

# 52. IWK

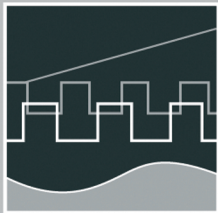
Internationales Wissenschaftliches Kolloquium  
International Scientific Colloquium



**PROCEEDINGS**

| 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**

**Bibliografische Information der Deutschen Bibliothek**  
Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; 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](http://www.tu-ilmenau.de/universitaetsverlag)
- Herstellung und Auslieferung: Verlagshaus Monsenstein und Vannerdat OHG  
Am Hawerkamp 31  
48155 Münster  
[www.mv-verlag.de](http://www.mv-verlag.de)
- Layout Cover: [www.cey-x.de](http://www.cey-x.de)
- Bezugsmöglichkeiten: Universitätsbibliothek der TU Ilmenau  
Tel.: +49 3677 69-4615  
Fax: +49 3677 69-4602

© Technische Universität Ilmenau (Thür.) 2007

Diese Publikationen und alle in ihr enthaltenen Beiträge und Abbildungen sind urheberrechtlich geschützt. Mit Ausnahme der gesetzlich zugelassenen Fälle ist eine Verwertung ohne Einwilligung der Redaktion strafbar.

## 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 52<sup>nd</sup> 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.

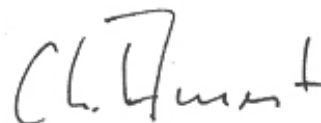
All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are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



Professor Christoph Ament  
Head of Organisation



## Table of Contents



# CONTENTS

	Page
<b>6 Environmental Systems: Management and Optimisation</b>	
T. Bernard, H. Linke, O. Krol A Concept for the long term Optimization of regional Water Supply Systems as a Module of a Decision Support System	3
S. Röhl, S. Hopfgarten, P. Li A groundwater model for the area Darkhan in Kharaa river Th. Bernard, H. Linke, O. Krol basin	11
A. Khatanbaatar Altantuul The need designing integrated urban water management in cities of Mongolia	17
T. Rauschenbach, T. Pfützenreuter, Z. Tong Model based water allocation decision support system for Beijing	23
T. Pfützenreuter, T. Rauschenbach Surface Water Modelling with the Simulation Library ILM-River	29
D. Karimanzira, M. Jacobi Modelling yearly residential water demand using neural networks	35
Th. Westerhoff, B. Scharaw Model based management of the drinking water supply system of city Darkhan in Mongolia	41
N. Buyankhishig, N. Batsukh Pumping well optimi ation in the Shivee-Ovoo coal mine Mongolia	47
S. Holzmüller-Laue, B. Göde, K. Rimane, N. Stoll Data Management for Automated Life Science Applications	51
N. B. Chang, A. Gonzalez A Decision Support System for Sensor Deployment in Water Distribution Systems for Improving the Infrastructure Safety	57
P. Hamolka, I. Vrublevsky, V. Parkoun, V. Sokol New Film Temperature And Moisture Microsensors for Environmental Control Systems	63
N. Buyankhishig, M. Masumoto, M. Aley Parameter estimation of an unconfined aquifer of the Tuul River basin Mongolia	67

M. Jacobi, D. Karimanzira 73  
Demand Forecasting of Water Usage based on Kalman Filtering

## **7 New Methods and Technologies for Medicine and Biology**

J. Meier, R. Bock, L. G. Nyúl, G. Michelson 81  
Eye Fundus Image Processing System for Automated Glaucoma Classification

L. Hellrung, M. Trost 85  
Automatic focus depending on an image processing algorithm for a non mydriatic fundus camera

M. Hamsch, C. H. Igney, M. Vauhkonen 91  
A Magnetic Induction Tomography System for Stroke Classification and Diagnosis

T. Neumuth, A. Pretschner, O. Burgert 97  
Surgical Workflow Monitoring with Generic Data Interfaces

M. Pfaff, D. Woetzel, D. Driesch, S. Toepfer, R. Huber, D. Pohlers, 103  
D. Koczan, H.-J. Thiesen, R. Guthke, R. W. Kinne  
Gene Expression Based Classification of Rheumatoid Arthritis and Osteoarthritis Patients using Fuzzy Cluster and Rule Based Method

