GSAR: GREEDY STAND-ALONE POSITION-BASED ROUTING PROTOCOL TO AVOID HOLE PROBLEM OCCURRENCE IN MOBILE AD HOC NETWORKS

MAHMOUD ALI AL-SHUGRAN

DOCTOR OF PHILOSOPHY
UNIVERSITY UTARA MALAYSIA
2014

Permission to Use

In presenting this thesis in fulfilment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the Universiti Library may make it freely available for inspection. I further agree that permission for the copying of this thesis in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor(s) or, in their absence, by the Dean of Awang Had Salleh Graduate School of Arts and Sciences. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my thesis.

Requests for permission to copy or to make other use of materials in this thesis, in whole or in part, should be addressed to:

Dean of Awang Had Salleh Graduate School of Arts and Sciences
UUM College of Arts and Sciences
Universiti Utara Malaysia
06010 UUM Sintok

Abstrak

Proses penentuan laluan di dalam Rangkaian Mudah Alih Ad Hoc (MANET) adalah sukar disebabkan kekerapan perubahan topologi serta keterbatasan sumber. Oleh itu, mereka bentuk protokol laluan yang boleh dipercayai, dinamik serta mampu memenuhi kehendak MANET amatlah diperlukan. Strategi Penghantaran Rakus (GFS) merupakan strategi yang paling banyak digunakan dalam protokol laluan berasaskan posisi. Algoritma GFS direka bentuk sebagai protokol berprestasi tinggi yang menggunakan kiraan hop untuk mendapatkan laluan paling dekat. Walau bagaimanapun, GFS tidak mengambil kira kehendak MANET yang lain. Oleh itu, ianya tidak mencukupi untuk membuat pengiraan laluan yang boleh dipercayai. Kajian ini bertujuan mempertingkatkan GFS sedia ada kepada protokol laluan yang dinamik, kendiri, boleh bertindak balas dengan pantas terhadap kehendak MANET, serta berupaya menyediakan laluan yang boleh dipercayai dalam kalangan nod yang berhubung. Untuk mencapai matlamat ini, dua mekanisme telah diusulkan sebagai penambahbaikan terhadap GFS yang sedia ada iaitu Mekanisme Pengemaskinian Mata Arah Dinamik (DBUM) dan Mekanisme Keandalan Anggaran Dinamik dan Reaktif dengan Metrik Terpilih (DRESM). Fungsi utama algoritma DBUM adalah untuk menyediakan nod dengan maklumat baru tentang status nod di sekitarnya. Fungsi algoritma DRESM pula adalah untuk membuat keputusan penghantaran berdasarkan pelbagai metrik laluan. Kedua-dua mekanisme ini telah disepadukan di dalam GFS konvensional bagi membentuk protokol Laluan Kendiri Rakus (GSAR). Penilaian ke atas GSAR telah dilakukan menggunakan simulator rangkaian Ns2 berdasarkan set metrik prestasi, senario dan topologi yang telah ditetapkan. Hasil penilaian menunjukkan bahawa GSAR dapat mengetepikan keperluan menggunakan mod pemulihan dan mencapai peningkatan menyeluruh pada prestasi rangkaian berbanding dalam GFS. Dalam pelbagai keadaan pergerakan nod yang diuji, GSAR dapat mengurangkan masalah lubang perangkap kira-kira 87% dan 79% berbanding Protokol Laluan Tanpa Keadaan Perimeter Rakus dan Protokol Laluan Oportunistik Berasaskan Posisi. Kesimpulannya, protokol GSAR merupakan alternatif munasabah kepada protokol laluan berasaskan posisi dalam MANET.

Kata Kunci: Rangkaian Mudah Alih Ad-hoc, Strategi Penghantaran Rakus, Protokol Laluan Berasaskan Posisi, Protokol Laluan Kendiri Rakus

Abstract

The routing process in a Mobile Ad Hoc Network (MANET) poses critical challenges because of its features such as frequent topology changes and resource limitations. Hence, designing a reliable and dynamic routing protocol that satisfies MANET requirements is highly demanded. The Greedy Forwarding Strategy (GFS) has been the most used strategy in position-based routing protocols. The GFS algorithm was designed as a high-performance protocol that adopts hop count in soliciting shortest path. However, the GFS does not consider MANET needs and is therefore insufficient in computing reliable routes. Hence, this study aims to improve the existing GFS by transforming it into a dynamic stand-alone routing protocol that responds swiftly to MANET needs, and provides reliable routes among the communicating nodes. To achieve the aim, two mechanisms were proposed as extensions to the current GFS, namely the Dynamic Beaconing Updates Mechanism (DBUM) and the Dynamic and Reactive Reliability Estimation with Selective Metrics Mechanism (DRESM). The DBUM algorithm is mainly responsible for providing a node with up-to-date status information about its neighbours. The DRESM algorithm is responsible for making forwarding decisions based on multiple routing metrics. Both mechanisms were integrated into the conventional GFS to form Greedy Stand-Alone Routing (GSAR) protocol. Evaluations of GSAR were performed using network simulator Ns2 based upon a defined set of performance metrics, scenarios and topologies. The results demonstrate that GSAR eliminates recovery mode mechanism in GFS and consequently improve overall network performance. Under various mobility conditions, GSAR avoids hole problem by about 87% and 79% over Greedy Perimeter Stateless Routing and Position-based Opportunistic Routing Protocol respectively. Therefore, the GSAR protocol is a reasonable alternative to position-based unicast routing protocol in MANET.

Keywords: Mobile Ad hoc Networks, Greedy Forwarding Strategy, Position-based Routing Protocols, Greedy Stand-alone Routing Protocol

Declaration

Some of the works presented in this thesis have been published or submitted as listed below.

[1] Mahmoud Al-Shugran, Osman Ghazali, Suhaidi Hassan, Omar M. Almomani, and Kashif Nisar, "Adaptive and Fuzzy Management for Greedy Routing in Mobile Ad-hoc Networks," in *the Proceeding of 3ed International Conference on Network Applications, Protocols and Services* (*NetApps2012*), Sintok, Malaysia, 19-20 Sep. 2012, pp. 36-41.

[2] Mahmoud Al-Shugran, Osman Ghazali, Suhaidi Hassan, Omar M. Almomani, and Kashif Nisar, "Comparative Performance Evalution of Unicast Routing Protocol in Mobile Ad-hoc Networks," in *the Proceeding of 3ed International Conference on Network Applications, Protocols and Services* (*NetApps2012*), Sintok, Malaysia, 19-20 Sep. 2012, pp. 42-47.

[3] Mahmoud Al-Shugran, Osman Ghazali and Suhaidi Hassan," A General Framework for Greedy Routing in Mobile Ad-hoc Networks, " in t*he Proceeding of International Conference on Advanced Computer Science Applications and Technologies* (*ACSAT2012*), Kuala Lumpur, Malaysia, Indexed by the IEEE Xplore, 26-28 Nov. 2012.

[4] Mahmoud Al-Shugran, Osman Ghazali and Suhaidi Hassan, " Performance Comparison of Position-Based Routing Protocol in the Context of Enhancing Greedy Failure," in *the Proceeding of International Conference on Advanced Computer Science Applications and Technologies* (*ACSAT2012*), Kuala Lumpur, Malaysia, Indexed by the IEEE Xplore, 26-28 Nov. 2012.

[5] Mahmoud Al-shugran, Osman Ghazali, Suhaidi Hassan, Kashif Nisar, and A. Suki M. Arif "A Qualitative Comparison Evaluation of the Greedy Forwarding Strategies in Mobile Ad Hoc Network," *Journal of Network and Computer Applications*, vol. 36, issue 2, pp. 887–897, Impact factor 1.467, Publisher Elsevier, Mar. 2013.

Acknowledgements

Alhamdullilah and thanks Allah (s.w.t) for His blessings to successfully complete this Ph.D thesis. I would like to express my deepest gratitude to my supervisors, Assoc. Prof. Dr. Osman Ghazali and Prof. Dr. Suhaidi Hassan. Their guidance, support, and kindness made this work possible. I feel honoured to have had the opportunity to work with both of them. Osman was always encouraging. Although he was far away on a post-doctorate programme, whenever I had problems, he was always ready to help me resolve them. I would also like to express my sincere gratitude to my examiners Prof. Dr. Sabira Khatun and Prof. Dr. Rahmat Budiarto. Thank you for your invaluable comments and the time you took despite your hectic and busy schedule. You not only enabled me to go on the right path, but also helped me to converge my scattered and incoherent findings to structure them in harmony and consistency and bringing them to a designated end. I thank you for being so knowledgeable, enthusiastic, reassuring, committed and supportive.

This thesis is the result of many years of effort and would not have been possible without the contributions of my friends and my family, which I would like to acknowledge. First, I would like to thank Ns2 users, for improving my understanding of the tools I selected to use. I would also like to express my sincere gratitude to Mr. Tariq Alshugran, I am deeply indebted to him for his insight and suggestion to the thesis topic. He has helped me in many ways and has developed my programming skills to modify the GPSR code to meet the specific alteration for GSAR. I am grateful to Dr. Shengbo Yang, for showing me the way to better simulations with his own work on extending GPSR protocol. Grateful acknowledgment should be mentioned here to Dr. Omar Almomani who guided me through a better way to run a series of simulation experiments. In the same vein, I remain thankful to Dr. Tracy Camp for helping in the venue of selecting the proper mobility models for GSAR. Also, I thank the TEX-LATEX users for improving my understanding of the LYX tool that I selected to text this thesis. I am thankful to Dr. Lian Tze Lim for her help to write this thesis using LYX. To many

others in the Networks Research Lab, I will forever cherish the many useful conversations and insights that helped to shape this study. I would like to thank Dr. A. Suki M. Arif for his help in translating the thesis abstract to Bahasa Melayu. My thanks go to Omar Alshugran, Salah Alshugran, and Tariq Alshugran for their financial support without which this PhD work would not have been possible.

