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Optimal Capacity-Delay Tradeofff in MANETs with Correlation of Node Mobility

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ABSTRACT: We analyze the capacity and delay in mobile ad hoc networks (MANETs) considering the correlation of node mobility (correlated mobility). Mobility models of MANET have been still research area in mobile computing and in wireless network with lots of mobility algorithms to design the efficient mobility model . We focused on different techniques such as capacity achieving scheme and routing scheme. We deeply explore the characteristics of correlated mobility, and figure out the fundamental relationships between the network performance and scheduling parameters. Based on that we establish the overall upper bound of capacity-delay tradeoff in all the sub-case of correlated mobility. Then we try to obtain the achievable lower bound by identifying the optimal scheduling parameters on certain constrains. To improve this scheme the new method is proposed here that is “Link Failure Detection ” that gives better throughput and less overhead.

KEYWORDS: MANETs , capacity and delay tradeoff, correlated mobility, node, constrains.

I.INTRODUCTION

Correlation mobility can be divided into three sub-case based on different degrees of correlation of node mobility the cluster sparse regime (node mobility show strong correlation the cluster dense regime (node mobility show weak correlation) the cluster critical regime (node mobility show medium correlation). Ciullo et al. First introduced correlated mobility into the scaling analysis of wireless networks. They obtained the maximum capacity with the corresponding packet delay in cluster sparse regime and the lower bound of capacity with the corresponding packet delay in cluster dense regime, respectively.

They obtained the maximum capacity with the corresponding packet delay in cluster sparse regime and the lower bound of capacity with the corresponding packet delay in cluster dense regime, respectively. Yet the problem of optimal capacity performance under various delay constraints remains to be solved, which can provide significant insights for the better design of wireless networks requiring operating in various delay conditions.

The network generally performs worse in cluster sparse regime (strong correlation of node mobility). Mobility model. Because the strong correlation of node mobility has destroyed the network connectivity. The optimal capacity-delay tradeoff in cluster dense regime and in cluster critical regime both perform better than that in. Mobility model, which is also better than the results in previous works on correlated mobility. The correlated mobility in cluster critical regime can achieve the best performance of the optimal capacity-delay tradeoff among the three sub-cases. It indicates that the medium correlation of node mobility can greatly benefit the network performance. The main contribution of this paper is that we are the first to demonstrate a whole picture of how correlated mobility impacts the capacity-delay tradeoff in MANETS.

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II.PROJECT DESCRIPTION

A. EXISTING SYSTEM

Existing works on correlated mobility investigated the maximum capacity with the corresponding delay in several sub-case, the problem of optimal capacity under various delay constraints (the optimal capacity delay tradeoff) still remains open. The mobile ad hoc network is a collection of wireless nodes that are able to communicate with each other without the need of any established infrastructure. Such a self-configuring network is highly appealing for some specific applications, such as battle field or disaster recovery.

2.1.1 DISADVANTAGES

1. Optimal capacity delay is high.
2. Inter-cluster duplications via traditional broadcast and one-hop unicast scheme.
3. Node mobility correlation is low

B. PROPOSED SYSTEM

The scheduling scheme in cluster sparse regime that two mechanisms (inter-cluster duplication and intra-cluster duplication) of duplicating messages are proposed to deliver the source packet to its destination as quickly as possible. However, we have observed some special phenomenon's during the analysis, which suggests adapting the message duplicating mechanism to the cluster dense regime.

1) The cluster sparse regime (node mobility show strong correlation).
2) The cluster dense regime (node mobility show weak correlation).
3) The cluster critical regime (node mobility show medium correlation).

2.2.1 ADVANTAGES

1. Node mobility correlation is high.
2. Easy to find duplicate messages.
3. Optimal capacity delay is decreasing

III.MODULE DESCRIPTION

A. MODULES

1. Cluster analysis
2. Mobile Ad-hoc networks
3. Node mobility
4. Correlation

1. CLUSTER ANALYSIS

Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense or another) to each other than to those in other groups (clusters). It is a main task of exploratory data mining, and a common technique for statistical data analysis, used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, bioinformatics, data compression, and computer graphics. Cluster analysis itself is not one specific algorithm, but the general task to be solved. It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them.

