# 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 regular battery lifetime is also limited. In order to study the relationship between energy consumption and the lifetime 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 assume the packet arrival process to be a batch arrival process. For simplicity, we assume that 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 derive the balance equations of the analytical 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, we use the C language to write the simulation programs and 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.**