MiNEMA Winter School 2009
March 23-26, 2009
Goteborg, Sweden

Scientific Report

Luís Rodrigues
INESC-ID / IST
ler@ist.utl.pt
(Scientific Coordination)

Marina Papatriantafilou
Chalmers University
ptrianta@chalmers.se
(Local Coordination)

1 School Details

Title: MiNEMA Winter School 2009
URL: http://www.cse.chalmers.se/minema2009/
Date: March 23-26, 2009
Location: Chalmers University, Gteborg, Sweden
Duration: 4 days
Organizers: Luís Rodrigues (INESC-ID/IST) and Marina Papatriantafilou (Chalmers University) and Philipas Tsigas (Chalmers University)

2 Summary

The MiNEMA Winter School 2009 was a joint organization between the Distributed Computing and Systems group of the Chalmers University in Sweden and the Distributed Systems Group (GSD) of the INESC-ID research lab in Portugal. The school took place at the Chalmers University in Gteborg, Sweden on March 23-26 2009.

The MINEMA Winter School 2009 was planned as the last major event of the MiNEMA project. MINEMA is a Scientific Programme of the European Science Foundation (ESF) aiming to bring together European groups from different communities working on middleware for mobile environments. The programme intends to foster the definition and implementation of widely recognized middleware abstractions for new and emerging mobile applications. The school aimed at fostering a deeper understanding on the state-of-the-art in middleware for mobile environments, and at advertising the network's activities, with a

special focus on the recently published book by Springer "Middleware for Network Eccentric and Mobile Applications", authored by well-established researchers connected to the MiNEMA network.

The scientific program of the school was organized by Luís Rodrigues from INESC-ID/IST (Portugal). The local organization was handled by the Marina Papatriantafilou, Philipas Tsigas and their team at Chalmers University (Sweden).

3 Scientific Content

3.1 Scientific Program

The school's scientific program was established by following the contents covered on the MiNEMA book closely. However, due to scheduling limitations and speaker availability not all topics were covered. The following list highlights what was presented at the school.

- Energy in Wireless Sensor Networks
- Programming Wireless Sensor Networks
- Mobility Models
- Ad Hoc Routing
- Opportunistic Networks
- Population Protocols
- Wireless Mesh Networks
- Gossip-based Dissemination
- Application Layer Multicast
- Publish/Subscribe
- Tuple Spaces
- Vehicular Networks
- Context-aware Applications
- Dynamic Adaptation

3.2 Program Organization

The school program was organized as a set of invited talks from speakers actively involved in the MiNEMA scientific network activities, and more specifically in the production of the MiNEMA book, with a recognized scientific track record.

Luís Rodrigues was in charge of the invitation process and invited fourteen speakers to present the state-of-the-art developments in the wide range of topics covered in the MiNEMA book.

The sessions took place in the morning (2 sessions) and in the afternoon (2 sessions).

3.3 Speakers Short Biographies

António Loureiro

António Loureiro is a professor of Computer Science at the Universidade Federal de Minas Gerais, Brazil. Prof. Loureiro holds a PhD in Computer Science from the University of British Columbia, Canada, 1995. In the last 10 years he has lectured regularly on ubiquitous computing and wireless sensor networks, presented tutorials at international conferences, published more than 100 papers in journals and conferences, supervised many graduate students, and involved in research projects related to his research interests.

Francisco Martins

Francisco Martins is an Assistant Professor at the Department of Informatics, Faculty of Sciences, University of Lisbon. Francisco received his Ph.D. in Computer Science at University of Lisbon (Faculty of Sciences) in 2006, his M.Sc. (by research) in Computer Science at University of Azores in 2000, and his B.Sc. in Mathematics and Informatics at the University of Azores in 1995. His current interestes include Concurrency theory, Mobile Computing, Type Systems, and Programming Languages.

