PERFORMANCE ENHANCEMENT OF ADAPTIVE CLUSTER FORMATION AND ROUTING PROTOCOLS IN WIRELESS NETWORKS

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Thesis submitted in fulfilment of the requirements
for the award of the degree of
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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scopes and quality for the award of the degree of Doctor of Philosophy in Computer Science.

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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Date : MARCH 2017

Dedicated To

My

Parents;

Brothers and sisters

Beloved wife and daughter

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"*Allah will rise up, to (suitable) ranks (and degrees), those of you who believe and who have been granted (mystic) Knowledge. And Allah is well-acquainted with all ye do*"
(The Holy Quran - Al-Mujadila 11:58)

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CHAPTER 5 CONCLUSIONS & FUTURE WORK

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LIST OF ABBREVIATIONS

ACK	Acknowledgment
AODV	Ad-Hoc On-demand Distance Vector Routing
ARPANET	Advanced Research Projects Agency Network
AVC	Advanced Video Coding
BL	Base Layer
CBR	Continuous Bit Rate
DARPA	*Defence Advanced Research Projects Agency*
DSDV	Destination Sequenced Distance Vector
DSL	Digital Subscriber Line
DSR	Dynamic Source Routing
EBCRA	Effective Broadcast Control Routing algorithm
ESRSBRP	Route Stability Based Routing Protocol
EL	Enhancement Layer
HC	Hop Count
IP	Internet Protocol
IVRP	Improved Video Routing protocol
ISM	Industrial, Scientific and Medical
LDC	Layer description coding
LET	Link out Expiration Time
LANs	Local Area Network
MANET	Mobile Ad-Hoc Network
MaxHC	Maximum Hop Count
MaxRET	Maximum Route Expiration Time
MDC	Multi Description Coding
NS2	Network simulator2
OLSR	Optimized Link State Routing
OTCL	Object Transcript Control Language
PBCC	Packet Binary Convolution Coding
PDAs	Personal Digital Assistants
PDR	Packet Delivery Ratio
PSNR	Peak Signal to Noise Ratio
QoS	Quality of Service
RE	Residual Energy
RE-RREQ	Route-Request
RE-REPLY	Route-Replay
RET	Route Expiration Time
SDC	Single Description Coding
SF	Scale Factor
TCP	Transmission Control Protocol
UNII	Unlicensed National Information Infrastructure
UDP	User Datagram protocol
WLAN	Wireless Local Area Network

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ABSTRACT

Quality of service (QoS) in Mobile Ad hoc Networks (MANET) has been an interesting research field. The main challenges like packet loss, congestion, multipath fading and link failure, have to be handled wisely. These challenges happen due to several factors like interference, noise, impairments at the physical and network layer, etc. This thesis describes an analysis on the effect of these challenges on the perceived video quality over MANET which is considered the important network in many studies. An enhanced algorithm has been suggested to improve the video quality using routing algorithm which is used to transfer the data packets with minimum number of errors. The impacts of many parameters such as routing protocols, wireless propagation type and encoded video format, on the perceived video quality have been studied. Moreover, the effect of routing protocol and the wireless channel propagation standards on the quality of the received video have been analysed. Layer description coding (LDC), which divides the video frames into the base layer (BL) and enhanced layer (EL), is used to encode and decode the original video. BL can be decoded to construct the original video with basic quality and EL is used to improve the quality of BL. An enhanced routing protocol, which is used to route the BL video packets, namely the improved video transmission protocol (IVRP) was proposed. It is proven can reduce the link failure problem and deliver the video packet in a high quality. The routing discovery process is divided into two stages: intra-routing and inter-routing discovery. The inter- routing corresponds to routing between two sets and it uses the *global positioning system* (GPS) to obtain location information for each node. For EL video packets, an enhanced routing algorithm was proposed to route the Enhance Layer (EL) packets, namely, Energy Sensible and Route Stability Based Routing Protocol (ESRSBRP) which is used over Mobile network. ESRSBRP selects the highly stable route in term of energy as well as mobility of nodes for the individual data transmission between the source and destination. An enhanced algorithm which is used to improve the video quality was proposed, namely, Effective Broadcast Control Routing algorithm (EBCRA). EBCRA solves the issue of redundant re-transmission of RREQ packet and propose a routing algorithm that deal with the broadcast storm problem which is widely practiced in MANET routing protocol. A model for MANET has been simulated, with various scenarios. The effects of changes in movement (speed), number of sent packets and node density (number of nodes), on the quality of the transmitted video quality have been measured. The IVRP, EBCRA and ESRSBRP performance have been compared with the other routing algorithms. The efficiency and scalability of the proposed algorithms are measured based on different performance metrics, namely: throughput, packet delivery ratio, end to end delay, the number of dropped packets and normalized control overhead. The simulation results have shown that these algorithms can increase the throughput and packet delivery ratio. Furthermore, the end to end delay, number of dropped packets, and normalized control overhead has been reduced, as reflected significantly in the video transmission quality.

