An analysis of Node/Peer Discovery Approach and Routing Algorithms in Mobile & Traditional Peer-to-Peer Networks

MOHAMED OMAR ABDULLAHI

UNIVERSITI UTARA MALAYSIA
2012

An analysis of Node/Peer Discovery Approach and Routing Algorithms in Mobile & Traditional Peer-to-Peer Networks

A project submitted to Dean of Awang Had Salleh Graduate School in partial
Fulfillment of the requirement for the degree of
Master of Science (Information Technology)
Universiti Utara Malaysia

By
Mohamed Omar Abdullahi

DEAN OF AWANG HAD SALLEH GRADUATE SCHOOL
UNIVERSITI UTARA MALAYSIA

PERMISSION TO USE

In presenting this project in partial fulfillment of the requirements for a postgraduate degree from the Universiti Utara Malaysia, I agree that the University Library may make it freely available for inspection. I further agree that permission for copying of this project in any manner in whole or in part, for scholarly purposes may be granted by my supervisor(s) or in their absence by the Dean of Awang Had Salleh Graduate School. It is understood that any copying or publication or use of this project or parts 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 project.

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

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

ABSTRACT

Mobile devices are becoming an increasingly indispensable part of people's everyday life, in the form of mobile phones, PDAs and laptop computers to communicate or share data between them. Centralized client-server networks are being transformed to distributed peer-to-peer networks. Lessons learned from fixed networks have been applied in cellular network. So, there are many challenges faced by traditional and mobile peer-to-peer networks therefore, in this study we examine a comparative analysis of node/peer discovery approach and routing algorithms employed in both traditional and mobile peer-to-peer networks. A qualitative methodology approach was used for data sources. Documents related to node/peer discovery approach and routing algorithms were studied. A comparative method and content analysis were used to analyze the data collected.

Findings of the study indicated that there are two clear differences in the aspects of neighboring node/peer discovery approach beside the similarities. The study also showed another differences and similarities in the aspect of routing algorithms. This thesis hopes to offer all necessary useful tips of the divergence on these two aspects and thus to make a contribution allowing researchers to know such divergence.

ACKNOWLEDGEMENT

All praise is due to Allah SWT, and peace and blessing be upon Prophet Muhammad SAW, his Family and his Companions. I would like to express my appreciation to the following persons who always help me during this project paper.

First and foremost, I wish to express my sincere gratitude to my supervisor, Dr. Ahmad Suki Che Bin Mohamed Arif, for having introduced me to the field and for his constant encouragement, guidance and support during the course of this project. Thank you for all the opportunities that you have showed me to which definitely will help me in my future career.

Secondly, I am grateful to the SIMAD University for providing the financial support which has enabled me to pursue this Masters degree. I would also like to give high appreciation to my family; my mother, Shukri Weheliye Tohow, who never stopped and always show their support and encouragement to my study, my Beloved wife Rahma Mohamed Abdulle, who always standing by me, supporting me, and giving me spiritual uplifting. I would not be able to achieve my success without her support.

Lastly, I would like to thank my dear friend Mohamed-Deeq Mohamud Yalahow and special thanks to my friends and colleagues who always patiently give me spirit and courage in order to finish my study.

"Sometimes our light goes out but is blown into flame by another human being. Each of us owes deepest thanks to those who have rekindled this light."

Albert Schweitzer

TABLE OF CONTENTS

LIST OFABBREVIATIONS

PDA	**P**ersonal **D**igital **A**ssistant
P2P	**P**eer-**To**-**P**eer
ARPANET	**A**dvanced **R**esearch **P**rojects **A**gency **Net**work
IMPs	**I**nterface **M**essage **P**rocessors
C/S	**C**lient/**S**erver
SRI	**S**tanford **R**esearch **I**nstitute
UCLA	**U**niversity **C**alifornia, **L**os **A**ngeles
UCSB	**U**niversity **C**alifornia, **S**anta **B**arbara
UUCP	**U**nix-to-**U**nix **C**opy **P**rotocol
TCP	**T**ransmission **C**ontrol **P**rotocol
IP	**I**nternet **P**rotocol
NNTP	**N**etwork **N**ews **T**ransport **P**rotocol
DNS	**D**omain **N**ame **S**ystem
NAT	**N**etwork **A**ddressable **T**ranslation
ADSL	**A**symmetric **D**igital **S**ubscriber **L**ine
DHS	**D**istributed **H**ash **T**able
CAN	**C**ontent **A**ddressable **N**etwork
WLAN	**W**ireless **L**ocal **A**rea **N**etwork
IEEE	**I**nstitute of **E**lectrical and **E**lectronics **E**ngineers
LAN	**L**ocal **A**rea **N**etwork
WAN	**W**ide **A**rea **N**etwork
CPU	**C**entral **P**rocessing **U**nit
UCP2P	**U**ser-**C**entric **P**eer-to-**P**eer
DCP2P	**D**ata-**C**entric **P**eer-to-**P**eer
HSDPA	**H**igh-**S**peed **D**ownlink **P**acket **A**ccess
GSM	**G**lobal **S**ystem for **M**obile
CSD/GPRS	**C**ircuit **S**witched **D**ata/**G**eneral **P**acket **R**adio **S**ervices
LTE	**L**ong **T**erm **E**volution
Wi-Fi	**Wi**reless **Fi**delity
WiMAX	**W**orld **W**ide **i**nteroperability for **M**icrowave **A**ccess
TDMA	**T**ime **D**ivision **M**ultiple **A**ccess
FH	**F**requency **H**opping