S. Toepfer, S. Zellmer, D. Driesch, D. Woetzel, R. Guthke, R. Gebhardt, M. Pfaff 107  
A 2-Compartment Model of Glutamine and Ammonia Metabolism in Liver Tissue

J. C. Ferreira, A. A. Fernandes, A. D. Santos 113  
Modelling and Rapid Prototyping an Innovative Ankle-Foot Orthosis to Correct Children Gait Pathology

H. T. Shandiz, E. Zahedi 119  
Noninvasive Method in Diabetic Detection by Analyzing PPG Signals

S. V. Drobot, I. S. Asayenok, E. N. Zacepin, T. F. Sergiyenko, A. I. Svirnovskiy 123  
Effects of Mm-Wave Electromagnetic Radiation on Sensitivity of Human Lymphocytes to Ionizing Radiation and Chemical Agents in Vitro

## **8 Embedded System Design and Application**

B. Däne 131  
Modeling and Realization of DMA Based Serial Communication for a Multi Processor System



M. Müller, A. Pacholik, W. Fengler Tool Support for Formal System Verification	137
A. Pretschner, J. Alder, Ch. Meissner A Contribution to the Design of Embedded Control Systems	143
R. Ubar, G. Jervan, J. Raik, M. Jenihhin, P. Ellervee Dependability Evaluation in Fault Tolerant Systems with High-Level Decision Diagrams	147
A. Jutmann On LFSR Polynomial Calculation for Test Time Reduction	153
M. Rosenberger, M. J. Schaub, S. C. N. Töpfer, G. Linß Investigation of Efficient Strain Measurement at Smallest Areas Applying the Time to Digital (TDC) Principle	159
<b>9 Image Processing, Image Analysis and Computer Vision</b>	
J. Meyer, R. Espiritu, J. Earthman Virtual Bone Density Measurement for Dental Implants	167
F. Erfurth, W.-D. Schmidt, B. Nyuyki, A. Scheibe, P. Saluz, D. Faßler Spectral Imaging Technology for Microarray Scanners	173
T. Langner, D. Kollhoff Farbbasierte Druckbildinspektion an Rundkörpern	179
C. Lucht, F. Gaßmann, R. Jahn Inline-Fehlerdetektion auf freigeformten, texturierten Oberflächen im Produktionsprozess	185
H.-W. Lahmann, M. Stöckmann Optical Inspection of Cutting Tools by means of 2D- and 3D-Imaging Processing	191
A. Melitzki, G. Stanke, F. Weckend Bestimmung von Raumpositionen durch Kombination von 2D-Bildverarbeitung und Mehrfachlinienlasertriangulation - am Beispiel von PKW-Stabilisatoren	197
F. Boochs, Ch. Raab, R. Schütze, J. Traiser, H. Wirth 3D contour detection by means of a multi camera system	203

M. Brandner Vision-Based Surface Inspection of Aeronautic Parts using Active Stereo	209
H. Lettenbauer, D. Weiss X-ray image acquisition, processing and evaluation for CT-based dimensional metrology	215
K. Sickel, V. Daum, J. Hornegger Shortest Path Search with Constraints on Surface Models of In-the-ear Hearing Aids	221
S. Husung, G. Höhne, C. Weber Efficient Use of Stereoscopic Projection for the Interactive Visualisation of Technical Products and Processes	227
N. Schuster Measurement with subpixel-accuracy: Requirements and reality	233
P. Brückner, S. C. N. Töpfer, M. Correns, J. Schnee Position- and colour-accurate probing of edges in colour images with subpixel resolution	239
E. Sparrer, T. Machleidt, R. Nestler, K.-H. Franke, M. Niebelschütz Deconvolution of atomic force microscopy data in a special measurement mode – methods and practice	245
T. Machleidt, D. Kapusi, T. Langner, K.-H. Franke Application of nonlinear equalization for characterizing AFM tip shape	251
D. Kapusi, T. Machleidt, R. Jahn, K.-H. Franke Measuring large areas by white light interferometry at the nanopositioning and nanomeasuring machine (NPMM)	257
R. Burdick, T. Lorenz, K. Bobey Characteristics of High Power LEDs and one example application in with-light-interferometry	263
T. Koch, K.-H. Franke Aspekte der strukturbasierten Fusion multimodaler Satellitendaten und der Segmentierung fusionierter Bilder	269
T. Riedel, C. Thiel, C. Schmallius A reliable and transferable classification approach towards operational land cover mapping combining optical and SAR data	275
B. Waske, V. Heinzl, M. Braun, G. Menz Classification of SAR and Multispectral Imagery using Support Vector Machines	281

