

# Scientific report of the 6<sup>th</sup> MiNEMA workshop

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## 1 Summary

This document reports on the organization of the 6<sup>th</sup> MiNEMA workshop, its scientific content and its outcome.

During the past four years, the MiNEMA workshop series has grown into an international forum for middleware research, supported by the European Science Foundation (ESF). The objective is to bring together a mixture of young and senior researchers working on middleware for network eccentric and mobile applications. The workshops help to foster further collaboration between existing MiNEMA members, with special emphasis on PhD students, to advertise and widen participation in the MiNEMA network and to establish links with the software industry.

The 6<sup>th</sup> MiNEMA workshop was held in Glasgow, Scotland on April 1, 2008 and was co-located with the EuroSys2008 conference. The objective of this workshop was to foster further collaboration in the domain of middleware, and to advertise and widen participation in a broader systems research community. For this reason, the workshop was co-located with the EuroSys2008 conference.

EuroSys2008 is organized by EuroSys, the European Chapter of ACM SIGOPS, in cooperation with the British Computer Society (BCS) and Gesellschaft für Informatik. EuroSys welcomes submissions and attendance from all over the world and aims to bring together researchers from different areas of computer systems, who are otherwise spread over multiple conferences.

The scientific program of the 6<sup>th</sup> MiNEMA workshop was organized by Sam Michiels from the K.U.Leuven (Belgium) and Douglas Schmidt from Vanderbilt University (US). Local arrangements were handled by the EuroSys2008 organization (Joe Sventek from Glasgow University (Scotland)).

The workshop attracted 36 participants, of which 18 (50%) members of the MiNEMA scientific network, 9 (25%) from industry and 27 from academia, from 10 countries and 21 institutions. These results confirm that the MiNEMA network succeeds in attracting a diverse public from academic institutions as well as industry.

## 2 Scientific content

### 2.1 Research scope

The research scope of the workshop was the design, implementation, deployment, and evaluation of middleware and architectures for mobile computing and communication environments.

Middleware is crucial to bridge the gap between applications and the lower-level hardware and system software in order to coordinate how application components are connected and how they interoperate in a distributed context. Middleware research is a very promising research area mainly focusing on developing algorithms, components, and software architectures for enhancing a.o. distributed communication, resource management, reconfiguration management, and reliability.

Solicited research topics included, but were not limited to:

- Communication paradigms, group communication
- Publish/subscribe systems
- Coordination protocols
- Middleware architecture
- QoS architectures
- Adaptation
- Ad hoc, sensor networking and routing
- Security
- Multimedia support and applications
- Performance
- Context Awareness

### 2.2 Research contributions

The type of contributions was in line with previous MiNEMA workshops in Leuven, Sintra and Magdeburg. The scientific program consisted of (1) research papers, (2) study topics and (3) lessons learned:

- **Research papers.** Research papers presenting new, still preliminary research on Middleware for mobile environment. The recommended length of the submission was between 3 and 5 pages.
- **Study topic.** A study topic identifying potentially open questions in the domain, and setting out a plan for how to answer those questions during the workshop. These submissions could not exceed 3 pages.
- **Lessons Learned.** A summary of complete research tracks and/or projects. This work could be submitted by sending a position paper, optionally complemented with a report or reference to an existing publication describing the work. The recommended length of the submission was between 3 and 5 pages.

The presentation of completed research as well as work-in-progress created a dynamic program which encouraged fruitful discussions and new collaborations.

For each accepted submission, one author was invited to give a presentation at the workshop. Research papers were presented in a 30 minute slot; study topics were presented in a 15 minute slot (plus 15 minutes Q&A after the presentations); a 2 hour demo and poster session was organized for presenting lessons learned.

The authors of accepted submissions were requested to revise their contribution by considering the feedback of reviewers. The proceedings of the workshop, composed of all submissions accepted, will be uploaded to the ACM Digital Library and were collected on the EuroSys2008 proceedings CD.

