ENHANCED WIRELESS NETWORK PERFORMANCE USING FUZZY LOGIC

A thesis submitted to
The Faculty of Computer Science & Information Technology
University of Malaya
in partial fulfillment of the requirements for
the degree of Master of Computer Science

by

SOO WOOI KING
(WGA 020021)

September 2004

Supervisor : Mr. Ang Tan Fong

ABSTRACT

Wireless networks which were once a rarity has now become commonplace especially in situations where traditional wired networks were deemed unsuitable. However, these networks are known to suffer problems of poor connectability which results in low performance and high packet losses. Many problems in a wireless network could be attributed to congestion of the medium and the mobility of the mobile nodes because this results in false reports of link availability and therefore increases TCP retransmission timeouts.

In this thesis, an effort has been made to introduce fuzzy logic control into the MAC layer of an IEEE 802.11b wireless network model to diagnose the link between nodes based on the distances and relative velocities between communicating nodes. The proposed logic control predicts whether the nodes are still (and will remain) in communicating range and consequently attempt to reestablish a link between nodes and alleviate the false availability problem. Implementation of the proposal was developed and completed using the '*ns*' network simulator. Results of simulation tests show that the fuzzy logic control increases the amount of packets transferred around 7% whilst maintaining the level of overhead traffic. The number of packets dropped during delivery is also reduced by around 4%, thus giving a higher delivery ratio of packets.

ACKNOWLEDGEMENTS

I would like to gratefully acknowledge the contributions of several people that have helped me in the process of completing this thesis.

Firstly, I would like to thank my supervisor and lecturers namely Mr. Ang Tan Fong and Dr. Phang Keat Keong for their assistance in helping me understand and complete this project.

Secondly, I would like to thank my coursemates from the MCS group and labmates from the research lab for all their help and for putting up with persistent rants and raves from me.

Thirdly, I would like to thank the developers and forum moderators of the NS program of which without their help and assistance, this project could not be completed. Special thanks go out to Atul Salhotra and Joshua Robinson from the NS forums for answering my many questions about the layer management in NS.

Finally, I would like to thank my family for the support given to me throughout the length of this thesis.

Thank you.

TABLE OF CONTENTS

Chapter 3 Literature Review (Fuzzy Logic Methods)

Chapter 4 Simulation Environments

LIST OF FIGURES

Chapter 5

Chapter 6

LIST OF TABLES

ABBREVIATIONS

ACK	Acknowledge/ment(s)
AI	Artificial intelligence
AODV	Ad hoc on-demand distance vector routing protocol
AP	Access point
API	Application programming interface
ARIB	Association of radio industries and businesses
ARP	Address resolution protocol
ATM	Asynchronous transfer mode
B-SIG	Bluetooth Special Interest Group
BSS	Basic service set
CBR	Constant bit rate
CCK	Complementary code keying
CLR	Clear
CONSER	Collaborative Simulation for Education and Research
CRC	Cyclic redundancy check
CSMA/CA	Carrier sense multiple access with collision avoidance
CSMA/CD	Carrier sense multiple access with collision detection
CTS	Clear to send
CW	Contention window / Congestion window
DARPA	Defense Advanced Research Projects Agency
DCF	Distributed coordination function
DGPT	*Direction Generale des Postes et Telecominications*
DIFS	Distributed inter frame space
DS	Distribution system
DSDV	Dynamic destination sequenced distance vector routing protocol
DSR	Dynamic source routing protocol
DSSS	Direct sequence spread spectrum
ECN	Explicit congestion notification

EIFS	Extended inter frame space
ESS	Extended service set
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commision
FHSS	Frequency hopping spread spectrum
FTP	File transfer protocol
GHz	Gigahertz
GPRS	General packet radio service
HFC	Hybrid fibre coaxial
IBSS	Independent basic service set
IC	Industrie Canada
ICMP	Internet control message protocol
IEEE	Institute of Electrical and Electronics Engineers
IFQ	Interface queue
IP	Internet protocol
IR	Infrared
ISM	Industrial, scientific and medical
LAN	Local area network
LLC	Logical link control (layer)
MAC	Medium access control (layer)
Mbps	Megabits per second
MHz	Megahertz
MSDU	MAC service data unit
NAV	Network allocation vector
NIST	National Institute of Standards and Technology
NSF	National Science Foundation
OEM	Original equipment manufacturer
OFDM	Orthorgonal frequency division multiplexing
OSI	Open system interconnection
OTcl	Object tool command language
PARSEC	Parallel simulation environment for complex systems
PCF	Point coordination function
PDU	Protocol data unit

PHY	Physical (layer)
PIFS	Point coordination inter frame space
PLCP	Physical layer convergence procedure
PMD	Physical media dependant
QRY	Query
RF	Radio frequency(ies)
RREQ	Route request
RTO	Retransmission timer timeout
RTS	Request to send
RTX	Retransmission timer
SAMAN	Simulation augmented by measurement and analysis for networks
SIFS	Short inter frame space
SNR	Signal-to-noise ratio
SSID	Service set identifier
SST	Slow start threshold
STA	Station
Tcl (TCL)	Tool command language
TCP	Transmission control protocol
Tk	Toolkit
TORA	Temporally ordered routing algorithm
UNII	Unlicensed national information infrastructure
UPD	Update
VBR	Variable bit-rate
VCS	Virtual carrier sense
VLAN	Virtual local area network
VoIP	Voice over IP
WEP	Wireless equivalent protection / Wired equivalent privacy
WLAN	Wireless local area network
WPA	Wireless privacy authentication / Wifi protected access
WPAN	Wireless personal area network
ZRP	Zone routing protocol