Mirco Musolesi

Mirco Musolesi is a Research Associate affiliated both with the Department of Computer Science, University College London and the Computer Laboratory, University of Cambridge, where he is a member of the Networking and Operating Systems research group. Previously, from October 2005 to August 2007 he was a Research Fellow at the Department of Computer Science, University College London and from September 2007 to August 2008 he was an ISTS Postdoctoral Research Fellow at Dartmouth College. He received a PhD in Computer Science from University College London and a Master in Electronic Engineering from the University of Bologna. His research interests lie in the broad area of mobile systems and networking (with a current focus on mobility modeling, sensing systems based on mobile phones and delay tolerant networking). More information about his research profile can be found at the following URL: `http://www.cl.cam.ac.uk/~mm753`

Filipe Araújo

Filipe Arajo graduated in 1996 and received his M.Sc. degree in 1999 from the University of Coimbra, Portugal. He received his Ph.D. in 2006 from the University of Lisboa. Currently he is an Assistant Professor at the University of Coimbra and a researcher of the Centre for Informatics and Systems of the University of Coimbra. He was also a Teaching Assistant in the Polytechnic Institute of Leiria, Portugal and in the University of Lisboa. His research interests include wireless ad hoc networks, peer-to-peer systems and grid systems.

Eric Ruppert

Eric Ruppert was educated at the University of Toronto, where he completed his Ph.D. in computer science in 1999. He spent a year as a postdoctoral fellow at Brown University and then returned to Canada to teach at York University, where he is now an associate professor. He has also been a visiting professor at the cole Polytechnique Fdrale de Lausanne.

Silvia Giordano

Prof. Silvia Giordano holds a PhD. from EPFL, Switzerland. She is currently the head of the Networking Lab (NetLab) in the Institute of System for Informatics and Networking (ISIN), and as direction member of ISIN, at the University of Applied Science - SUPSI in Ticino, Switzerland. She is teaching several courses in the area of: Networking, Wireless and Mobile Networking, Quality of Services and Networks Applications. She is co-editor of the book Mobile Ad Hoc Networking (IEEE-Wiley 2004). She has published extensively on journals, magazines and conferences in the areas of quality of services, traffic control, wireless and mobile ad hoc networks. She has participated in several European ACTS/IST projects and European Science Foundation (ESF) activities. Since 1999 she serves as Technical Editor of IEEE Communications Magazine, and is currently editor of the series co-editor of the new Series on Ad Hoc And Sensor Networks of the IEEE Communication Magazine. She is also editor of Ad hoc networks journal and Computer Communications journal by Elsevier, Ad Hoc & Sensor Wireless Networks journal, Ocpscience, Journal of Ubiquitous Computing and Intelligence (JUCI) and Journal of Autonomic and Trusted Computing (JoATC) both by American Scientific Publishers (ASP), and Mediterranean Journal of Computer and Networks, SoftMotor. She was already co-editor of several special issues of IEEE Communications Magazine and Baltzer MONET and Cluster Computing on mobile ad hoc networking and QoS networking. She is general chair of WoWMoM 2009, program co-chair of IEEE PERCOM 2009, was program co-chair of IEEE VTC-Fall 2008, IEEE MASS 2007, workshop chair of IEEE WOWMoM 2007, tutorial chair of MobiHoc 2006, general chair of IEEE WONS 2005, organizer of IEEE Persens 2005-2009 workshop, IEEE AOC2005-2009 workshop and ACM Mobihoc SANET workshop 2007-2008 and is/was on the executive committee and TCP of several international conferences, and serves as reviewer on transactions and journals, as well as for several important conferences. Silvia Giordano is a member of IEEE Computer Society, ACM and IFIP WG 6.8. Her

current research interests include wireless and mobile ad hoc networks, QoS and traffic control.

Johnathan Ishmael

Dr. Johnathan Ishmael is a researcher at Lancaster University and works in the area of computer communication and distributed systems. His current research activities are focused around the EU FP7 project P2P-Next. Looking at future multimedia distribution technologies and their impact on heterogeneous networks. Previous to this he has also worked on the EU FP6 ENTHRONE project, providing end-to-end QoS guarantees to the core of the Internet. During his PhD studies Johnathan investigated the deployment of Community Wireless Mesh Networks and the emerging requirements for autonomic management and control. His teaching duties involve both BSc and MSc levels and includes lecturing on Contemporary Operating Systems and Multimedia Content Networking courses.

Hugo Miranda

Hugo Miranda is an Assistant Professor at the Informatics Department of the Faculty of Sciences of the University of Lisbon where he teaches courses on Computer Systems Organisation like Computer Networks and Distributed Fault Tolerance. He has a PhD (2007) in Informatics by the University of Lisbon. He co-authored more than 30 papers mostly in distributed fault tolerance and data dissemination in mobile ad hoc networks. He is a member of the ACM and the IEEE.

