# Impact of International Teacher and Student Mobility on IT Research in Arcada University of Applied Sciences

Dr.Tech., Senior Lecturer *Göran Pulkkis*, goran.pulkkis@arcada.fi

Dr.Tech., Senior Lecturer *Kaj Grahn*, kaj.grahn@arcada.fi

Dr.Sc. (Econ.) Senior Researcher, Senior Lecturer, *Carl-Johan Rosenbröijer*, carl-johan.rosenbroijer@arcada.fi

Arcada University of Applied Sciences

This paper outlines the impact of teacher, researcher and student mobility to the Information Technology research and education in Arcada University of Applied Sciences. Research areas and the IT research projects CryptMobi, WISEciti and ARBIT are presented. The international cooperation of Arcada's IT research is outlined. Integration of international exchange of students, teachers and researchers is described. The impact of Arcada's international IT research cooperation on Arcada's IT education is pointed out. The contribution of Arcada's international research cooperation to the results of Arcada's IT research is summarized and assessed.

**Keywords:** student mobility, teacher mobility, network security, applied cryptography, wireless networking, mobile networking, business IT

*

## Introduction

The emerging Information Society has focused research and education in engineering, media and business on IT and related areas. Global data networks and geographically distributed computing resources are accessible nearly everywhere. Many context, location, time and user oriented mobile digital services are already available. Completely new type of services, business operations and companies have been founded and successfully grown within the Internet world, e.g. Amazon (f.

1994), eBay (originally AuctionWeb, f. 1995), Google (f. 1998), Wikipedia (f. 2001), Second Life (f. 2003), Facebook (f. 2004), YouTube (f. 2005), etc. The functions of society are strongly dependent on an operational IT infrastructure, but computers and networks are also more and more used for criminal purposes.

All these circumstances emphasize secure access to reliable information as well as secure functionality and use of computers and networks. Challenges associated with the public accessibility to a wireless communication medium and with the dynamic topology of mobile networks emphasize the importance of research on secure mobility. Digitalized services have created changes in the economic revenue logic, in the logistical flows, and in the role of the consumer, who is becoming also a producer of content. The next big step is the future mobile Internet. This creates a need and challenge to develop the research and education within business, IT and media to understand, create new knowledge and educate students within the digitalized world.

IT research in Arcada has since the start in year 2000 focused on network security related topics. Exchange of students, teachers, and researcher has been integrated in Arcada's IT research activities from the start of these activities.

## IT Research in Arcada

### *Research Areas*

IT research areas include data communication security software, applied cryptography, security in wireless and mobile data communication, education concepts, and IT in business processes.

**Data communication security software**. The research is focused on development, testing, and verification of mobile security software for wireless data networks such as MIP (Mobile Internet Protocol), HIP (Host Identity protocol) and VPN (Virtual Private Network).

**Applied cryptography**. In this area authentication methods (certificate, identity based) are studied. Confidential and certified health information, and security based on quantum cryptography are examples.

**Security in wireless and mobile data communication**. Included topics are security testing of standardized mobile and wireless networks, security of MANET networks, security software testing based on HIP, and application security of smart cell phones.

**Education concepts**. Flash animations are being developed. Network courses like ”Network Security” and ”Communication Platforms for Mobile Services” are in use.

**Mobile/web-based applications and IT in business processes.** In this area mobile and web-based digital services are developed and commercialized by using an interdisciplinary R&D approach (i.e. Business, IT and Media). Apart from this IT based business process tools like for example ERP (Enterprise Resource Planning) and CRM (Customer Relationship Management) systems are used in educational activities within different degree programs at Arcada.

### *Research Projects*

***CryptMobi*** is a research project started in 2001 in Arcada University of Applied Sciences. The research is related to didactical concepts, to security software, to applied cryptography, and to wireless and mobile data communication. The focus is on development, testing, and verification of new cryptographic security solutions (authentication methods, network security protocols, secure routing, etc.) and mobile applications based on

- cryptographic chips and software
- wireless technologies like WLAN (Wireless Local Area network), Bluetooth, GPRS (General Packet Radio Service), UMTS (Universal Mobile Telecommunications system), WiMAX (Worldwide Interoperability for Microwave Access), and RFID (Radio Frequency Identification)
- Symbian OS and other OS platforms for mobile computers
- Internet standards like IPSec (Internet Protocol Security), TLS (Transport Layer Security), SSH (Secure Shell), Mobile IP.

