

Learning and Optimization: A Trust-Aware Routing Framework

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Abstract: Mobile ad hoc networks (MANETs) face significant challenges in maintaining secure and efficient communication owing to their dynamic nature and vulnerability to security threats. Traditional routing protocols often struggle to adapt to rapidly changing topologies and potential malicious nodes, compromising network performance and security. This study addresses these challenges by proposing FLSTMT-LAR (Federated Learning Long Short-Term Memory Trust-aware Location-aided Routing), a novel framework that integrates multiobjective optimization with LSTM-based trust prediction for robust routing decisions, implements a decentralized federated learning mechanism for collaborative trust model updates while preserving node privacy, incorporates dynamic trust assessment using LSTM networks for accurate temporal behavior pattern analysis, and provides an adaptive routing decision mechanism that effectively balances multiple performance objectives including trustworthiness, energy efficiency, and network latency. We evaluate this framework against existing protocols across various scenarios, including different network densities, mobility patterns, and malicious node percentages. Results demonstrate FLSTMT-LAR's superior performance in high-threat environments, achieving up to 80% packet delivery ratio compared with 45% for traditional approaches. In mobile scenarios, it shows improved adaptability, maintaining consistent performance as network density increases. MOO, particularly nondominated sorting genetic algorithm III, effectively balances conflicting network objectives, offering a 15% improvement in overall network performance compared with single-objective approaches. These findings highlight the potential of integrating advanced machine learning and optimization techniques in MANET routing protocols, paving the way for secure, efficient, and adaptive network communications in challenging environments

Keywords: Mobile ad hoc networks (MANETs), trust-aware routing, federated learning, LSTM networks, multiobjective optimization, security in wireless networks

