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# Managing Power in Mesh Connection Based Network with Automatic Metering

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**ABSTRACT:** The system that has been used to manage power comprises of Zigbee digital meters at user end and e-Billing unit at the provider end. The ZPM has Zigbee modem which utilize the WSN to send usage information to energy provider end. An e-billing system is used to manage a received reading and compute the billing cost, update the database, and to publish billing notification to its respective consumer through wireless media. Also the circuit is designed to manage power when the available power is less present to the electricity board. The controller first prioritizes the electrical appliances in each node, then it gives the highest priority to the most necessary appliance needed for the user in the same way it gives priority to all other nodes connected to the concentrator. When the power value reaches below a threshold value the pc at the admin section gives command to the concentrators to supply power to high priority appliances and stop providing power to the low ones. Like the same way available power is equally distributed to all the nodes connected to the concentrator so that each node can at least have the most used appliance without total power shutdown.

**KEYWORDS:** AMI, GSM, MDMS, Zigbee, ZPM.

## I. INTRODUCTION

An Embedded system is a combination of computer hardware, software and additional mechanical parts designed to perform a specific function. An example is the microwave oven. It is hardly realized that the oven actually consists of a processor and the software running inside. Another example is the TV remote control. Very few actually realize that there is a microcontroller inside that runs a set of programs especially for the TV. Automated metering is expected to be an integral part of the modern energy grid. Automated metering entails transport of metering data from the energy consumer's premises to the data management systems of the energy provider and potentially information in the other direction. The power management system consists of Zigbee Digital Power meters installed in every consumer unit and an Electricity e-Billing system at the energy provider side. The Zigbee Digital Power meter (ZPM) with embedded Zigbee modem which utilize the Wireless sensor network to send its power usage reading to the energy provider wirelessly. At the power provider side an e-billing system is used to manage a received zigbee meter reading, compute the billing cost, update the database, and to publish billing notification to its respective consumer through wireless. The concept of dynamic assignment of priorities to interrupts is discussed which reduces the time delay for a lower priority task which under some circumstances becomes a higher priority task. Slicing of interrupt timings is also discussed which can be used to improve the performance. the highest priority task is serviced more number of times and with lesser time period. Hence it need not wait for the slack time of other previously higher priority interrupts. If power will be less in grid, automatically power will be manage using RTOS.

## II. RELATED WORK

There are alternative approaches which may be used to implement smart metering solutions using different Communication technologies such as GPRS and 3G. In the case of cellular, the utility provider will have to sort out agreements with the cellular operator which may have cost implications. Cellular penetration may be another factor that needs to be considered to ensure coverage is adequate. Broadband technology is another alternative wherein the data can be securely tunneled over the broadband network. However, broadband penetration issues need to be considered to ensure coverage. PLC appears like an attractive choice given the seamless penetration of power lines in the consumer premises.



**III. OVERVIEW OF PROPOSED SYSTEM**

*A. Introduction*

Motivated by the need to improve energy efficiency and reduce the impact on the environment, we see efforts being directed towards enabling a ‘Smart Grid’. One of the fundamental elements of the Smart Grid is the Automated Metering Infrastructure (AMI), envisaged to be a network of meter and concentrator nodes wherein meter readings are automatically sent by smart meters located at the customer premises to the Meter Data Management System (MDMS) through concentrators provisioned by the utility provider. Also the circuit is designed to manage power when the available power is less present to the electricity board. The controller first priorities the electrical appliances in each node (i.e houses). Then it gives the highest priority to the most necessary appliance needed for the user the in the same way it gives priority to all other nodes connected to the concentrator.

When the power value reaches below a threshold value the pc at the admin section gives command to the concentrators to supply power to the higher priority appliances and stop providing power to the lower one. Like the same way according the power available the power is equally distributed to all the nodes connected to the concentrator so that each node can at least have the most used appliance without total power shutdown.

