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Intelligent Realy Based Smart Mode Communications Over Mobile Adhoc Networks

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ABSTRACT: Understanding the real achievable performance of mobile ad hoc networks (MANETs) under practical network constraints is of great importance for their applications in future highly heterogeneous wireless network environments. This system explores, for the first time, the performance modeling for MANETs under a general limited buffer constraint, where each network node maintains a limited source buffer of size Bs to store its locally generated packets and also a limited shared relay buffer of size Br to store relay packets for other nodes. Based on the Queuing theory and birth-death chain theory, we first develop a general theoretical framework to fully depict the source/relay buffer occupancy process in such a MANET, which applies to any distributed MAC protocol and any mobility model that leads to the uniform distribution of nodes' locations in steady state. With the help of this framework, we then derive the exact expressions of several key network performance metrics, including achievable throughput, throughput capacity, and expected end-to-end delay. We further conduct case studies under two network scenarios and provide the corresponding theoretical/simulation results to demonstrate the application as well as the efficiency of our theoretical framework. Finally, we present extensive numerical results to illustrate the impacts of buffer constraint on the performance of a buffer-limited MANET.

KEYWORDS*:* MANET, Mobile ad hoc networks, buffer constraint, throughput, delay, performance modeling.

I. INTRODUCTION

The mobile ad hoc networks (MANETs), a class of self autonomous and flexible wireless networks, are highly appealing for lots of critical applications, like disaster relief, battlefield communications, D2D communications for traffic offloading, and coverage extension in future 5G cellular networks. In particular, the applications of MANETs in vehicle-to-vehicle communications, i.e., the vehicular ad hoc networks (VANETs) have attracted considerable academic attention recently as a promising solution to improving safety and driving experience. Motivated by these, understanding the fundamental performance limits of MANETs is of great importance to facilitate the application and commercialization of such networks. By now, extensive works have been devoted to the performance study of MANETs, which can be roughly classified into two categories, the ones with the consideration of practical limited buffer constraint and the ones without such consideration. Regarding the performance study for MANETs without the buffer constraint, Grossglauser and Tse first explored the capacity scaling law, i.e., how the per node throughput scales in the order sense as the number of network nodes increases, and demonstrated that with the help of node mobility a $\Theta(1)$ per node throughput is achievable in such networks.

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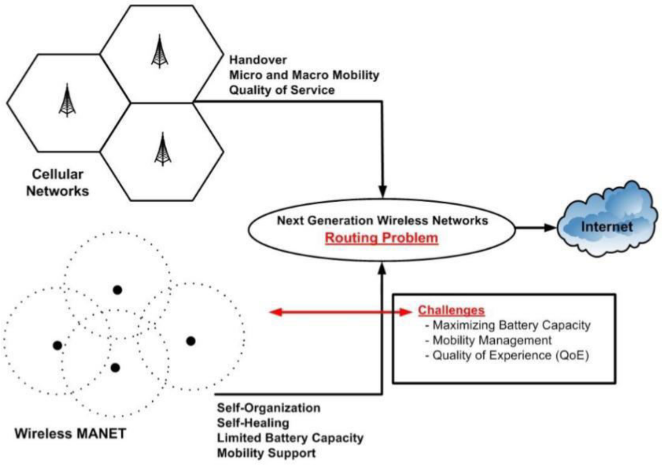

Fig.1 System Architecture Design

Later, Neely et al. studied the delay-throughput tradeoff issue in a MANET under the independent and identically distributed (i.i.d) mobility model and showed that achievable delay-to throughput ratio is lower bounded as delay/throughput ≥ O(n) (where n is the number of network nodes). Gamal et al. then explored the delay-throughput tradeoff under a symmetric random walk mobility model, and showed that a Θ(n log n) average packet delay is incurred to achieve the Θ(1) per node throughput there. Sharma et al. further studied the delay-throughput tradeoff under a general and unified mobility model, and revealed that there exists a critical value of delay below which the node mobility is not helpful for capacity improvement. Recently, Wang et al. explored the throughput and delay performance for MANETs with multicast traffic in earlier systems, and further conducted the network performance comparison between the unicast and multicast MANETs in past approaches. Those results indicate that the mobility can significantly decrease the multicast gain on per node capacity and delay, and thus weaken the distinction between the two traffic models.