V. Heinzl, J. Franke, G. Menz Assessment of differences in multisensoral remote sensing imageries caused by discrepancies in the relative spectral response functions	287
I. Aksit, K. Bunger, A. Fassbender, D. Frekers, Chr. Gotze, J. Kemenas An ultra-fast on-line microscopic optical quality assurance concept for small structures in an environment of man production	293
D. Hofmann, G. Linss Application of Innovative Image Sensors for Quality Control	297
A. Jablonski, K. Kohrt, M. Bohm Automatic quality grading of raw leather hides	303
M. Rosenberger, M. Schellhorn, P. Bruckner, G. Lin Uncompressed digital image data transfer for measurement techniques using a two wire signal line	309
R. Blaschek, B. Meffert Feature point matching for stereo image processing using nonlinear filters	315
A. Mitsiukhin, V. Pachynin, E. Petrovskaya Hartley Discrete Transform Image Coding	321
S. Hellbach, B. Lau, J. P. Eggert, E. Korner, H.-M. Gro Multi-Cue Motion Segmentation	327
R. R. Alavi, K. Brie Image Processing Algorithms for Using a Moon Camera as Secondary Sensor for a Satellite Attitude Control System	333
S. Bauer, T. Doring, F. Meysel, R. Reulke Traffic Surveillance using Video Image Detection Systems	341
M. A-Megeed Salem, B. Meffert Wavelet-based Image Segmentation for Traffic Monitoring Systems	347
E. Einhorn, C. Schroter, H.-J. Bohme, H.-M. Gro A Hybrid Kalman Filter Based Algorithm for Real-time Visual Obstacle Detection	353
U. Knauer, R. Stein, B. Meffert Detection of opened honeybee brood cells at an early stage	359

## 10 Mobile Communications

K. Ghanem, N. Zamin-Khan, M. A. A. Kalil, A. Mitschele-Thiel Dynamic Reconfiguration for Distributing the Traffic Load in the Mobile Networks	367
N. Z.-Khan, M. A. A. Kalil, K. Ghanem, A. Mitschele-Thiel Generic Autonomic Architecture for Self-Management in Future Heterogeneous Networks	373
N. Z.-Khan, K. Ghanem, St. Leistritz, F. Liers, M. A. A. Kalil, H. Kärst, R. Böringer Network Management of Future Access Networks	379
St. Schmidt, H. Kärst, A. Mitschele-Thiel Towards cost-effective Area-wide Wi-Fi Provisioning	385
A. Yousef, M. A. A. Kalil A New Algorithm for an Efficient Stateful Address Autoconfiguration Protocol in Ad hoc Networks	391
M. A. A. Kalil, N. Zamin-Khan, H. Al-Mahdi, A. Mitschele-Thiel Evaluation and Improvement of Queueing Management Schemes in Multihop Ad hoc Networks	397
M. Ritzmann Scientific visualisation on mobile devices with limited resources	403
R. Brecht, A. Kraus, H. Krömker Entwicklung von Produktionsrichtlinien von Sport-Live-Berichterstattung für Mobile TV Übertragungen	409
N. A. Tam RCS-M: A Rate Control Scheme to Transport Multimedia Traffic over Satellite Links	421
Ch. Kellner, A. Mitschele-Thiel, A. Diab Performance Evaluation of MIFA, HMIP and HAWAII	427
A. Diab, A. Mitschele-Thiel MIFAv6: A Fast and Smooth Mobility Protocol for IPv6	433
A. Diab, A. Mitschele-Thiel CAMP: A New Tool to Analyse Mobility Management Protocols	439