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2. MOBILE AD-HOC NETWORKS

A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected wirelessly. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. MANETS are a kind of Wireless ad hoc network that usually has a routable networking environment on top of a Link Layer ad hoc network. MANETS consist of a peer-to-peer, self-forming, self-healing network. MANETS circa 2000-2015 typically communicate at radio frequencies (30 MHz - 5 GHz).System supports mobile ad hoc network ,point-to-point and point-to-multipoint network configuration with one waveform. Coverage 0-30km depending on antenna configuration, antenna height, and frequency. Adaptive data transfer capacity shared between connected nodes.

The growth of laptops and 802.11/Wi-Fi wireless. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. They may contain one or multiple and different transceivers between nodes. This results in a highly dynamic, autonomous topology.[2]

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3. NODE MOBILITY

A mobile node is an Internet-connected device whose location and point of attachment to the Internet may frequently be changed. This kind of node is often a cellular telephone or handheld or laptop computer, although a mobile node can also be a router. If nodes change their location over time, they have to update their location estimates frequently in order to avoid inaccuracies resulting from using outdated location estimates moreover, node movement during the measurement of parameters needed for location computation can cause inaccuracies in the estimated location.

4. CORRELATION

In statistics, dependence or association is any statistical relationship, whether causal or not, between two random variables or two sets of data. Correlation is any of a broad class of statistical relationships involving dependence, though in common usage it most often refers to the extent to which two variables have a linear relationship with each other. Familiar examples of dependent phenomena include the correlation between the physical statures of parents and their offspring, and the correlation between the demand for a product and its price.

IV.SYSTEM MODEL

Time Scale: Time is divided into slots of equal unit duration. Nodes move over slots following a correlated mobility fashion and remain static during each slot. In addition, we consider slow mobility time scale here, i.e., the speed of node movement is much slower than that of packet transmission. Thus the multi-hop routing can be realized within one slot.

Correlated Mobility: Define a particular cluster center as j and one of its cluster members as i. Based on the features of correlated mobility, we describe the motion as follows:

1) The **Motion of Cluster Center**: At the end of each slot, the network scheduler decides the position of each cluster center j in the next slot. In each slot, the position of cluster center j is randomly and uniformly chosen within the

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entire network area, independently from other cluster centers. After receiving the decision, all the cluster centers move to the scheduled positions in the next slot.

2) **The Motion of Cluster Member**: Once the new position of cluster center j is selected, all nodes in this cluster move to the new region close to j, then the position of cluster member i is randomly and uniformly chosen within the new region, independently from other nodes in this region.

Achievable Lower Bound: We divide unit slot into three sub-slot. The operation of each sub-slot are shown below:

1) Nodes (source and relays) create inter-cluster duplications and C_d receives messages from one of the inter cluster duplications via one hop unicast transmission. Each hop exploits the transmission range of r^s.

2) R_d^s intra-cluster duplications are created via broadcasting within C_d.

3) If one of the intra-cluster duplications is captured by the destination within range l^s, then the message of s will be delivered to the destination via h^s-hop unicast transmission. Each hop exploits the transmission range of r^s.

Traffic Pattern: We assume that each node is a source node associated with one destination, which is randomly and independently chosen among all the other nodes in the network. We also assume that the destination is uniformly chosen among all the clusters excluding the cluster of the source. Then the source send packets to the corresponding destination via a common wireless channel and we utilize the protocol model [1] to reduce the interference.

V.CLUSTER SPARSE REGIME

The analysis of capacity-delay tradeoff in cluster sparse regime.

Scheduling Policy: A traffic stream s -> d, we denote s and d as the source and its destination respectively. In addition, We denote C_s and C_d as two clusters who containing s and d respectively, where $C_s \neq C_d$. Opportunistic broadcasting scheme (nodes only broadcast messages when there exist a large number of nodes around) is applied here to fully utilize the correlation of node mobility. We show the scheduling policy as follow:

1) When s meets a cluster C_k (k=1,...... R_c^s , where R_c^s is the maximum number of clusters who contain messages of s) who contains no messages of s, a relay will be created in C_k via one-hop unicast. We call this process as inter-cluster duplication and this process will not end
until one of the relays meets C_d.