I would like to thank my mother, Jameelah, my father, Ali, and my only sister, Basma, for their love and enthusiasm, and for offering me the stability I needed to accomplish my project. My mother taught me in my formative years and gave me the most solid foundation on which I could develop my skills. I thank her for teaching me her moral principles, for all her loving and caring attention, and her enormous effort to make sure I would survive away from home. My father has been the best example to guide me through life; he taught me the importance of hard work, dedication, persistence and honesty. My parents were the first persons that believed I was able to pursue this project - I thank them for encouraging me to expand my horizons, and for making me a better person. I thank my sister for being my eternal friend and ally, for drowning me with her kindness, and for patiently helping me to focus on my work. I hope I can bring as much happiness to her life as she has brought to mine. Also, I would like to express my gratitude to my brothers, for their moral support and prayers. Their support kept me motivated and inspired me to strive and complete my Ph.D. journey.

Finally, yet importantly, the people who deserve the greatest acknowledgement are the ones to whom this thesis is dedicated: my loving and beautiful wife, Wejdan, my stunning daughters, and my sons. Wejdan is an extraordinary person and her contribution to this work is apparent in every word, she pushed me forward at all times, she gave me constant support and stimulation, she fostered my best ideas, she listened patiently to my constant divagations, and she offered me more understanding than I could ever imagine. I love her dearly and I wish I could one day have the opportunity to help her realise her most ambitious dreams in the way she helped me to realise mine. During my PhD, I was extremely fortunate to experience one of the most rewarding and joyful moments of my life: the birth of my daughter Nor. I only wish I can offer her the same wisdom that her grandparents gave to me.

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations

ACK	Acknowledgement Packet
AI	Artificial Intelligence
APU	Adaptive Position Update
BCF	Beacon-based Cooperative Forwarding
BPIT	Beacon Packet Interval Time
BP	Beacon Packet
BPsize	Beacon Packet Size
BTA	Backtracking Based Approach
Bw	Bandwidth
CHT	Check Time
COH	Control Overhead
CR	Compass Routing
CSMA/CA	Carrier Sense Multiple Access/Collision Avoidance protocol
CTF	Clear To Forward message
CUT	Compulsory Update Technique
DFLCH	Dynamic Fuzzy Logic Controller Check-time
DARPA	Defence Advanced Research Projects Agency
DATA	Data Packet
DLI	Destination Location Information
DBUM	Dynamic Beaconing Updates Mechanism,
DCF	Distributed Coordination Function
DIFS	Distributed Inter Frame Space
DPsize	Data Packet Size
DPS	Destination Prediction Scheme
DRESM	Dynamic and Reactive Reliability Estimation with Selective Metrics Mechanism
DREAM	Distance Routing Effect Algorithm for Mobility
DRM	Dynamic Route Maintenance algorithm
DSDV	Destination-Sequenced Distance-Vector
DSR	Dynamic Source Routing Protocol

Du	Duration for MAC usage
EED	Average End to End Delay
ELT	Neighbourhood Entry Lifetime
FBPIT	Fixed Beacon Packet Interval Time
FIFO	First-In-First-Out policy
FLDRE	Fuzzy Logic Dynamic Reliability Estimation technique
FLC	Fuzzy Logic Controller
GEDIR	Geographic Distance Routing
GAs	Genatic Algorithms
GFS	Greedy Forwarding Strategy
GG	Gabriel Graph Algorithm
GLS	Scalable Location Service for Geographic Ad Hoc Routing
GPS	Global Positioning System
GPSR	Greedy Perimeter Stateless Routing
ID	Node Identity
IDOTM	Information Distribution and Outgoing Traffic Control Management technique
IDPI	Inaccuracy in Destination Position Information
INM	Inconsistency of Neighbourhood Matrix
LAR	Location Aided Routing
LLT	link lifetime
MAC	Medium Access Control
MANET	Mobile Ad Hoc Network
MFR	Most Forward Within Transmission Range
MNs	Wireless Mobile Nodes
MP	Message Packet (used with the RTF, CTF, etc.)
MPsize	Message Packet size
MPDM	Mobility Prediction Using Dead-reckoning Model
NAM	Network Animator
NAV	Network Allocation Vector
NBL	Neighbour Break Link
NFP	Nearest With Forward Progress

NLM Neighbourhood's Location-Matrix

NMEM Neighbourhood Matrix Entries Management

NPN Number of a node's Positive Neighbours

Ns2 Network Simulator 2

NS Node Speed

OTcl Object-Oriented Tool Command Language

PDn Packet Distinction Number

PDR Packet Delivery Ratio

POR Position-based Opportunistic Routing protocol

QoS Quality of Service

RSGF Recovery Strategies with Greedy Failure

REEF REliable and Efficient Forwarding mechanism

RIN Reliability Index

RLT Residual Links Lifetime

RNG Relative Neighbourhood Graph algorithm

RPF Random Progress Forwarding

RSN Reliability Sequence Number of the candidate node

RTF Request To Forward message

RWP Random WayPoint mobility model

SEGF Supportive Enhancement for Greedy Forwarding

SIFS Short Interframe Space

SLPS Self Location Prediction Scheme

Tcl Tool Command Language

TOD TOlerance Deviation distance

TSF Local Timing Synchronization Function

TTL Time To Live

UBM Urgent Beacon Message

VDVH Virtual Destination-based Void Handling

WTSA Waiting Time to Send ACK packet

CHAPTER ONE

INTRODUCTION

1.1 Overview

This thesis proposes a new extension to the current Greedy Forwarding Strategy (GFS) in the Mobile Ad hoc Network (MANET). In this chapter, Section 1.2 provides a general background. Section 1.3 presents the motivation and research problem. Sections 1.4 and 1.5 present the research objectives and the research scope respectively. Sections 1.6 and 1.7 present research assumptions and key research steps respectively. Finally, Section 1.8 presents the organization of the thesis.

1.2 Background

Interest in mobile computing has grown immensely over the last decade. Mobile computing aims to provide users access to information and communication from anywhere and at any time [1]. Mobile Ad Hoc Network (MANET) is a subset of mobile computing [2]. MANET is a spontaneous network because it does not need a pre-fixed infrastructure such as a base station or access points to provide the capacity for communication [3]. MANET is a rapidly deployable, self-organized, multi-hop wireless network that is set up for a limited period of time and for a particular purpose [4].

MANET consists of wireless mobile nodes such as laptops, tablets and personal digital assistants [2]. These mobile nodes may reside in vehicles, instruments and mobile machines, thus, making the network topology highly dynamic [5]. Nodes in MANET may move arbitrarily while communicating over wireless links [3]. In MANET, mobile nodes capable of connecting and communicating with each other use limited-bandwidth radio links. They are incorporated with routing functionality and computational power so that they can perform the operations of host and router simultaneously. Mobile nodes have limited resources including CPU capacity, buffer capacity, and battery power [4]. A schematic illustration of MANET is shown in Figure 1.1 below.

The contents of the thesis is for internal user only

REFERENCES

[1] S. Ilarri, E. Mena, and A. Illarramendi, "Location-dependent Query Processing: Where we are and where we are Heading," *ACM Computing Surveys*, vol. 42, no. 3, pp. 12:1–12:73, Mar. 2010. [Online]. Available: http://doi.acm.org/10.1145/1670679.1670682.[Accessdate10/12/2013]

[2] J.-Z. Sun, "Mobile Ad Hoc Networking: An Essential Technology for Pervasive Computing," in *the Proceedings of International Conferences on Infotech & Infonet*, Beijing, China, 29 Oct -01 Nov 2001, pp. 316–321. [Online]. Available: http://dx.doi.org/10.1109/ICII.2001.983076.[Accessdate10/12/2013]

[3] F. Magnus, J. Per, and L. Peter, "Wireless Ad Hoc Networking-The Art of Networking without A Network," *Ericsson Review*, vol. 77, no. 1, pp. 248–262, 2000, ISSN: 0014-0171. [Online]. Available: http://www.citeulike.org/user/sergiocabrero/article/1943206-AT.[Accessdate10/12/2013]

[4] D. Bein, "Self-Configuring, Self-Organizing, and Self-Healing Schemes in Mobile Ad Hoc Networks," in *Guide to Wireless Ad Hoc Networks*, S. Misra, I. Woungang, and S. C. Misra, Eds. Springer-Verlag London Limited, 2009, ch. 2, pp. 27–42. [Online]. Available: http://dx.doi.org/10.1007/978-1-84800-328-6_2.

[5] S. Sesay, Z. Yang, and J. He, "A Survey on Mobile Ad Hoc Wireless Network," *Information Technology Journal*, vol. 3, no. 2, pp. 168–175, 17-19, Mar. 2004. [Online]. Available: manet.eurecom.fr/Sesay.pdf.[Accessdate10/12/2013]

[6] P. Mohapatra and S. Krishnamurthy, "Ad Hoc Networks, Emerging Applications, Design Challenges and Future Opportunities," in *Ad Hoc Networks: Technologies and Protocols*. Springer, Oct. 2010, pp. 1–22. [Online]. Available: http://books.google.com.my/books?id=JhQIkgAACAAJ

[7] A. Boukerche, D. Camara, A. Loureiro, and C. Figueiredo, "Algorithms for Mobile Ad Hoc Networks," in *Algorithms and Protocols for Wireless and Mobile Ad Hoc Networks*, A. Boukerche, Ed. John Wiley & Sons, Inc., 2009, ch. 1, pp. 1–20, ISBN 978-0-470-38358-2. [Online]. Available: http://dx.doi.org/10.1002/9780470396384.ch1.

[8] I. Chlamtac, M. Conti, and J. J. Liu, "Mobile Ad Hoc Networking: Imperatives and Challenges," *Ad Hoc Networks*, vol. 1, no. 1, pp. 13–64, Jul. 2003. [Online]. Available: http://dx.doi.org/10.1016/S1570-8705(03)00013-1. [Accessdate10/12/2013]

[9] J. Hoebeke, I. Moerman, B. Dhoedt, and P. Demeester, "An Overview of Mobile Ad Hoc Networks: Applications and Challenges," *Journal Communications Network*, vol. 3, no. 3, pp. 60–66, Sep. 2004. [Online]. Available: cwi.unik.no/images/Manet_Overview.pdf.[Accessdate10/12/2013]

[10] J. Jain, M. Fatima, R. Gupta, and K. Bandhopadhyay, "Overview and Challenges of Routing Protocol and MAC Layer in Mobile Ad-Hoc Network," *Journal of Theoretical and Applied Information Technology*, vol. 8, no. 1, pp. 6–12, Oct. 2009. [Online]. Available: www.jatit.org/volumes/research-papers/Vol8No1/2Vol8No1.pdf.[Accessdate10/12/2013]

[11] M. K. Marina and S. R. Das, "Routing in Mobile Ad Hoc Networks," in *Ad Hoc Networks Technologies and Protocols*, P. Mohapatra and S. V. Krishnamurthy, Eds. Springer Science + Business Media, Inc.: New York, NY, USA, 2005, ch. 3, pp. 63–90. [Online]. Available: http://dx.doi.org/10.1007/0-387-22690-7_3.

