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Performance Improvements to the AODV Routing Protocol and Multiple Hop Wireless Routes

A thesis presented in partial fulfilment of the requirements for the degree of

Masters of Engineering
in
Computer Systems Engineering

at Massey University, Palmerston North,
New Zealand.

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2005

Abstract

This research focused on improving the performance of the Ad-hoc On-demand Distance Vector (AODV) routing protocol over multiple hop routes. The two specific areas that this research addressed were the dramatic decrease in throughput over multiple hop IEEE 802.11 wireless routes and the problems caused by the use of hello messages by AODV implementations to detect broken routes. To help ensure that this research was suitable for real world scenarios, only off-the-shelf software and hardware was used for both the implementations and the tests.

This thesis firstly presents an overview of IEEE 802.11 based wireless networking and the AODV protocol, along with wireless networking and networking in general within the Linux operating system. The thesis then presents the problems caused by hello messages and shows how the IEEE 802.11 wireless standard contributes to the dramatic decrease in throughput over multiple hop routes.

To overcome the hello message problems, an AODV implementation was developed which used existing mechanisms on the data link layer, specifically the transmit retry limit, rather than hello messages to detect broken links. To address the multiple hop route throughput problem, the use of two and four IEEE 802.11 based wireless network interfaces per node were investigated, rather than using just a single wireless interface per node. These proposed solutions, and the AODV implementation that was developed as part of this research, were then tested in the areas of functionality and throughput performance improvements.

The thesis concludes by presenting the performance improvements resulting from using multiple interfaces per node and the non hello message based AODV implementation along with outlining possible future research in this area.

Acknowledgments

I want to thank firstly my supervisors Amal Punchihewa, Liyanage De Silva and Firas Al-Ali. Your direction, encouragement and knowledge throughout my masters and honors research has been greatly appreciated.

I want to also thank my friends, family and especially my wife for always backing me and encouraging me even though I took much longer to complete this research then initially expected. Thank you so much.

Lastly I want to thank fellow post graduate research student and friend Michael Morrison. Thank you so much for all the ideas and knowledge you provided during this research, for your sense of humor and for always being a great friend.

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1 Introduction

Ad-hoc wireless networking is an exciting technology with huge potential. It allows networks to form without the need for any fixed infrastructure already in place, permitting clients to be completely mobile while remaining connected, and allowing networks to form in locations and over areas not easily possible for wired networks. Previous research by the author [1] looked at the Ad-hoc On-demand Distance Vector (AODV) routing protocol, a routing protocol commonly used worldwide to provide multiple hop routing capabilities to ad-hoc wireless networks. From this research two areas were identified as needing improvement to make AODV a more efficient and effective routing protocol. The two problem areas were:

1. The use of hello messages in AODV implementations resulting in increased network interference, decreased throughput and the possible creation of unusable routes
2. The rapid throughput decrease per hop over multiple hop routes

The focus of this research was to find solutions to these two problems; specifically to find an alternative route error detection technique to hello messages and improve throughput over multiple hop routes. The general research structure is shown in *Figure 1.1*.

Firstly, this thesis gives a brief introduction on wireless networking with more detail on the AODV routing protocol and networking within the Linux kernel. The thesis then focuses on finding an alternative to hello messages and the throughput decrease over multiple hop routes, proposing solutions to both problems. The solutions were: using the transmit retry limit, a feature of IEEE 802.11 based wireless networking, instead of hello messages, to detect broken routes and using multiple wireless interfaces per node to address the problem of throughput decrease over multiple hop routes. The thesis then covers the implementation stage of the research, which involved creating an AODV

