



UNIVERSITI PUTRA MALAYSIA

***SEAMLESS VERTICAL HANDOVER BETWEEN 3G UNIVERSAL
MOBILE TELECOMMUNICATIONS SYSTEM AND WIRELESS LAN
WITH MODIFIED MOBILE STREAM CONTROL TRANSMISSION
PROTOCOL***

BASHAR JABBAR HAMZA

FK 2011 69

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PROTOCOL**

By

BASHAR JABBAR HAMZA

**Thesis Submitted to the School Graduate Studies, University Putra Malaysia, in
Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

August 2011

قال تعالى:

{ ن والقلم وما يسطرون }

القلم 1

DEDICATION

To the dear memories of my Father and Brother (Jabbar and Riad)

To my dear Mother, Sabeha, for her love and encouragement

To my kindest wife, Safaa for her love, her loyalty, and her support

To my lovely daughter and son (Maryam and Mohammed)

To my brothers (Diae and Waddah)

And to my sisters for their extraordinary love,

their endless care and encouragement

Thank you

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfilment
of the requirement for the degree of Doctor of Philosophy

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August 2011

Chairman: Nor Kamariah Noordin, PhD

Faculty: Engineering

With an increasing popularity in different kinds of wireless technologies, an internet user can acquire universal wireless access with a mobile node (MN). Different wireless technologies can make up a heterogeneous wireless network (HWN) such as universal mobile telecommunications system (UMTS) and wireless local area networks (WLAN). Communications between two or more different access networks will undergo vertical handover (VHO). To achieve the seamless VHO and smooth mobility in the HWN between UMTS and WLAN, a mobile stream control transmission protocol (mSCTP) is exploited in this thesis. A MN may experience performance degradation during VHO due to the deficiencies of mSCTP such as

selective acknowledgement (SACK) transmission lost, packet retransmission timeout and packet reordering. These deficiencies occur due to the disparity of given bandwidth and propagation delay between UMTS and WLAN access paths. In order to overcome these deficiencies, a packet reordering model (PRM) is proposed. The proposed PRM works as a special buffer with a large capacity to receive all transmission sequence numbers (TSNs). It then forwards all incoming abovementioned data chunks to the MN/WLAN or MN/UMTS networks after the VHO. The performance of the scheme is simulated and analyzed using NS-2 simulator. The simulation results show that the proposed PRM scheme enhances the performance throughput by 16% compared to conventional mSCTP. Also, the congestion window (CWND) of the mSCTP will be increased during VHO by 21 % when the proposed scheme is exploited.

In addition, we also propose a new scheme which is a hybrid scheme of mSCTP with multicasting mechanism called Bi-mSCTP under the mobile internet protocol (MIP) to overcome the MIP issues such as hybrid routing, registration delay, data session disruption during VHO, and packet overhead. These issues occur when the data packets of the MIP are sent from a foreign agent (FA) to a home agent (HA) via a tunnel when a MN moves to a new network. When a MN is in the area of VHO the proposed scheme relies on the generated mSCTP signals to allocate a new care-of-address (CoA) to the corresponding node (CN) dynamically before the link layer handover. At the same time, it inserts a multicasting flag inside the address configuration (ASCONF) control chunk to inform the CN to start the transmission

over both WLAN and UMTS links. The system performance was analyzed using the NS-2 simulation tool. The results showed that the hybrid Bi-mSCTP scheme introduces approximately 1.02s and 2.64s reduction in delay performance over both mSCTP and MIP schemes respectively. It also reduces the packet loss rate by more than 21.7% and 45% compared to mSCTP and MIP, respectively.

Finally, we proposed SHP scheme, a Seamless VHO Scheme, which is a combination of the hybrid Bi-mSCTP and pRM schemes. SHP scheme adopts the advantage of hybrid Bi-mSCTP and PRM schemes to achieve better serve for fast-moving users and smooth mobility in the HWN between cellular UMTS and WLAN networks. The simulation results showed that the proposed SHP scheme outperforms the other three schemes (conventional mSCTP, MIP and SIGMA schemes) in terms of VHO delay, throughput, and packet loss. In addition, the simulation results confirm that the proposed SHP scheme can achieve a smooth VHO and keep the VHO delay a minimum.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**ALIH MENEGAK ANTARA SEAMLESS 3G SEPERTI SISTEM
TELEKOMUNIKASI BERGERAK UNIVERSAL DAN WAYARLES LAN
OLEH SUATU PROTOKOL PENGHANTARAN KAWALAN ALIRAN
BERGERAK MODIFIKASI**

Oleh

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Dengan peningkatan populariti dalam pelbagai jenis teknologi wayarles, pengguna internet boleh mendapatkan capaian wayarles universal dengan menggunakan nod bergerak (MN). Teknologi-teknologi wayarles yang berbeza membentuk suatu rangkaian wayarles heterogen (HWN) seperti sistem telekomunikasi bergerak universal (UMTS) dan rangkaian kawasan tempatan wayarles (WLAN). Komunikasi antara dua atau lebih rangkaian capaian yang berbeza akan menjalani lepas tangan menegak (VHO). Untuk mencapai VHO licin dan mobiliti lancar dalam HWN antara UMTS dan WLAN, suatu protokol penghantaran kawalan aliran bergerak (mSCTP) dimanfaatkan. Suatu MN boleh mengalami penurunan prestasi sewaktu VHO kerana kekurangan mSCTP seperti perakuan selektif (SACK) kehilangan penghantaran,

