# Abstract

With the rapid development of 5G network technology, the demand for Wireless sensor networks (WSNs) continues to grow. Wireless sensor networks are capable of collecting, storing, and processing environmental information, with features such as low power consumption, low cost, small size, and dynamic networking. In recent years, Energy Harvesting-based WSNs have gained attention in the context of the Internet of Things (IoT). The energy supply for these networks may come from renewable sources such as solar energy, ocean energy, hydro energy, wind energy, or geothermal energy. However, the collected energy may not always meet the demand. To address this issue, we introduce an additional regular battery as an auxiliary energy source. The battery life is also limited. In order to study the relationship between energy consumption and the lifespan of the regular battery, we define an additional performance metric called "regular energy consumption ratio (RECR)." Based on the aforementioned mechanisms, we further consider the possible attributes of packets, including non-preemptive priority and impatience, and for a more realistic scenario, we define packet arrivals as batch arrivals, where a batch includes the arrival of one or two packets at a time. Additionally, we study two scenarios: (1) a system with a single node, and (2) a network composed of three interconnected nodes. We use the C language to derive the balance equations of the model through a four-dimensional Markov chain. We obtain the steady-state probability distribution and calculate various performance metrics using iterative algorithms. We then investigate the impact of different parameters on the system's performance. Finally, in the majority of research cases, the analytical results are in good agreement with the simulation results.

**Keywords: wireless sensor network, energy harvesting, regular battery, non-preemptive priority, impatience, batch arrival.**