UTMOST: A Traffic Modeling Tool in Java

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1.0 Committee Members and Signatures:

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2.0 Introduction

Colorado Advanced Software Institute (CASI) in conjunction with USWest has provided a grant to UCCS to work on Resource Allocation and Admission Control Evaluator for Wireless Information Networks (RACEWIN). The initial effort is to provide a user traffic analysis tool for Personal Communications Services (PCS) Wireless Information Networks [1]. UTMOST is the name of the tool being developed. It has a Graphical User Interface (GUI) and is a stand-alone Java application. UTMOST stands for User Traffic MOdelling and Simulation Tool.

Some traffic model algorithms will be implemented to show user calling and movement patterns over time. These algorithms will calculate whether a user has crossed boundaries of cells based on current user movement. They will also calculate exact location and time of boundary crossing.[2] UTMOST will allow for at least 6 different traffic-cell models: 3 traffic patterns for a 7 cell model and 3 patterns for a 4 cell model.

Other algorithms will be developed for the GUI portion of the tool. These will include flexible and extensible cell drawing methods (hexagon cells and their sectors) and intuitive means of showing information about users and their history.

Finally, various hooks into UTMOST will be needed so that at a future time, data from UTMOST can be tied to a discrete simulator which handles base station hand-off algorithms and wireless network resource allocation simulation.

3.0 Thesis Plan

The largest deliverable of this project will be the simulation tool, UTMOST, and its documentation. Below is an early prototypes of UTMOST.

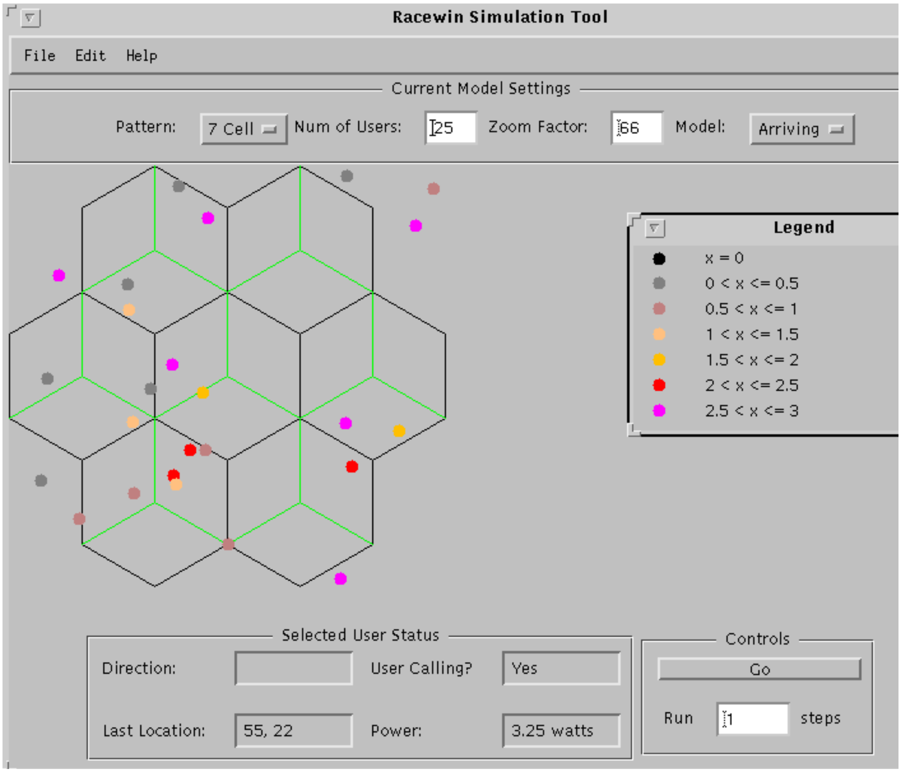

FIGURE 1. UTMOST User Interface

The GUI above represents a seven base station cell pattern. This pattern could represent a football stadium with users moving towards the center or moving away. Each hexagon is separated into three sectors. An additional pattern of four base stations cells can be displayed. This would represent a straight highway simulation. Each pattern has three models which can be studied: Arriving, Leaving or Random. [5][6]

The dots represent current locations of users which are people making or not making a phone calls. The user's color represents his phone's current power output.

The control of the model allows for single stepping through the simulation or the execution of many steps followed by displaying the last status of any user. Some sort of means for displaying history of a particular user will be provided. It may be a double click on any user which may provide a popup history window. This and other details have not been completely defined.

This thesis will explore various aspects of the traffic modelling and display of information. It will include: [5][6][9][10]

1. How traffic is modeled - travelling patterns and their initial conditions.
2. Location calculation functions - given current location, in what sector does the user reside.
3. Functions to determine cell/sector boundary crossing locations and times for each user.

4. The sector pairs in the model and which pairs or individual sectors may serve a user given his current location.
5. Using sector pairs, analyze the soft hand-off statistics.
6. Develop efficient yet effective ways of displaying the model information.

3.1 Tasks:

3.1.1 Already Complete - done during Summer 96 to present

- Master the Java Abstract Windowing Toolkit and User Interface interactions. [3], [4], [7], [8]
- Prototype the GUI for UTMOST.
- Figure out how to draw a hexagon (2 methods have been used, so far).

3.1.2 In Progress - should finish in Fall 96

- Design files which will contain simulation information to be displayed and updated.
- Activate the GUI and simulation - i.e. make it work and do something productive!

3.1.3 Future - complete during Spring 97 (Listed from highest to lowest priority)

Must be done.

- Graduate
- Write Thesis
- Complete development of V1.0 of UTMOST
- Write user manuals and file design documents for UTMOST V1.0
- Design and implement 6 simulation initial conditions and update patterns: 7 cell - arriving, leaving and random and 4 cell - arriving, leaving and random
- Design files for activity and boundary crossing data and for other necessary data.
- Functions to calculate current sector and cell.
- Functions to calculate cell/sector boundary crossing time and location.
- Design and implement the User Interface which will provide intuitive information about current state of the model.
- Ability to save or print a particular simulation step (snapshot).
- Functions to calculate sectors visible to user and perhaps users visible to sectors.
- Interact dynamically with discrete event simulator.
- Study soft hand-off of users from sector to the other sector in the sector pair.

- Study multi-layer cell structure and generalized cell design (includes having varying sized cells in the model.)

May be done.

- Analyze hexagon drawing methods - suggest a way which will provide flexible modelling. May involve java library enhancements.
- Read sets of initial conditions into model.
- Allow for user travel that is not linear.

3.2 Deliverables:

- The simulation tool, UTMOST, with user manual and other supporting documentation.
- A thesis report documenting the design and implementation of UTMOST, related cell drawing and cell boundary crossing algorithms, the analysis of traffic pattern and cell boundary crossing statistics, and the lessons learned in this thesis project.

4.0 References

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