Applied cryptography means use of traditional symmetrical cryptography, certified and identity based public key cryptography and quantum cryptography in security solutions. Research related to didactical concepts means development of new net based education in network security as well as in wireless and mobile data commu-

nication. The Department of Computer Science at the University of Helsinki is a research cooperation partner on development and verification of network and information security protocols. International cooperation partners are both Universities of Applied Sciences (Munich, Frankfurt, and Ostfalia in Wolfenbüttel) and Universities (The Open University in UK, Surrey, and Zaragoza).

***WISEciti (Wireless Community Services for Mobile Citizens)*** was a 2-year (1.3.2008-31.5.2010) project comprised of collaborative research between Arcada University of Applied Sciences, Birdstep Technology, Ericsson Finland, Helsinki Institute for Information Technology (HIIT), Helsinki University of Technology/Product Modelling & Realization Group (PM&RG), NetHawk Ltd, M-OAS Ltd, Nokia, Finnish Defence Forces Technical Research Centre (PvTT), TeliaSonera Finland, University of Helsinki, and Technical Research Centre of Finland (VTT) on deployment and further development of the cryptographic network protocol Host Identity Protocol (HIP) for the need of a future mobile Internet. Arcada contributed to this research by

- implementation and evaluation of a globally accessible HIP network infrastructure,
- testing and further development of HIP based mobile Virtual Private Network (VPN) solutions,
- further development and evolution of HIP network security,
- demonstrations and deployment promotion of HIP networking, and
- identifying and evaluating business models for mobile network services.

***ARBIT-"Applied Research in business and IT"*** is a research group at Arcada University of Applied Sciences. ARBIT has in 2005 established an eBusiness Lab where digital business applications and tools are used by students, teachers and researchers. This eBusiness Lab focuses on business processes (e.g. marketing, logistics, accounting, etc.) and on commercialization. However, the abbreviation BIT (Business and IT) indicates strong interdependence between Business and IT. Therefore ARBIT has in 2009 initiated a cross-disciplinary R&D project named Value Creating Digital Services. The objective of this project is to create a critical knowledge cluster by combining the Business, IT and Media competence within Arcada. With this cross-disciplinary approach we aim at identifying personal and organiza-

tional needs that can be taken care of in a new manner by developing innovative digital services in a future mobile Internet.

## International Research Cooperation and Contacts

### *Contact Network*

The research cooperation and contact network of the CryptMobi project consists of the following universities:

- University of Surrey in UK: student exchange and teacher/researcher exchange
- The Open University in UK: PhD thesis project and teacher/researcher exchange
- Brandenburg Technical University Cottbus in Germany: teacher/researcher exchange
- Munich University of Applied Sciences in Germany: teacher/researcher exchange
- Ostfalia University of Applied Sciences in Germany: teacher/researcher exchange
- Frankfurt University of Applied Sciences in Germany: student exchange
- Universidad de Zaragoza, Escuela Universitaria Politecnica de Teruel in Spain: student exchange and teacher/researcher exchange
- ENSEIRB - Ecole Nationale Superiéure d'Electronique, Informatiqueet Radiocommunications de Bordeaux in France: student exchange
- Institut Supérieur Industriel Gramme in Belgium: student exchange
- Kwantlen Polytechnic University in Canada: student exchange and virtual student exchange
- Technical University of Iceland: virtual student exchange and teacher/researcher exchange.
- Universita Ca´Foscari Venice, Italy: research assistant exchange
- University Politechnica of Bucharest in Romania: researcher exchange

International cooperation partners of the ARBIT project are European Universities through Microsoft Academic Alliance Advisory Council and the German software application provider ePages through Vilkas Group in Finland.

### *International Cooperation Project*

Arcada participated together with four other European universities - project coordinator Espoo-Vantaa University of Technology in Finland, Polytechnic University of Madrid in Spain, Munich University of Applied Sciences in Germany, and University of Applied Sciences Regensburg in Germany - in the EU funded project *Canada-EU Consortium on Computer Networks and Network Security Studies.* The Canadian project partners were Kwantlen University College in Vancouver, Mount Royal College in Calgary, and Centennial College in Toronto.

In the project was planned to include

- development of a joint curriculum in computer networks and network security, which will be recognised by all eight partner institutes
- development of an infrastructure to promote virtual and actual student mobility for 60 students
- a faculty tour for Canadian partners in Europe and for EU partners in Canada
- web based courseware development
- collaborative group projects
- language and cultural training
- implementation of credit transfer system

Most of this planned project activity was realized. Arcada's main contribution to the project result was a considerable virtual exchange of students and teachers/researcher in the form of an extensive remote participation from Canadian project partners in Arcada's net based Network Security courses. The feedback from this remote participation significantly improved these Network Security courses. This international project also enlarged and strengthened Arcada's contact network for international IT research cooperation.

