

Chapter 7.5

Rethinking Realistic Wireless Network Mobility: Model and Trust

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ABSTRACT

With recent advances of wireless ad hoc networking, especially opportunistic forwarding and cognitive radio, there is an increasing concern that existing mobility models are insufficient to represent network mobility in real world settings. In this chapter, the author discusses his proposal for a more realistic mobility model which captures key features of human movements in pervasive markets. His findings lead to a non-traditional mobility model which can be used to reconstruct the statistical patterns commonly observed in the literature, and facilitate the study of mobile communication and software engineering design problems under the context of pervasive computing for markets.

INTRODUCTION

The communication environment surrounding our daily experience is increasingly characterized by mobile devices that can exchange information and provide access to various services of complex nature. The trend is clear that future personal computing experience would be more and more

based on pervasive communication devices and services, and the underlying mobile networks are becoming cooperative as mobile devices are increasingly rely on nearby nodes to maintain connectivity or relay messages.

In the future scenarios of wireless ad hoc networking like above, local connections and user mobility are as important as infrastructure access today for delivering data (Su et al., 2007), but those mobility issues are not well studied in

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the past. As mobile devices are often attached to users, understanding their mobility patterns would lead to more realistic network simulation and better software and communication system design in general. However, existing mobility models are either too simplistic or do not represent the key characteristics of user mobility (Camp et al., 2002). In the literature, most commonly used mobility models can be categorized into two types: individual mobility model and group mobility model.

Individual mobility models address the movement at individual node level, where each node is assumed to be independent from others: the Random Walk model (Nain et al., 2005) is the de facto mobility model for most mobile network simulations, which is a direct implementation of Brownian motion. The Random Waypoint model (Yoon et al., 2003; Navidi et al., 2004) is also widely used in mobile network simulations, where nodes travel between randomly chosen locations. The Gauss-Markov model (Liang et al., 1999) was designed to adapt to different levels of randomness, where nodes update their speed and direction at each time step, taking previous values into account.

In a group mobility model, the movement of a node is calculated relatively to the movement of a reference point in the group it belongs to: the Reference Point Group model (Hong et al., 1999) was based on the observation that mobile nodes in real world tend to coordinate their movement (e.g., in battlefield, a number of soldiers may move together in a group or platoon; or during disaster relief, various rescue crews form different groups and work cooperatively), where nodes are assumed to be in groups of one leader and a number of members. The movement of the group leader determines the mobility behavior of the entire group. The Social Network and Community model (Musolesi et al., 2004; Boldrini et al., 2007) is a recent approach to deriving mobility traces based on the analysis of community structure in social networks, which further considers the group

dynamics and clustering techniques in the node movement calculations.

Observing that above approaches are all top-down: they try to define the real characteristics that a mobility model should capture and then build the model accordingly, we take a reversed thinking bottom-up that mobility models should be inferred from observations made in real world networks, due to two facts: (1) real characteristics are actually hard to define; (2) node mobility characteristics in real world are very application specific.

DATA COLLECTION

Camden market was chosen for collecting user mobility traces. Camden market is a large craft and clothing market in Camden town and the fourth most popular visitor attraction in London, attracting approximately 100,000 people each weekend (Wikipedia, n.d.). HP GPS rx5730 handheld receiver is used for data collection, with a position accuracy of better than 3 meters most of the time. Users were supposed to keep the GPS receiver with them for as much of their visiting time as possible, with most carrying the GPS receiver in pockets. Occasionally, tracking information has discontinuity mainly when users move inside the indoor part of Camden market where GPS signals cannot be received.

The GPS receiver takes reading of the user's position every second and records it into a trace log. The trace log contains at least the following data:

Latitude; Longitude; Altitude; Speed; Date; Heading (1)

For the preliminary study, we collected traces of 4 market visitors (2 male and 2 female) over two month period. The assumption we taken here is that every visitor in the Camden market has the same statistical mobility tendency, and we believe it is reasonable to analyze the aggregative statistical

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