

Abstract

Wireless Sensor Networks (WSNs) have emerged as a key technology in various applications, ranging from environmental monitoring to healthcare and industrial automation. Efficient data communication among sensor nodes is essential for the success of WSNs, and routing protocols play a critical role in determining the overall network performance. This review aims to comprehensively analyze and synthesize the existing literature on routing protocols in WSNs, highlighting their strengths, weaknesses, and applications. The review also aims to highlight various performance indicators (metrics) used by researchers to evaluate the performance of routing protocols in WSN, emerging trends that may influence the future design of routing protocols in WSN, and security concerns in WSN routing protocols. To attain this goal, a systematic literature review process was employed based on Barbara Kitchenham's original guidelines (2007). Relevant papers were retrieved from major academic databases such as Elsevier, Springer, Wiley, IEEE, and the ACM Digital Library, as well as preprints posted on arXiv. The findings demonstrate that various existing routing protocols have been created throughout time and are classified as data-centric, location-based, mobility-based, multi-path-based, heterogeneity-based, and hierarchical routing protocols. The routing protocols in WSNs vary depending on the application and network architecture. The paper also focuses on the performance criteria used to evaluate them, their pros, limitations, areas of applications, emerging trends in WSN, and security challenges. The future of WSN routing protocols is moving toward intelligent, adaptive, and robust protocols that can serve larger, more complex networks