Benoit Garbinato

Benot Garbinato is a professor in computer science at the University of Lausanne, where he leads the Distributed Object Programming Lab. In the nineties, he contributed to the emerging research trend on separation concerns and protocol composition in fault-tolerant distributed systems, as part of his Ph.D. thesis. He then worked in the industry, first for the research lab of UBS in Zurich (Ubilab), where he lead the software engineering group, and later for Sun Microsystems' professional services, as senior software architect. Since his return to the academic world, his research and teaching activities focus on the design and implementation of adequate programming abstractions for emerging distributed architectures, such as pervasive and mobile systems.

Roberto Baldoni

Roberto Baldoni is Full Professor of Distributed Systems at the University of Rome "La Sapienza". In the past he has been visiting Professor at INRIA, Cornell Univ. and EPFL. He is the founder of MIDdleware LABoratory (MIDLAB) and he has been PI of several large national and european research projects. Currently he is the the coordinator person of SM4ALL an EU project designing middleware infrastructures for Networked Embedded Systems and he is the Technical CoDirector of COMIFIN an EU project on the protection of

the Financial Infrastructure. Recently, he has been the General Chair of DEBS 2008. This year he is the PC-Chair of the track on "Reliable and Dependable Systems" at ICDCS08. Roberto Baldoni is a member of the IFIP WG 10.4 and of the steering committees of DEBS and Autonomics conferences. Finally, he belongs to the Scientific Committee of Sapienza Innovazione where he is Director of the "Joint-Lab on Security Research"

Gian Pietro Picco

Gian Pietro Picco is an Associate Professor in the Dipartimento di Ingegneria e Scienza dell'Informazione (DISI) at University of Trento, Italy. Previously, he has been on the faculty of Washington University in St. Louis, MO, USA (1998-1999) and Politecnico di Milano, Italy (1999-2006). The goal of his current research is to ease the development of modern distributed systems through the design and implementation of appropriate programming abstractions and of communication protocols efficiently supporting them. His work spans the research fields of software engineering, middleware, and networking, and is oriented in particular towards wireless sensor networks, mobile computing, and large-scale distributed systems. More information at `http://disi.unitn.it/~picco`.

Paul Grace

Paul Grace is a senior research associate in the Computing Department at Lancaster; he has also worked as a researcher in the Computer Science department at K.U. Leuven. He received a Ph.D. and an M.Sc. from Lancaster University in 2004 and 2000 respectively, and a B.Sc. in Computer Science from the University of York. He has significant experience in the design and development of adaptive systems software and was the primary architect of ReMMoC, a reconfigurable middleware solution for mobile devices. He is also the lead developer of Gridkit which uses overlay networks to support heterogeneity. His research interests include adaptive software, aspect-oriented programming, reflection, middleware, and mobile/ pervasive computing. He has served on many international conference PCs and has published over 50 articles in the field of middleware and distributed systems.

Patrick Eugster

Patrick Eugster is an assistant professor at Purdue University where he conducts research on programming languages and distributed systems. Particular interests include programming language support for wide area and wireless settings. Before that, Patrick held positions as research associate and lecturer at both Swiss Federal Institutes of Technology in Lausanne and Zurich, and worked as a senior software architect for Sun Microsystems. Patrick holds an MS degree and a PhD degree both from EPFL. Patrick's current research is sponsored by several grants from the National Science Foundation (NSF). He is a recipient of the NSF CAREER award and has received twice the prize of excellence from EPFL as a graduate student, once for research and once for teaching. At Purdue University Patrick is a core member of the Secure Software Systems (C3) laboratory, and is

affiliated with the renowned Center for Education and Research in Information Assurance and Security (CERIAS). He is a member of ACM and IEEE.

Mélanie Bouroche

Mlanie Bouroche is a Research Fellow in the Distributed Systems Group of the Department of Computer Science at Trinity College Dublin. She was awarded a "Diplome d'Ingnieur en Tlcommunications" by INP Grenoble, France in 2003, an M.Sc. in Computer Science (Networks and Distributed Systems) from Trinity College Dublin in 2003 and a Ph.D. in Computer Science from Trinity College Dublin in 2007. Her research interests include distributed systems, and in particular, middleware for sentient computing, and real-time coordination of mobile autonomous entities. Mlanie's thesis presents an approach to systematically translating system-wide safety constraints into requirements on the behaviour of autonomous mobile entities. Since her PhD is finished, Mlanie is working on networked and embedded systems for intelligent transportation systems (ITS).

