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Routing Techniques in Wireless Sensor Networks for Disaster Management: A Comprehensive Overview

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ABSTRACT

Wireless Sensor Networks (WSNs) have emerged as essential tools in disaster management scenarios due to their ability to collect real-time data from affected areas and facilitate rapid response efforts. Effective routing techniques are critical to ensure reliable and timely data delivery in WSNs during such critical situations. This paper provides a comprehensive overview of various routing techniques employed in WSNs for disaster management.

Introduction

In disaster conditions, WSNs face numerous challenges such as limited energy resources, dynamic network topologies, unreliable communication links, and the need for rapid data dissemination. Traditional routing approaches designed for general-purpose wireless networks may not be suitable due to these unique challenges. Therefore, specialized routing techniques are developed and deployed to optimize data transmission, conserve energy, and ensure network connectivity in disaster-affected areas.

Firstly, the flat routing approach is discussed, which includes Direct Diffusion and Geographic Routing. Direct Diffusion enables data packets to be disseminated directly from source nodes to sink nodes without relying on hierarchical structures. Geographic Routing leverages location information to forward packets towards the sink, utilizing proximity-based next hop selection.

Next, the hierarchical routing technique is explored, which establishes a hierarchical structure within the WSN. Cluster-based routing protocols, such as LEACH (Low-Energy Adaptive Clustering Hierarchy), divide the network into clusters, enabling efficient data aggregation and forwarding by cluster heads to the base station. Hierarchical routing helps conserve energy and enhances scalability.

Multipath routing is then introduced, which utilizes multiple paths between source and destination nodes. This technique improves reliability and fault tolerance by leveraging alternative routes, crucial in disaster scenarios where network connectivity may be disrupted. Protocols like AOMDV and DYMO exemplify multipath routing approaches [1].

The importance of QoS-based routing is highlighted, where routing decisions are based on specific metrics such as latency, reliability, or energy efficiency. These protocols optimize network performance to meet the unique requirements of disaster management applications. Examples include AODV and DSR, which offer QoS support [2].

Related work

[3] provides a comprehensive overview of various routing protocols specifically designed for WSNs in disaster scenarios. It discusses the strengths and limitations of existing routing techniques, including flat, hierarchical, and multipath routing protocols. The survey also highlights the challenges and open research issues in routing for disaster management.

[4] proposes a dynamic routing protocol for disaster management in WSNs. The protocol takes into account the dynamic network topology caused by the unpredictable nature of disasters. It focuses on energy efficiency and load balancing to prolong network lifetime and ensure reliable data transmission. The research evaluates the proposed protocol through simulations and demonstrates its effectiveness in disaster scenarios.

[5] work proposes a content-based routing protocol specifically designed for disaster management scenarios in WSNs. The protocol enables the retrieval of specific types of data by leveraging content-based queries. It focuses on efficient data dissemination and information retrieval, allowing responders to access targeted information based on their needs during disaster operations. The paper evaluates the protocol's performance through simulations and demonstrates its effectiveness in disaster management applications.

[6] provides a comprehensive overview of multipath routing protocols in WSNs. It discusses the advantages of multipath routing in disaster management scenarios and presents an in-depth analysis of various multipath routing protocols. The study highlights the trade-offs, challenges, and performance evaluation metrics associated with multipath routing in WSNs.

Conclusion

Selecting the appropriate routing technique is crucial in WSNs for effective disaster management. The choice depends on factors such as energy efficiency, scalability, data delivery reliability, and network dynamics. By understanding and leveraging various routing techniques, disaster management professionals can enhance data collection, analysis, and decision-making processes, ultimately leading to more efficient and coordinated disaster response and recovery efforts.

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