### International Exchange of Teachers and Researchers

Exchange of teachers and researchers between Arcada and IT research cooperation partner universities:

- University of Surrey in UK
    - PhD Charles Free from Surrey in Arcada (2001-2006 in January): Course "Microwave Communication"

    - Dr.Tech. Göran Pulkkis from Arcada in Surrey (autumn 2004): course module ”Network Security Architecture”
    - Dr. Tech. Kaj Grahn from Arcada in Surrey (autumn 2004): course module ”RFID Technology”
- The Open University in UK
    - Prof. Laurence Dooley from The Open University in Arcada (2009 and 2010 in September): Lectures in course module ”ABC of DSP”, international research seminar/summit on network security topics, PhD thesis project on security of future 4G mobile networks
    - BSc (Eng.) Jonny Karlsson from Arcada to The Open University (several times in 2009 and 2010): PhD thesis project on security of future 4G mobile networks
- Brandenburg Technical University Cottbus in Germany
    - Prof. Christian Hentschel from Cottbus in Arcada (every year in Autumn since 2005): Lectures in course module ”ABC of DSP”
    - Dr.Tech. Göran Pulkkis from Arcada in Cottbus (November 2008): Lectures on ”Quantum Informatics and Information Security” in a Workshop of the International Graduate School for doctoral students
- Munich University of Applied Sciences in Germany
    - Prof. Klaus Köhler from Munich in Arcada (Winter 2002): Course module ”Mathematical Background, Algorithms, and Protocols of Cryptography”
    - Prof. Heidi Anlauff from Munich in Arcada (2005-2007 in autumn): Course module ”Smartcard Technology”
    - Dr. Tech. Göran Pulkkis from Arcada in Munich (2001 and 2003 in October, 2005-2007 in May): Lectures on foundations of cryptography, on elliptic curve cryptography, on PKI, on secure email with PGP, on smartcard applications, and a course module ”Foundations of Quantum Computation and Quantum Cryptography”
- Ostfalia University of Applied Sciences in Germany
    - Prof. Peter Buchwald from Ostfalia in Arcada (every year in Autumn since 1997): Lectures in course module ”ABC of DSP”

    - Dr.Tech. Göran Pulkkis from Arcada in Ostfalia (May 2000): Course ” Cryptographic Programming”
    - Dr.Tech Kaj Grahn from Arcada in Ostfalia (December 2009): Course module ”Quadrature Amplitude Modulation”
- Universidad de Zaragoza, Escuela Universitaria Politecnica de Teruel
    - Dr. Tech. Kaj Grahn from Arcada in Teruel (spring 2003): Course module ”Wireless Technologies”
- Technical University of Iceland
    - Dr.Tech. Göran Pulkkis from Arcada in Iceland (May 2000): Lecture presenting Arcada’s net based Network Security course
- Universita Ca´ Foscari Venice, Italy
    - BSc. Andrea Dianin from Ca´Foscari worked within ARBIT at Arcada from 5th of September 2009 to 21st of February 2010. During this period Mr. Dianin worked as an r&d assistant in ARBIT´s project “Value Creating Digital Services”.
- International cooperation project ”EU-Canada Consortium on Computer Networks and Network Security Studies”
    - Dr.Tech. Göran Pulkkis from Arcada was invited lecturer on a conference 30.5-1.6.2005 in Munich University of Applied Sciences in Germany. Lecture topic was *Information Security based on Quantum Cryptography*.
- University Politechnica of Bucharest in Romania
    - Dr.Tech. Göran Pulkkis from Arcada was in September 2010 nominated thesis examination committee of the PhD thesis “New techniques for computing and information processing - Quantum Computing” of Lucian Dragne. The PhD dissertation will take place in January 7th, 2011 in the Department of Computer Science and Engineering

**Impact on Education in Arcada**

Integration of the international exchange of students, teachers and researchers in Arcada’s IT research has resulted in research oriented student and thesis projects as well as in design and implementation of new courses.