3.4 Session Abstracts

3.4.1 Energy in Wireless Sensor Networks

Speaker: António Loureiro (Federal University of Minas Gerais, Brazil)
Abstract: Wireless sensor networks have the potential to be applied in different applications such as habitat, environmental and industrial monitoring. Each sensor node is responsible for performing sensing, processing and communication functions that depend on a power source, which is typically represented by a battery that has a limited energy capacity. Energy awareness is a very important design consideration for protocols and algorithms in sensor networks. Energy management in WSNs involves not only reducing the energy consumption of a single sensor node but also maximizing the lifetime of the entire network. Furthermore, energy awareness should be incorporated into every stage of the wireless sensor network design and operation with the goal of making dynamic tradeoffs between energy consumption, system performance, and operational fidelity. In this tutorial it is discussed the main energy techniques that can be applied to the design of applications, algorithms and protocols for wireless sensor networks. The discussion is based on a taxonomy of techniques used by algorithms and protocols to save energy.

3.4.2 Programming Wireless Sensor Networks

Speaker: Francisco Martins (University of Lisbon, Portugal)
Abstract: Robust programming of large-scale sensor networks is a difficult problem. The severe restrictions imposed by the underlying hardware platform and the choice of an appropriate set of abstractions to model the processes occurring in these networks makes the task quite formidable. Despite these difficulties, the potential pay-off is immense with applications in many areas from mundane (domotics) to state-of-the-art science (high energy physics). It is therefore not surprising that a considerable amount of research has

been devoted to the subject and that some solutions have emerged with various degrees of success. This tutorial presents a survey of the current state of the art in programming languages and runtime systems for wireless sensor networks, while trying to identify problems not addressed adequately by the current body of research and, tendencies for future developments.

3.4.3 Mobility Models for Systems Evaluation

Speaker: Mirco Musolesi (University of Cambridge, UK)
Abstract: Mobility models play an essential role in the evaluation of protocols and algorithms for mobile systems, especially for the simulation of large-scale scenarios. In this tutorial we present a survey of the state-of-the-art of mobility modelling for networking and systems research. We discuss the most important synthetic models, considering both purely random mobility models and those based on real traces. We also present the most important analytical results about human connectivity derived from the analysis of real traces. Finally, we discuss recent developments related to the application of social network theory to mobility modelling and outline the existing research challenges.

3.4.4 Ad Hoc Routing

Speaker: Filipe Araújo (University of Coimbra, Portugal)
Abstract: MANETs topology may change frequently as nodes move, thus turning multi-hop routing into a particularly difficult problem. In this tutorial, we focus on topology-based, and position-based routing schemes. In topology-based approaches, nodes exchange connectivity information with their neighbors to create routing tables. First topology-based routing protocols, were directly derived from distance vector IP protocols. Unfortunately, they are not suitable for wireless environments, because they waste precious resources collecting topological information for destinations that might never be contacted. To address this problem, newer protocols postpone collection of routes up to the moment when nodes need them. One shortcoming of topology-based routing is that nodes have to collect routing information that might be arbitrarily distant. As this might be impossible in a wireless network, position-based routing emerged as a less expensive alternative. By using location of the destination, of the node itself and of its neighbors, it is possible to reach destination with only a very limited view of the network, often restricted to the immediate one-hop neighborhood. We divide the presentation of position-based routing schemes in two major parts, as both play equally important roles: routing algorithms and pre-processing algorithms. The routing algorithm runs at each node and determines which neighbor should be the next hop for a packet. The pre-processing algorithm serves to create a graph for the routing algorithm. This usually means to create in each node a local view of a global planar graph. Unfortunately, simplicity of position-based routing comes with some costs, namely in the technology required to determine position and in routing failures, even in extremely simple scenarios. Hence, both approaches, topology and position-based, have their own advantages and disadvantages.

