52. IWK

Internationales Wissenschaftliches Kolloquium

International Scientific Colloquium

PROCCEDINGS | **10 - 13 September 2007**

FACULTY OF
COMPUTER SCIENCE AND AUTOMATION

COMPUTER SCIENCE MEETS AUTOMATION

VOLUME II

Session 6 - Environmental Systems: Management and Optimisation

Session 7 - New Methods and Technologies for Medicine and Biology

Session 8 - Embedded System Design and Application

Session 9 - Image Processing, Image Analysis and Computer Vision

Session 10 - Mobile Communications

Session 11 - Education in Computer Science and Automation

TECHNISCHE UNIVERSITÄT
ILMENAU

Bibliografische Information der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbiografie; detaillierte bibliografische Daten sind im Internet über **http://dnb.ddb.de** abrufbar.

ISBN 978-3-939473-17-6

Impressum

Herausgeber:	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
Redaktion:	Referat Marketing und Studentische Angelegenheiten Kongressorganisation Andrea Schneider Tel.: +49 3677 69-2520 Fax: +49 3677 69-1743 e-mail: kongressorganisation@tu-ilmenau.de
Redaktionsschluss:	Juli 2007
Verlag:	Technische Universität Ilmenau/Universitätsbibliothek Universitätsverlag Ilmenau Postfach 10 05 65 98684 Ilmenau www.tu-ilmenau.de/universitaetsverlag
Herstellung und Auslieferung:	Verlagshaus Monsenstein und Vannerdat OHG Am Hawerkamp 31 48155 Münster www.mv-verlag.de
Layout Cover:	www.cey-x.de
Bezugsmöglichkeiten:	Universitätsbibliothek der TU Ilmenau Tel.: +49 3677 69-4615 Fax: +49 3677 69-4602

Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.
I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.

Professor Peter Scharff	Professor Christoph Ament
Rector, TU Ilmenau	Head of Organisation

Table of Contents

C O N T E N T S

Page

6 Environmental Systems: Management and Optimisation

10 Mobile Communications

11 Education in Computer Science and Automation

52nd Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
10 – 13 September 2007

C. Kellner / A. Mitschele-Thiel / A. Diab

Performance Evaluation of MIFA, MIP and HAWAII

ABSTRACT

All-IP networks become increasingly visible. The various communication networks are aimed to be connected with each other through a common IP core, so that the user will stay always online, anytime and anywhere. We believe that these networks will be the popular network in the future. However a lot of challenges remain unsolved until today. One of the major challenges is how to achieve a seamless and fast handoff while moving from one point of attachment to another.

Mobile IP Fast Authentication Protocol (MIFA) is proposed to avoid the problems of MIP and to match the real-time requirements without introducing intermediate nodes and without making any restriction on the network topology.

In this paper we evaluate the performance of MIFA compared to Mobile IP (MIP) and Handoff-Aware Wireless Access Internet Infrastructure (HAWAII). The evaluation is performed by means of network simulator 2 (ns-2). The three protocols are evaluated deploying the same topology.

Our simulation results have shown that MIFA outperforms the other two protocols with respect to handoff latency and the number of dropped packets for uplink and downlink traffic. This is because MIFA needs only to register with the new Foreign Agent (FA) to be able to resume sending of packets, while MIP needs to register with the HA and HAWAII requires updating the new location at the old FA. For downlink traffic HAWAII and MIFA perform comparable to each other.

I. INTRODUCTION

All-IP networks become increasingly visible. The various communication networks are aimed to be connected with each other through a common IP core, so that the user will stay always online, anytime and anywhere. We believe that these networks will be the popular network in the future. However a lot of challenges remain unsolved until today. One of the major challenges is how to achieve a seamless and fast handoff while moving from one point of attachment to another.

MIP [1], [2] presents the standard protocols used to support mobility in IP based networks. With MIP, the Mobile Node (MN) has to be registered and authenticated by the Home Agent (HA) every time it moves from one subnet to another. This produces communication latency during the movement, especially, if the HA is far a way. This latency makes MIP only suitable for the management of global mobility. Therefore, it is important to develop a new mobility solution able to satisfy the real-time requirements.

The rest of this paper is organized as follows: In section (II) we present the related work. After that, we describe the simulation scenarios and discuss the results in section (III). Lastly, we conclude with the main results and the future work in section (IV).

