Movement Generator for Mobile Network Simulation

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Background Information:

Mobiles (or cell phones) have become one of the necessities of daily life. Using the Internet through a mobile makes life easier and smoother, and it helps you stay better connected. Mobile Internet uses different protocols than computers do to make the connection. One of the protocols is called MITP, which stands for Mobile Internet Telephony Protocol [3]. MVoIP is another protocol that is used to communicate and pass voice through the mobile; it stands for Mobile Voice over IP [1].

A Mobile or cellular network is a radio network that uses one or more base stations. A base station is a fixed-location transceiver that serves each cell on the network [4]. Hundreds of phone users in a specific area who are supported by the same base station are assigned different frequencies. The base stations and the base station controllers can be connected by one of three link types: wireline, fiberline, or wireless microwave links. A typical base station controller serves more than 100,000 phone users and switches the support for them among the adjacent base stations. A base station is characterized by such things as its location, its connectivity to a public switched telephone network using a mobile switching center, and its ability to communicate with mobile stations using transceivers. A major concept of cellular networks is frequency reuse. Each adjacent cell in a network uses a different radio frequency, but these frequencies are reused for other phones that are not adjacent [5].

Objectives:

The main objective of my research is to build new movement generators for mobile network simulation. The generators will use ns-2 to simulate mobile ad-hoc networks. It will generate a series of nodes and movements following random patterns. Different ways of generating random movement will be considered. The generated node movement patterns will be tested statistically and compared with the ns-2 built in movement generators and with other available generators. For implementation, I plan to use JAVA or the Tcl scripting language used with ns2.

Possible solutions:

- We can write a program to output a movement file using random numbers to generate the next move for ns-2.
- By using JAVA, we can build new random movement generators that keep the nodes connected as often as possible.

Problem:

In order to evaluate the network performance, we do not only need to simulate the network behavior, we also need to simulate the node movement itself in the case of mobile networking. This requires generating the node's trajectories and movement, which can be accomplished with a movement generator. Every mobile network simulation requires such generators. As a result, we need a variety of movement generators to study different mobile network scenarios.

Example cases:

- Random movement in free space
- Random movement in a city especially if there are many roads or one-way streets in this city
- Random movement that requires a special generator to keep these mobiles connected with the network at all times
- Non-random movement

Investigating Network Performance:

The network performance investigating can be done in many ways, such as empirical study, simulation, and/or analytical modeling. Each aspect of the network also can be investigated to achieve the needed approaches and performance from the network.

First, the empirical study can be done through a controlled actual network environment using tests done by people who behave like real network users. The main inconvenience with this approach is that we have to build the entire network or portion thereof, which can be difficult and expensive.

Second, simulation using a computer program that tracks the behavior of a real network can be used. Simulation includes protocol simulation, movement simulation, and traffic generators. Using network simulation helps to determine how real networks would work and understand their behavior. Several programing languages are used for network simulation, such as Java, C, and ns-2. An integral part of mobile network simulation is movement generation.

Investigating ns2 Random Movement Generator Performance:

Setdest is a tool in ns-2 that generates random nodes' positions, moving directions, and moving speeds and then outputs them to a file that can be read by ns-2. Setdest accepts parameters such as the version of setdest itself, the number of nodes, the pause time, the maximum speed for all the nodes, the simulation time, the x-coordinate value of the topology, and the y value of the topology. While the simulation is operating, the time, nodes' numbers, x-coordinates, and y-coordinates are written to a separate file to be ready for testing later on. To start evaluating the results of the simulation, the time, nodes' numbers, x-coordinates, and y-coordinates are divided into an equal quadrats topology using a test called "Quadrats Counts". The quadrats counts method means "the data have been collected on a grid with rectangular grid cells of equal size" [2].

The results of three different tests will be demonstrated in this poster with the exact same setdest parameters entered. The tests in the poster will be based on two main aspects: division of the parts of topology and the number of results for each test. The simulation has been run 11 times to get the average number of nodes in each square of the topology. The topology has been divided in three different ways, using 4 equal parts, 16 equal parts, and 64 equal parts as shown below:

We plan to develop more tests for evaluating the randomness of the node movement used in ns2 simulation environment. We also plan to develop a new tool for generating node movement in ns2, similar to the setdest tool.

Supervised By:

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Test Results

The averages for 100 nodes over the 4-square grid from 11 different tests.	
25.82	23.63
27.19	23.38

The averages for 100 nodes over the 16-square grid from 11 different tests.			
4.09	5	5.36	2.36
6	10.7	8.73	7.18
7	10.2	9.73	5.82
3.64	6.36	4.36	3.45

The averages for 100 nodes over the 64-square grid from 11 different tests.							
1.64	0.73	0.91	0.64	0.55	1.45	0.91	0.09
0.45	1.27	1.36	2.09	1.82	1.55	1	0.36
0.64	2	1.82	2.18	2.64	1.36	2.36	1.45
1.09	2.27	3.18	3.55	2.18	2.55	2.36	1
1.64	2.09	2.82	3.27	2.45	1.91	2.91	0.73
1	2.27	1.73	2.36	3.27	2.09	1.55	0.64
0.45	1.64	2.55	2.45	1.27	1.82	1.45	0.82
0.64	0.91	0.64	0.73	0.64	0.64	0.55	0.64

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