3.4.5 An Introduction to Population Protocols

Speaker: Eric Ruppert (York University, Canada)
Abstract: Population protocols are used as a theoretical model for a collection (or population) of tiny mobile agents that interact with one another to carry out a computation. The agents are identically programmed finite state machines. Input values are initially distributed to the agents, and pairs of agents can exchange state information with other agents when they are close together. The movement pattern of the agents is unpredictable, but subject to some fairness constraints, and computations must eventually converge to the correct output value in any execution that results from that movement. This framework can be used to model mobile ad hoc networks of tiny devices or collections of molecules undergoing chemical reactions. This tutorial surveys results that describe what can be computed in various versions of the population protocol model.

3.4.6 Routing Issues in Opportunistic Networks

Speaker: Silvia Giordano (SUPSI-DTI, Switzerland)
Abstract: Opportunistic networking constitutes a medium-term application of general-purpose MANET for providing connectivity opportunities to pervasive devices when no direct access to the Internet is available. Pervasive devices, equipped with different wireless networking technologies, are frequently out of range from a network but are in the range of other networked devices, and sometime cross areas where some type of connectivity is available (e.g. Wi-Fi hotspots). Thus, they can opportunistically exploit their mobility and contacts for data delivery. Opportunistic networksthus aim at building networks out of mobile devices carried by people, possibly without relying on any pre-existing infrastructure. Moreover, opportunistic networks look at mobility, disconnections, partitions, etc. as "features" of the networks rather than exceptions. Actually, mobility is exploited as a way to bridge disconnected "clouds" of nodes and enable communication, rather than a drawback to be dealt with. More specifically, in opportunistic networking no assumption is made on the existence of a complete path between two nodes wishing to communicate. Source and destination nodes might never be connected to the same network, at the same time. Nevertheless, opportunistic networking techniques allow such nodes to exchange messages. By exploiting the "store-carry-and-forward" paradigm, intermediate nodes (between source and destination) store messages when no forwarding opportunity towards the final destination exists, and exploit any future contact opportunity with other mobile devices to bring the messages closer and closer to the destination. This approach to build self-organising infrastructure-less wireless networks turns out to be much more practical than the conventional MANET paradigm.

3.4.7 Wireless Mesh Networks

Speaker: Johnathan Ishmael (Lancaster University, UK)
Abstract: Wireless Mesh Networks have emerged as an important technology in building next-generation networks. They are seen to have a range of benefits over traditional wired

and wireless networks including low deployment costs, high scalability and resiliency to faults. Moreover, Wireless Mesh Networks (WMNs) are often described as being autonomic with self-* (healing and configuration) properties and their popularity has grown both as a research platform and as a commercially exploitable technology. Initially this tutorial examines the challenges faced by traditional network technologies and discusses the role of WMNs in overcoming some of these problems. Following this an overview of Wireless Mesh Networks is presented, providing comparisons with similar network technologies including sensor networks and Mobile Ad Hoc Networks (MANETs). The core of the tutorial then details the state-of-the-art technologies involved in the construction of WMNs, including standards based activities, academic research, commercial products and deployment testbeds.

3.4.8 Gossip-Based Dissemination

Speaker: Hugo Miranda (University of Lisbon, Portugal)
Abstract: This tutorial addresses the use of gossip-based protocols in mobile ad hoc networks. Gossip-based protocols have the advantage of requiring little or no structure to operate, making them particularly appealing to apply in dynamic systems such as wireless self-organizing networks. The use of gossip-based protocols is illustrated with three different, but related, middleware services, namely: broadcast, publish/subscribe, and data placement.

3.4.9 Application Layer Multicast

Speaker: Benoit Garbinato (University of Lausanne, Switzerland)
Abstract: Application Layer Multicast (ALM) has increasingly gained interest, in particular because this approach makes it possible to overcome the shortcomings of IP multicast. Along that line, several approaches have been proposed, each focusing on a different set of criteria, such as reliability, scalability, control overhead, etc. The set criteria of an ALM solution then largely depends on its target application requirements. To provide a better understanding of key research results in this field, this presentation proposes a classification a large number of ALM solutions proposed in the literature. In doing so, we try to position each solution via three viewpoints: (1) quality of service, (2) underlying architecture and (3) applicative focus. Since many interesting ALM solutions were not explicitly designed for MANETs, we also try to assess to what extend these solutions may be suitable for MANETs deployment, by defining a set of criteria specific to deployments in MANETs.