II. RELATED WORK

In order to avoid MIP drawbacks, several approaches have been proposed to support local mobility. These approaches can be classified into two main groups [3], Proxy Agent Architectures (PAA) and Localized Enhanced Routing Schemes (LERS). PAA solutions try to extend MIP principle by using intermediate agents to process the movements of MNs inside a certain domain locally. Regional Registration for MIPv4 (RMIP) [4], Hierarchical Mobile IPv6 (HMIPv6) [5] and MIFA [6] are examples of this group. LERS solutions introduce a new dynamic layer3 routing protocol inside a certain localized area. A special path set-up protocol is used to implement per host soft-stat forwarding entries. HAWAII [7] is an example of this group.

With RMIP and HMIPv6 the HA is not aware of every change in the point of attachment. This is due to the fact that the handoff procedures are processed locally by a special node, e.g. a Gateway Foreign Agent (GFA) or Mobility Anchor Point (MAP), when the MN moves inside a certain domain. The MN communicates with the HA only if it changes the domain.

HAWAII does not try to replace IP. Its domain is controlled by a certain Gateway called Domain Root Router (DRR). There is a set of stations under this DRR. Each station maintains a routing cache, which is updated when the MN moves inside the domain. The packets are forwarded then hop by hop towards the MN. The two main schemes are forwarding (UNF) and non-forwarding path scheme (MSF). Using forwarding path scheme, the MN is assumed to be able to detect the new BS while still connected to the old one. In this case a path update message is sent to the old FA, which sends it towards the new one. The packets are forwarded after that to the new BS. By non-forwarding path scheme, the MN moves to the new BS and after that the MN sends a path update message to the old one. No packets are forwarded here from the old BS to the new one. All nodes of the domain should be mobility aware. Although HAWAII processes the mobility locally inside a certain domain, it still needs MIP when moving between different domains.

MIFA is developed to eliminate the latency sources of MIP and to match the real-time requirements without requiring intermediate nodes between the Foreign Agent (FA) and the HA. The basic idea is that MIFA deploys a set of neighbouring FAs called Layer3 Frequent Handoff Region (L3-FHR). This is motivated from the fact that the MN moves always to a neighbour subnet. Therefore, after moving to the new FA, the MN performs re-authentication only with this FA, it's not necessary to communicate with the HA. So, MIFA reduces the registration latency and let the MN able to quickly resume transmission on up- and downlink.

III. SIMULATION RESULTS

a) Simulation scenario

In order to evaluate the three protocols we have implemented MIFA in the network simulator ns-2 [8] (version 2.29). For comparison with MIP we use the existing implementation in ns-2. The two protocols are compared to the HAWAII UNF scheme using the "Columbia IP Micro-Mobility Suite (CIMS)" updated to ns2.29 [9].

The network topology is presented in figure 1. We use a set of sixteen FAs. There are ten mobiles in the range of each FA. 60 of these mobiles generate traffic; other mobiles are in idle mode. The mobiles communicate with 6 different correspondent hosts. The distance between each two FAs is 140 meters. Neighbor FAs are overlapped. The MN loses the communication, when it receives an advertisement message from the new FA. The delay on the wired links in our topology is 5 ms with a capacity of 100 Mbit/s. We observe the traffic of one MN, which moves with a speed of 40 km/h from the first to the last FA. This means, that the MN makes 15 handoffs. A UDP-traffic in up- and downlink is generated. We use CBR with an interval of 20 ms and a packet size of 500 bytes. The scenario is re-simulated 10 times to get stable results.

The same network topology with the same parameters is used for the evaluation of the three protocols.

