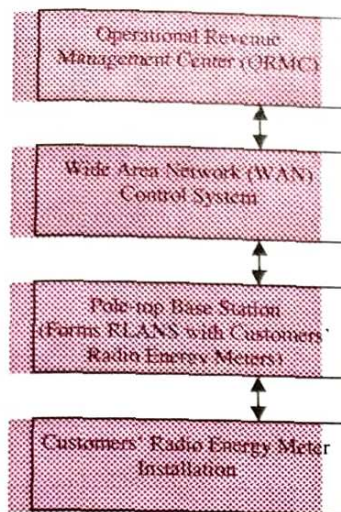


Fig 3: Functional Hierarchy of the system

The system is Expandable and as NEPA network is a hierarchical interconnected system, the proposed System can be expanded in that order as shown in fig. 4.

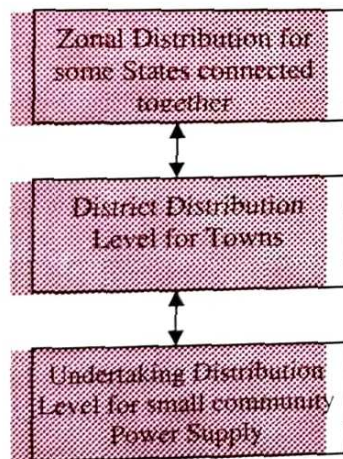


Fig 4. Hierarchical Expansion of the system in NEPA

4. Benefits Of The System

The System of Meter Readers walking around customers' premises with pencils to collect meter readings through obsolete in many countries is still practiced in Nigeria with its attendant problems such as:

- Abuse of Meter readers and sometimes attacking them
- Bribing them

- Inaccessible terrain
- Other prevailing problems

This is why Automatic meter Reading (AMR) was introduced in many Utilities to not only solve these problems but to bring about other derivable benefits. The Wireless Revenue Management is a form of AMR using wireless technology. Some of the benefits derivable form the System are:

- Improved meter reading efficiency
- Flexibility in purchase of energy at any time
- Improvement in overall power delivery system such as accurate and improved system planning and maintenance, reduction in outage response time
- Improved customer services and satisfaction such as reduction in estimated energy consumption, reduction in billing errors, reductions in customers complaints, etc.
- Optimal billing system for increased revenue such as revenue protection.
- Value added services to the customers such as internet access to load access to load data, outage detections and notification service etc.
- Real time pricing
- Prepayment features available
- Reduction in labour cost – no more Field personnel to collect meter data, is connect for nonpayment and to reconnect after payment

5. Conclusion

The wireless Based Revenue Management System has been the main focus of this paper. Its introduction into the Revenue Cycle Management in NEPA will undoubtedly improve services to the large electricity market in Nigeria. Despite the initial huge capital investment that will involve the replacement of the old metering System etc. the long –term return in investment will be staggering.

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