II. MOTIVATION OF THE WORK

The motivation of our study is to take a step forward in the practical performance modeling for MANETs. In particular, this system focuses on a practical MANET where each network node maintains a limited source buffer of size Bs to store its locally generated packets and also a limited shared relay buffer of size Br to store relay packets for all other nodes. This buffer constraint is general in the sense that it covers all the buffer constraint assumptions adopted in available works as special cases, like the infinite buffer assumption (Bs→∞, Br → ∞), limited source buffer assumption (0 ≤ Bs < ∞,Br → ∞), and limited relay buffer assumption (Bs → ∞, 0 ≤ Br < ∞). It should be pointed out that compared with the previous works where packet loss never occurs, under the general limited-buffer scenario packet loss is inevitable, which makes deriving achievable throughput a new challenging and significant problem, and the impacts of feedback mechanism on network performance worthy of study. To the best of our knowledge, this system represents the first attempt on the exact performance modeling for MANETs under general limited-buffer constraint.

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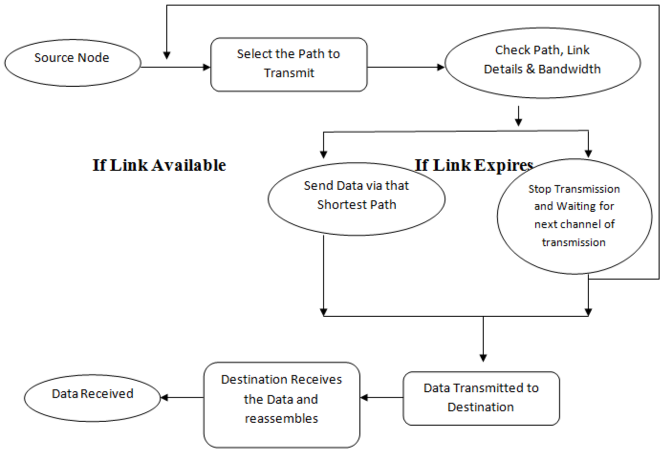

Fig.2 Flow Diagram of the Proposed System

III. SYSTEM SUMMARY

Once S gets access to wireless channel at the beginning of a time slot, it executes the 2HR scheme without/with feedback as follows.

(Source-to-Destination)

If D is within the transmission range of S, S executes the Source-to-Destination operation. If the source queue of S is not empty, S transmits the HoL packet to D; else S remains idle. If D is not within the transmission range of S, S randomly designates one of the nodes (say R) within its transmission range as its receiver, and chooses one of the following two operations with equal probability.

(Source-to-Relay)

Without feedback: If the source queue of S is not empty, S transmits the HoL packet to R; else S remains idle. With feedback: R sends a feedback to S to indicate whether its relay buffer is full or not. If the relay buffer of R is not full, S executes the same operation as that without feedback; else S remains idle.

(Relay-to-Destination)

In this operation, S serves as the relay node forwarding packets to R, and R is the destination of packets forwarded from S. If S has packet(s) in the corresponding relay queue for R, S sends the HoL packet of this queue to R; else S remains idle. We let psd, psr and prd denote the probabilities that a node gets the chance to execute the Source-to-Destination, Source-to-Relay, and Relay-to-Destination operations, respectively. It is worth noting that these probabilities are determined by the specific MANET scenario and will be regarded as known quantities in the following two sections, where the performance modeling is developed for a general MANET based on the basic system models mentioned above. The performance metrics involved in this paper are defined as follows. Throughput: The throughput T of a flow (in units of packets per slot) is defined as the time-average number of packets that can be delivered from its source to its destination. Throughput Capacity: For the homogeneous finite buffer network scenario considered in this paper, the network level throughput capacity Tc can be defined by the maximal achievable per flow throughput, i.e., Tc = max+s∈(0;1]T. End-to-end Delay: The end-to-end delay D of a packet2 (in units of slots) is defined as the time it takes the packet to reach its destination after it is generated by its source, and we use E{D} to denote the expectation of D.

