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*Research Paper*

# AVANT-GRADE METERING INFRASTRUCTURE ATTAINMENT USING PLC COMMUNICATION NETWORKS

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Power line carrier communication is the emerging technology which has placed its mark in advanced metering infrastructure. Power-line communication (PLC) carries data on a conductor that is also used simultaneously for AC electric power transmission or electric power distribution to consumers . In this context, device language message specification/companion specification for energy metering (DLMS/COSEM) is an increasingly popular standardized application protocol for communication between utilities and their customers. With this study we have implemented the PLC communication using Phase Shift Keying technique which helps in two way communication. Power line intelligent metering evolution (PRIME) is used to send DLMS/COSEM messages. We can easily control the power delivered to the client from the EB station. It makes simple by making PREPAID EB CARDS, So that only limited usage is Permitted, no extra or billing issues will exist. We use an IR reader to sense from the rechargeable cards, and it updates the value to the Client meter as well as the EB SECTION. As the client consumes power, the meter rotates and the recharged amount gets reduced as per the reading. This will be updated at the EB section immediately. When the amount goes below a par value, it intimates the user. We communicate between the client and the EB section through the power lines. As power line cables are present in all corners of India, we can easily monitor the EB through smart metering. Drawbacks such as high bit error rate, difficulty in monitoring has been overcome in the hardware implementation. Energy theft involved in the power line can be effectively controlled and identified through this technique. If implemented, this project can reduce the theft involved in power transmission by which it enhances the power line carrier communication.

Keywords: Power line, Intelligent metering evolution

## INTRODUCTION

Power-Line Communication (PLC) carries data on a conductor that is also used simultaneously for AC electric power transmission or electric power distribution to consumers. It is also known as power-line

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carrier, Power-line Digital Subscriber Line (PDSL), mains communication, power-line telecommunications, Power-Line Networking (PLN). A wide range of power-line communication technologies are needed for different applications ranging from home automation to Internet access which is often called Broadband over Power Lines (BPL). Most PLC technologies limit themselves to one type of wires (such as premises wiring within a single building), but some can cross between two levels (for example, both distribution network and premises wiring). Typically transformers are used to prevent propagating the signals, which requires multiple technologies to form very large networks. Various data rates and wide range of frequencies are used in different situations. Recent years have seen an increasing interest in narrow-band Power Line Communication (PLC) on the part of utility companies. Although this technology is not new, there are several characteristics that make it suitable for smart grid applications, such as the automatic meter-reading. As a result, several transceiver designs have appeared in the past few years as designers have attempted to offer solutions for communication via power lines. Early models (X-10 or KNX) made use of a single-carrier technology to modulate data. These solutions were targeted for in-home scenarios using demotic applications. One of the first solutions to implement multi-carrier modulation while working in the Low-Voltage (LV) network is power line intelligent metering evolution (PRIME), which was introduced in 2007.

## LITERATURE SURVEY

In [1] the author gave a brief discussion on Smart Metering. A Smart metering system or issue is captivated by countless profits. Projects in India and other part of countries prove that smart metering is technically practicable. Main issues are real value of the payback, the outlay involved in the distribution of overheads and gross settlement of smart metering between markets parties involved. An advanced metering in the road and rail network put forward the leeway for auxiliary energy allied services such as demand side management and consciousness of virtual power plants. The potential of the smart metering relies profoundly on the policy and decisiveness of the legislative bodies mixed up. Energy savings and an improved up security of supply are the major drivers and deems in smart metering as huge targets of a nation.

In [2] the author describes about smart meters. Smart meters are the key component of the smart grid which helps both the user and supplier to control consumption of energy according to availability of resources. Electricity market is facing the great losses due to an increase in cost for generation of resources. The wastage of electric energy again results in economic problem, thus smart metering system has been considered as a good method to make use of energy effectively. The proposed energy metering system consists of energy meter, communication using Ethernet and web server.

In [3] the authors conducted experiment on PLC. PLC uses electric power lines to carry information over the power line. It is a technique used for home automation through remote control as it can use the household electrical power wiring as a transmission medium. PLC

has been a very important interdisciplinary topic for power, communication, industrial and automation engineers and researchers since the 1980s. PLC promises to be an enabling home network technology due to its ability to deliver data over existing power lines in the homes. Similar to RF, Power line is a shared medium that exists in a noisy environment, although the respective of noise sources differ markedly. Motors, switch-mode power supplies, fluorescent ballasts, and the other impairments, which generate substantial impulse and wideband noise share power lines.