*B. Disadvantages Of Existing System:*

Till today Meter reading is taken manually by humans that can cause fatal errors these errors occurs due to less concentration which cannot be avoided. Huge Manpower needed as population rate increases. Work can be delayed due to external conditions such as weather, natural calamities etc. Power cut is done manually due to lack of payment. Power shutdown in case of less available power generation.

*C. Advantages Of Proposed System:*

Meter reading taken automatically using gsm technology. Power cut achieved from EB office through wireless .Normal work happen at any time and external conditions. Less Manpower. High Accurate meter reading. Customer service well. Power management

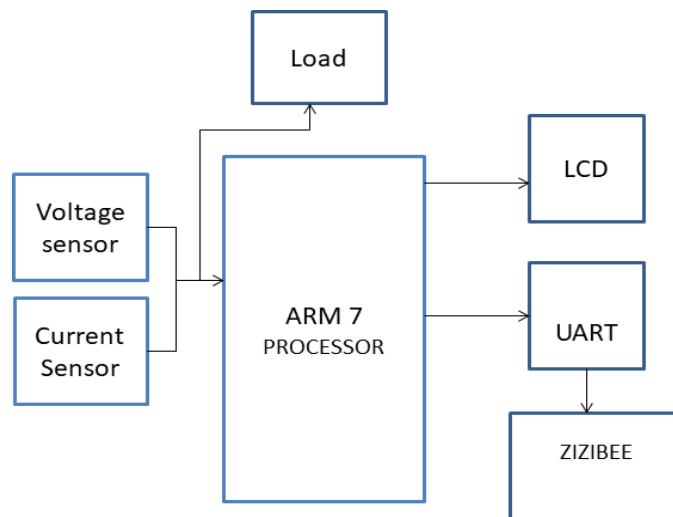


Fig 1. Block Diagram of Proposed System.(Admin Section)

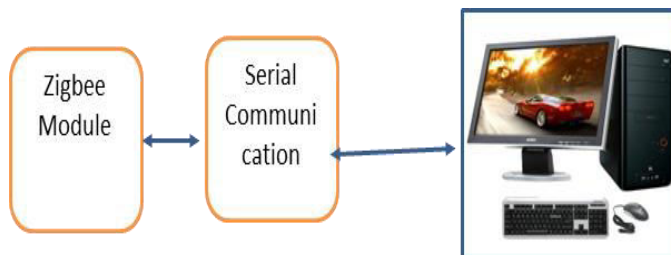


Fig 1. Block Diagram of Proposed System.(User's Section)

#### IV. EXPLANATION OF BLOCK DIAGRAM

##### A. Current Transformer

In electrical engineering, a current transformer (CT) is used for measurement of electric currents. Current transformers, together with voltage transformers (VT) (potential transformers (PT)), are known as instrument transformers. When current in a circuit is too high to directly apply to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments.

The current transformer also isolates the measuring instruments from what may be very high voltage in the monitored circuit. Current transformers are used here for metering purpose, which calculates the amount of current consumed by the user.

##### B. Voltage Transformer

Voltage transformer (often abbreviated as VT) is also known as potential transformers. These are a type of instrument transformers that gauge and protect the safety levels in high-voltage circuits. Their designs allow presenting a negligible load to a supply that's being measured and for creating a precise voltage ratio for stepping down high voltages accurately. It allows operations at lower potentials.

The voltage transformer is used for the same purpose as that of the current transformer. It measures the amount of voltage consumed and gives it to the controller. The controller calculates the power from the readings of the voltage and current transformers and manipulates the e-bill.

##### C. ZIG BEE

**ZigBee** is a specification for a suite of high level communication protocols using small, low-power digital radios based on an IEEE 802 standard for personal area networks. ZigBee devices are often used in mesh network form to transmit data over longer distances, passing data through intermediate devices to reach more distant ones. This allows ZigBee networks to be formed ad-hoc, with no centralized control or high-power transmitter/receiver able to reach all of the devices. Any ZigBee device can be tasked with running the network. ZigBee is targeted at applications that require a low data rate, long battery life, and secure networking. ZigBee has a defined rate of 250 kbit/s. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. Here it is used to transfer the meter reading calculated by the controller to be transmitted to the admin (nearby electricity office) for calculating the electricity bill and also the admin to transfer the control signals to the user side to enable and disable the corresponding loads according to the power that is present at the electricity board.