[12] V. Narsimha, B. Sujatha, and T. SampathKumar, "A Survey of Wireless Mobile Ad-Hoc Networks (MANET)," *International Journal of Science and Advanced Technology*, vol. 1, no. 5, pp. 189–192, Jul. 2011. [Online]. Available: http://www.ijsat.com/pdf.php?pdf_id=98.pdf.

[13] Z. Ren and W. Guo, "Unicast Routing in Mobile Ad Hoc Networks: Present and Future Directions," in *the Proceedings of the Fourth International Conference In Parallel and Distributed Computing, Applications and Technologies*. Chengdu, Sichuan, China: IEEE, 27-29 Aug. 2003, pp. 240–243. [Online]. Available: http://dx.doi.org/10.1109/PDCAT.2003.1236318.

[14] L. K. Qabajeh, L. M. Kiah, and M. M. Qabajeh, "A Qualitative Comparison of Position-Based Routing Protocols for Ad-Hoc Networks," *International Journal of Computer Science and Network Security*, vol. 9, no. 2, pp. 131–140, Feb. 2009. [Online]. Available: http://eprints.um.edu.my/id/eprint/4945.[Accessdate10/12/2013]

[15] D. Chen and V. Pramod K., "Geographic Routing in Wireless Ad Hoc Networks," in *Guide to Wireless Ad Hoc Networks*. Springer, 2009, ch. 7, pp. 157–181. [Online]. Available: http://dx.doi.org/10.1007/978-1-84800-328-6_7.[Accessdate10/12/2013]

[16] M. L. M. Kiah, L. K. Qabajeh, and M. M. Qabajeh, "Unicast Position-based Routing Protocols for Ad-Hoc Networks," *Acta Polytechnica Hungarica*, vol. 7, no. 5, pp. 16–46, Oct.-Dec. 2010. [Online]. Available: http://www.uni-obuda.hu/journal/Issue26.htm.[Accessdate10/12/2013]

[17] C. Lemmon, S. Lui, and I. Lee, "Geographic Forwarding and Routing for Ad-Hoc Wireless Network: A Survey," in *the Proceeding of the 5th International Joint Conference on INC, IMS and IDC, (NCM'09)*, Myongji Univ., Yongin, South Korea, 25-27 Aug. 2009, pp. 188–195. [Online]. Available: http://dx.doi.org/10.1109/NCM.2009.80.

[18] A. Maghsoudlou, M. St-Hilaire, and T. Kunz, "A Survey on Geographic Routing Protocols for Mobile Ad hoc Networks," Department of Systems and Computer Engineering, Carleton University, Ottawa, ON, Canada, Tech. Rep. 3, Oct. 2011. [Online]. Available: www.csit.carleton.ca/~msthilaire/Tech_Report/2011-GRPreport.pdf.[Accessdate10/12/2013]

[19] S.-H. Cha, M.-W. Ryu, and K.-H. Cho, "A Survey of Greedy Routing Protocols for Vehicular Ad Hoc Networks," *Smart Computing Review*, vol. 2, no. 2, pp. 125–137, Apr. 2012. [Online]. Available: http://dx.doi.org/10.6029/smartcr.2012.02.003.[Accessdate10/12/2013]

[20] A. M. Popescu, G. Tudorache, B. Peng, and A. H. Kemp, "Surveying Position Based Routing Protocols for Wireless Sensor and Ad-hoc Networks," *International Journal of Communication Networks and Information Security (IJCNIS)*, vol. 4, no. 1, pp. 41–67, Apr. 2012. [Online]. Available: www.ijcnis.org/index.php/ijcnis/article/download/85/90.

[21] C. Lemmon, S. M. Lui, and I. Lee, "Review of Location-Aware Routing Protocols," *Advances in Information Sciences and Service Sciences (AISS)*, vol. 2, no. 2, pp. 132–143, Mar. 2010. [Online]. Available: http://dx.doi.org/10.4156/aiss.vol2.issue2.15.

[22] F. Araujo, L. Rodrigues, F. Araujo, and L. Rodrigues, "Survey on Position-Based Routing1," University of Lisbon, Tech. Rep. Jan., 2006. [Online]. Available: http://eden.dei.uc.pt/~filipius/publications.html.

[23] G. G. Finn, "Routing and Addressing Problems in Large Metropolitan-Scale Internetworks," University of Southern California, Marina del Rey. Information Sciences Inst., Tech. Rep., Mar. 1987. [Online]. Available: http://www.dtic.mil/dtic/tr/fulltext/u2/a180187.pdf.[Accessdate10/12/2013]

[24] S. Ruhrup, "Position-Based Routing Strategies," Ph.D. Dissertation, Faculty of Electrical Engineering, Computer Science and Mathematics, University of Paderborn, Jul. 2006. [Online]. Available: www2.cs.uni-paderborn.de/cs/ag-madh/WWW/sr/thesis.pdf.[Accessdate10/12/2013]

[25] G. Xing, C. Lu, R. Pless, and Q. Huang, "On Greedy Geographic Routing Algorithms in Sensing Covered Networks," in *the Proceedings of the 5th ACM International Symposium on Mobile Ad Hoc Networking and Computing*. Roppongi Hills, Tokyo, Japan: ACM, 24-26 May 2004, pp. 31–42. [Online]. Available: http://doi.acm.org/10.1145/989459.989465.[Accessdate10/12/2013]

[26] S. Ruhrup, "Theory and Practice of Geographic Routing," Department of Computer Science, University of Freiburg, Germany, Tech. Rep., Feb. 2009. [Online]. Available: http://hondo.informatik.uni-freiburg.de/people/ruehrup/georouting-chapter-draft.pdf.[Accessdate10/12/2013]

[27] J. Li and S. M. Shatz, "Toward Using Node Mobility to Enhance Greedy-Forwarding in Geographic Routing for Mobile Ad Hoc Networks," in *the Proceeding of the International Workshop on Mobile Device and Urban Sensing (MODUS 08)*, St. Louis, MO, USA, 21 Apr. 2008, pp. 1–8. [Online]. Available: www.cs.uic.edu/~shatz/papers/modus08.pdf.[Accessdate10/12/2013]

[28] N. Arad and Y. Shavitt, "Minimizing Recovery State in Geographic Ad Hoc Routing," *IEEE Transactions on Mobile Computing*, vol. 8, no. 2, pp. 203–217, Feb. 2009. [Online]. Available: http://doi.ieeecomputersociety.org/10.1109/TMC.2008.86.[Accessdate10/12/2013]

[29] P. J. Wan, C. W. Yi, L. Wang, and X. Yao, F.and Jia, "Asymptotic Critical Transmission Radii for Greedy Forward Routing in Wireless Ad Hoc Networks," *IEEE Transactions on Communications*, vol. 57, no. 5, pp. 1433–1443, May 2009. [Online]. Available: http://dx.doi.org/10.1109/TCOMM.2009.05.070307.

[30] F. Cadger, K. Curran, J. Santos, and S. Moffett, "A Survey of Geographical Routing in Wireless Ad-Hoc Networks," *IEEE Communications Surveys & Tutorials*, vol. 15, no. 2, pp. 621–653, Jul. 2012. [Online]. Available: http://dx.doi.org/10.1109/SURV.2012.062612.00109.

[31] M. Lukic, B. Pavkovic, N. Mitton, and I. Stojmenovic, "Greedy Geographic Routing Algorithms in Real Environment," in *the Proceeding of the 5th International Conference on Mobile Ad-hoc and Sensor Networks*. Wu Yi Mountain, China: IEEE, 14-16 Dec. 2009, pp. 86–93. [Online]. Available: http://dx.doi.org/10.1109/MSN.2009.11.[Accessdate10/12/2013]

[32] S. Giordano, I. Stojmenovic, and L. Blazevic, "Position Based Routing Algorithms for Ad Hoc Networks: A Taxonomy," *Ad Hoc Wireless Networking*, vol. 8, no. 64, pp. 1–20, 2001. [Online]. Available: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.15.3076.[Accessdate10/12/2013]

[33] A. K. Haboush, M. A. Nabhan, M. Al-Tarazi, and M. Al-Rawajbeh, "Load Balancing Using Multiple Node Disjoint Paths," *Computer and Information Science*, vol. 5, no. 3, pp. 83–89, May 2012. [Online]. Available: http://dx.doi.org/10.5539/cis.v5n3p83.[Accessdate10/12/2013]

[34] D. S. J. D. Couto, D. Aguayo, B. A. Chambers, and R. Morrist, "Performance of Multihop Wireless Networks: Shortest Path is not Enough," *ACM SIGCOMM Computer Communication Review*, vol. 33, no. 1, pp. 83–88, Jan. 2003. [Online]. Available: http://doi.acm.org/10.1145/774763.774776.[Accessdate10/12/2013]

[35] G. I. Ivascu, S. Pierre, and A. Quintero, "QoS Routing With Traffic Distribution in Mobile Ad Hoc Networks," *Computer communication*, vol. 32, no. 2, pp. 305–316, Feb. 2009. [Online]. Available: http://dx.doi.org/10.1016/j.comcom.2008.10.012.

[36] S. Venkatasubramanian and N. Gopala, "A Quality of Service Architecture for Resource Provisioning and Rate Control in Mobile Ad Hoc Networks," *International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC)*, vol. 1, no. 3, pp. 106–120, Sep. 2010. [Online]. Available: http://dx.doi.org/10.5121/ijasuc.2010.1309.[Accessdate10/12/2013]

[37] F. De Rango and M. Tropea, "Energy Saving and Load Balancing in Wireless Ad Hoc Networks Through Ant-based Routing," in *the Proceeding of the International Symposium on Performance Evaluation of Computer & Telecommunication Systems*. Istanbul, Turkey: IEEE, 13-16 Jul. 2009, pp. 117–124. [Online]. Available: http://ieeexplore.ieee.org.www.ezplib.ukm.my/ielx5/5204040/5224098/05224137.pdf?tp=&arnumber=5224137&isnumber=5224098.

