

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

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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, sendiri, 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 Evaluation 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 *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.

[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.

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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 Beacons 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	Genetic 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

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