DS	**D**irect **S**equence
IF	**I**nfrared
OFDM	**O**rthogonal **F**requency **D**ivision **M**ultiplexing
SNR	**S**ign to **N**oise **R**atio
MAC	**M**edium **A**ccess **C**ontrol
DCF	**D**istributed **C**oordination **F**unction
CSMA/CA	**C**arrier **S**ense **M**ultiple **A**ccess/**C**ollision **A**voidance
RTS	**R**eady-**T**o-**S**end
CRT	**C**lear-**T**o-**S**end
TTL	**T**ime-**T**o-**L**ive
DBF	**D**istributed **B**ellman **F**ord
DSDV	**D**estination **S**equenced **D**istance **V**ector
DSR	**D**ynamic **S**ource **R**outing
AODV	**A**d hoc **O**n-demand **D**istance **V**ector
RREQ	**R**oute **R**equest
RREP	**R**oute **R**eply
OSI	**O**pen **S**ystems **I**nterconnection
FEC	**F**orward **E**rror **C**orrection

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

1.0.INTRODUCTION

The emergence of mobile devices has changed the landscape of Peer-to-Peer computing. Traditionally, Peer-to-peer network is another network model which provides the architecture of traditional client-server [1]. Peer to peer networks use a form of decentralization where each machine, referred to as a peer, functions as a client with a layer of its own functionality of the server. The role of a client and a server will be played by a peer at the same time. Therefore, request initiation to other peer, and despite this, responses to the incoming requests from other peer will go through on the network. It is different from the traditional client-server model which only clients can send request to a server and then wait for the response of the server.

Now, with the drastic increment of mobile devices, Peer-to-Peer works differently and has shown their advantages and possibility over centralized approaches. Inspired by the fixed domain, peer-to-peer networks are now penetrating the wireless and mobile domain which is interesting to be studied.

With the approach of a client-server, the server performance degradation as the number of clients requesting services from server increase [2]. However, in Peer-to-Peer networks, the overall performance of the network actually improves as is added to a growing number of his peers to the network. Such peers organize themselves into ad hoc groups as they communicate and collaborate and share their bandwidth with each other to accomplish the tasks at hand (such as file sharing). Each peer uploads and downloads at the same time, as well as in such an operation, and the new peer can

The contents of the thesis is for internal user only

REFERENCES

[1] G. Kortuem, "When Peer-to-Peer comes Face-to-Face: Collaborative Peer-to-Peer Computing in Mobile Ad Hoc Networks," in *First IEEE International Conference on Peer-to-Peer Computing*, 2001, pp. 75-91.

[2] B. Leuf, *Peer to Peer Collaboration and Sharing over the Internet*, Indianapolis: Addison-Wesley, 2002.

[3] R. Shollmeier, I. Gruber and M. Finkenzeller, "*Routing in Mobile Ad Hoc Networks and Peer-to-Peer Networks, a Comparison*", Inter. Workshop on Peer-to-Peer Computing, Pisa, Italy, 2002.

[4] G. Ding and B. Bhargava, "Peer-to-peer file-sharing over mobile ad hoc networks," in Pervasive Computing and Communications Workshops, 2004. Proceedings of the Second IEEE Annual Conference on, 2004.

[5] O. Andy, Peer-to-peer: harnessing the power of disruptive technologies, O'Reilly Media, 2001.

[6] J. M., McQuillan, and D. C., Walden "The ARPANET design decisions". Computer Networks, 1977 pp. 243–289.

[7] J. M., McQuuillan, G. Folk, and I. Richer, A review of the Development and Performance of the ARPANET Routing Algorithm, *IEEE Trans. On Comm.*, COM-26,12, 1978, pp. 1802-1811.

[8] B. Aboba, The online user's encyclopedia, Addison-Wesley, 1993.

[9] C., Lueg, and D., Fisher, From Usenet to CoWebs: interacting with social information spaces., Springer, 2003.

[10] K., Nagaraja, S., Rollins, and M., Khambatti, Looking beyond the legacy of Napster and Gnutella. IEEE Distributed Systems, 2006.

[11] R. Schollmeier, "A Definition of *Peer-to-Peer* Networking for the Classification of *Peer-to Peer* Architectures and Applications," in *First IEEE International Conference on Peer-to-Peer Computing*, 2001, pp. 101-102.

[12] "Dictionary.com,", http://www.dictionary.com. Accessed February, 28, 2012.

[13] S. ANDROUTSELLIS-THEOTOKIS AND D. SPINELLIS, *A Survey of Peer-to-Peer Content Distribution Technologies*, ACM Computing Surveys, 2004, Vol. 36, No. 4, pp. 335–371.

