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C-FLBADC: Clustered Fuzzy Logic-Based Adaptive Duty Cycling Protocol for Energy-Efficient IoT Networks

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Abstract: *The increasing deployment of battery-operated Internet of Things (IoT) devices in remote and resource-constrained environments necessitates highly energy-efficient communication protocols. Traditional clustering-based solutions such as LEACH and TEEN offer partial energy savings but often lack adaptability to dynamic network conditions. In this study, we propose C-FLBADC: Clustered Fuzzy Logic-Based Adaptive Duty Cycling Protocol for Energy-Efficient IoT Networks, a novel protocol that integrates dynamic clustering, in-network data aggregation, and a fuzzy logic-based mechanism for adaptive duty cycling. C-FLBADC enhances energy efficiency by intelligently adjusting the activity cycles of sensor nodes based on parameters such as battery level, data change rate, and cluster density. The protocol aims to minimize redundant transmissions while preserving network connectivity and data quality. Simulation results show that C-FLBADC outperforms conventional LEACH and TEEN protocols in terms of residual energy retention, prolonged network lifetime, and higher active node count. This work contributes a scalable and intelligent solution for energy-constrained IoT systems, paving the way for sustainable green technology applications.*

Keywords: Energy Efficiency, IoT, Battery operated IoT Devices, Wake-Up Radio, Adaptive Duty Cycling

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