ABSTRAK

Kualiti perkhidmatan (QoS) di Mobile Ad Hoc Networks (MANET) telah menjadi bidang penyelidikan yang menarik. Cabaran utama seperti kehilangan paket, kesesakan, pelbagai arah pudar dan kegagalan pautan, perlu ditangani dengan bijak. Cabaran-cabaran ini berlaku disebabkan oleh beberapa faktor seperti gangguan, bunyi bising, gangguan pada lapisan fizikal dan lapisan rangkaian serta lain-lain lagi. Laporan ini menerangkan tentang analisis mengenai kesan daripada cabaran-cabaran tersebut kepada kualiti video yang dilihat dalam Manet ini sebagai rangkaian penting dalam kebanyakan kajian. Algoritma tertingkat telah dicadangkan untuk meningkatkan kualiti video menggunakan algoritma penghalaan yang digunakan untuk memindahkan paket data dengan jumlah kesilapan yang minimum. Kesan daripada parameter yang banyak seperti protokol penghalaan, jenis rambatan tanpa wayar dan format video telah dikodkan ke atas kualiti video yang dilihat telah dikaji. Selain itu, kesan protokol penghalaan dan piawaian saluran rambatan tanpa wayar ke atas kualiti video yang diterima telah dianalisis. Lapisan perihal pengekodan (LDC), yang membahagikan bingkai video ke dalam lapisan asas (BL) dan lapisan tertingkat (EL), digunakan untuk mengekod dan menyahkod video asal. BL boleh dinyahkod untuk membina video asal dengan kualiti asas dan EL digunakan untuk meningkatkan kualiti BL. Protokol penghalaan tertingkat, yang digunakan untuk laluan paket video BL, iaitu Protokol Penghantaran Video yang Diperbaiki (IVRP) telah dicadangkan. Ini membuktikan bahawa ia mengurangkan masalah kegagalan pautan dan menyampaikan paket video dalam kualiti yang tinggi. Proses penemuan laluan dibahagikan kepada dua peringkat iaitu penemuan dalam laluan dan penemuan antara laluan. Penemuan antara laluan ialah sepadan dengan laluan antara dua set dan ia menggunakan sistem kedudukan global (GPS) untuk mendapatkan maklumat lokasi bagi setiap nod. Untuk paket video EL, algoritma penghalaan dipertingkatkan telah dicadangkan untuk laluan lapisan tertingkat (EL) paket, iaitu, Protokol Penghalaan Berdasarkan Kestablilan Laluan dan Tenaga yang Munasabah (ESRSBRP) yang digunakan melalui rangkaian Mobile. ESRSBRP memilih laluan yang sangat stabil dari segi tenaga dan mobiliti nod untuk penghantaran data individu di antara sumber dan destinasi. Algoritma tertingkat yang digunakan untuk meningkatkan kualiti video yang telah dicadangkan iaitu algoritma Penghalaan Kawalan Siaran Berkesan (EBCRA). EBCRA menyelesaikan isu berlebihan penghantaran-paket semula (RREQ) dan mencadangkan algoritma penghalaan yang berurusan dengan masalah siaran ribut yang diamalkan secara meluas dalam protokol penghalaan Manet. Satu model untuk Manet telah disimulasi dengan pelbagai keadaan. Kesan perubahan dalam pergerakan (kelajuan), bilangan paket yang dihantar dan ketumpatan nod (bilangan nod), pada kualiti video yang dipindahkan telah diukur. IVRP, EBCRA dan prestasi ESRSBRP telah dibandingkan dengan algoritma penghalaan yang lain. Kecekapan dan kebolehan algoritma yang dicadangkan adalah diukur berdasarkan metrik yang berbeza prestasi, iaitu daya pemprosesan, nisbah penghantaran paket, kelewatan hujung ke hujung, bilangan paket digugurkan dan overhead kawalan normal. Keputusan simulasi telah menunjukkan bahawa algoritma ini boleh meningkatkan nisbah penghantaran pemprosesan dan paket. Tambahan pula, kelewatan hujung ke hujung, bilangan paket gugur, dan overhed kawalan normal telah dikurangkan, seperti yang ditunjukkan dengan ketara dalam kualiti penghantaran video.

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