[38] S.-B. Lee and A. Campbell, "HMP: Hotspot Mitigation Protocol for Mobile Ad hoc Networks," in *the Proceeding of the Eleventh International Workshop on Quality of Service*, ser. Lecture Notes in Computer Science, K. Jeffay, I. Stoica, and K. Wehrle, Eds., vol. 2707. CA, USA: Springer Berlin Heidelberg, 2–4 Jun. 2003, pp. 266–283. [Online]. Available: http://dx.doi.org/10.1007/3-540-44884-5_15.

[39] V. Thilagavathe and Dr. K. Duraiswamy, "Cross Layer Based Congestion Control Technique for Reliable and Energy Aware Routing in MANET," *International Journal of Computer Applications*, vol. 36, no. 12, pp. 1–6, Dec. 2011. [Online]. Available: http://www.ijcaonline.org/archives/volume36/number12/4549-6288.[Accessdate10/12/2013]

[40] S. Sheeja and R. V. Pujeri, "Effective Congestion Avoidance Scheme for Mobile Ad Hoc Networks," *International Journal of Computer Network and Information Security (IJCNIS)*, vol. 5, no. 1, pp. 33–40, 2013. [Online]. Available: www.mecs-press.org/ijcnis/ijcnis-v5-n1/IJCNIS-V5-N1-4.pdf.[Accessdate10/12/2013]

[41] G. Wang, G.and Wang, "An Energy-Aware Geographic Routing Protocol for Mobile Ad Hoc Networks," *International Journal of Software and Informatics*, vol. 4, no. 2, pp. 183–196, Jun. 2010. [Online]. Available: GWang,GWang-InternationalJournalofSoftwareandInformatics,2010-st.ewi.tudelft.nl.[Accessdate10/12/2013]

[42] Y. Wang, "Study on Energy Conservation in MANET," *Journal of Networks*, vol. 5, no. 6, pp. 708–715, Jun 2010. [Online]. Available: http://dx.doi.org/10.4304/jnw.5.6.708-715.[Accessdate10/12/2013]

[43] D. G. Anand, H. G. Chandrakanth, and M. N. Giriprasad, "Energy Efficient Coverage Problems in Wireless Ad Hoc Sensor Networks," *International Journal of Advanced Networking and Applications*, vol. 3, no. 1, pp. 999–1005, Jul./Aug. 2011. [Online]. Available: http://dx.doi.org/10.5121/acij.2011.2204.[Accessdate10/12/2013]

[44] B. Karp and H. T. Kung, "GPSR: Greedy Perimeter Stateless Routing for Wireless Networks," in *the Proceedings of the 6th Annual International Conference on Mobile Computing and Networking (MobiCom)*. Boston, Massachusetts, US: ACM, 6-11 Aug. 2000, pp. 243–254. [Online]. Available: http://doi.acm.org/10.1145/345910.345953.[Accessdate10/12/2013]

[45] S. Yang, C. K. Yeo, and B.-S. Lee, "Toward Reliable Data Delivery for Highly Dynamic Mobile Ad Hoc Networks," *IEEE Transactions on Mobile Computing*, vol. 11, no. 1, pp. 111–124, Jan. 2012. [Online]. Available: http://dx.doi.org/10.1109/TMC.2011.55.

[46] R. Alsaqour, M. Shanudin, M. Ismail, and M. Abdelhaq, "Analysis of Mobility Parameters Effect on Position Information Inaccuracy of GPSR Position-Based MANET Routing Protocol," *Journal of Theoretical and Applied Information Technology*, vol. 28, no. 2, pp. 114–120, Jun. 2011. [Online].

Available: www.jatit.org/volumes/research-papers/Vol28No2/8Vol28No2.pdf. [Accessdate10/12/2013]

[47] D. Son, A. Helmy, and B. Krishnamachari, "The Effect of Mobility-Induced Location Errors on Geographic Routing In Mobile Ad Hoc Sensor Networks: Analysis and Improvement Using Mobility Prediction," *IEEE Transactions on Mobile Computing*, vol. 3, no. 3, pp. 233–245, Jul. 2004. [Online]. Available: http://dx.doi.org/10.1109/TMC.2004.28.[Accessdate10/12/2013]

[48] J. Tsumochi, K. Masayama, H. Uehara, and M. Yokoyama, "Impact of Mobility Metric on Routing Protocols for Mobile Ad Hoc Networks," in *the Proceeding of the IEEE Pacific Rim Conference on Communications Computers and signal Processing (PACRIM)*, University of Victoria, Victoria, BC, Canada, 28-30 Aug. 2003, pp. 322–325. [Online]. Available: http://dx.doi.org/10.1109/PACRIM.2003.1235782.

[49] V. C. Giruka and M. Singhal, "Hello Protocols for Ad-Hoc Networks: Overhead and Accuracy Tradeoffs," in *the 6th IEEE International Symposium on a World of Wireless Mobile Multimedia Networks, (WoWMoM)*, Taormina-Giardini Naxos, 13-16 Jun. 2005, pp. 354–361. [Online]. Available: http://dx.doi.org/10.1109/WOWMOM.2005.50.

[50] F. Ingelrest, N. Mitton, and D. Simplot-Ryl, "A Turnover based Adaptive HELLO Protocol for Mobile Ad Hoc and Sensor Networks," in *the Proceedings of the 15th International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems*. Istanbul, Turkey: IEEE, 24-26 Oct. 2007, pp. 9–14. [Online]. Available: http://dx.doi.org/10.1109/MASCOTS.2007.5

[51] C. Li, L. Zhu, C. Zhao, and H. Lin, "Hello Scheme for Vehicular Ad Hoc Networks: Analysis and Design," *Journal on Wireless Communications and Networking (EURASIP)*, vol. 2013, no. 1, p. 28, Feb. 2013. [Online]. Available: http://jwcn.eurasipjournals.com/content/2013/1/28.

[52] M. Heissenbüttel, T. Braun, M. Wälchli, and T. Bernoulli, "Evaluating the Limitations of and Alternatives in Beaconing," *Ad Hoc Networks*, vol. 5, no. 5, pp. 558–578, Jul. 2007. [Online]. Available: http://dx.doi.org/10.1016/j.adhoc.2006.03.002.[Accessdate10/12/2013]

[53] Q. Chen, S. S. Kanhere, and M. Hassan, "Adaptive Position Update for Geographic Routing in Mobile Ad-hoc Networks," *IEEE Transactions on Mobile Computing*, vol. 12, no. 3, pp. 4046–4051, Mar. 2013. [Online]. Available: http://dx.doi.org/10.1109/TMC.2012.20.[Accessdate10/12/2013]

[54] S. Kwon and N. B. Shroff, "Geographic Routing in the Presence of Location Errors," *International Journal of Computer and Telecommunications Networking*, vol. 50, no. 15, pp. 2902–2917, Oct. 2006. [Online]. Available: http://dx.doi.org/10.1016/j.comnet.2005.11.008.[Accessdate10/12/2013]

[55] B. Leong, B. Liskov, and R. Morris, "Geographic Routing without Planarization," in *the Proceeding of the 3rd conference on Networked Systems*

Design and Implementation. San Jose, CA: ACM, 8-10 May 2006, pp. 1–14. [Online]. Available: http://dl.acm.org/citation.cfm?id=1267680.1267705. [Accessdate10/12/2013]

[56] J. Na, D. Soroker, and C.-K. Kim, "Greedy Geographic Routing using Dynamic Potential Field for Wireless Ad Hoc Networks," *IEEE Communications Letters*, vol. 1, no. 3, pp. 243–245, Mar. 2007. [Online]. Available: http://dx.doi.org/10.1109/LCOMM.2007.061612.[Accessdate10/12/2013]

[57] R. H. Khokhar, M. A. Ngadi, M. S. Latiff, K. Z. Ghafoor, S. Ali, "Multi-criteria Receiver Self-Election Scheme for Optimal Packet Forwarding in Vehicular Ad hoc Networks," *International Journal of Computers, Communication and Control*, vol. 7, no. 5, pp. 865–878, Dec. 2012. [Online]. Available: journal.univagora.ro/download/pdf/639.pdf.[Accessdate10/12/2013]

[58] Z. G. Kayhan, A. B. Kamalrulnizam, and H. N. A., "A Novel Delay-and Reliability-Aware Inter-Vehicle Routing Protocol," *Network Protocols and Algorithms*, vol. 2, no. 2, pp. 66–88, Jul. 2010. [Online]. Available: http://dx.doi.org/10.5296/npa.v2i2.427.[Accessdate10/12/2013]

[59] J. Gong, C. Z. Xu, and J. Holle, "Predictive Directional Greedy Routing in Vehicular Ad hoc Networks," in *the Proceeding of the 27th International Conference on Distributed Computing Systems Workshops*. Toronto, Ont.: IEEE, 22-29 Jun. 2007, pp. 2–10. [Online]. Available: http://dx.doi.org/10.1109/ICDCSW.2007.65.[Accessdate10/12/2013]

[60] Z. G. Kayhan, A. B. Kamalrulnizam, S. Shaharuddin, C. L. Kevin, M. M. Mohd, K. Maznah, and M. A. Marina, "Fuzzy Logic-assisted Geographical Routing over Vehicular Ad Hoc Networks," *International Journal of Innovative Computing, Information and Control*, vol. 8, no. 7, pp. 1–15, Jul. 2012. [Online]. Available: www.ijicic.org/11-05101-1.pdf.[Accessdate10/12/2013]

[61] D. Liarokapis and A. Shahrabi, "Fuzzy-based Probabilistic Broadcasting in Mobile Ad Hoc Networks," in *Wireless Days (WD)*. Glasgow Caledonian University, Glasgow, UK: IEEE, 10-12 Oct. 2011, pp. 1–6. [Online]. Available: http://dx.doi.org/10.1109/WD.2011.6098185.