masa luput penghantaran semula paket dan penyusunan semula paket. Kekurangan-kekurangan ini berlaku kerana ketidaksamaan lebar jalur yang diberikan dan lengah perambatan antara UMTS dan laluan capaian WLAN. Untuk mengatasi kekurangan-kekurangan ini, suatu model penyusunan semula paket (PRM) dicadangkan. PRM yang dicadangkan berfungsi sebagai suatu penimbal khusus dengan kapasiti besar untuk menerima semua nombor urutan penghantaran (TSNs). Ia kemudiannya menghantar semua potongan data tersebut ke rangkaian MN / WLAN atau MN / UMTS selepas VHO. Prestasi skim disimulasikan dan dianalisis menggunakan simulator NS-2. Keputusan simulasi menunjukkan bahawa skim PRM yang dicadangkan meningkatkan prestasi truput sebanyak 16% berbanding mSCTP piawai. Juga, tettingkap kesesakan (CWND) bagi mSCTP akan meningkat semasa VHO sebanyak 21% apabila skim yang dicadangkan dimanfaatkan.

Selain itu, kami mencadangkan skim baru yang dipanggil skim mSCTP hibrid dengan mekanisma dwi-tuangan atau dinamakan Bi-mSCTP di bawah MIP untuk mengatasi isu-isu protokol internet bergerak (MIP) seperti penghalaan hibrid, lengah pendaftaran, gangguan sesi data semasa VHO dan *overhead* paket. Isu-isu ini berlaku ketika paket-paket data MIP dihantar daripada wakil asing (FA) kepada ejen rumah (HA) melalui suatu terowong apabila satu MN bergerak ke rangkaian baru. Apabila suatu MN berada di dalam kawasan VHO, skim yang dicadangkan bergantung pada isyarat-isyarat mSCTP yang dihasilkan bagi memperuntukkan satu alamat-jagaan-baru (CoA) kepada nod yang berkenaan (CN) secara dinamik sebelum penyerahan lapisan paut. Pada masa yang sama, ia memasukkan bendera dwi-

tuangan di dalam konfigurasi alamat (ASCONF) potongan data untuk memberitahu CN untuk memulakan penghantaran melalui kedua-dua pautan WLAN dan UMTS. Prestasi sistem dianalisa dengan menggunakan alat simulasi NS-2. Keputusan kajian menunjukkan bahawa skim hibrid memperkenalkan pengurangan dalam prestasi kelewatan sekitar 1.02s dan 2.64s berbanding skim mSCTP dan MIP masing-masing. Ini juga mengurangkan kadar kehilangan paket lebih daripada 21.7% dan 45% berbanding dengan mSCTP dan MIP masing-masing.

Selain itu, kami mencadangkan skim SHP, suatu skim VHO licin, yang merupakan gabungan skim Bi-mSCTP hibrid dan skim PRM. Skim SHP mengadaptasi kelebihan skim Bi-mSCTP hibrid dan skim PRM untuk mencapai layanan yang lebih baik terhadap pengguna yang bergerak pantas dan mobiliti lancar dalam HWN antara UMTS selular dan rangkaian WLAN. Keputusan simulasi menunjukkan bahawa skim SHP yang dicadangkan mengatasi prestasi dua skim lain (mSCTP piawai dan skim hibrid) dari segi lengah VHO, truput dan kehilangan paket. Sebagai tambahan, hasil simulasi mengesahkan bahawa skim SHP dicadangkan mampu mencapai VHO lancar dan memastikan lengah VHO yang minimum.

ACKNOWLEDGEMENTS

First and foremost, Alhamdulillah for giving me the strength, patience, courage, and determination in completing this work. All grace and thanks belongs to Almighty Allah (S.W.T)

Many special thanks go to my supervisor Associate Professor Dr. Nor Kamariah bt. Noordin, for her incredible guidance, continuous support, and encouragement. She always having time for me and readily providing her technical expertise throughout the period of my study. I owe more than I can ever repay. The completion of this work becomes possible due to her supervision. Her high stance of diplomatic power and professionalism set a great model for me to follow.

I would also like to thank Dr. Mohd. Fadlee A.Rasid and Dr. Alyani Ismail for serving on my thesis committee. Their helpful suggestions and advices on various aspects of my research work have certainly been very constructive. Without their kind cooperation and support, my graduate study would not have been accomplished.

Last but not least, I would like to thank Dr. Micheal Ng for giving me precious comments and suggestions on my research project. He is always friendly and kind to us. I also learned invaluable paper writing skills from him.

I would also like to include acknowledgment to my housemate, Yaseen. He provided me a comfortable working environment during my study. Chatting with him during the leisure time made me feel relaxed and motivated.

I owe a lot to Omar M. Ceesay for helping me during the analysis of data. I want to thank my research collaborator and all my colleagues in the wireless laboratory, M. Ben Mubarak, Mostafa, Bassam, Aws, Alaa, Melad, Yassen, Yaquap, Ayyoup, Sabah, Sammer, Adam, Farhad and Sohail for the illuminating discussions and invaluable help in the development of this research. Thanks to everyone at the Faculty of Engineering and all those who asked "how is your thesis going?" These memories at the Faculty of Engineering will always be cherished.

I certify that a Thesis Examination Committee has met on 18- 08- 2011 to conduct the final examination of Bashar Jabbar Hamza on his Doctor of Philosophy thesis entitled “Seamless Vertical Handover between 3G UMTS and Wireless LAN with Modified Mobile Stream Control Transmission Protocol” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the University Putra Malaysia [P. U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the degree of Doctor of Philosophy

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at University Putra Malaysia or at any other institution.

BASHAR JABBAR HAMZA

Date: 18 August 2011

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