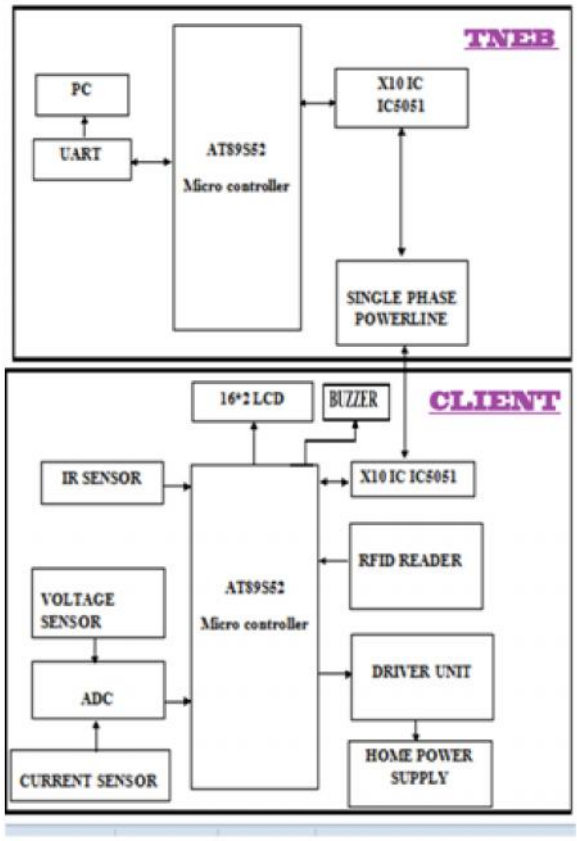
## X10 PROTOCOLS

Household electrical wiring (the same which powers lights and appliances) is used to send digital data between X10 devices. This digital data is encoded into a 120 kHz carrier which is transmitted as bursts during the relatively quiet zero crossings of the 50 or 60 Hz AC alternating current waveform. One bit of data is transmitted at each zero crossing. The digital data consists of address and a command sent from a controller to a controlled device.More advanced controllers can also query equally advanced devices to respond with their status. This status may be as simple as “off” or “on”, or the current dimming level, or even the temperature or other sensor reading.

Devices usually plugged into the wall where the lamp, television, or other household appliance plugs in; however some built-in controllers are also available for wall switches and ceiling fixtures.

The relatively high-frequency carrier frequency carrying the signal cannot pass through a power transformer or across the phases of a multiphase system. For the split phase systems, the signal can be passively coupled from phase-to-phase using a passive capacitor, but three phase systems provides insufficient coupling, an active X10 protocol can be used. To allow signals to be coupled with phases and still match each phase’s zero crossing point, each bit is transmitted every three times in each and every half cycle, offset by 1/6 cycles.It may also be desirable to block X10 signals from leaving the local area so, for example, the X10 controlled in one house do not interfere with the X10 controls in a neighboring house. In this situation, inductive filters could be used

Figure 1: Block Diagram Representation of Avant Grade Metering Infrastructure



to attenuate the X10 signals coming into or going out of the local area.

### Protocol

Whether using power line or radio communications, packets are transmitted using the X10 control protocol consist of a four bit house code followed by one or more four bit unit codes, finally followed by the four bit commands. For the convenience of the users configuring a system, the four bit house code is selected from a letter from A through P while the four bit unit code is a number 1 through 16.When the system is installed, each controlled device is configured to respond to one of the 256 possible addresses (16 house codes × 16 unit codes); each device reacts to commands specifically addressed to it, or it is possibly to several broadcast commands.

The protocol may transmit a message that says “select code A4”, followed by “turn on”, which commands unit “A4” to turn on its device. Several number of units can be addressed before giving the command and allowing a command to affect several units . For example, “select A4”, and “select A16” and then “select A5”, and finally, “turns into on”, causes units A4, A5, and A16 to all turn on. Note that there is no restriction that prevents using more than one house code within a single house. The “all lights on” command and “all units off” commands will only affect a single house code, so installing using the multiple house codes effectively has the devices divided into separate zones.

### One Way vs Two Way

Inexpensive X10 devices only receive commands and do not acknowledge their status to the rest of the network. Controller devices allowed for more robust network but cost two to four times more and require two-way X10 devices.

## IMPLEMENTATION

The implementation has two major modules.

