Predicting Connectivity in Wireless Ad Hoc Networks

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BIT (Hons)

A dissertation submitted in fulfilment of the requirements of the degree of Doctor of Philosophy for the School of Information Technology, Bond University

1st November 2005

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Statement of Originality

The material in this thesis has not been previously submitted for a degree or diploma in any university. To the best of my knowledge this thesis contains no material previously published or written by another person except where due acknowledgement is made in the thesis itself.

Henry Larkin

Date:

Summary

The prevalence of wireless networks is on the increase. Society is becoming increasingly reliant on ubiquitous computing, where mobile devices play a key role. The use of wireless networking is a natural solution to providing connectivity for such devices. However, the availability of infrastructure in wireless networks is often limited. Such networks become dependent on wireless *ad hoc* networking, where nodes communicate and form paths of communication themselves. Wireless ad hoc networks present novel challenges in contrast to fixed infrastructure networks. The unpredictability of node movement and route availability become issues of significant importance where reliability is desired.

To improve reliability in wireless ad hoc networks, predicting future connectivity between mobile devices has been proposed. Predicting connectivity can be employed in a variety of routing protocols to improve route stability and reduce unexpected drop-offs of communication. Previous research in this field has been limited, with few proposals for generating future predictions for mobile nodes. Further work in this field is required to gain a better insight into the effectiveness of various solutions.

This thesis proposes such a solution to increase reliability in wireless ad hoc routing. This research presents two novel concepts to achieve this: the Communication Map (CM), and the Future Neighbours Table (FNT). The CM is a signal loss mapping solution. Signal loss maps delineate wireless signal propagation capabilities over physical space. With such a map, connectivity predictions are based on signal capabilities in the environment in which mobile nodes are deployed. This significantly improves accuracy of predictions in this and in previous research. Without such a map available, connectivity predictions have no knowledge of realistic spatial transmission ranges.

The FNT is a solution to provide routing algorithms with a predicted list of future periods of connectivity between all nodes in an established wireless ad hoc network. The availability of this information allows route selection in routing protocols to be greatly improved, benefiting connectivity. The FNT is generated from future node positional

information combined with the CM to provide predicted signal loss estimations at future intervals. Given acceptable signal loss values, the FNT is constructed as a list of periods of time in which the signal loss between pairs of nodes will rise above or fall below this acceptable value (predicted connectivity). Future node position information is ideally found in automated networks. Robotic nodes commonly operate where future node task movement is developed and planned into the future, ideal for use in predicted connectivity. Non-automated prediction is also possible, as there exist some situations where travel paths can be predictable, such as mobile users on a train or driving on a highway. Where future node movement is available, predictions of connectivity between nodes are possible.

Detailed analysis of the two proposed concepts are presented in this thesis. Comparisons with existing prediction algorithms illustrate that employing a signal loss map (the CM) vastly improves the accuracy of predictions. The fundamental concepts of the FNT are validated, though in the testing environment the FNT is not shown to be the ideal predicted connectivity architecture for wireless ad hoc networks in comparison to previous work.

Acknowledgments

This PhD thesis would not have been possible without the support of many people and organisations to whom I owe a great deal. I would like to thank particularly:

Dr. Zheng da Wu, for his belief in my abilities, his advice, his encouragement, his wisdom, and his endless kindness. You have been a great and wonderful supervisor.

Dr. Warren Toomey, for his years of supervision, suggestions, guidance, teachings and his willingness to listen when I needed to talk about everything technical.

The School of Information Technology, Bond University, for providing me with a scholarship, resources and the opportunity to complete a PhD, as well as introducing me to and allowing me to pursue my teaching career. Also thanks to the numerous staff over the years who have helped make life easier. Special thanks to *Stephanie Patching*, who continually made all the difficult paperwork that much easier.

The Australian Government, for providing me with an Australian Postgraduate Award during my PhD candidature.

To fellow PhD candidate *James Montgomery*, whose numerous donations of advice were outweighed only by the humour and reassurance he constantly provided. So much of this thesis would not have been possible without him.

Officemate *Helen Kennett*, who has been as much an inspiration as a companion in this journey of life. I doubt I will find an officemate as important as you have been to me.

Simon McGuinness and his family, for encouraging me, for providing me with food, comfort and internet, and making me feel like I had a second home.

Satomi Hagiwara, without whom I probably would have lost focus so long ago. I extend countless thanks for all the memories I've shared with you.

To the *numerous friends* who have helped make my life really mean something, for providing me with near infinite hours of enjoyment, direction and stability in life. Incredible thanks to *Watcharin Surapongwanitchakool*, for always believing in me. To Lina Piao for nudging me into life after PhD. To *Nick Tran*, *Laurent Corgnet*, *Paul Chen*, *Esther Choong*, *Maki Nonaka*, *Yukari Okano*, *Nick Hamilton*, *Takeshi Ashenden*, and the entire *Anime club*.

The many, many *students* who I have taught since I began teaching 7 years ago. It is because of you and the positive experiences that you have provided me with that have been the source of much inspiration over my entire life at Bond.

And finally *my family, Brian, Judy, Andrew, James and Kate*, for giving me the best home and family I could have hoped for, a place I never want to leave, a place I have been able to achieve everything from my education to my dreams & goals. Thank you.

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