

**A PROXY-ASSISTED ROUTING FOR
EFFICIENT DATA TRANSMISSION IN
MOBILE AD HOC NETWORKS**

MAY ZIN OO

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Name of Candidate: May Zin Oo

(I.C/Passport No: OM-143806)

Registration/Matric No: WHA070002

Name of Degree: Doctor of Philosophy

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ABSTRACT

A new protocol, named Proxy-Assisted Routing for efficient data Transmission (PART), that uses a cross layer approach is proposed to route packets to a destination efficiently in Mobile Ad Hoc Networks (MANETs).

PART limits the number of control packets with the aid of proxy nodes, adapts to route failures and avoids congestion quickly by broadcasting routing information within a predefined zone. It utilizes the address information of the Medium Access Control (MAC) layer to transmit unicast control messages and limit the broadcast zone. Only mobile nodes that are in this zone are allowed to broadcast routing information to reduce the control overhead and packet collision.

A middle node is selected to perform proxy duty for a TCP connection. The responsibility of a proxy node is to reply to a new route request from a source node and to request a new route to the destination when there is a link break. In order to reduce the extra routing overhead of assigning a proxy node, a unicast route reply packet is modified by adding a proxy address and a proxy hop count field in the packet header.

A destination node determines whether a proxy node is needed based on the hop count. If the hop count to the source node is longer than a pre-defined value, it initiates a procedure to appoint a proxy node. Otherwise, a proxy node is not appointed. Whenever a route failure occurs between a source and proxy node, the source node takes the responsibility of searching for a new route to the proxy node. The proxy node also does the same thing, as long as the proxy node is available.

In order to ensure the reliability of TCP, a proxy node acknowledgement (PACK) is introduced to check the correctness of data packets and informing the source node of missing packets by sending an acknowledgement to the source node in advance. By doing so, the source node does not have to wait for an end-to-end acknowledgement from a destination, resulting in increased throughput and decreased delay.

For the purpose of performance analysis, an analytical framework is proposed to compare the robustness and efficiency of PART to other routing protocols. The comparisons were done across the mobility models that are intended for MANETs. The simulation results show that PART improves the overall network performance in terms of throughput, control overhead, delay, packet losses and packet collisions at the MAC layer. Among the contributions of this research are to limit the broadcast region by using a proxy node, to repair broken routes between source-proxy and proxy-destination nodes, and the use of local acknowledgement from a proxy to a source to ensure the reliability and correctness of TCP packets.

ABSTRAK

Satu protokol baru, bernama Proxy-Assisted Routing for efficient data Transmission (PART), yang menggunakan pendekatan lapisan silang dicadangkan untuk menghalakan bingkisan ke destinasi dengan cekap dalam Mobile Ad Hoc Network (MANET).

PART menghadkan bilangan bingkisan kawalan dengan bantuan nod proksi, menyuai terhadap kegagalan hala dan mengelakkan kesesakan dengan cepat dengan menyiarkan maklumat penghalaan dalam lingkungan zon pra-takrif. Ia menggunakan maklumat alamat di lapisan Medium Access Control (MAC) untuk menghantar utusan kawalan secara unikas dan menghadkan zon penyiaran. Hanya nod kembara dalam zon ini dibenarkan untuk menyiarkan maklumat penghalaan untuk mengurangkan overhed kawalan dan pelanggaran bingkisan.

Satu nod tengah dipilih untuk menjalankan tugas proksi bagi satu sambungan TCP. Tanggungjawab nod proksi adalah untuk menjawab permintaan penghalaan baru dari nod sumber dan meminta hala baru ke destinasi bila terdapat hala yang terputus. Untuk mengurangkan overhed penghalaan semasa melantik nod proksi, bingkisan jawapan hala unikas diubahsuai dengan menambah medan alamat proksi dan medan bilangan lompatan proksi dalam kepala bingkisan.

Nod destinasi menentukan sama ada nod proksi diperlukan berdasarkan bilangan lompatan. Jika bilangan lompatan ke nod sumber lebih panjang daripada nilai pra-takrif, ia memulakan prosedur untuk melantik nod proksi. Jika tidak, nod proksi tidak dilantik. Apabila kegagalan hala berlaku di antara nod sumber dan nod proksi, nod sumber memikul tanggungjawab mencari hala baru ke nod proksi. Nod proksi melakukan hal yang sama selagi mana nod proksi masih sedia ada.

Untuk memastikan kebolehpercayaan TCP, teknik perakuan nod proksi (PACK) diperkenalkan untuk menyemak ketepatan bingkisan data dan memaklumkan nod sumber mengenai sebarang bingkisan yang hilang dengan menghantar perakuan ke nod sumber lebih awal. Dengan ini, nod sumber tidak perlu menunggu perakuan hujung-ke-hujung dari destinasi.