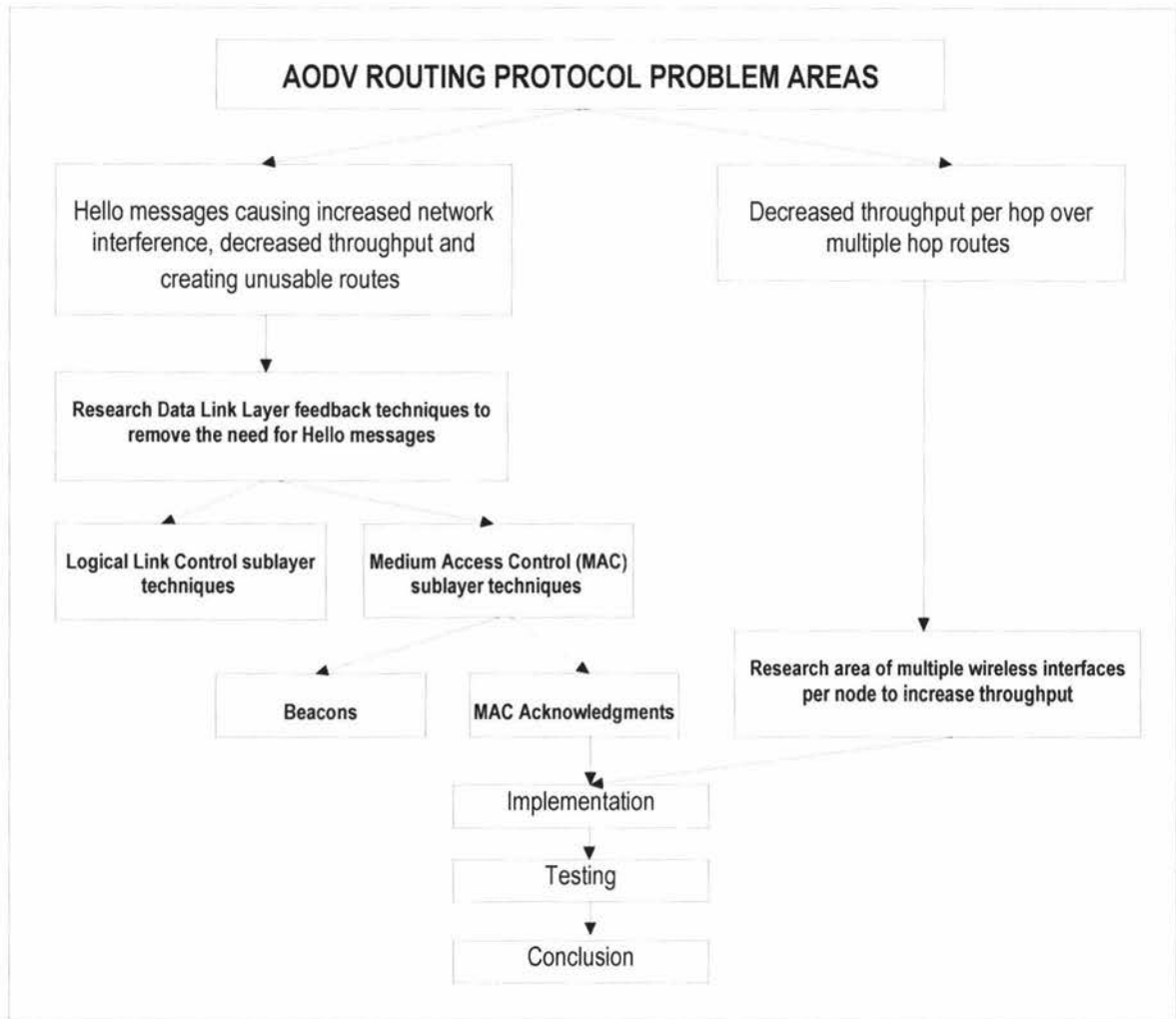


Figure 1.1 Research structure

implementation suitable for testing which uses feedback from the transmit retry limit on the data link layer to detect broken routes and is also capable of working with multiple wireless interfaces. Next the testing methodology is covered, followed by the results and finally conclusions are drawn.