[62] R. Saqour, M. Shanudin, and M. Ismail, "Dynamic Beaconing for Ad Hoc Position-based Routing Protocol Using Fuzzy Logic Controller," in *the Proceedings of the International Conference on Electrical Engineering and Informatics (ICEEI)*, Bandung, Indonesia, 17-19 Jun. 2007, pp. 966–969. [Online]. Available: http://research.mercubuana.ac.id/proceeding/H-14.pdf. [Accessdate10/12/2013]

[63] D. Liarokapis and A. Shahrabi, "A Probability-Based Adaptive Scheme for Broadcasting in MANETs," in *the Proceedings of the 6th International Conference on Mobile Technology, Application and Systems*. Nice, France: ACM, 10-13 Sep. 2009, pp. 235–239. [Online]. Available: http://dx.doi.org/10.1145/1710035.1710081.

[64] A. K. Ahmad and N. Mitton, “Adapting Dynamically Neighbourhood Table Entry Lifetime in Wireless Sensor Networks,” in *the Preceding of the 10th International Conference on Wireless Communications and Signal Processing*, Univ. Lille 1, Lille, France, 21-23 Oct. 2010, pp. 1–6. [Online]. Available: {http://dx.doi.org/10.1109/WCSP.2010.5633707}.

[65] D. Chen and P. K. Varshney, “A Survey of Void Handling Techniques for Geographic Routing in Wirless Networks,” *IEEE Communications Surveys & Tutorials*, vol. 9, no. 1, pp. 50–67, Jan. 2007. [Online]. Available: http://dx.doi.org/10.1109/COMST.2007.358971.

[66] J. Na, Y.-J. Kim, and R. Govindan, “Minimizing Recovery Overhead in Geographic Ad Hoc Routing,” *Computer Communications*, vol. 33, no. 11, pp. 1343–1353, Jul. 2010. [Online]. Available: http://dx.doi.org/10.1016/j.comcom.2010.03.021.

[67] B. Leong, S. Mitra, and B. Liskov, “Path Vector Face Routing: Geographic Routing with Local Face Information,” in *the Proceeding of the 13th IEEE International Conference on Network Protocols (ICNP ’05)*, Boston, MA, USA, 6-9 Nov. 2005, pp. 147–158. [Online]. Available: http://dx.doi.org/10.1109/ICNP.2005.32.

[68] C. Jayapal and S. Vembu, “Performance Evaluation of Hole Avoidance Techniques in Geographic Forwarding for Mobile Ad Hoc Networks,” *International Journal of Information Technology Convergence and Services (IJITCS)*, vol. 1, no. 4, pp. 21–32, Aug. 2011. [Online]. Available: http://www.docshut.com/hohohohohohohohoi/Ijitcs.html.

[69] W. Kieb, H. Fubler, J. Widmer, and M. Mauve, “Hierarchical Location Service for Mobile Ad-Hoc Networks,” *ACM SIGMOBILE Mobile Computing and Communications Review*, vol. 8, no. 4, pp. 47–58, Oct. 2004. [Online]. Available: http://doi.acm.org/10.1145/1052871.1052875.[Accessdate10/12/2013]

[70] M. Ayaida, H. Fouchal, L. Afilal, and Y. Ghamri-Doudane, “A Comparison of Reactive, Grid and Hierarchical Location-Based Services for VANETs,” in *the Proceeding of the IEEE Vehicular Technology Conference (VTC Fall)*. Québec City, Canada: IEEE, 3-6 Sept. 2012, pp. 1–5. [Online]. Available: http://dx.doi.org/10.1109/VTCFall.2012.6398920.

[71] C. Liu and J. Kaiser, “A Survey of Mobile Ad Hoc network Routing Protocols,” University of Magdeburg, Tech. Rep. 8, Oct. 2005. [Online]. Available: http://vts.uni-ulm.de/docs/2005/5346/vts_5346.pdf.[Accessdate10/12/2013]

[72] N. Gupta and R. Gupta, “Routing Protocols in Mobile Ad-Hoc Networks: an Overview,” in *in the Proceedings of the International Conference on Emerging Trends in Robotics and Communication Technologies (INTERACT)*. Chennai: IEEE, 3-5 Dec. 2010, pp. 173–177. [Online]. Available: http://dx.doi.org/10.1109/INTERACT.2010.5706220.

[73] A. Boukerche, M. Z. Ahmad, D. Turgut, and B. Turgut, “A Taxonomy of Routing Protocols for Mobile Ad Hoc Networks,” in *Algorithms and Protocols*

for Wireless and Mobile Ad Hoc Networks. New Jersey: Wiley, 2009, ch. 5, pp. 129–164. [Online]. Available: http://dx.doi.org/10.1002/9780470396384.ch5.

[74] M. G. Rubinstein, I. M. Moraes, M. E. M. Campista, L. H. M. K. Costa, and O. C. M. B. Duarte, "A Survey on Wireless Ad Hoc Networks," in *Mobile and Wireless Communication Networks (from International Federation for Information Processing (IFIP))*, ser. IFIP Advances in Information and Communication Technology, G. Pujolle, Ed. Springer US, Aug. 2006, vol. 211, ch. 1, pp. 1–33. [Online]. Available: http://dx.doi.org/10.1007/978-0-387-34736-3.[Accessdate10/12/2013]

[75] N. N. Qadri and A. Liotta, "Analysis of Pervasive Mobile Ad Hoc Routing Protocols," in *Computer Communications and Networks, Pervasive Computing*. Springer, 2010, ch. 19, pp. 433–453. [Online]. Available: http://dx.doi.org/10.1007/978-1-84882-599-419.[Accessdate10/12/2013]

[76] C. Perkins and P. Bhagwat, "Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers," in *the Proceedings of the Conference on Communications Architectures, Protocols and Applications (SIGCOMM '94)*. London, England UK: ACM, 31 Aug.-2 Sep. Aug. 31 - Sep. 02, 1994, pp. 234–244. [Online]. Available: http://dx.doi.org/10.1145/190809.190336.

[77] D. B. Johnson and D. A. Maltz, "Dynamic Source Routing in Ad Hoc Wireless Networks," in *Mobile Computing*, ser. The Kluwer International Series in Engineering and Computer Science, T. Imielinski and H. Korth, Eds. Springer US, 1996, vol. 353, ch. 5, pp. 153–181. [Online]. Available: http://dx.doi.org/10.1007/978-0-585-29603-6_5.[Accessdate10/12/2013]

[78] G. Kumar, Y. Reddyr, and M.Nagendra, "Current Research Work on Routing Protocols for MANET: A Literature Survey," *International Journal on Computer Science and Engineering (IJCSE)*, vol. 2, no. 3, pp. 706–713, May. 2010. [Online]. Available: www.enggjournals.com/ijcse/doc/IJCSE10-02-03-82.pdf.

[79] S. A. K. Al-Omari and P. Sumari, "An Overview of Mobile Ad Hoc Networks for the Existing Protocols and Applications," *International Journal on Application of Graph Theory in Wireless Ad Hoc Networks and Sensor Networks (Graph-Hoc)*, vol. 2, no. 1, pp. 87–110, Mar. 2010. [Online]. Available: arxiv.org/pdf/1003.3565.[Accessdate10/12/2013]

[80] S. Parul, K. Arvind, and T. Jawahar, "Performance Analysis of AODV, DSR and DSDV Routing Protocols in Mobile Ad-hoc Network (MANET)," *Journal of Information Systems and Communication*, vol. 3, no. 1, pp. 322–326, 2012. [Online]. Available: http://www.bioinfo.in/contents.php?id=45.[Accessdate10/12/2013]

[81] T. Camp, J. Boleng, B. Williams, L. Wilcox, and W. Navidi, "Performance Comparison of Two Location Based Routing Protocols for Ad Hoc Networks," in *the Proceeding of the 21st Annual Joint Conference of*

the IEEE Computer and Communications Societies INFOCOM'02. New York, USA: IEEE, 23-27 Jun. 2002, pp. 1678–1687. [Online]. Available: http://dx.doi.org/10.1109/INFCOM.2002.1019421.[Accessdate10/12/2013]

[82] H. Fubler, M. Mauve, H. Hartenstein, M. Kasemann, and D. Vollmer, "A Comparison of Routing Strategies for Vehicular Ad-Hoc Networks," Department of Computer Science, University of Mannheim, Atlanta, Georgia, USA, Tech. Rep. TR-02-003, Jul. 2002. [Online]. Available: http://www.cn.uni-duesseldorf.de/publications/details/Fuessler2002b.html.[Accessdate10/12/2013]

[83] S. Jain and S. Sahu, "Topology vs. Position based Routing Protocols in Mobile Ad hoc Networks: A Survey," *International Journal of Engineering Research & Technology (IJERT)*, vol. 1, no. 3, pp. 1–11, May 2012. [Online]. Available: http://www.ijert.org/browse/may-2012-edition?download=34%.[Accessdate10/12/2013]

[84] P. H. Dana, "Global Positioning System (GPS) Time Dissemination for Real-Time Applications," *Real-Time Systems*, vol. 12, no. 1, pp. 9–40, Jan. 1997. [Online]. Available: http://www.pdana.com/PHDWWW_files/Rtgps.pdf.[Accessdate10/12/2013]

[85] N. Bulusu, J. Heidemann, and J. Estrin, "GPS-less Low-Cost Outdoor Localization for Very Small Devices," *IEEE Personal Communications Journal*, vol. 7, no. 5, pp. 28–35, Oct. 2000. [Online]. Available: http://dx.doi.org/10.1109/98.878533.[Accessdate10/12/2013]

[86] K. Abrougui, P. Richard Werner Nelem, and A. Boukerche, "Performance Evaluation of Location-Based Service Discovery Protocols for Vehicular Networks," in *the Proceeding of the IEEE International Conference on Communications (ICC)*. Cape Town: IEEE, 23-27 May 2010, pp. 1–5. [Online]. Available: http://dx.doi.org/10.1109/ICC.2010.5502662.