##### D. Serial Communication

In telecommunication and computer science, serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole, on a link with several parallel channels.



*E. Microprocessor*

A Microprocessor is a small computer on a single integrated circuit containing a processor core, memory, programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microprocessors are designed for embedded applications, in contrast to the microcontrollers used in personal computers or other general purpose applications. Microprocessors are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

**V. SCENARIOS AND PERFORMANCE ANALYSIS**

The following chapter presents the analyzed scenarios together with the conducted performance analysis.

*A. Scenario Description*

Two scenarios are analyzed in order to evaluate the performance of the deployed system:

Scenario 1: Small-scale scenario with 350 meters.

Scenario 2: Full-scale scenario with 17,181 meters.

Scenario 1 is used for validation purposes to confirm proper functionality of geographical routing algorithm, whereas the second scenario is used to derive statistics for complete scenarios. Both scenarios are evaluated for a simulation time of 24h. Each node sends a data packet towards the data Collector every four hours with a uniformly randomized starting time

*B. Performance Analysis*

The results of the simulation runs for different reference scenarios are presented in the following section. The results focus on the success rate of received packets per node in order to measure the performance of the deployed system. Communication gaps and bottlenecks are measured by the success rate of received packets per node.

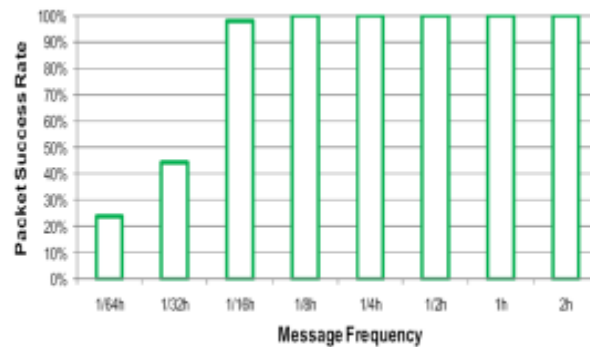


Fig .2 Packet Success Rate Vs Message Frequency

The system performs with 100% success rate (i.e. received packet ratio) for the small-scale area. For the given message frequency of 1 message per 4h. In order to identify bottlenecks in the network topology, the message frequency was increased to 1h, 15min, 7.5min and 4min which led to more than 98% success rate for a message frequency below 7.5min (see Figure 2). Above this frequency a drastically reduced success rate was noticed due to collisions in some central nodes.

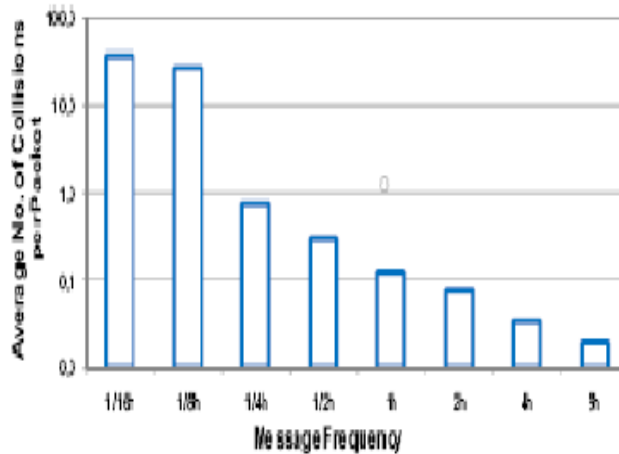


Fig.3 No Of Collisions Vs Message Frequency

The number of average collisions per packet is shown in Figure 3. Within the large-scale scenario, an overall success rate of the system was observed with 99.99% for a message frequency of 1 message per 4h.

### VI. SIMULATION RESULTS

Network simulator 2 is used to visualize the network and the data packets. When the code is executed the nodes get appeared. The power provider first priorities the electrical appliances in each node. Initially all the nodes are given equal priority when the power level is high and all nodes receives power.