- Hardware Module
- Software Module

### Hardware Module

The implementation of Hardware module has

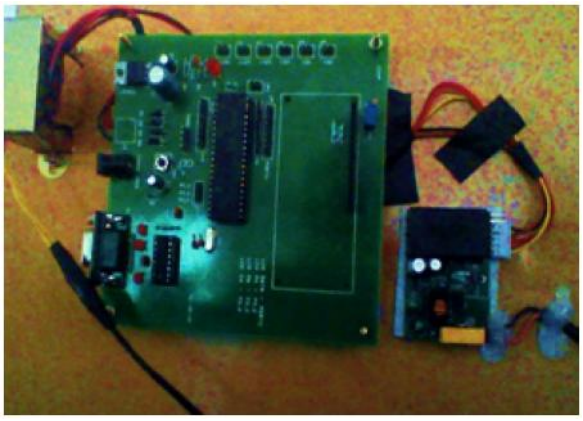
- Micro controller (AT89S52),
- Current sensor,
- PC, X10-IC5051,
- IR sensor,
- Voltage sensor,
- RFID reader,
- Drive unit
- LCD
- Power supply

Figure 2: Client Section

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. This device is manufactured using Atmel high-density nonvolatile memory technology and is compatible with the Industry-standard 80C51 instruction set and pin out. Sensors are an integral part of every automatic control system because they supply information about the actual state of the system.

Here we are going to use voltage and current sensor to measure the voltage and current reading. A universal asynchronous receiver or transmitter is a type of "asynchronous receiver or transmitter". Figure 2 shows the hardware implementation of the client section. The Figure 3 shows the EB section hardware.

Figure 3: EB Section

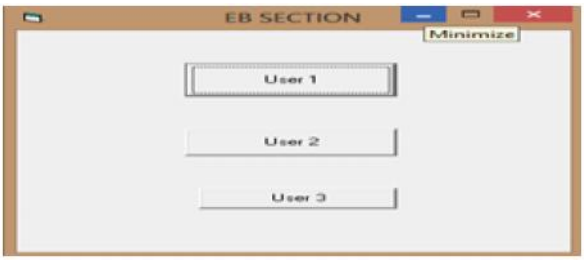


## Software Module

- Embedded C
- Keil compiler
- VB

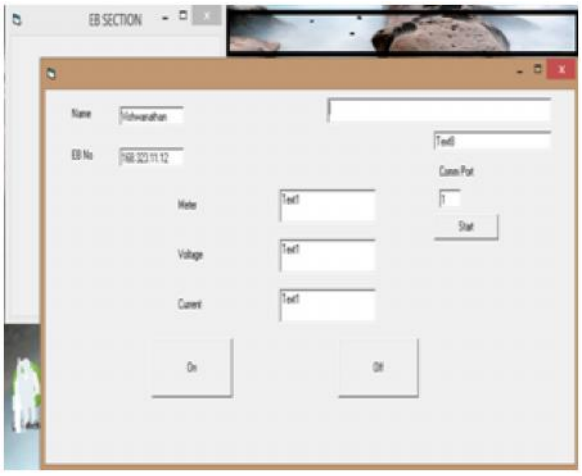
Visual Basic software is to create the front end of our project. It is placed in the EB section. Keil Compiler is used to type and compile the programs as shown in the Figure 4; we have individual section for each user. We have the select the required user.

Figure 4: Module to Select User




The Figure 5 shows the Meter number, the available balance, current reading and voltage reading. We can switch the power supplied to the client by clicking on the ON OFF button.

Figure 5: Module to See the Consumption of Each User




## CONCLUSION

Thus effective smart metering is implemented in hardware considering various plc parameters with reduced noise. PSK technique is used for two ways Communication. The main advantage of the proposed system is that we can overcome the

error, avoid the electricity theft, Easy to monitor the metering system, two ways communication.If implemented, this project can reduce the theft involved in power transmission by which it enhances the power line carrier communication.

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## REFERENCES

1. Aswathy P R and Shanthi C, "An Automated Energy Metering System-Home Based Approach", *International Journal of Advanced Research in Electronics and Instrumentation Engineering*.
2. Halder T, "A Smart Metering System", Department of Electrical and Electronics Engineering, Kalyani Government Engineering College.
3. Javier Matanza, Sadot Alexandres and Carlos Rodríguez-Morcillo, "Advanced Metering Infrastructure Performance Using European Low-Voltage Power Line Communication Networks", IET Communications.
4. Kim M S, Son D M, Ko Y B and Kim Y H (2008), "A Simulation Study of the PLC-MAC Performance Using Network Simulator-2", *IEEE Int. Symp. Power Line Communications and its Applications (ISPLC)*, Vol. 2, April, pp. 99-104.
5. Mengi A and Han Vinck A J (2010), "Successive Impulsive Noise Suppression in OFDM", *Int. Symp. Power Line Communications and its Applications (ISPLC)*, pp. 33-37.
6. Sanz A, Pinero P J, Montoro D and Garcia J I (2012), "High-Accuracy Distributed Simulation Environment for PRIME Networks Analysis and Improvement", *IEEE Int. Symp. Power Line Communications and its Applications (ISPLC)*, pp. 108-113, Beijing, P.R. China.