[14] Frank H. P. Fitzek and Hassan Charaf, *Mobile Peer to Peer (P2P): A Tutorial Guide*, John Wiley & Sons, 2009.

[15] Stichbury, J., *'Games on Symbian OS'*, ISBN: 0470998040, John Wiley & Sons, Inc., Hoboken, NJ, 2008.

[16] '*Connected Limited Device Configuration*'. Available at: http://java.sun.com/products/cldc.

[17] "Sensible-computer-help.com" http://www.sensible-computer help.com/computer-network.html accessed March, 04, 2012

[18] I. Stoica, R. Morris, D. Liben-Nowell, D. R. Karger, F. F. Kaashoek, F. Dabek, and H. Balakrishnan, "Chord: a scalable peer-to-peer lookup protocol for internet applications," IEEE/ACM Trans. Netw., pp. 17-32, 2003.

[19] S. Ratnasamy, P. Francis, M. Handley, R. Karp, and S. Schenker, "A scalable content-addressable network," in SIGCOMM '01: Proceedings of the 2001 conference on Applications, technologies, architectures, and protocols for computer communications, pp. 161-172, 2001.

[20] R. Ramanathan and J. Redi, "A Brief Overview of Ad Hoc Networks: Challenges and Directions," *IEEE Communications*, no. 50th Anniversary Commemorative Issue, pp. 20-22, 2002.

[21 http://www.wirelessdictionary.com/wireless_dictionary_bluetooth_definition.html accessed April, 04, 2012

[22] B. E. Henty, "A Brief Tutorial on the PHY and MAC layers of the IEEE 802.11b Standard," 2001.

[23] R. Yin, *Case study research: Design and methods* (2nd ed.). Thousand Oaks, CA: Sage Publishing, 1994.

[24] J. Luo, B. Xiao, Z. Yang and S. Zhou, "A Clone of Social Networks to Decentralized bootstrapping P2P networks," in Quality of Service (IWQoS), 18th International Workshop on Digital Object Identifier, 2010.

[25] A. Oram, PEER-TO-PEER – Harnessing the Power of Disruptive Technologies, California: O'Reilly & Associates, 2001.

[26] M. Portmann et. al., "The Cost of Peer Discovery and Searching in the Gnutella Peer-to-peer File Sharing Protocol," in Ninth IEEE International Conference on Networks, 2001, pp. 263-268.

[27] M. Portmann and A. Seneviratne, "The Cost of Application-level Broadcast in a Fully Decentralized Peer-to-Peer Network," in Seventh IEEE International Symposium on Computers and Communications, 2002, pp. 941-946.

[28] K. Morsi, Q. Gao and H. Xiong, "Analysis and modelling of interference in bluetooth device discovery," *IET JOURNAL & MAGAZINES*, vol. 5, no. 6, pp. 890-900, 2011.

[29] H. Fornazier, A. Martin and S. Messner, "Wireless COmmunication: Wi-Fi, Bletooth, IEEE 802.15.4, DASH7," 2012.

[30] The Gnutella Protocol Specification v0.4. http://dss.clip2.com/GnutellaProtocol04.pdf

[31] Christpher Rohrs. “Query Routing for the Gnutella Network”. http://www.limewire.com/developer/query_routing/keyword%20routing.htm. 2001.

[32] http://www.fasttrack.nu/index_int.html.

[33] C. Perkins, “Highly Dynamic Destination Sequence Distance Vector Routing (DSDV) for Mobile Computers”, ACM SIGCOMM'94, 1994

[34] O. Bertsekas, R. Gallager, Data Networks, 2nd Edition, Prentice Hall Inc., 1992

[35] D. Johnson, D. Maltz, “Dynamic Source Routing in Ad hoc Wireless Networks”, edited by T. Imielinski and H. Korth, Kluwer Academic Publisher, pp. 153-181, 1996

[36] D. Johnson, D. Maltz, Y. Hu, "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR)," IETF Internet-Draft, draft-ietf-manet-dsr-06.txt, 2001

[37] C. Perkins, E. Royer, “Ad hoc On demand Distance Vector Routing”, Proceeding of 2nd IEEE Workshop on Mobile Computing Systems and Applications, 1999

[38] Z. Haas, M. Pearlman, “The Performance of Query Control Schemes for the Zone Routing Protocol”, IEEE/ACM Transactions on Networking, Vol. 9, No. 4, 2001

[39] Z. Haas, M. Pearlman, and P. Samar, "Zone Routing Protocol (ZRP)," IETF Internet Draft, draft-ietfmanet-zrp-04.txt, 2001.

[40] P.Johansson et al. “Scenario Based Performance Analysis of Routing Protocols for Mobile Ad-hoc Networks”, Mobicom ’99, 1999 Seatle, USA

[41] J. Broch et al., “A Performance Comaprison of Multi-Hop Wireless Ad hoc Network Routing Protocols”, MobiCom ’98, 1998, Dallas, USA

[42] http://hexus.net/tech/news/network/34025-buffalo-announces-80211ac-wireless-router/ access June, 13, 2012.