[87] S. M. Das, H. Pucha, and Y. C. Hu, "Performance Comparison of Scalable Location Services for Geographic Ad Hoc Routing," in *the Proceeding of the 24th Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM)*. Miami, FL, USA: IEEE, 13-17 Mar. 2005, pp. 1228–1239. [Online]. Available: http://dx.doi.org/10.1109/INFCOM.2005.1498349.[Accessdate10/12/2013]

[88] S. Basagni, I. Chlamtac, V. R. Syrotiuk, and B. A. Woodward, "A Distance Routing Effect Algorithm for Mobility (DREAM)," in *the Proceeding of the 4th Annual ACM/IEEE International Conference on Mobile Computing and Networking*, Dallas, Texas, United States, 25-30 Oct. 1998, pp. 76–84. [Online]. Available: http://doi.acm.org/10.1145/288235.288254.[Accessdate10/12/2013]

[89] M. Kasemann, H. Hartenstein, and M. M., "A Reactive Location Service for Mobile Ad Hoc Networks," Department of Computer Science, University of Mannheim, Tech. Rep. TR-14-2002, 2002. [Online]. Available: http://www.cn.uni-duesseldorf.de/publications/details/Kaesemann2002c.html.[Accessdate10/12/2013]

[90] Z. J. Haas and B. Liang, "Ad Hoc Mobility Management with Uniform Quorum Systems," *IEEE/ACM Transactions on Networking*, vol. 7, no. 2, pp. 228–240, Apr. 1999. [Online]. Available: http://dx.doi.org/10.1109/90.769770. [Accessdate10/12/2013]

[91] L. Jinyang, J. John, S. J. D. C. Douglas, R. K. David, and M. Robert, "A Scalable Location Service for Geographic Ad Hoc Routing," in *the Proceeding of the 6th Annual International Conference on Mobile Computing and Networking*, ser. MobiCom '00. New York, NY, USA: ACM, 6-11 Aug. 2000, pp. 120–130. [Online]. Available: http://doi.acm.org/10.1145/345910.345931.[Accessdate10/12/2013]

[92] C.-C. Hsu and . I. F. I. Chin-Laung Lei., "A Geographic Scheme with Location Update for Ad Hoc Routing," in *the Proceeding of the 4th IEEE International Conference on Systems and Networks Communications*. Porto: IEEE, 20-25 Sept. 2009, pp. 43–48. [Online]. Available: http://dx.doi.org/10.1109/ICSNC.2009.83.

[93] M. Ayaida, M. Barhoumi, H. Fouchal, Y. Ghamri-Doudane, and L. Afilal, "HHLS: A hybrid Routing Technique for VANETs," in *the Proceeding of the IEEE Global Communications Conference (GLOBECOM)*. Anaheim, CA: IEEE, 3-7 Dec. 2012, pp. 44–48. [Online]. Available: http://dx.doi.org/10.1109/GLOCOM.2012.6503088.

[94] Y.-B. Ko and N. H. Vaidya, "Location-Aided Routing (LAR) in Mobile Ad Hoc Networks," *Wireless Networks*, vol. 6, no. 4, pp. 307–321, Jul. 2000. [Online]. Available: http://dx.doi.org/10.1023/A:1019106118419. [Accessdate10/12/2013]

[95] L. Blazevic, L. Buttyan, S. Capkun, S. Giordano, J.-P. Hubaux, and J.-Y. L. Boudec, "Self Organization in Mobile Ad Hoc Networks: the Approach of TERMINODES," *IEEE Communications Magazine*, vol. 39, no. 6, pp. 166–174, Jun. 2001. [Online]. Available: http://dx.doi.org/10.1109/35.925685. [Accessdate10/12/2013]

[96] H. Takagi and L. Kleinrock, "Optimal Transmission Ranges for Randomly Distributed Packet Radio Terminals," *IEEE Transactions on Communications*, vol. 32, no. 3, pp. 246–257, Mar. 1984. [Online]. Available: http://dx.doi.org/10.1109/TCOM.1984.1096061.

[97] R. Nelson and L. Kleinrock, "The Spatial Capacity of A slotted ALOHA Multihop Packet Radio Network with Capture," *IEEE Transactions on Communications*, vol. 32, no. 6, pp. 684–694, Jun. 1984. [Online]. Available: http://dx.doi.org/10.1109/TCOM.1984.1096124.

[98] E. Kranakis, H. Singh, and J. Urrutia, "Compass Routing on Geometric Networks," in *the Proceeding of the 11th Canadian Conference on Computational Geometry*, Vancouver, Canada, 15-18 Aug. 1999, pp. 51–54. [Online]. Available: www.cccg.ca/proceedings/1999/c46.pdf.[Accessdate10/12/2013]

[99] T.-C. Hou and V. Li, "Transmission Range Control in Multihop Packet Radio Networks," *IEEE Transactions in Communications*, vol. 34, no. 1, pp. 38–44, Jan. 1986. [Online]. Available: http://dx.doi.org/10.1109/TCOM.1986.1096436.[Accessdate10/12/2013]

[100] B. N. Karp, "Geographic Routing for Wireless Networks," Ph.D Dissertation, Harvard University, Cambridge, Massachusetts, 2000. [Online]. Available: https://www-new.comp.nus.edu.sg/~bleong/geographic/related/karp00geographic.pdf.[Accessdate10/12/2013]

[101] J. Gao and L. Zhang, "Load Balanced Short Path Routing in Wireless Networks," *IEEE Transactions on Parallel and Distributed Systems*, vol. 17, no. 4, pp. 377–388, Apr. 2006. [Online]. Available: http://dx.doi.org/10.1109/TPDS.2006.49.[Accessdate10/12/2013]

[102] D. Tran and H. Raghavendra, "Routing with Congestion Awareness and Adaptivity in Mobile Ad Hoc Networks," in *the Proceeding of the IEEE Wireless Communications and Networking Conference (WCNC)*, New Orleans, USA, 13-17 Mar. 2005, pp. 1988–1994. [Online]. Available: http://dx.doi.org/10.1109/WCNC.2005.1424824.

[103] N. Tantubay, D. R. Gautam, and M. K. Dhariwal, "A Review of Power Conservation in Wireless Mobile Adhoc Network (MANET)," *International Journal of Computer Science Issues (IJCSI)*, vol. 8, no. 4, pp. 378–383, Jul. 2011. [Online]. Available: http://www.ijcsi.org/papers/IJCSI-8-4-1-378-383.pdf.[Accessdate10/12/2013]

[104] F. Xue and P. R. Kumar, "The Number of Neighbors Needed for Connectivity of Wireless Networks," *Wireless Networks Journal*, vol. 10, no. 2, pp. 169–181, Mar. 2004. [Online]. Available: http://dx.doi.org/10.1023/B:WINE.0000013081.09837.c0.[Accessdate10/12/2013]

[105] E. M. Royer, P. M. Melliar-Smith, and L. E. Moser, "An Analysis of the Optimum Node Density for Ad hoc Mobile Networks," in *the Proceedings of the IEEE International Conference In Communications (ICC'01)*. Helsinki: IEEE, 11-14 Jun. 2001, pp. 857–861. [Online]. Available: http://dx.doi.org/10.1109/ICC.2001.937360.[Accessdate10/12/2013]

[106] N. Ali, R. Ahmad, and S. Aljunid, "Link Availability Estimation for Routing Metrics in MANETs: An Overview," in *International Conference on Electronic Design (ICED)*. Penang, Malaysia: IEEE, 1-3 Dec. 2008, pp. 1–3. [Online]. Available: http://dx.doi.org/10.1109/ICED.2008.4786686.

[107] Z. Cheng and W. B. Heinzelman, "Discovering Long Lifetime Routes in Mobile Ad Hoc Networks," *Ad Hoc Networks*, vol. 5, no. 6, pp. 661–674, Jul. 2008. [Online]. Available: http://dx.doi.org/10.1016/j.adhoc.2007.06.001.

[108] E. Y. Hua and Z. Z. Haas, "An Algorithm for Prediction of Link Lifetime in MANET Based on Unscented Kalman Filter," *IEEE Communications Letters*, vol. 13, no. 10, pp. 782–784, Oct. 2009. [Online]. Available: http://dx.doi.org/10.1109/LCOMM.2009.090974.[Accessdate10/12/2013]

[109] M. Shanudin, M. Ismail, and R. Saqour, "Impact of Mobility Metrics on Greedy Ad Hoc Network Routing Protocol and Improvement Using Angular Prediction Model," in *the Proceeding of the 13th IEEE International Conference on Networks, Jointly held with the 7th Malaysia International Conference on Communication*, Kuala Lumpur, Malaysia, 16-18 Nov. 2005, pp. 262–267. [Online]. Available: http://dx.doi.org/10.1109/ICON.2005.1635481.

[110] Y. Kim, J.-J. Lee, and A. Helmy, "Modeling and Analyzing the Impact of Location Inconsistencies on Geographic Routing in Wireless ," *Mobile Computing and Communications Review*, vol. 8, no. 1, pp. 48–60, Jan. 2004. [Online]. Available: http://doi.acm.org/10.1145/980159.980168. [Accessdate10/12/2013]

[111] R.-H. Cheng and C. Huang, "Efficient Prediction-Based Location Updating and Destination Searching Mechanisms for Geographic Routing in Mobile Ad Hoc Networks," *Journal Of Information Science And Engineering*, vol. 28, no. 1, pp. 115–129, Aug. 2012. [Online]. Available: http://www.iis.sinica.edu.tw/page/jise/2012/201201_08.html,[Accessdate10/12/2013]

[112] G. T. Toussaint, "The Relative Neighbourhood Graph of a Finite Planar Set," *Pattern Recognition*, vol. 12, no. 4, pp. 261–268, 1980. [Online]. Available: http://dx.doi.org/10.1016/0031-3203(80)90066-7.[Accessdate10/12/2013]

[113] R. K. Gabriel and R. R. Sokal, "A New Statistical Approach to Geographic Variation Analysis," *Systematic Biology*, vol. 18, no. 3, pp. 259–278, Sep. 1969. [Online]. Available: http://dx.doi.org/10.2307/2412323.