### *New Courses based on International Research Cooperation*

An eCommerce course, a Digital Marketing course, and two net based network security and mobility courses have been designed and implemented. These new net based courses have been objects of virtual student exchange, Altogether ten students and six faculty members from the Canadian partners in the international cooperation project *EU-Canada Consortium on Computer Networks and Network Security Studies* have in 2004-2006 remotely participated in Arcada's net based courses on Network Security. Also nine students from the Technical University in Iceland participated remotely during this period in these net based courses

### *Research Oriented Student Projects*

The Erasmus exchange student Francisco Broto Bergua from Universidad de Zaragoza, Escuela Universitaria Politecnica de Teruel in Spain has in 2006 in Arcada carried out the research oriented project work *Bluetooth Modulation and Adaptive Frequency Hopping* as a part of the course *Specialisation in Telecommunications.*

The Erasmus exchange student Iñigo López Letamendia from Universidad de Zaragoza, Escuela Universitaria Politecnica de Teruel in Spain has in 2008 in Arcada carried out the research oriented project work *Car reporting system*. In this project was designed and built an electronic device, which using GPS for localization can be preset to automatically submit a request for help through the UMTS/GPRS network in a car accident situation.

### *Research Oriented Thesis Projects*

Finished thesis work projects in Arcada on wireless network security:

- a BSc thesis work on state of the art of wireless network security (Guillard, 2001) by an ERASMUS exchange student from ENSEIRB - Ecole Nationale Superiéure d'Electronique, Informatiqueet Radiocommunications de Bordeaux in France.
- a BSc thesis work on WLAN security (Escartin, 2004) by an ERASMUS exchange student from Escuela Universitaria Politecnica de Teruel in Spain

- a BSc level diploma thesis work on UMTS security (Bucher, 2004) by an ERASMUS exchange student from Frankfurt University of Applied Sciences in Germany
- a MSc thesis work on security architectures for wireless networking (Chatzinotas, 2006) by an ERASMUS student from University of Surrey in UK

Finished thesis work projects in Arcada on Bluetooth networking;

- a BSc thesis work on file transfer with Bluetooth (Potero, 2003) by an ERASMUS exchange student from Universidad de Zaragoza in Spain
- a BSc thesis work on context aware transfer of airport flight information with Bluetooth (Le Duigou, 2003) by an ERASMUS exchange student from ENSEIRB - Ecole Nationale Supérieure d'Electronique, Informatique et Radiocommunications de Bordeaux (ENSEIRB) in France
- a BSc level diploma thesis work on transmission of measurement data with Bluetooth (Dieckert and Schneider, 2003) by two ERASMUS exchange students from Frankfurt University of Applied Sciences in Germany
- a MSc level thesis work on a framework for Bluetooth application development (Apiranthiti, 2004) by an ERASMUS student from University of Surrey in UK
- a MSc level thesis work on secure roaming between Bluetooth access points (Rodríguez, 2004) by an ERASMUS student from University of Surrey in UK
- a MSc level thesis work on transmission of measured health monitoring data with Bluetooth (Ricke, 2004) by an ERASMUS student from University of Surrey in UK

Finished thesis work projects in Arcada on network security solutions based on applied cryptography

- a BSc thesis work on user authentication in UNIX environment (Evrard, 2002) be an ERASMUS exchange student from Institut Supérieur Industriel Gramme in Belgium
- a MSc thesis work on integration of quantum cryptography protocols in TCP/IP networks (Nicolaou, 2005) by an ERASMUS exchange student from University of Surrey in UK

- a BSc thesis work on smartcards and web services (Mastral, 2005) by an exchange student from Escuela Universitaria Politecnica de Teruel in Spain

Finished thesis work projects on security of mobile networking

- a MSc thesis work of security services based in Identity Based encryption in mobile networking (Lloyd, 2007) by an ERASMUS exchange student from University of Surrey in UK
- a BSc thesis work in Arcada on intrusion management in mobile networks (Ariño, 2007) by an ERASMUS exchange student from Escuela Universitaria Politecnica de Teruel in Spain
- a BSc thesis work in Kwantlen Polytechnic University in Canada on mobile Virtual Private Networking (Mårtens, 2010) by an ERASMUS exchange student from Arcada

Ongoing thesis work project on security of mobile networking

- a PhD thesis work in Arcada for The Open University in UK on security of future 4G networks by an Arcada graduate (Karlsson, 2005), who is presently working as a researcher and teacher in Arcada, and is a doctoral student of The Open University since Spring 2009

**Publication of Research Results**

Results of the IT research projects ARBIT, CryptMobi, and WISEciti in Arcada have been published in several scientific peer reviewed conference papers, book chapters, and encyclopaedia articles as well as in many MSc and BSc thesis works. International exchange students to and from Arcada have in their BSc and MSc thesis projects contributed to the following scientific publications:

