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Effects of Mobility Patterns for Geocast Routing Protocol in Mobile Ad Hoc Networks

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Abstract: A mobile ad hoc network is a collection of wireless mobile nodes forming a temporary network without using any existing infrastructure. In this paper, we investigate the routing performance of geocast routing protocol according to several mobility patterns for mobile nodes in mobile ad hoc networks. After introducing several popular mobility models, such as RWP (random way point) and RPGM (reference point group mobility) models, we design several scenarios to evaluate the performance for FLOOD and BOX forwarding approaches of geocast routing protocol. From the simulation results, we show that different mobility patterns can affect the routing performance to some extent, which can be explained by the interaction of the mobility characteristics with the connectivity feature. Finally we propose a modification for geocast routing in case of RPGM, which can reduce routing overhead without sacrificing the performance.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless nodes communicating with each other in the absence of any infrastructure. The MANET is suitable for long distance education, battlefields and disaster relief activities. However, only few real MANETs have been realized, while most of the research is still simulation based. As we all know, the MANETs can be unstablized when the mobile nodes (MNs) move a lot. It is imperative to use a mobility model that accurately represents the MNs. However, 90% of existing works are simulated by using RWP (random way point) model [1], which is sometimes referred to as Brownian motions. However the moving pattern is too simple to mimic the movements of real MNs. Thus the simulation based on this RWP model can t meet the requirements in real scenarios such a troop moving as groups in a battle field. In [2], RPGM (reference point group mobility) model is proposed to imitate this kind of scenario.

Geocast is the delivery of messages to nodes within a geographical region [6], which is a location-based multicast algorithm in MANETs. The current Internet has no knowledge about the geographic location of the nodes. With cheap and small Global Positioning System (GPS) receivers, and with evolving MANETs and ubiquitous computing, it is likely that location information of network nodes or regions will become available. This is why recent proposals of point-to-point routing protocols for MANETs make use of geographic knowledge to enhance their efficiency and scalability. In a MANET environment, there are lots of scenarios that can benefit from geocast communication. For example, during a rescue/emergency operation, consider the benefits of delivering a message that states "immediate help needed? to all rescue personnel within one block of that address. In [3][4], some research about mobility patterns already have been done for unicast routing protocols. However, the mobility effect in multicast scenarios such as geocast has not been sufficiently discussed till now.

As we know, geographic routing is highly dependent on MNs? moving tracks. We can expect that the protocol performance also varies with the mobility model. In this paper, we investigate features of mobility effect in geocast associated with RPW and RPGM, and try to give an explanation about these phenomena. After that, we propose a modification for geocast to reduce the overheads considering RPGM model.

The rest of this paper is organized as follows. Section II summarizes most of existing mobility pattern models for MANET. Section III gives a brief description of the geocast routing protocols. Section IV presents the simulation scenarios. Simulation results and its discussion are also in this section. After that we propose a slight modification for geocast in case of RPGM. Finally, our conclusion from this study and planned future work are listed in Section V.

II. MOBILITY MODELS AND GEOCAST

To show how mobility patterns affect the performance of geocast routing protocol later, we first summarize several popular mobility models. Mobility metrics to quantify the parameters for a specific scenario are also introduced subsequently.

A. Different Mobility Models

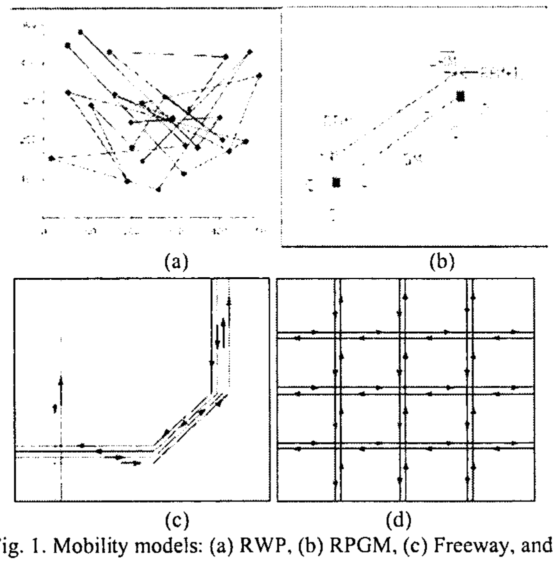

Fig. 1. Mobility models: (a) RWP, (b) RPGM, (c) Freeway, and (d) Manhattan.

According to [3], all the mobility models can be divided into two classes. One class, entity mobility model, comprises of random walk mobility model, RWP model, random direction model, boundless simulation area model, Gauss-Markov model, probabilistic version of random walk, and city section mobility model. The other class is group mobility model, including exponential correlated random mobility model, column mobility