Analysis of Energy and Mobility Model on Opportunistic Routing Algorithms

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***Abstract*—An Opportunistic Network is an extreme network where the communication mainly depends on the mobility of the participating nodes to address the intermittent connectivity. This opportunistic routing utilizes a store-carry-forward paradigm exploiting node mobility and local forwarding to transfer the messages. The mobile nodes are normally low-power portable wireless communication devices employing as wireless ad hoc network for multi-hop transmission. With the limited resource, the performance of the routing protocols can be degraded. Thus, it is vital to consider the energy consumption of the mobile node in this opportunistic environment, especially with different mobility patterns. This paper aims to study and analyze the energy usage on the node mobility. The results from the simulations show that MapBased mobility models consume more energy than random based mobility models while gaining higher delivery ratio. In the random based models, random direction consume more power than random waypoint and random walk respectively.**

I. Introduction

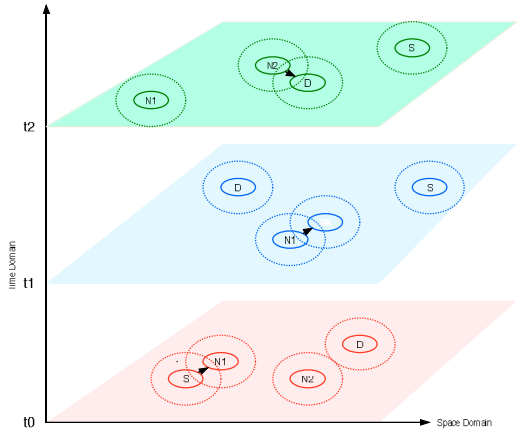

Fig. 1. Store-Carry-Forward routing model

Commonly, an Opportunistic Network (OppNet) is a challenged network consists of the following characteristics [1]:

- Network contacts are intermittent
- An end-to-end path between the source and destination infrequently exists
- Link performance is highly variable or extreme

Therefore, routing in the opportunistic environment requires collaboration among mobile nodes. Formally, opportunistic routing use *store-carry-forward* (SCF) paradigm to route the messages which any possible node can opportunistically be used as a next hop in order to bring the messages closer to the destination [1]. The example in Fig. 1 shows the SCF model when source node (S) wants to send a message to destination node (D) but there is no connection between them. At time t_0, S node contacts node N_1 and send the messages to N_1. Node N_1 has to store the messages and carries them while moving. Then, node N_1 meets node N_2 at time t_1 and sends the messages to node N_2. Node N_2 carries the messages and meets node D at t_2, then the message are sent to the destination node.

A crucial aspect of an opportunistic algorithm evaluation is the mobility pattern of the nodes in order to determine a contact duration as well as a contact pattern. In fact, the mobility pattern can be influenced by physical factors such as obstacles, the speed limits and boundaries defined by the streets and social factors [2]. Even though, mobility is one of the major issues in OppNet research, it can only be studied and not engineered, unlike other important aspects [3].

This paper aims to study the behavior of node mobility models on the energy consumption which is another critical factors on OppNets. In fact, the energy efficiency has long been the main concern in the implementation of routing protocols for MANET to prolong the operational time of network [4], [5]. Since most of the mobile devices in OppNets environment are usually equipped with energy limited battery, the energy efficient protocols are obligation.

The rest of the paper is organized as follows. In Section 2, we discuss the literature reviews of OppNet routing and existing works. The detail of evaluation is elaborated in Section 3, which presents the metrics and the result of our simulation. We conclude the paper and point out some future research directions in Section 4.

II. Literatures Review

In OppNet, the messages are delivered using Store-Carry-Forward routing by which the nodes can exchange data whenever they come in close. If there is no direct connection from source to destination, data holding nodes will discover their nearest neighbor nodes to forward messages toward the destination node as shown in Fig. 1. There are several existing works in the literature [6]–[12] with the aim for 100% delivery ratio which is quite difficult to achieve especially in sparse