- the BSc thesis project on state of the art of wireless network security (Guillard, 2001) by an ERASMUS exchange student from ENSEIRB - Ecole Nationale Superiéure d'Electronique, Informatiqueet Radiocommunications de Bordeaux in France has contributed to a conference paper on security of mobile and wireless networks (Grahn et al., 2002)
- the BSc thesis projects on file transfer with Bluetooth (Potero, 2003) by an ERASMUS exchange student from Universidad de Zaragoza in Spain and on

context aware transfer of airport flight information with Bluetooth (Le Duigou, 2003) by an ERASMUS exchange student from ENSEIRB - Ecole Nationale Supérieure d'Electronique, Informatique et Radiocommunications de Bordeaux (ENSEIRb) in France have contributed to a conference paper on context aware airport flight information system (Le Duigou et al., 2003)

- the BSc level diploma thesis project on transmission of measurement data with Bluetooth (Dieckert and Schneider, 2003) by two ERASMUS exchange students from Frankfurt University of Applied Sciences in Germany has contributed to a conference paper on measurement data logging via Bluetooth (Grahn et al., 2005)
- the BSc thesis project on WLAN security (Escartin, 2004) by an ERASMUS exchange student from Escuela Universitaria Politecnica de Teruel in Spain has contributed to a book chapter on recent developments in WLAN security (Pulkkis et al., 2005)
- the MSc thesis project on security architectures for wireless networking (Chatzinotas, 2006) by an ERASMUS student from University of Surrey in UK has contributed to a book chapter on security architectures for mobile broadband access (Chatziniotas et al., 2008)
- the BSc thesis work in Kwantlen Polytechnic University in Canada on Virtual Private Network mobility (Mårtens, 2010) by an ERASMUS exchange student from Arcada has contributed to a conference paper on mobile Virtual Private Networking (Pulkkis et al., 2010)
- the ongoing PhD thesis work in Arcada for The Open University in UK on security of future 4G networks by an Arcada graduate (Karlsson, 2005), who is as a doctoral student of The Open University since Spring 2009 working in Arcada as a researcher and teacher in Arcada, has contributed to a book chapter on secure routing and mobility in future IP networks (Grahn et al., 2010)

**Conclusions**

Arcada's IT research activities started in the year 2000 . By combining Arcada's knowledge and expertise from Information Technology and Electrical Engineering

(Telecommunications) scientific critical mass was achieved. The areas of information security and mobile communication were integrated. ERASMUS mobility and other mobility of students, teachers was integrated into these IT research activities. During the period 2000-2010 a considerable amount of BSc and MSc thesis works as well as scientific peer reviewed conference papers and book chapters have been published.

The integration of student, teacher and researcher mobility in Arcada's IT research has also had a positive impact on Arcada's IT education. Traditional and net based new courses related to research experience have been designed and implemented. Virtual student exchange has thus been made possible. During the exchange the foreign students have got research experience and have contributed to the research results achieved in Arcada. International research cooperation and the contact networks established is of great importance in the future IT research in Arcada.

## References

The referenced sources are BSc and MSc thesis works, conference papers, and book chapters published as results of integration of international exchange of students, teachers, and researcher in Arcada's IT research. The MSc thesis works are done in Arcada by ERASMUS exchange students, supervised in Arcada, and finally approved by a research cooperation partner, the University of Surrey in UK

### *BSc Thesis Works*

Ariño, Oscar: *Intrusion Detection in Mobile IP Networks*. BSc Thesis. Arcada University of Applied Sciences. 2007

Bucher, Björn: *Security of UMTS and Studies of the Radio Network Simulator NetSim*. BSc level Diploma Thesis. Arcada University of Applied Sciences. 2004

Dieckert, Christian and Schneider Frank: *Measurement Data Logging by Using Bluetooth Technology.* BSc level Diploma Thesis. Arcada University of Applied Scences. 2003

Escartin, Daniel: *WPA Security for Linux Based WLAN Clients and Access Points*. BSc Thesis. Arcada University of Applied Sciences. 2004

Evrard, Marc: *User Authentication in UNIX Environment.* BSc Thesis to obtain the qualification of Industrial Engineer Section: Industry in Belgium. Arcada University of Applied Scences. 2002

Guillard, Jean-Sébastien**:** *State of the Art in Security and Cryptography in the Wireless Environments**.*** BSc Thesis. Arcada University of Applied Sciences. 2001

Le Duigou, Nicolas: *A Virtual Airport Flight Information System Implemented with Bluetooth*. BSc Thesis. Arcada University of Applied Sciences. 2003

Mastral, Daniel José: *Smartcard Technology and WEB Services*. BSc Thesis. Arcada University of Applied Sciences. 2005

Mårtens, Mathias. *Implementations of Mobile Virtual Private Networks*, BSc Thesis, Arcada University of Applied Sciences in cooperation with Kwantlen Polytechnic University in Canada, 2010.