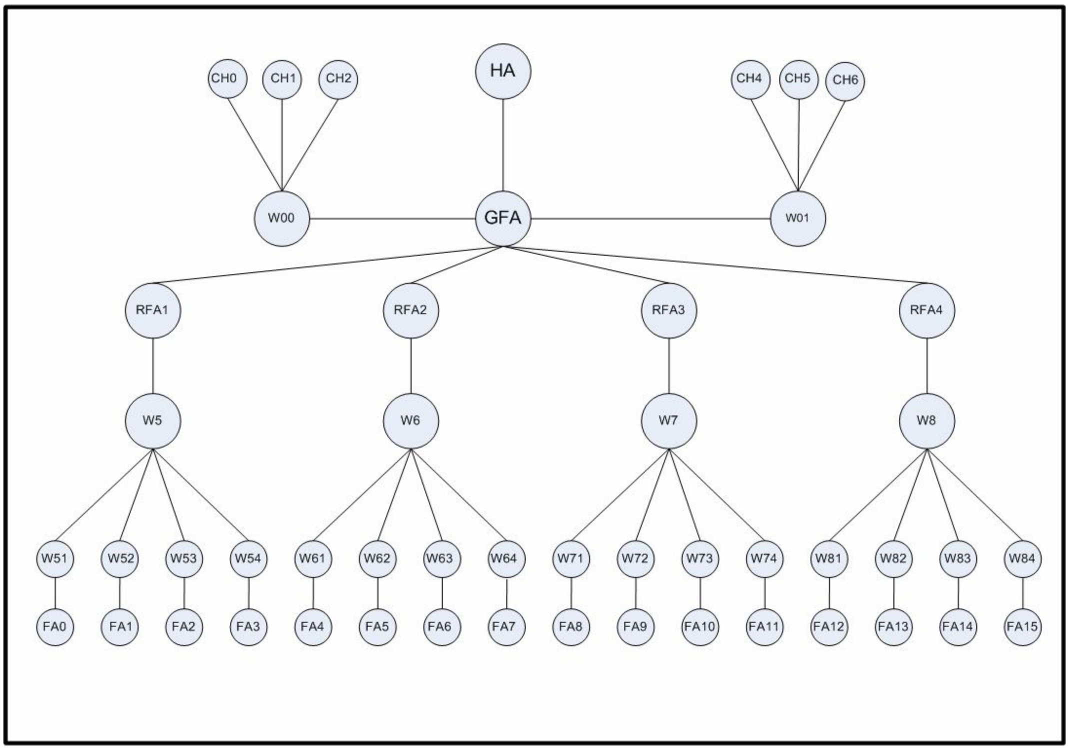

Figure 1. Simulation scenario

b) Handoff latency

The handoff latency is measured as the duration between sending of registration request message and receiving of the registration reply message. The network load is changed randomly through changing the sending interval of other mobiles from 40 to 90 ms. Figure 2 shows the distribution function of the handoff latency experienced by each protocol. From figure 2 we can notice that MIFA density function is more stable than the other protocols, 90% of the handoffs take a time less than 15 ms on uplink and less than 82 ms on downlink. HAWAII and MIP suffer from higher handoff latency, 90% from the handoffs by MIP takes a time less than 160 ms and by HAWAII less than 205 ms. MIFA is always better than HAWAII and MIP for low and high loads. HAWAII is better than MIP for low loads, while MIP starts to be better while increasing the load after a certain threshold. Taking the average value of the handoff latency over the all measurements, we see that HAWAII is about 0,8% better than MIP, while MIFA is about 64% better than MIP and HAWAII on downlink and about 97% on uplink.

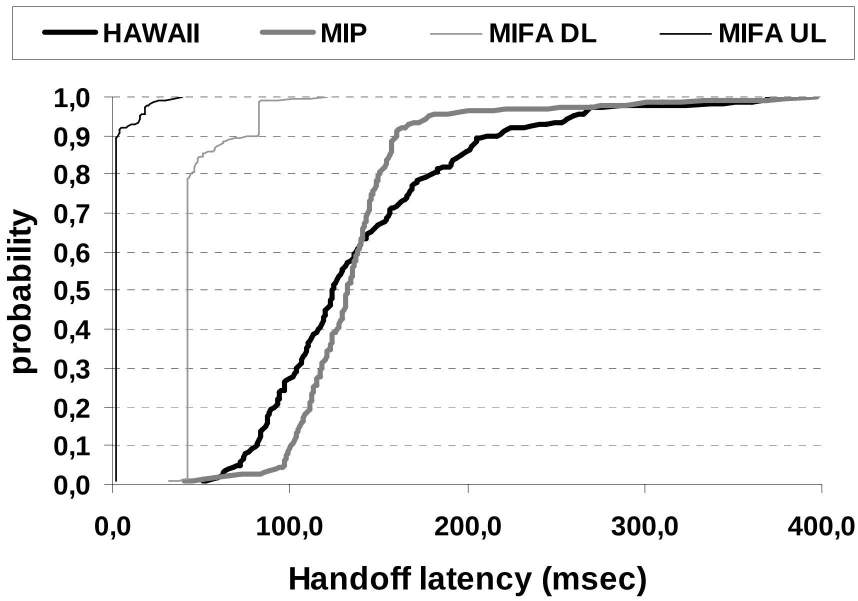

Figure 2. Distribution function of the handoff latency

c) Packet dropping

Figure 3 shows the distribution function of the expected number of dropped packets. Similar results can be obtained here. MIFA clearly outperforms HAWAII and MIP. The average number of dropped packets by MIFA is about 0,87 and 1,53 on up- and downlink respectively. HAWAII on the other side produces about 2,89 dropped packets, while MIP is the worst and generates about 7, 54 dropped packets on average.