3.4.10 Distributed Event Routing in Publish/Subscribe Systems

Speaker: Roberto Baldoni (Sapienza Università di Roma, Italy)
Abstract: Distributed event routing has emerged as a key technology for achieving scalable information dissemination. In particular it has been used as preferential communication backbone within publish/subscribe communication system. Its aim is to reduce the network and computational overhead per event diffusion to a set of interested recipients. This

tutorial introduces the reader to modern publish/subscribe systems through an overview on current techniques for event dissemination. The approach we follow proposes a decomposition of these architectures in functional layers. We survey current algorithms for event based routing, and possible overlay infrastructures in wired and mobile systems.

3.4.11 Tuple Space Middleware for Wireless Networks

Speaker: Gian Pietro Picco (University of Trento, Italy)
Abstract: Tuple spaces are a communication and coordination model based on data sharing. Applications based on this model are highly decoupled, a fundamental asset in the dynamic wireless setting. This tutorial looks back at almost a decade of efforts in the research community, by concisely describing some of the most representative tuple space systems and analyzing them along some fundamental dimensions of comparison. In doing so, it considers two main classes of applications that rely on wireless communication: mobile computing and wireless sensor networks. Some case studies are presented, borrowed from the instructor's own work on the Lime middleware and its adaptation to wireless sensor networks, TeenyLime.

3.4.12 Dynamic Adaptation

Speaker: Paul Grace (Lancaster University, UK)
Abstract: The fundamental characteristic of mobile entities connected via wireless networks (either fixed infrastructure or ad hoc) is change in environmental conditions. Dynamic adaptation is an essential technique to allow mobile systems to ensure they continually provide the required levels of service in the face of change. This tutorial investigates the software techniques for performing adaptation, and the adaptive middleware technologies that have been used to develop dynamic mobile applications. Finally, the future challenges in this emerging field of research are investigated.

3.4.13 Middleware Support for Context-aware Applications

Speaker: Patrick Eugster (Purdue University, USA)
Abstract: With computing devices becoming more mobile and pervasive, a stronger interaction between an application and its changing environment opens new horizons in terms of application functionalities. Location-based applications, such as GPSnavigation systems, are good examples of how information provided to an application on its surroundings offers new kinds of functionalities. Location is one of many environmental variables that might influence the behavior of an application. The notion of context encompasses these variables in the broad sense.

3.4.14 Vehicular Networks and Applications

Speaker: Mélanie Bouroche (Trinity College Dublin, Ireland)

Abstract: Vehicular networks represent a particularly challenging class of mobile (ad hoc) networks that enable vehicles to communicate with each other and/or with roadside infrastructure. This tutorial describes potential applications, middleware approaches and communication protocols proposed for vehicular networks.

4 School Program Schedule

	MONDAY	**TUESDAY**	**WEDNESDAY**	**THURSDAY**
Session A (9h-10h30)	Registration & Welcome	Ad Hoc Routing	Gossip-based Dissemination	Duple Spaces
Session B (11h-12h30)	Energy in WSN	Opportunistic Networks	Publish / Subscribe	Vehicular Networks
Session C (14h-15h30)	Programming WSNs	Population Protocols	Application Layer Multicast	Context-aware Applications
Session D (16h-17h30)	Mobility Models	Wireless Mesh Netowrks		Dynamic Adaptation

5 Statistics

Bellow are some statistic information gathered during and before the school.

5.1 Participation

The school had a total of 92 participants, including the speakers. From all students, 30 received scholarships. Participation in the school originated from seventeen countries, mainly in the European Union, but also from Brazil and the USA. A summary plot is presented in Figure 1.

5.2 Feedback Summary

The organizers made available to all the school participants a feedback form to assess the quality of the program and the organization. The form consisted in four questions, and an open space for comments and potential improvements. The questions were:

1. Outcome:
1. The school broadened my understanding of concepts and principles.
2. The school improved my ability to carry out original research.
3. The material presented in the school was relevant to my research.
4. Overall, the school met my expectations.