Potero, Carlos: *Bluetooth. File Transfer using Bluetooth Technology**.*** BSc Thesis. Arcada University of Applied Sciences, 2003

***MSc Thesis Works***

Apiranthiti, Ioanna: *Framework for Bluetooth Application Development*. MSc Thesis. The University of Surrey in UK in cooperation with Arcada University of Applied Scences. 2004

Chatzinotas, Symeon: *Security Architectures for Wireless Networking*. MSc Thesis. The University of Surrey in UK in cooperation with Arcada University of Applied Scences. 2006

Lloyd, Matthew: *Security Services based on IBE in Mobile Networking*. MSc Thesis. The University of Surrey in UK in cooperation with Arcada University of Applied Scences. 2007

Nicolaou, Michalis: *Integration of Quantum Cryptography Protocols in TCP/IP Networks*. MSc Thesis. The University of Surrey in UK in cooperation with Arcada University of Applied Scences. 2005

Ricke, Tim-Oliver: *Bluetooth Health Monitor*. MSc Thesis. The University of Surrey in UK in cooperation with Arcada University of Applied Scences. 2004

Rodríguez, Carlos: *Survey and Experimental Design for Secure Roaming between Bluetooth Access Points*. MSc Thesis. The University of Surrey in UK in cooperation with Arcada University of Applied Scences. 2004

### *Conference Papers*

Le Duigou, Nicolas, Grahn, Kaj, Hagelin, Niklas, Potero, Carlos, and Pulkkis, Göran: *A Virtual Airport Flight Information System Implemented with Bluetooth.* Proceedings of the 21st NORDUnet Conference in Reykjavik, Iceland, August 24th - 27th 2003.

Grahn, Kaj, Dieckert, Christian, Schneider, Frank, and Pulkkis, Göran: *Measurement Data Logging via Bluetooth*. Informing Science + IT Education Conference, Flagstaff, Arizona, USA, 16-19.6.2005 Retrieved November 20th, 2010 from http://proceedings.informingscience.org/InSITE2005/I52f45Grah.pdf

Grahn, Kaj, Pulkkis, Göran and Guillard, Jean-Sébastien: *Security of Mobile and Wireless Networks*. in Proceedings of Informing Science + IT Education Conference, June 19-21, 2002, Cork, Ireland. Retrieved November 20th, 2010 from http://proceedings.informingscience.org/IS2002Proceedings/papers/Grahn152Secur.pdf

Pulkkis, Göran, Grahn, Kaj, Mårtens, Mathias, and Mattsson, Jonny: "Mobile Virtual Private Networking", In T. Zseby, R. Savola, and M. Pistore (Eds.) Future Internet - FIS 2009 Second Future Internet Symposium, FIS 2009, Berlin Germany, September 1-3, 2009, Revised Selected Papers, pp. 57-69, 2010, Springer, Germany, ISBN 978-3-642-14955-0.

### *Book Chapters*

Chatzinotas, Symeon, Karlsson, Jonny, Pulkkis, Göran, and Grahn, Kaj: *Evaluation of Security Architectures for Mobile Broadband Access.* In Y. Zhang, J. Zheng, and M. Ma (Eds) Handbook of Research on Wireless Security. IGI Global, USA, 2008, Vol. II, pp. 759-775, ISBN 978-1-59904-899-4

Grahn, Kaj, Karlsson, Jonny, and Pulkkis, Göran: *Secure Routing and Mobility in Future IP Networks.* Approved in February 2010 to be published as a book chapter in

the forthcoming M. Cruz-Cunha and F. Moreira (Eds.) Handbook of Research on Mobility and Computing: Evolving Technologies and Ubiquitous Impacts. IGI Global, Hershey PA, USA

Pulkkis, Göran, Grahn, Kaj, Karlsson, Jonny, Martikainen, Mikko, and Escartin, Daniel: *Recent developments in WLAN security*. in M. Pagani (Ed.) Mobile and Wireless Systems Beyond 3G: Managing New Business Opportunities. IRM Press, USA, 2005. ISBN 1-59140-570-X