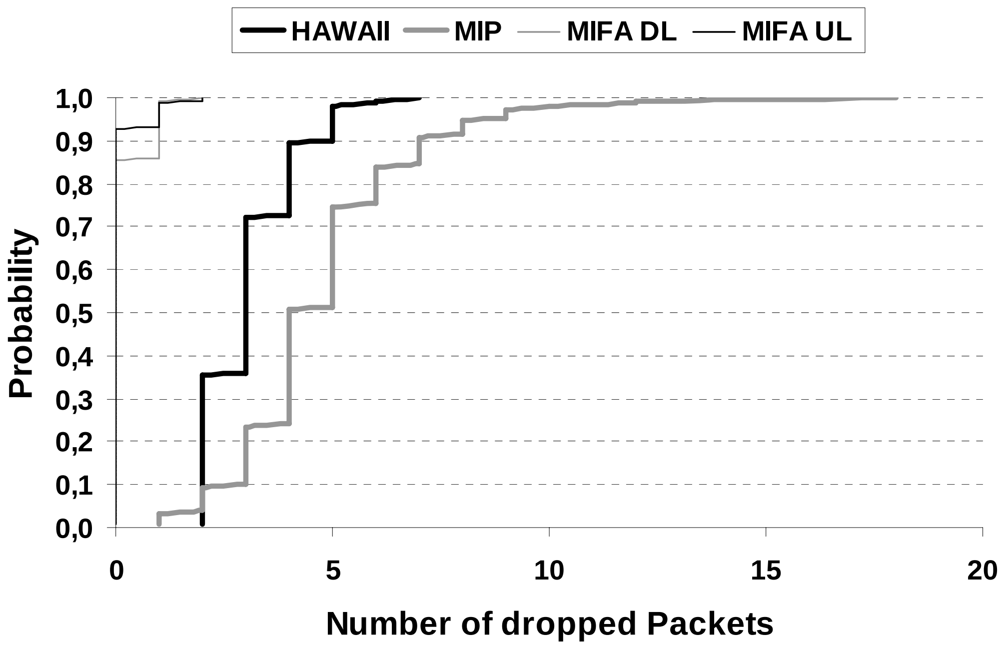

Figure 3. Distribution function of expected dropped packets

IV. Conclusion for future work

In this paper we have evaluated the performance of MIFA compared to MIP and HAWAII deploying the same topology. Our simulation results have shown that MIFA outperforms the other two protocols with respect to handoff latency and the expected number of dropped packets for uplink and downlink traffic. MIFA achieves a seamless handoff and satisfies the requirements of real-time applications.

Currently we are measuring tcp throughput to evaluate the impact of MIFA on TCP performance. Further we are studying the impact of the MN's speed on the performance.

References:

[1] C. Perkins, Ed, " IP Mobility Support for IPv4 ", RFC: 3344, 2002.
[2] D. Johnson, C. Perkins, J. Arkko, " Mobility Support in IPv6 ", < draft-ietf-mobileip-ipv6-23.txt >, 2003.
[3] P. Eardley, A. Mihailovic, T. Suihko, " A framework for the evaluation of IP mobility protocols ", 11th PIMRC, 2000.
[4] D E. Gustafsson, A. Jonsson, C. E. Perkins, " Mobile IPv4 Regional Registration ", < draft-ietf-mobileip-reg-tunnel-08.txt >, 2003.
[5] H. Soliman, et.al, " Hierarchical Mobile IPv6 mobility management (HMIPv6)", < draft-ietf-mobileip-hmipv6-08.txt >, 2003.
[6] A. Diab, A. Mitschele-Thiel, J. Xu, " Perfomance Analysis of the Mobile IP Fast Authentication Protocol ", MSWIM04, 2004.
[7] R. Ramjee, T. La Porta, S. Thuel, K. Varadhan, " IP micro-mobility support using HAWAII ", < draft-ietf-mobileip-hawaii-00 >, 1999.
[8] Network simulator ns-2, URL: http://www.isi.edu/nsnam/ns/
[9] Columbia IP Micro-Mobility Suite (CIMS) updated to ns-2.29, URL: http://wcms1.rz.tu-ilmenau.de/fakia/Micro-Mobility.5233.0.html

Authors:
Christian Kellner
Dipl.-Ing Ali Diab
Prof. Dr.-Ing. habil. Andreas Mitschele-Thiel
TU - Ilmenau, Faculty for Informatics und Automation, Gustav-Kirchhoff-Str. 1, P.O.B. 10 0565
98693, Ilmenau
Phone: +49 3677 69 2819
Fax: +49 3677 69 1220
E-mail: christian.kellner@stud.tu-ilmenau.de, {ali.diab|mitsch}@tu-ilmenau.de