UNIVERSITI PUTRA MALAYSIA

PERFORMANCE ENHANCEMENT OF AIMD ALGORITHM FOR CONGESTION AVOIDANCE AND CONTROL

HAYDER NATIQ JASEM

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PERFORMANCE ENHANCEMENT OF AIMD ALGORITHM

FOR CONGESTION AVOIDANCE AND CONTROL

By

HAYDER NATIQ JASEM

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PERFORMANCE ENHANCEMENT OF AIMD ALGORITHM FOR CONGESTION AVOIDANCE AND CONTROL

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HAYDER NATIQ JASEM

August 2011

Chairman: Zuriati Ahmad Zukarnain, PhD.

Faculty: Computer Science and Information Technology.

Computer networks have revolutionized the human life in the end of the last century. Two major technical differences between telephone communication and the computer networks are as follows. First, telephones use a dedicated physical wire for each communication between two parties (circuit switched network). In contrast, computers share this physical line between many – unlimited, at least theoretically – computers (packet switch network). Secondly, telephone communication is used only for voice messages while the packets in packet switch network can contain any kind of information, even voice messages.

It should be obvious that these automatic robots (computers) need specific rules and regulations (protocols) to be able to communicate, interleaving data, through a single connection channel (e.g. bottleneck link). These protocols have been developed and

improved since the advent of the Internet. One major issue arose in 80s when routers got congested and the connections collapsed because they were pushed to their limits by the competing robots for connection. Since then, many mechanisms have been suggested and developed to solve this problem. New applications in computers and their specific requirements for communication have even added more complexity to this issue. Hence, more work needs to be done.

Additive Increase Multiplicative decrease (AIMD) is one of the best principles offered to solve this problem. This study is also in this field and offers an enhanced version of this mechanism. The contribution of this research is to improve the performance of AIMD in terms of efficiency (the network utilization) and fairness. National Chiao Tung University's network simulation (NCTUns) has been used in this development to compare the new algorithm with the older versions and determine its advantages over the older versions.

In addition to theoretical (mathematical) proof and to provide laboratory confirmation, this research has also used NCTUns to conduct tests and experiments to measure different performance metrics of the new algorithm such as end-to-end delay, link utilization, efficiency and fairness, and compared the results with the results of the same tests on older versions. The results have shown improvement in all aspects particularly the major ones, efficiency and fairness over the previous algorithms.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia

sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PERFORMANCE ENHANCEMENT OF AIMD ALGORITHM

FOR CONGESTION AVOIDANCE AND CONTROL

Oleh

HAYDER NATIQ JASEM

August 2011

Pengerusi: Zuriati Ahmad Zukarnain, PhD.

Fakulti: Sains Komputer dan Teknology Maklomat.

Rangkaian komputer telah merevolusi kehidupan manusia pada akhir abad lalu. Dua perbezaan teknikal utama antara komunikasi telefon dan rangkaian komputer adalah sebagai berikut. Pertama, telefon menggunakan kawat fizikal khusus untuk setiap komunikasi antara dua pihak (circuit switched rangkaian). Sebaliknya, komputer membahagi garis fizikal antara banyak - tak terbatas, sekurang-kurangnya secara teori - komputer (rangkaian pakej switch). Kedua, komunikasi telefon hanya digunakan untuk mel suara apabila pakej dalam rangkaian pakej switch boleh mengandungi pelbagai macam maklumat, bahkan mel suara.

Harus jelas bahawa robot automatik (komputer) perlu Peraturan dan peraturanperaturan (protokol) untuk dapat berkomunikasi, interleaving data, melalui saluran Sambungan perseorangan (link bottleneck misalnya). Protokol ini telah dibangunkan

dan dipertingkatkan sejak munculnya internet. Salah satu isu utama terangsang pada tahun 80-an ketika router mendapat padat dan sambungan runtuh kerana mereka didorong ke batas mereka oleh robot bersaing untuk sambungan. Sejak itu, pelbagai mekanisme telah dicadangkan dan dibangunkan untuk menyelesaikan masalah ini. aplikasi baru di komputer dan keperluan khusus mereka untuk komunikasi bahkan telah menambah kompleksitas yang lebih tinggi untuk masalah ini. Oleh kerana itu, bekerja lebih perlu dilakukan.

Kenaikan Aditif penurunan multiplikatif (AIMD) adalah salah satu prinsip terbaik ditawarkan untuk mengatasi masalah ini. Kajian ini juga dalam bidang ini dan menawarkan peningkatan versi dari mekanisme ini. Sumbangan daripada kajian ini adalah untuk meningkatkan prestasi AIMD dalam hal kecekapan (pemanfaatan rangkaian) dan keadilan. Simulasi rangkaian Nasional Chiao Tung Universiti (NCTUns) telah digunakan dalam pembangunan ini untuk membandingkan algoritma baru dengan versi yang lebih tua dan menarik keuntungan atas versi lama.

Selain teori (matematik) bukti dan untuk memberikan pengesahan makmal, kajian ini juga digunakan NCTUns untuk melakukan ujian dan percubaan untuk mengukur metrik prestasi yang berbeza dari algoritma baru seperti delay end-to-end, utilisasi link, kecekapan dan keadilan dan membandingkan hasil dengan keputusan ujian yang sama pada versi yang lebih tua. Keputusan kajian menunjukkan peningkatan dalam semua aspek khususnya yang utama, kecekapan dan keadilan atas algoritma sebelumnya.

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And I would like to say to all the people at University Putra Malaysia 'Thank you very much' for your help and support for me in my study.

HAYDER NATIQ JASEM

I certify that a thesis Examination Committee has met on 18 August 2011 to conduct the final examination of Hayder Natiq Jasem on his thesis entitled "Performance enhancement of AIMD algorithm for congestion avoidance and control" in accordance with the Universities and University Colleges Act 1971 and Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy. Members of the Thesis Examination Committee were as follows:

Abdul Azim b Abd Ghani, PhD
Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Chairman)

Ali b Mamat, PhD
Associate Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

Ramlan b Mahmod, PhD
Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Internal Examiner)

Mike Wood Ward, PhD
Professor
Department of Computing
School of Information
University of Bradford
(External Examiner)

_____
NORITAH OMAR, PhD
Associate Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis was submitted to the senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Zuriati Ahmad Zukarnain, PhD
Senior Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Chairman)

Mohamed Othman, PhD
Professor
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

Shamala Subramaniam, PhD
Senior Lecturer
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
(Member)

_____
HASANAH MOHD GHAZALI, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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.

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HAYDER NATIQ JASEM

Date:

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