

OPTIMIZATION METHOD FOR MAC PROTOCOLS FOR HETEROGENEOUS COMMUNICATION NETWORKS

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Heterogeneous communication networks combine different access technologies, traffic types, and service requirements, which poses significant challenges to the design and optimization of Medium Access Control (MAC) protocols. This work proposes an optimization method aimed at improving MAC performance in such complex environments by dynamically adapting to traffic conditions and node capabilities.

The method integrates traffic classification [1], resource allocation, and adaptive contention resolution into a unified optimization framework. Each node monitors local traffic characteristics—such as delay sensitivity, burstiness, and source priority—and adapts MAC parameters accordingly. The optimization objective is to maximize throughput and fairness while minimizing delay and packet loss.

The approach is based on multi-objective optimization using fuzzy logic to handle uncertainties in traffic behavior and network dynamics [2]. A hybrid algorithm combining fuzzy inference and genetic optimization is developed to tune MAC parameters like backoff intervals, slot durations, and priority weights. The proposed method is compatible with IEEE 802.11 and 802.15.4 standards and can be implemented as an extension layer.

Simulation experiments carried out in NS-3 show that the method outperforms traditional static MAC schemes in terms of latency [3], throughput, and QoS compliance under mixed traffic conditions. It also demonstrates scalability and robustness in networks with varying node densities and mobility patterns.

The proposed optimization method for MAC protocols effectively addresses the challenges of heterogeneous communication networks by enabling adaptive, traffic-aware access control. Through dynamic tuning of MAC parameters using fuzzy logic and multi-objective optimization, the approach enhances throughput, reduces latency, and maintains QoS across diverse network conditions. Its flexibility and compatibility with existing standards make it a practical solution for real-world deployments.

References

1. Stallings W. *Wireless Communications & Networks* // Pearson Education. – 2nd ed. – 2005. – 608 p. – ISBN: 9780131918353.
2. Zungeru A.M., Ang L.-M., Seng K.P. *Radio Frequency Medium Access Control for Wireless Sensor Networks: A Survey and Future Research Directions* // Springer. – 2018. – 250 p. – ISBN: 9783319925552.
3. Sauter M. *From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband* // Wiley. – 4th ed. – 2021. – 608 p. – ISBN: 9781119763004.