2. Lectures:
1. The instructors' knowledge of the subjects was good.

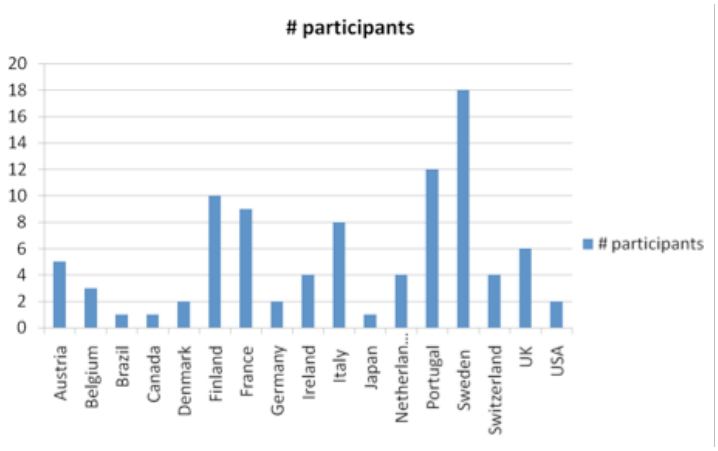

Figure 1: Participation in the school.

2. The instructors explained the material well.
3. Lectures incorporated recent developments in the field.
4. The instructors stimulated my intellectual curiosity.

3. Communication:
1. The school web site was informative before the school started.
2. The course material was available and well-aligned with the talks.
3. Instructors were available for Q&A outside the lecture periods.
4. The range of lectures captured the overall essentials of the field.

4. Organization:
1. The school was well organized.
2. The lecture room (auditorium) was conductive to learning.
3. Access to the Internet was provided in a satisfactory manner.
4. The social program enhanced the school experience.

The results of the questionnaire are depicted in Figure 2 and the comments summarized below.

Best things about the school: Good talks (4); Friendly and kind organization staff (5); Networking (4); Well-known & open-minded instructors; Social events (4); Good handbook (4); Careful selection of topics and speakers; Good organization of talks (5); High international environment; Good cafeteria/food (2); Everything; Exchange of ideas during the breaks; The vehicular networks and Context-aware applications talks.

Potential improvements: Hotel or better accommodation. (5); Could have offered fruits during the breaks; A tour or an introduction to the city; More address indications (2);

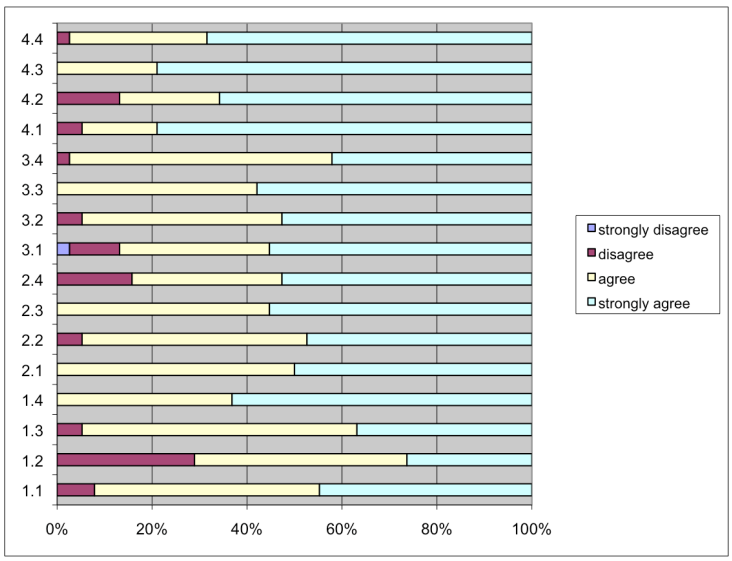

Figure 2: Feedback results.

More power sockets (3); Option of single room accommodation in SGS (3); Provide better transportation means; Coffee in the morning (before talks); Better Internet connection in SGS rooms (2); Smaller lecture room; An electronic version of the book before the School; Reduce the number of lectures to 3/day to give ample time to students for shopping and sightseeing; Shorten talks; Add interactive discussions to make talks more engaging; The sessions could be with less participants and organized in a more intensive way; Fewer topics (allowing for more in-depth discussion though limiting scope); A PhD student colloquium asking for papers from PhDs and presenting the best to provide awareness of cutting edge research; Some more on mobile phones/smartphones.

6 Conclusions

The school's goal of gathering a set of recognized speakers, previously involved in MiNEMA activities, to present and discuss the state-of-the-art developments in different areas related to middleware in mobile environments was a great success. Presentations originated fruitful discussions amongst the audience and speakers, that will hopefully contribute to the widening of the network's visibility outside its natural environment and to the publicizing of the recently published MiNEMA book, whose contents were the basis for the scientific program of the school.