Untuk tujuan analisis prestasi, suatu rangkakerja analitikal dicadangkan untuk membandingkan keteguhan dan kecekapan PART dengan protokol-protokol penghalaan lain. Perbandingan dilakukan merentas model mobiliti MANET. Keputusan simulasi menunjukkan PART meningkatkan prestasi keseluruhan rangkaian daripada sudut daya pemprosesan, overhed kawalan, lengah, kehilangan bingkisan dan pelanggaran bingkisan di lapisan MAC. Antara sumbangan penyelidikan ini adalah menghadkan kawasan penyiaran dengan menggunakan nod proksi, memperbaiki hala rosak antara nod sumber-proksi dan nod proksi-destinasi, dan penggunaan perakuan setempat dari proksi ke sumber untuk memastikan kebolehpercayaan dan ketepatan bingkisan TCP.

DEDICATION

To my father and mother:

U Hla Myint + Daw Khin Thein Oo

The two admired persons who guide me throughout my life,
for their endless love.

To my high school teacher:

Sayar U Win Than

Who has supported and encouraged me.

To my little brother:

Thiha Soe Lin

Who loves and cares about me.

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LIST OF SYMBOLS AND ABBREVIATIONS

AAODV	Adaptive AODV
ABL	AODV Adaptive Backup with Local Repair Route
ABR	Associatively Based Routing
ABR	Adaptive Backup Routing
ACK	Acknowledgement
ADV	Adaptive Proactive
AGAR	Adaptive Gossip-based Ad Hoc Routing
AIR	Applicative Indirect Routing
AODV	Ad-hoc On-demand Distance Vector
AODV-2T	AODV-Two Level Thresholds
AODV-BR	AODV Backup Routing
AOMDV	Ad-hoc On-demand Multipath Distance Vector
ATCP	Ad hoc TCP
ATM	Asynchronous Transfer Mode
BRRP	Backup Route Reply
BUS	Buffering Capacity and Sequence Information
CBR	Constant Bit Rate
CBK	Call Back
CMU	Carnegie Mellon University
COPAS	Contention-based Path Selection
CWND	Congestion Window
DCF	Distributed Coordination Function
DFRP	Direct Forwarding Routing Protocol
DOA	DSR over AODV
DOOR	Detection of Out-of-Order and Response
DSDV	Destination Sequence Distance Vector
DSR	Dynamic Source Routing
ECN	Explicit Congestion Notification
ELFN	Explicit Link Failure Notification
ERDN	Explicit Route Disconnection Notification
ERP	Early Route Update
ERRA	Early Route Rearrangement
ERSN	Explicit Route Successful Notification

FPR	Fixed Probabilistic Route discovery
FTP	File Transfer Protocol
Geo-AODV	GPS-enhanced AODV
GPS	Global Positioning System
HC	Hop Count
HTTP	Hypertext Transfer Protocol
IETF	Internet Engineering Task Force
LACK	Local Acknowledgement
MAC	Media Access Control
MACT	Multicast Activation
MANET	Mobile Ad Hoc Network
MAODV	Multicast AODV
MG	Manhattan Grid
MHGR-P	Multihop Hello Guided Routing with Proactive
MHGR-R	Multihop Hello Guided Routing with Reactive
MHGR-U	Unified MHGR
MMS	Maximum Segment Size
MNH	Multiple Next Hop
MPR	Multipoint Relays
NRL	Normalized Routing Load
NS	Network Simulator
OAODV	Optimized Ad-hoc On-demand Distance Vector
OGPR	On-demand Geographic Path-based Routing
OHPACK	One Hop Broadcast PACK
OLSR	Optimized Link State Routing
OSI	Open Systems Interconnection
OTcl	Object-oriented Tool Command Language
PACK	Proxy Acknowledgement
PART	Proxy-Assisted Routing for Efficient Data Transmission
PDF	Packet Delivery Fraction
PHC	Proxy Hop Count
PLR	Packet Loss Rate
PLRR	Preemptive Local Route Repair

PN	Pivoting Node
PRDS	Priority Route Discovery Strategy
RED	Random Early Detection
RFN	Route Reestablishment Notification
RPGM	Reference Point Group Mobility Model
RREP	Route Reply
RREQ	Route Request
RERR	Route Error
RT	Routing Table
RTE	Routing Table Entry
RTO	Retransmission Timeout
RTT	Round Trip time
RWP	Random Waypoint
SACK	Selective Acknowledgements
SHAODV	Self-Healing AODV
SHARP	Sharp Hybrid Routing Protocol
SMTP	Simple Mail Transfer Protocol
SN	Sequence number
SNR	Signal to Noise Ratio
SPC	Statistic Process Control
TCP	Transmission Control Protocol
TCP-F	TCP-Feedback
THP	Three-hop Horizon Pruning
UDP	User Datagram Protocol
VINT	Virtual Internet Testbed
VoIP	Voice over IP
WWW	World Wide Web
ZRP	Zone-based Routing Protocol