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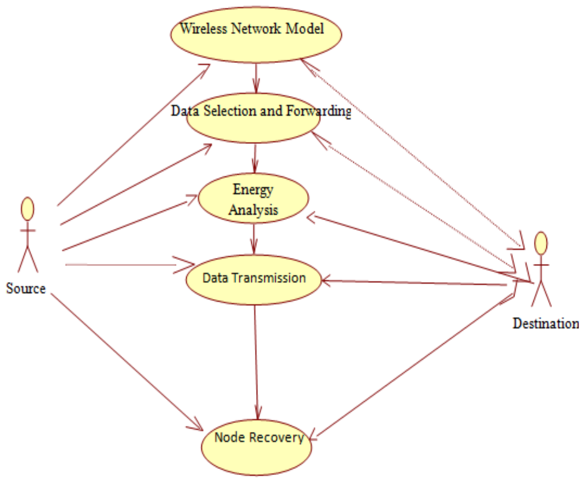

Fig.3 Usecase Specification of the System

IV. PAST AND PROPOSED SYSTEM SUMMARY

In past system, the applications of MANETs in vehicle-to-vehicle communications, i.e., the vehicular ad hoc networks (VANETs) have attracted considerable academic attention recently as a promising solution to improving safety and driving experience. Motivated by these, understanding the fundamental performance limits of MANETs is of great importance to facilitate the application and commercialization of such networks. By now, extensive works have been devoted to the performance study of MANETs, which can be roughly classified into two categories, the ones with the consideration of practical limited buffer constraint and the ones without such consideration. Regarding the performance study for MANETs without the buffer constraint, Grossglauser and Tse first explored the capacity scaling law, i.e., how the per node throughput scales in the order sense as the number of network nodes increases, and demonstrated that with the help of node mobility a $\Theta(1)$ per node throughput is achievable in such networks.

Later, Neely et al. studied the delay-throughput tradeoff issue in a MANET under the independent and identically distributed (i.i.d) mobility model and showed that achievable delay-tothroughput ratio is lower bounded as delay/throughput $\geq O(n)$ (where n is the number of network nodes). Gamal et al. then explored the delay-throughput tradeoff under a symmetric random walk mobility model, and showed that a $\Theta(n \log n)$ average packet delay is incurred to achieve the $\Theta(1)$ per node throughput there. Sharma et al. further studied the delay-throughput tradeoff under a general and unified mobility model, and revealed that there exists a critical value of delay below which the node mobility is not helpful for capacity improvement.

In the proposed system, the following are the major contributions, which are summarized as follows: Based on the Queuing theory and birth-death chain theory, we first develop a general theoretical framework to fully depict the source/relay buffer occupancy process in a MANET with the general limited-buffer constraint, which applies to any distributed MAC protocol and any mobility model that leads to the uniform distribution of nodes' locations in steady state. With the help of this framework, we then derive the exact expressions of several key network performance metrics, including achievable throughput, throughput capacity, and expected end-to-end (E2E) delay. We also provide the related theoretical analysis to reveal the fundamental network performance trend as the buffer size increases.

We further conduct case studies under two network scenarios and provide the corresponding theoretical/simulation results to demonstrate the efficiency and application of our theoretical framework. Finally, we present extensive numerical results to illustrate the impacts of buffer constraint on network performance and our theoretical findings.

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V. EXPERIMENTAL RESULT

The following figure illustrates the input parameters of the proposed system.

