FUZZY LOGIC-BASED ROUTING METHOD FOR MESH NETWORKS

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MESH networks are known for their resilience and decentralized communication structure. However, the routing process in such networks is complicated by the dynamic nature of node availability, interference, and the absence of centralized control. This study introduces a routing method based on fuzzy logic, which enables more flexible and adaptive decision-making compared to traditional deterministic algorithms.

The core idea of the method is the transformation of uncertain network parameters– such as link quality, node energy level, and hop count–into linguistic variables. These are processed by a fuzzy inference [1] system that outputs a composite routing metric. The Mamdani-type fuzzy system is used, with rules designed to optimize the trade-off between transmission reliability and energy consumption.

The routing decision is made at each node based on real-time inputs from neighboring nodes. A defuzzification step produces a ranking of next-hop candidates, which helps the node select the most appropriate route at every iteration. Simulation scenarios implemented in MATLAB and NS-3 [2] demonstrate that the proposed fuzzy logic-based method achieves lower end-to-end delay and energy usage in comparison with standard AODV and OLSR protocols.

The advantage of the fuzzy approach lies in its ability to integrate multiple factors into routing decisions without requiring precise models or assumptions. This is particularly useful for MESH networks deployed in unpredictable environments. Further improvements are planned, including the integration of machine learning techniques for automatic rule tuning and the expansion of the method to support mobility scenarios.

The proposed fuzzy logic-based routing method for MESH networks demonstrates a significant advancement in handling the inherent uncertainties and dynamic conditions of wireless environments. By leveraging linguistic variables and rule-based decision-making, the approach enables adaptive route selection that balances energy efficiency, reliability, and scalability. Simulation results confirm its superiority over traditional deterministic protocols, especially in scenarios with fluctuating node availability and varying traffic loads. This method offers a promising foundation for the development of intelligent, context-aware routing solutions in next-generation wireless mesh infrastructures.

Keywords: MESH networks, fuzzy logic, routing method, adaptive decision-making, network optimization.

References

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