2) If one of the relays meets C_d, a new relay will be created in C_d via one-hop unicast. If not, back to step 1).

3) The newly created relay in C_d will create relays within C_d via broadcast (R_d^s denotes the total number of relays created in C_d). We call this process as intra-cluster duplication.

4) If one of the relays in C_d is captured[2] by the destination within range l^2, the message of s will be transmitted to the destination via h^s-hop unicast transmission. If not, back to step 3).

This general causal scheduling policy only performs well when the correlation of node mobility is relatively strong. When the correlation of node mobility becomes extremely strong, we shall re-design the scheduling policy to achieve the optimal network performance.

V1.CLUSTER DENSE REGIME

We recall the scheduling scheme in cluster sparse regime that two mechanisms (inter-cluster duplication and intra-cluster duplication) of duplicating messages are proposed to deliver the source packet to its destination as quickly as possible. Intuitively, we can still apply these two mechanisms to the performance analysis in cluster dense region. However, we have observed some special phenomenon's during the analysis, which suggests adapting the message duplicating mechanism to the cluster dense regime. Thus, the deducing process of the case of cluster dense regime is very different from that of the case of cluster sparse regime, which is more complicated.

Topology Analysis and Some Observations: In cluster sparse regime, the correlation of node mobility is strong where either the number of clusters or the area that each cluster covers is relatively small. Thus, all clusters are distributed sparsely over the network and rarely overlap each other. One cluster should move over slots to meet another

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cluster and duplicate messages of the source. However in cluster dense regime, as the correlation degree of node mobility has been changed, the traditional scheduling scheme used in cluster sparse regime may be inefficient. In the following, we first take a look at some interesting observations.

We consider the case where a source cluster (or a cluster containing relays) meets another cluster which doesn't contain messages of the source. Intuitively, the larger number of message holders³ in one cluster, the higher probability we get to successfully hand over messages to another cluster who are not containing any message holder. however, the following lemma barely supports the above common view.

VII.CLUSTER CRITICAL REGIME

The capacity-delay tradeoff in cluster critical regime, which is better than that in cluster dense regime. The reason is that when the node mobility show weak correlation (even extremely weak correlation), the number of clusters is large and each cluster covers a large area of the network, which results in the severe competition of the limited radio resources and a longer delay within each cluster. On the contrary, in cluster critical regime, the node mobility show medium correlation where the number of clusters or the area each cluster covers is neither too large nor too small. The medium correlation of node mobility benefits the network performance mainly in three aspects: 1) the connectivity is guaranteed (but not strongly connected); 2) clusters are loosely overlapped which relieves the competition for radio resources among them compared with the case of cluster dense regime; 3) each cluster covers a relatively small area which reduces the transmission delay within the cluster. Thus, the node mobility in cluster critical regime can achieve better performance of capacity-delay tradeoff than that in cluster sparse regime and cluster dense regime.

VIII.CONCLUSION

This paper mainly focus on the impact of correlation of node mobility on the capacity-delay tradeoff in mobile ad hoc networks (MANETs). We have investigated the characteristics of correlated mobility and figured out the fundamental relationship between the capacity, delay and the associated system parameters, which afterwards provides great help to derive the capacity-delay tradeoff. Results demonstrate a whole picture of how the correlated mobility affect the network performance in different degrees of correlation. We reveal that all the three kinds of different degrees of correlated mobility can enhance the performance of capacity-delay tradeoff to some extents. In particular, the medium correlation of node mobility can better benefit the performance of capacity-delay tradeoff compared with the strong or weak correlation of node mobility. Because it can effectively control the number of clusters and area that each cluster covers, which further relieves the competition of limited radio resources and decrease the delay of the so called "last mile" transmission.

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