[114] K. Jaffres-Runser, C. Comaniciu, and J.-M. Gorce, "A Multiobjective Optimization Framework for Routing in Wireless Ad Hoc Networks," Dept. of Electrical and Computer Engineering, Stevens Institute of Technology, Hoboken, New-Jersey, USA, Research Report RR-7180, Jan. 2010. [Online]. Available: http://hal.inria.fr/inria-00449010/PDF/RR-7180.pdf.[Accessdate10/12/2013]

[115] M. Heissenbuttel and T. B., "Optimizing Neighbor Table Accuracy of Position-Based Routing Algorithms," in *the Proceedings of the 24th Annual Joint Conference of the IEEE Computer and Communications Societies INFOCOM*, Miami, FL USA, 13-17 Mar. 2005, pp. 143–152. [Online]. Available: citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.1.1625.[Accessdate10/12/2013]

[116] S. Corson and J. Macker, "Mobile Ad Hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations," *Network Working Group RFC 2501*, Jan. 1999. [Online]. Available: http://www.ietf.org/rfc/rfc2501.txt.

[117] K. M. Reineck, "Evaluation and Comparison of Network Simulation Tools," Master Thesis, University of Applied Sciences Bonn-Rhein-Sieg Department of Computer Science, Aug. 2008. [Online]. Available: http://www.projektiv.net63.net/doc/Reineck_-_Evaluation_and_Comparison_of_Network_Simulation_Tools.pdf.[Accessdate10/12/2013]

[118] S. R. Das, R. Castañeda, and J. Yan, "Simulation-Based Performance Evaluation of Routing Protocols for Mobile Ad Hoc Networks," *Mobile Networks and Applications (MONET) Journal*, vol. 5, no. 3, pp. 179–189, Sep. 2000. [Online]. Available: http://dx.doi.org/10.1023/A:1019108612308. [Accessdate10/12/2013]

[119] R. E. Shannon, "Design and Analysis of Simulation Experiments," in *the Preceding of the 10th conference on Winter simulation WSC*, ser. WSC '78, vol. 1. Piscataway, NJ, USA: IEEE Press, 1978, pp. 55–61. [Online]. Available: http://dl.acm.org/citation.cfm?id=800288.811210.

[120] O. Al-Momani, "Dynamic Redundancy Forward Error Correction Mechanism for the Enhancement of Internet-based Video Streaming," Ph.D. Thesis, Universiti Utara Malaysia, 2010. [Online]. Available: http://etd.uum.edu.my/2523/.[Accessdate10/12/2013]

[121] O. Ghazali, "Scaleable and Smooth TCP-friendly Receiver-based Layered Multicast Protocol," Ph.D. Thesis, Universiti Utara Malaysia, 2008. [Online]. Available: http://etd.uum.edu.my/1291/.[Accessdate10/12/2013]

[122] R. G. Sargent, "Validation and Verification of Simulation Models," in *the Preceding of the 2011 Winter Simulation Conference (WSC)*, Phoenix, Ariz, USA, 11-14 Dec. 2011, pp. 183–198. [Online]. Available: http://dx.doi.org/10.1109/WSC.2011.6147750.[Accessdate10/12/2013]

[123] O. Balci, "Principles of Simulation Model Validation, Verification, and Testing," *Transactions of the Society for Computer Simulation International Journal*, vol. 14, no. 1, pp. 3–12, Mar. 1997. [Online]. Available: http://dl.acm.org/citation.cfm?id=264096.264099.

[124] U. Atta, K. Rehman, M. Sardar, and O. Mazliza, "A Performance Comparison of Network Simulators for Wireless Networks," *arXiv preprint arXiv:1307.4129*, pp. 1–6, Jul. 2013. [Online]. Available: http://arxiv.org/ftp/arxiv/papers/1307/1307.4129.pdf.

[125] *The Network Simulator - ns-2*. [Online]. Available: http://www.isi.edu/nsnam/ns/.[Accessdate10/12/2013]

[126] T. Issariyakul and E. Hossain, *Introduction to Network Simulator NS2*, 2nd ed., July 2008. [Online]. Available: http://dx.doi.org/10.1007/978-0-387-71760-9. [Accessdate10/12/2013]

[127] *MATLAB Primer R2012b*. [Online]. Available: www.mathworks.com/help/pdf_doc/matlab/getstart.pdf.[Accessdate10/12/2013]

[128] *The Network Simulator MatLap: Documentation*. [Online]. Available: http://wireless-matlab.sourceforge.net/.[Accessdate10/12/2013]

[129] E. Natsheh, A. B. Jantan, S. Khatun, and S. Shamala, "A Survey on Fuzzy Reasoning Applications for Routing Protocols in Wireless Ad Hoc Networks," *International Journal of Business Data Communications and*

Networking (IJBDCN), vol. 4, no. 2, pp. 22–37, 2008. [Online]. Available: http://dx.doi.org/10.4018/jbdcn.2008040102.

[130] L. Zadeh, "Fuzzy Sets," *Information and Control*, vol. 8, no. 3, pp. 338–353, Jun. 1965. [Online]. Available: http://dx.doi.org/10.1016/S0019-9958(65)90241-X.[Accessdate10/12/2013]

[131] E. Cox, "Fuzzy Fundamentals," *IEEE Spectrum Magazine*, vol. 29, no. 10, pp. 58–61, Oct. 1992. [Online]. Available: http://dx.doi.org/10.1109/6.158640.

[132] V. B. Robinson, "A perspective on the fundamentals of fuzzy sets and their use in geographic information systems," *Transactions in GIS*, vol. 7, no. 1, pp. 3–30, Jan. 2003. [Online]. Available: http://dx.doi.org/10.1111/1467-9671.00127

[133] E. Mamdani and S. Assilian, "An Experiment in Linguistic Synthesis with A Fuzzy Logic Controller," *International Journal of Man-Machine Studies*, vol. 7, no. 1, pp. 1–13, Jan. 1975. [Online]. Available: http://dx.doi.org/10.1016/S0020-7373(75)80002-2.

[134] J. M. Mendel, "Fuzzy Logic Systems for Engineering: A Tutorial," *Proceedings of the IEEE*, vol. 83, no. 3, pp. 345–377, Mar. 1995. [Online]. Available: http://dx.doi.org/10.1109/5.364485.[Accessdate10/12/2013]

[135] J. Bas and A. Neira, "A Fuzzy Logic System for Interference Rejection in Code Division Multiple Access," in *the Preceding of the 12th IEEE international conference on fuzzy system (FUZZ)*, MO, USA, 25 - 28 May 2003, p. 996–1001. [Online]. Available: http://dx.doi.org/10.1109/FUZZ.2003.1206567.

[136] E. Natsheh, A. B. Jantan, S. Khatun, and S. Shamala, "Adaptive Optimizing of Hello Messages in Wireless Ad-Hoc Networks," *International Arab Journal Information Technology*, vol. 4, no. 1, pp. 191–200, Jan. 2007. [Online]. Available: http://dblp.uni-trier.de/db/journals/iajit/iajit4.html#NatshehJKS07a. [Accessdate10/12/2013]

[137] A. Agarwal and S. Das, "Dead Reckoning in Mobile Ad Hoc Networks," in *the Proceeding of the IEEE Wireless Communications and Networking (WCNC'03)*. New Orleans, LA, USA: IEEE, 20-20 Mar. 2003, pp. 1838–1843. [Online]. Available: http://dx.doi.org/10.1109/WCNC.2003.1200666.

[138] C. Bettstetter, "Mobility Modeling in Wireless Networks: Categorization, Smooth Movement, and Boder Effects," *ACM Mobile Computing and Communications Review (SIGMOBILE)*, vol. 5, no. 3, pp. 55–67, Jul. 2001. [Online]. Available: http://doi.acm.org/10.1145/584051.584056.

[139] T. Camp, J. Boleng, and V. Davies, "A Survey of Mobility Models for Ad Hoc Network Research," *Wireless Communications & Mobile Computing (WCMC): Special Issue On Mobile Ad Hoc Networking: Research, Trends And Applications*, vol. 2, no. 5, pp. 483–502, Aug. 2002. [Online]. Available: http://dx.doi.org/10.1002/wcm.72.[Accessdate10/12/2013]

[140] M. Grossglauser and D. Tse, "Mobility Increases the Capacity of Ad Hoc Wireless Networks," *IEEE/ACM Transactions on Networking*, vol. 10, no. 4, pp. 477–486, Aug. 2002. [Online]. Available: http://dx.doi.org/10.1109/TNET.2002.801403.[Accessdate10/12/2013]

[141] F. Bai, N. Sadagopan, and A. Helmy, "The IMPORTANT Framework for Analyzing the Impact of Mobility on Performance of Routing for Ad Hoc Networks," *AdHoc Networks Journal*, vol. 1, no. 1, pp. 383–403, Nov. 2003. [Online]. Available: http://dx.doi.org/10.1016/S1570-8705(03)00040-4.[Accessdate10/12/2013]

[142] J. Yoon, M. Liu, and B. Noble, "Random Waypoint Considered Harmful," in *the Preceding of the 22ed Annual Joint Conference of the IEEE Computer and Communications (INFOCOM)*, San Fransisco, California, USA, 30 Mar.-3 Apr. 2003, pp. 1312–1321. [Online]. Available: http://dx.doi.org/10.1109/INFCOM.2003.1208967.[Accessdate10/12/2013]

[143] W. Navidi and T. Camp, "Stationary Distributions for the Random Waypoint Mobility Model," *IEEE Transactions on Mobile Computing*, vol. 3, no. 3, pp. 99–108, Jan.-Mar. 2004. [Online]. Available: http://dx.doi.org/10.1109/TMC.2004.1261820.[Accessdate10/12/2013]

[144] J.-Y. Le Boudec and M. Vojnovic, "Perfect Simulation and Stationarity of A Class of Mobility Models," in *the Preceding of the IEEE 24th Annual Joint Conference of the IEEE Computer and Communications Societies*, Miami, FL, USA, 13-17 Mar. 2005, pp. 2743 – 2754. [Online]. Available: http://dx.doi.org/10.1109/INFCOM.2005.1498557.[Accessdate10/12/2013]

[145] G. Mohimani, F. Ashtiani, A. Javanmard, and M. Hamdi, "Mobility Modeling, Spatial Traffic Distribution, and Probability of Connectivity for Sparse and Dense Vehicular Ad Hoc Networks," *IEEE Transactions on Vehicular Technology*, vol. 58, no. 4, pp. 1998 – 2007, May 2009. [Online]. Available: http://dx.doi.org/10.1109/TVT.2008.2004266.[Accessdate10/12/2013]

[146] L. Zhuoqun, S. Lingfen, and E. Ifeachor, "Range-based Mobility Estimations in MANETs with Application to Link Availability Prediction," in *the Proceedings of the IEEE International Conference on Communications*. Glasgow: IEEE, 24-28 Jun. 2007, pp. 3376–3382. [Online]. Available: http://dx.doi.org/10.1109/ICC.2007.559.