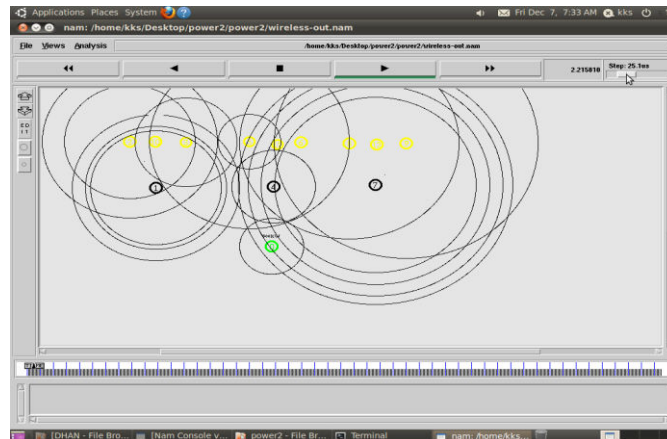


Fig .2 Snapshot of power providing to all nodes

As power at the provider decreases the lowest priority nodes get disconnected automatically. Then it gives the highest priority to the most necessary appliance needed for the user the in the same way it gives priority to all other nodes connected to the provider. When the power value reaches below a threshold value the pc at the admin section gives command to the concentrators to supply power to the higher priority appliances and stop providing power to the lower one.

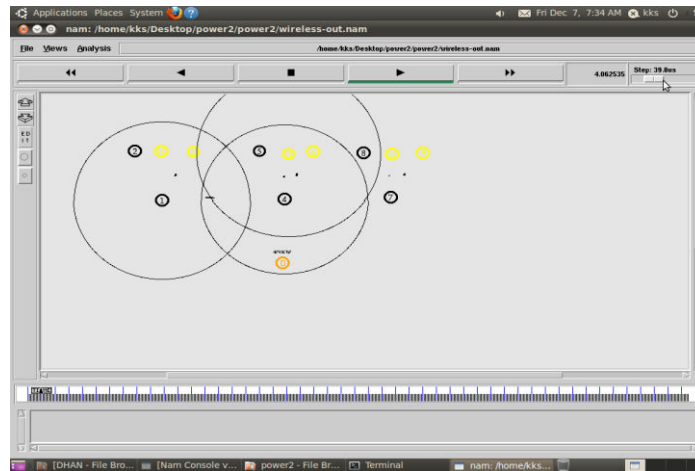


Fig .3Snapshot Of Power given to most prioritized nodes

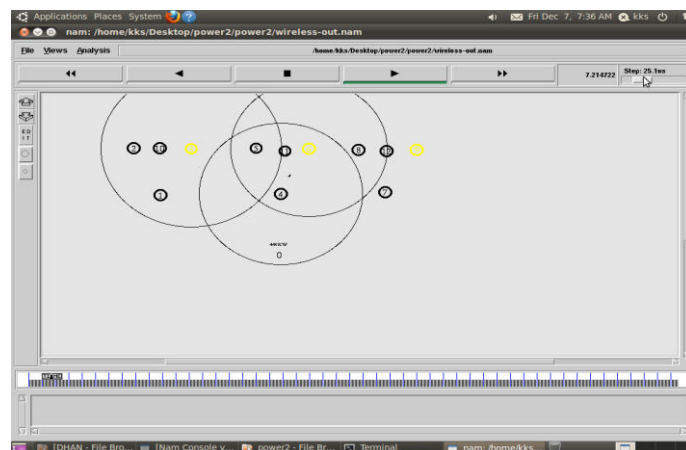


Fig. 4 Snapshot of Power given Only To Higher Priority Nodes

## VII. CONCLUSION

To overcome reading error and to manage power shut downs effectively this method has been proposed. Irrespective of power requirement, power is equally distributed to all consumers. The proper execution involves the commands sent to the user section issued by the controller that is placed at the power provider section. As an exclusive method, even though it does not prioritize a node it can be added as an enhancement in near future.

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