

Enhancing Smart Energy Metering and Billing with LoRa Technology in Rural Areas

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This paper introduces the use of smart meters integrated with rural electricity billing systems that use Long Range connectivity. It discusses the simulation of the network using Network Simulator 2. The network being simulated consists of multiple end nodes, which are basically houses in a village. Every village has a substation that collects data from these end nodes. The network utilizes a star topology for local regions and uses mesh topology for far places. For error-free transfer of data, the system relies on TCP and further optimizes paths of communication through an AODV routing protocol. Data received from the end nodes is sent to the cloud, where the Advanced Encryption Standard (AES) protects sensitive information such as service numbers and payment details. Authorized personnel can securely access the system for billing processing on the cloud server. The system's network performance was measured with the help of NS2 simulations using different loads and environmental conditions. The significant metrics for evaluation were throughput, delay, packet loss, delivery ratio, and queue utilization. The results provided efficient data transfer with little or no delays and losses, and this confirms that the designed communication protocols are reliable and safe. The conclusion drawn from this research is that advanced communication protocols, strong encryption, and efficient routing facilitate smart metering, thereby improving the rural energy billing system significantly.

Keywords: *Advanced Encryption Standard (AES) 1, Ad hoc On-Demand Distance Vector (AODV) 2, Long Range (LoRa) 3, Network Simulator 2 (NS2) 4, Transmission Control Protocol (TCP) 5*