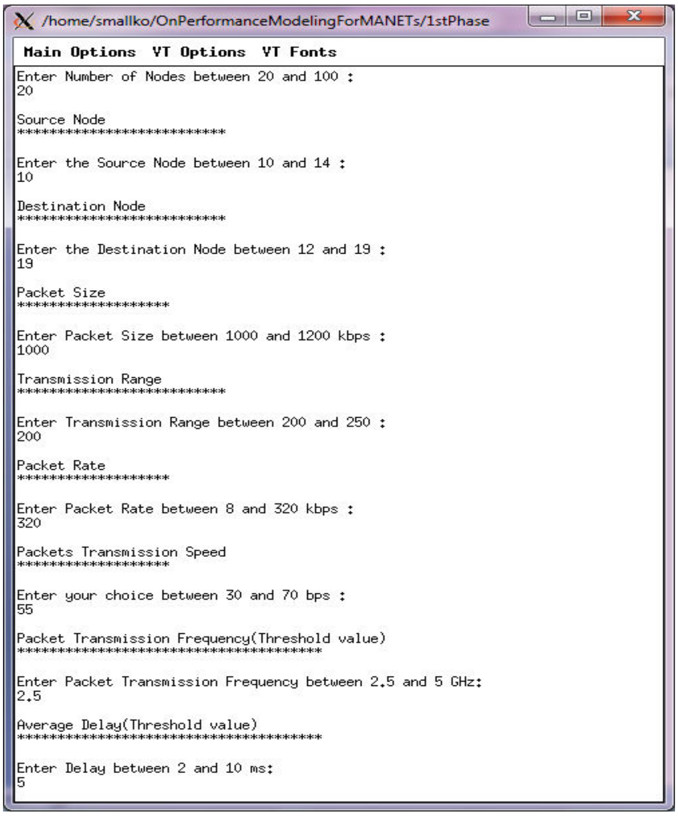

Fig.4 Input Parameters

The following figure illustrates the Node formation view of the proposed system.

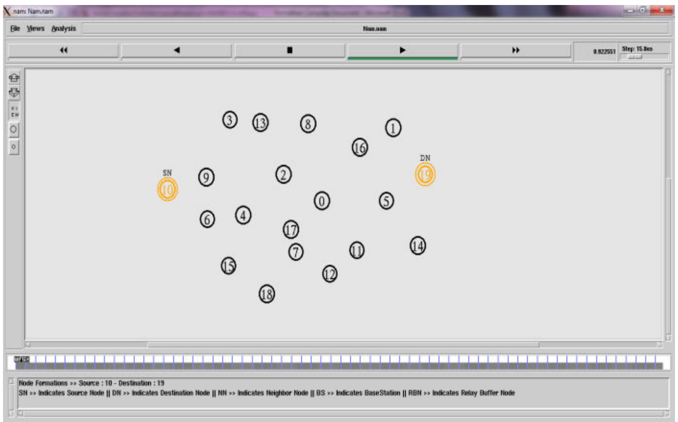

Fig.5 Node Formation

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he following figure illustrates the Communication flow of the proposed system.

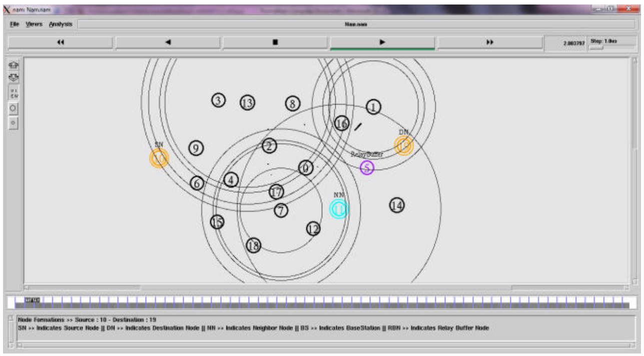

Fig.6 Communication Flow Design

The following figure illustrates the Throughput analysis of the proposed system.

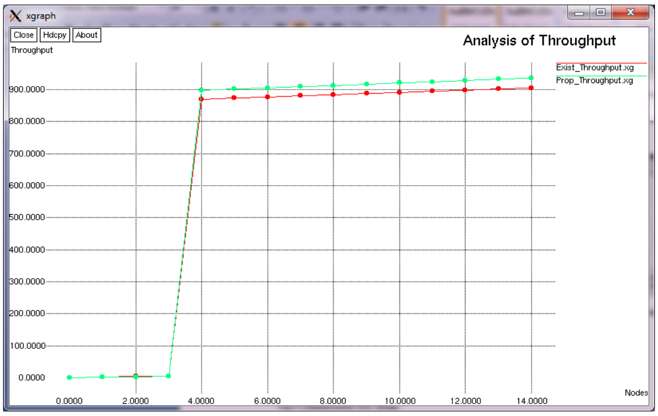

Fig.7 Throughput Analysis

The following figure illustrates the Packet Transmission Ratio Analysis of the proposed system.