## 11 Education in Computer Science and Automation

S. Bräunig, H.-U. Seidel Learning Signal and Pattern Recognition with Virtual Instruments	447
St. Lambeck Use of Rapid-Control-Prototyping Methods for the control of a nonlinear MIMO-System	453
R. Pittschellis Automatisierungstechnische Ausbildung an Gymnasien	459
A. Diab, H.-D. Wuttke, K. Henke, A. Mitschele-Thiel, M. Ruhwedel MAeLE: A Metadata-Driven Adaptive e-Learning Environment	465
V. Zöppig, O. Radler, M. Beier, T. Ströhla Modular smart systems for motion control teaching	471
N. Pranke, K. Froitzheim The Media Internet Streaming Toolbox	477
A. Fleischer, R. Andreev, Y. Pavlov, V. Terzieva An Approach to Personalized Learning: A Technique of Estimation of Learners Preferences	485
N. Tsyrelchuk, E. Ruchaevskaia Innovational pedagogical technologies and the Information educational medium in the training of the specialists	491
Ch. Noack, S. Schwintek, Ch. Ament Design of a modular mechanical demonstration system for control engineering lectures	497



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-state 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 HAWAll 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 HAWAll 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.

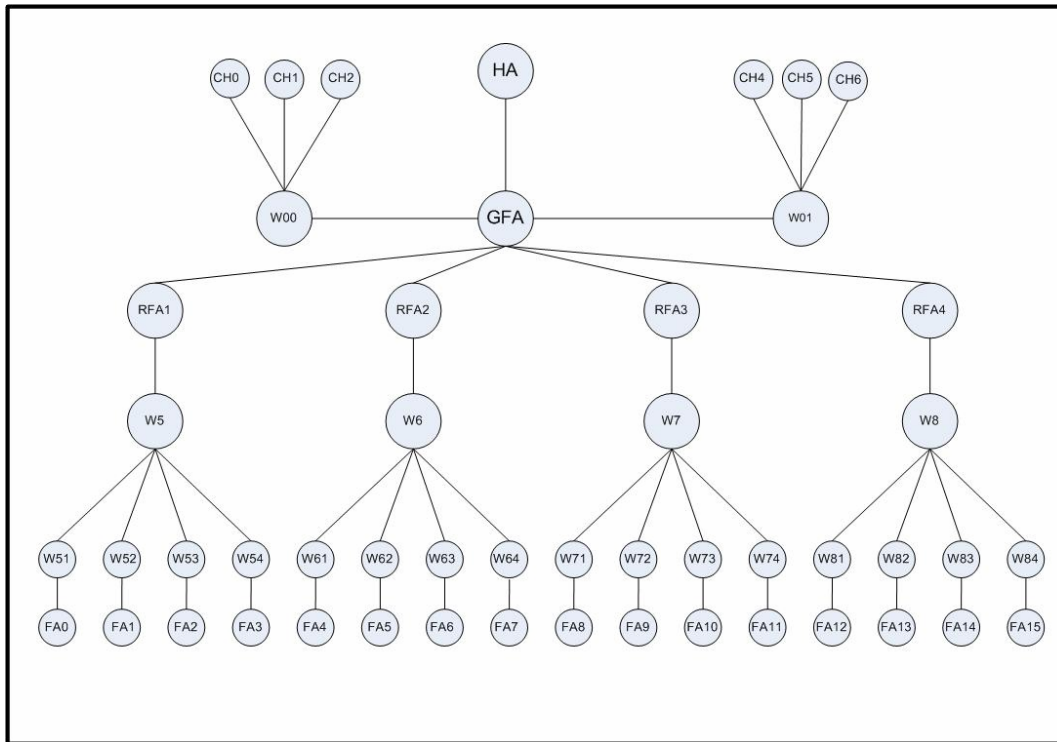


Figure 1. Simulation scenario

### 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.

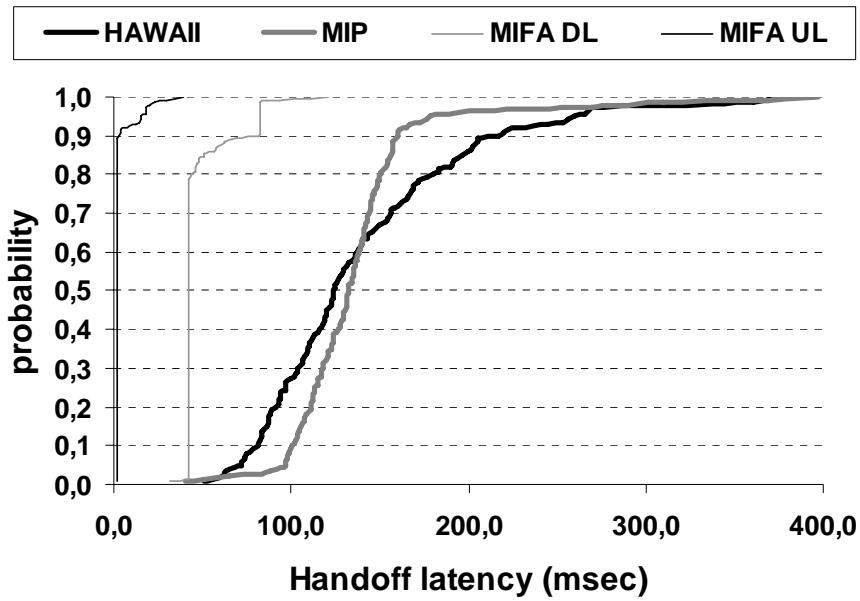


Figure 2. Distribution function of the handoff latency

### 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.

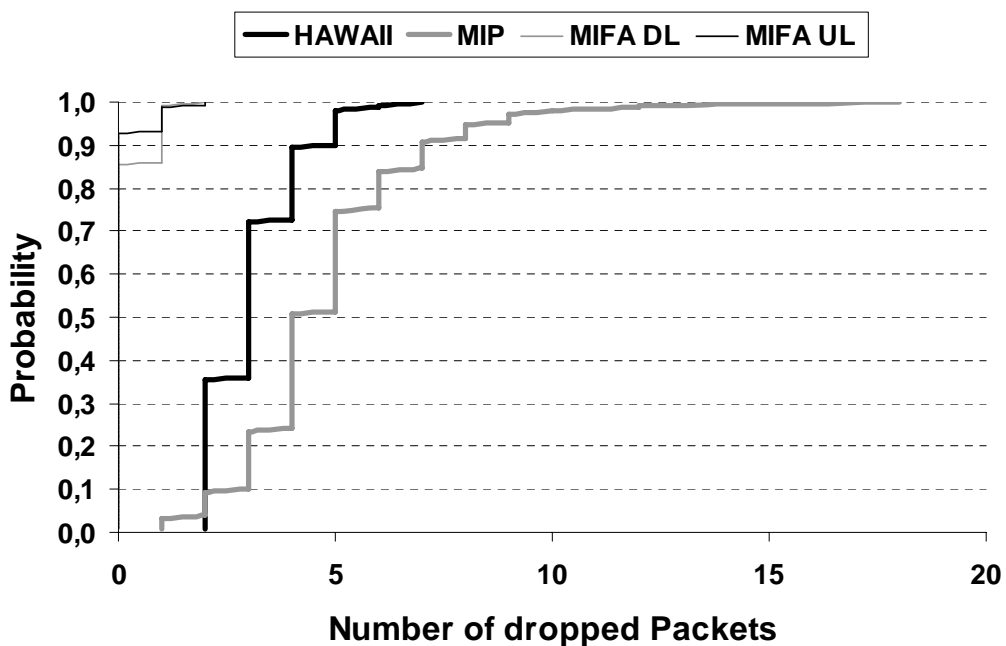


Figure 3. Distribution function of expected dropped packets

## 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](mailto:christian.kellner@stud.tu-ilmenau.de), [ali.diab@mitsch}@tu-ilmenau.de](mailto:ali.diab@mitsch}@tu-ilmenau.de)