[147] D. Veljan, "The 2500-year-old Pythagorean Theorem," *Mathematics Magazine*, vol. 73, no. 4, pp. 259–272, Oct. 2000. [Online]. Available: www.jstor.org/pss/2690973.[Accessdate10/12/2013]

[148] S. Bai, Z. Huang, and J. Jung, "Beacon-based Cooperative Forwarding Scheme for Safety-related Inter-vehicle Communications," in *the Proceedings of the 2010 International Conference on Computational Science and Its Applications - Volume Part IV*, ser. ICCSA'10. Berlin, Heidelberg: Springer-Verlag, 2010, pp. 520–534. [Online]. Available: http://dx.doi.org/10.1007/978-3-642-12189-0_45.

[149] D. Triantafyllidou and K. Al Agha, "Evaluation of TCP Performance in MANETs using an Optimized Scalable Simulation Model," in *the Proceedings of the 15th International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems (MASCOTS '07)*, Istanbul, 24-26 Oct. 2007, pp. 31 – 37. [Online]. Available: http://dx.doi.org/10.1109/MASCOTS.2007.25.

[150] D. Perkins, H. Hughes, and C. Owen, "Factors Affecting the Performance of Ad Hoc Networks," in *the proceeding of the IEEE International Conference on Communication (ICC'02)*. New York NY, USA: IEEE, 28 Apr. - 2 May 2002, pp. 2048–2052. [Online]. Available: http://dx.doi.org/10.1109/ICC.2002.997208.[Accessdate10/12/2013]

[151] S. H. Kurkowski, "Credible Mobile Ad Hoc Network Simulation-based Studies," Ph.D. Dissertation, Faculty and the Board of Trustees of the Colorado School of Mines, Golden, CO, USA, 2006. [Online]. Available: http://www.dtic.mil/get-tr-doc/pdf?Location=U2&doc=GetTRDoc.pdf&AD=ADA462915.[Accessdate10/12/2013]

[152] K. Stuart , N. William and C. Tracy, "Discovering Variables that Affect MANET Protocol Performance," in *the Proceeding of the IEEE Global Telecommunications Conference (GLOBECOM'07)*. Washington, DC: IEEE, 26-30 Nov. 2007, pp. 1237–1242. [Online]. Available: http://dx.doi.org/10.1109/GLOCOM.2007.238.

[153] M. Hyland, B. Mullins, R. Baldwin, and M. Temple, "Simulation-based Performance Evaluation of Mobile Ad Hoc Routing Protocols in A Swarm of Unmanned Aerial Vehicles," in *the Preceding of the 21st International Conference on Advanced Information Networking and Applications Workshops (AINAW'07)*. IEEE, 21-23 May 2007, pp. 249–256. [Online]. Available: http://dx.doi.org/10.1109/AINAW.2007.336.

[154] K. Stuart , N. William and C. Tracy, "Constructing MANET Simulation Scenarios that Meet Standards," in *the Preceding of the IEEE Internatonal Conference on Mobile Adhoc and Sensor Systems*. Pisa: IEEE, 8-11 Oct. 2007, pp. 1–9. [Online]. Available: http://dx.doi.org/10.1109/MOBHOC.2007.4428640.

[155] R. G. Sargent, "Validation and Verification of Simulation Models," in *the Proceedings of the 2008 Winter Simulation Conference*, no. „ Florida, USA, 7-10 Dec. 2008, pp. 157–169. [Online]. Available: http://dl.acm.org/citation.cfm?id=1516744.1516780.[Accessdate10/12/2013]

[156] T. C. M. GROUP, *Wireless and Mobility Extensions to ns-2*, THE CMU MONARCH GROUP, Oct. 1999. [Online]. Available: http://www.monarch.cs.cmu.edu/cmu-ns.html.Accessdate10/12/2013

[157] R. Santos, O. Alvarez, and A. Edwards, "Performance Evaluation of two Location-based Routing Protocols in Vehicular Ad-Hoc Networks," in *the proceeding of the IEEE 62nd Vehicular Technology Conference (VTC'05)*,

vol. 4, Dallas, Texas, USA, 25-28 Sept. 2005, pp. 2287 – 2291. [Online]. Available: http://dx.doi.org/10.1109/VETECF.2005.1558956.

[158] J. Broch, D. A. Maltz, D. B. Johnson, Y. C. Hu, and J. Jetcheva, "A Performance Comparison of Multi-hop Wireless Ad Hoc Network Routing Protocols," in *the Proceedings of the 4th annual ACM/IEEE international conference on Mobile computing and networking*. Dallas, Texas, USA: ACM, Oct. 1998, pp. 85–97. [Online]. Available: http://doi.acm.org/10.1145/288235.288256.[Accessdate10/12/2013]

[159] G. Almes, S. Kalidindi, A. Morton, and M. Zekauskas, "A One-Way Delay Metric for IPPM (draft-morton-ippm-2679-bis-00)," *Network Working Group RFC 4656*, 2012. [Online]. Available: http://www.hjp.at/doc/rfc/rfc4656.html.

[160] S. Charcranoon, "Measurement Architecture to Obtain Per-hop One-way Packet Loss and Delay in Multi-class Service Networks," USA Patent 7,292,537, Nov., 2007. [Online]. Available: http://worldwide.espacenet.com/publicationDetails/biblio?CC=US&NR=7292537B2&KC=B2&FT=D.[Accessdate10/12/2013]

[161] *IEEE Computer Society LAN MAN Standards Committee, Wireless LAN Medium Access Protocol (MAC) and Physical Layer (PHY) Specification, IEEE Std 802.11-1997*, The Institute of Electrical and Electronics Engineers, New York, NY, 1997. [Online]. Available: www.cs.uiuc.edu/homes/haiyun/cs598hl/papers/802.11-1999.pdf.[Accessdate10/12/2013]

[162] H. Chen and Y. Li, "Performance Model of IEEE 802.11 DCF with Variable Packet Length," *IEEE Communications Letters*, vol. 8, no. 3, pp. 186–188, Mar. 2004. [Online]. Available: http://dx.doi.org/10.1109/LCOMM.2004.823429.

[163] J. Simo Reigadas, A. Martinez-Fernandez, J. Ramos-Lopez, and J. Seoane-Pascual, "Modeling and Optimizing IEEE 802.11 DCF for Long-distance Links," *IEEE Transactions on Mobile Computing*, vol. 9, no. 6, pp. 881–896, Jun. 2010. [Online]. Available: http://dx.doi.org/10.1109/TMC.2010.27.

[164] D. Kim, C.-K. Toh, J.-C. Cano, and P. Manzoni, "A Bounding Algorithm for the Broadcast Storm Problem in Mobile Ad Hoc Networks," in *the Preceding of the IEEE Wireless Communications and Networking (WCNC)*, vol. 2. IEEE, 16-20 Mar. 2003, pp. 1131–1136. [Online]. Available: http://dx.doi.org/10.1109/WCNC.2003.1200530.

[165] E. M. Royer, S.-J. Lee, and C. E. Perkins, "The Effects of MAC Protocols on Ad Hoc Network Communication," in *the Proceedings of the IEEE Wireless Communications and Networking Confernce (WCNC)*, vol. 2. Santa Barbara, CA, USA: IEEE, 23-28 Sep. 2000, pp. 543–548. [Online]. Available: http://doi.acm.org/10.1109/WCNC.2000.903911,2013.03.14.[Accessdate10/12/2013]

[166] R. Baumann, S. Heimlicher, M. Strasser, and A. Weibel, "A Survey on Routing Metrics," Computer Engineering and Networks Laboratory, ETH-Zentrum, Switzerland, Technical Report TIK/262, Feb. 2007. [Online]. Available: http://www.baumann.info/public/tik262.pdf.[Accessdate10/12/2013]

[167] *Normalization Rank: Tutoriall, Kardi Teknomo's Personal Home Page*. [Online]. Available: http://people.revoledu.com/kardi/personal/cv/BriefCV.htm.[Accessdate10/12/2013]

[168] Y. Wang, X.-Y. Li, W.-Z. Song, M. Huang, and T. Dahlberg, "Energy-Efficient Localized Routing in Random Multihop Wireless Networks," *IEEE Transactions on Parallel and Distributed Systems*, vol. 22, no. 8, pp. 1249–1257, Aug. 2011. [Online]. Available: http://dx.doi.org/10.1109/TPDS.2010.198.[Accessdate10/12/2013]

[169] N. Luttenberger and H. Peters, "Node Degree-based Improved Hop Count Weighted Centroid Localization Algorithm," in *the Proceeding of the 17th Conference on Communication in Distributed Systems (GI/ITG)*, vol. 17. Kiel, Germany: Dagstuhl-Leibniz Center for computer science, 8-11 Mar. 2011, pp. 194–199. [Online]. Available: drops.dagstuhl.de/opus/volltexte/2011/2972/.

[170] K. Xu, M. Gerla, and S. Bae, "Effectiveness of RTS/CTS Handshake in IEEE 802.11 Based Ad Hoc Networks," *Ad Hoc Networks*, vol. 1, no. 1, pp. 107–123, Jul. 2003. [Online]. Available: http://dx.doi.org/10.1016/S1570-8705(03)00015-5.

[171] A. Mohammad, X. H., M. Islam, and K. Zunnurhain, "Delay Analysis of Wireless Ad Hoc Networks: Single vs. Multiple Radio," in *the Proceedings of the IEEE 35th Conference on Local Computer Networks (LCN)*. Denver, CO: IEEE, 10-14 Oct. 2010, pp. 814–820. [Online]. Available: http://dx.doi.org/10.1109/LCN.2010.5735817.

[172] J. Li, Z. Li, and P. Mohapatra, "Adaptive Per Hop Differentiation for End-to-end Delay Assurance in Multihop Wireless Networks," *Ad Hoc Netw.*, vol. 7, no. 6, pp. 1169–1182, Aug. 2009. [Online]. Available: http://dx.doi.org/10.1016/j.adhoc.2008.10.005.[Accessdate10/12/2013]