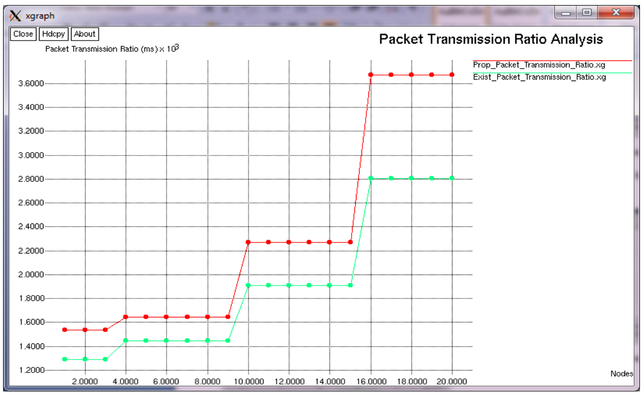

Fig.8 Packet Transmission Ratio

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The following figure illustrates the Network lifetime analysis of the proposed system.

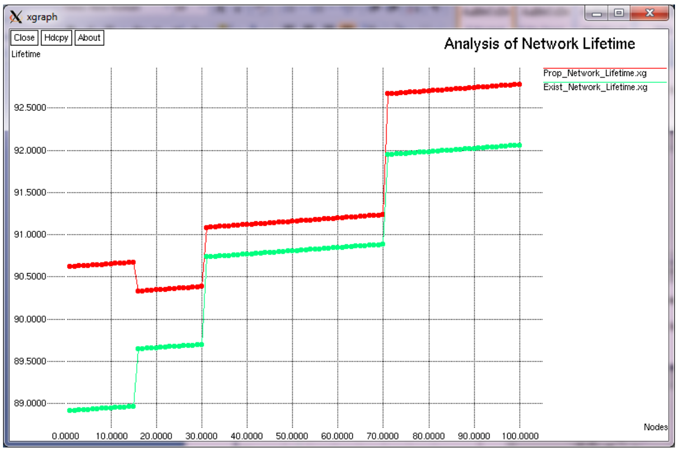

Fig.9 Network Lifetime Analysis

The following figure illustrates the delay analysis of the proposed system.

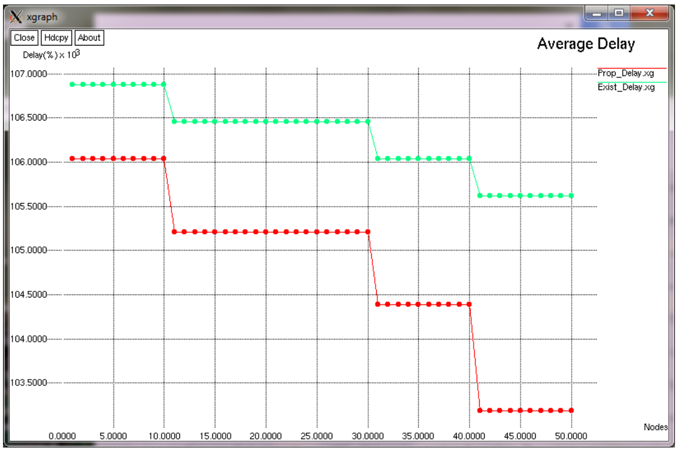

Fig.10 Delay Analysis

VI. CONCLUSION

This system explored, for the first time, the performance modeling for MANETs under the general limited buffer constraint. In particular, a complete and generally applicable theoretical framework was developed to capture the inherent buffer occupancy behaviors in such a MANET, which enables the exact expressions to be derived for some fundamental network performance metrics, like the achievable throughput, expected E2E delay and throughput capacity. Some interesting conclusions that can be drawn from this study are: 1) In general, adopting the feedback mechanism can lead to an improvement in the throughput performance, but such improvement comes with the cost of a relatively large delay; 2) For the purpose of throughput improvement, it is more efficient to adopt a large relay buffer rather than a large source buffer; 3) The throughput capacity is dominated by the relay buffer size rather than the source buffer size; 4) Feedback mechanism cannot improve the throughput capacity. Notice that in this system, only buffer constraint was investigated, so one promising future direction is to conduct performance study for MANETs under

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more practical network scenarios, where the packet loss could be caused by other reasons such as poor signal conditions. Another appealing future direction is to explore the performance modeling for MANETs with the retransmission scheme.

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