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論　文　要　旨

・論文の構成

Chapter 1 Introduction
Chapter 2 MANETs Preliminaries
Chapter 3 Source Delay for MAC-TG MANETs
Chapter 4 End-to-End Delay for MAC-TG MANETs
Chapter 5 Throughput Capacity for MAC-TG MANETs
Chapter 6 Conclusion
APPENDICES

・研究目的の妥当性，従来の手法との比較においての有意性，および理論・実験手法の新規性

This thesis conducted study on the two fundamental performance metrics of MANETs, i.e., delay and throughput capacity, both of which are critical for the applications of MANETs to meet Quality of Service requirements.

Available works on end-to-end delay in MANETs reported either its upper bounds, or its approximations, both of which may introduce noticeable errors to end-to-end delay evaluation in these networks. Different from these works, this thesis conducted research on exact end-to-end delay modeling for MANETs by employing the powerful QBD theory. Available works on throughput capacity of MANETs mainly focused on

either the order sense capacity scaling laws, or the exact throughput capacity under a specific routing protocol. This thesis studied the exact throughput capacity for MANETs, which holds for any routing protocols.

・得られた知見のシステム情報科学の分野における意義

The results of this thesis provide the following insights.

1. The novel delay analysis approach proposed in this thesis not only sheds lights on the challenging end-to-end delay modeling in MANETs, but also opens a new era for the challenging delay analysis in other network scenarios as well.
2. The exact throughput capacity derived in this thesis reveals the maximum throughput the considered MANETs could support, so it provides a target for developing high speed communication networks and serves as a roadmap to communication engineers.

審査結果の要旨

This thesis is devoted to the study of challenging delay and capacity performance for promising mobile ad hoc networks (MANETs) with the Transmission Group Based MAC Protocol. The thesis first studied the source delay, a fundamental delay metric common to all MANETs, by employing a novel and powerful Quasi-Birth-and-Death (QBD) theoretical framework. By extending the QBD framework, the thesis then conducted analysis on the challenging end-to-end delay and determined its mean value. Finally, the thesis studied the throughput capacity for the considered MANETs, where necessary and sufficient conditions for establishing throughput capacity were provided by employing the Lyapunov Drift Theory. All theoretical results were validated through extensive simulations. The effects of various network parameters on delay and capacity performance were also investigated. It is expected that our approach for MANET delay analysis could be helpful for delay analysis in general wireless networks as well, and the throughput capacity results we established could provide guideline for efficient network protocol design.