### **2.3 Program committee**

Each paper, in order to be accepted, was reviewed by three members of the workshop program committee. The program committee consisted of top researchers in the international research domain of middleware:

- **Filipe Araújo**, University of Coimbra, Portugal
- **Sonia Ben Mokhtar**, University College London, UK
- **Gordon Blair**, Lancaster University, UK
- **Paolo Costa**, Vrije Universiteit Amsterdam, Netherlands
- **Paul Grace**, Lancaster University, UK
- **Indranil Gupta**, University of Illinois, Urbana-Champaign, USA
- **Qi Han**, Colorado School of Mines, USA
- **Wouter Joosen**, K.U.Leuven, Belgium
- **Valérie Issarny**, INRIA Rocquencourt, France
- **Shanika Karunasekera**, University of Melbourne, Australia
- **Boris Koldehofe**, Universität Stuttgart, Germany
- **Fabio Kon**, University of São Paulo, Brazil
- **Hugo Miranda**, University of Lisbon, Portugal
- **Mirco Musolesi**, Dartmouth College, USA
- **Oriana Riva**, ETH, Switzerland
- **Luís Rodrigues**, Technical University of Lisbon, Portugal
- **Francois Taiani**, Lancaster University, UK
- **Nalini Venkatasubramanian**, UC Irvine, USA
- **Stefan Weber**, Trinity College, Ireland

### **2.4 Analysis of submissions**

This workshop received a total of 19 abstract submissions, of which 15 were turned into a paper. The set of 15 papers consisted of 9 research papers, 2 study topic papers and 4 lessons-learned papers which presented a demonstrator. The program committee decided to accept 9 submissions, i.e. 3 research papers, 2

study topic papers, and 4 demonstrators. The 5 accepted papers will be published in the ACM digital library.

In addition, the program chairs decided to invite two well-established researchers who are active in the middleware research domain; they presented a keynote talk at the beginning of the workshop.

## **2.5 Paper abstracts**

### **2.5.1 When cars start gossiping**

Vehicular ad hoc networks present challenging characteristics, such as very dynamic behavior and sparse connectivity that need to be taken into account in designing adequate communication support. Gossip-based protocols have recently emerged as an effective approach to providing reliable and efficient communication in this domain. Nonetheless, despite the preliminary encouraging results, to the best of our knowledge, no previous work has systematically analyzed how gossip protocols are affected by the intrinsic characteristics of vehicular networks such as the very specific mobility patterns of vehicles, the relative abundance of memory and computational resources that vehicles offer, and the availability of geographical information through GPS receivers. In this paper, we aim at filling this gap by examining core requirements of vehicular network applications and analyzing the research challenges that gossip-based communication protocols need to address.

### **2.5.2 An End-to-End routing protocol for Peer-to-Peer communication in Wireless Sensor Networks**

Interfacing Wireless Sensor Network (WSN) technologies with the Internet is a key requirement for making sensor data globally available. To this end, the authors have developed the TinyTorrents system; a peer-to-peer publishing and redundancy framework for the dissemination of sensor data in a reliable, redundant and self-consistent manner using torrent technology. TinyTorrents utilises a reactive routing protocol for WSNs which incorporates bidirectionality, reliability and generic communications modalities. In this paper the routing protocol, TinyHop, is presented. Tiny-Hop creates on-demand routes, is self managed and works in an end-to-end fashion. Any node in the mobile environment can establish communications with, and retrieve data from, any contactable node at any time. Thus any node can function as a base station or sink. Mobile elements (e.g. data mules) or static gateways can interconnect from different parts of the network, thereby balancing the traffic load and helping avoid network partition. The protocol has been implemented in TinyOS 2.0.2 and simulated in TOSSIM.

### **2.5.3 Decentralised Dynamic Code Management for OSGi**

Originally designed for the management of network-attached devices OSGi builds a de-facto standard to modularise all kinds of complex Java applications. It enables deployment and updating of components, which are called bundles, by

supporting automatic resolution of inter-component dependencies. Despite these benefits the OSGi specification omits dedicated support for discovery, selection and loading of locally unavailable bundles. However, this is a key requirement for large distributed applications especially in dynamic and heterogeneous environments. Current solutions are server-based and provide a central bundle repository thereby representing a single point of failure. Furthermore, these approaches lack support for automatic bundle selection based on non-functional properties such as resource demand or performance. We introduce the D<sup>2</sup>CM infrastructure accounting these issues and enabling automatic discovery, selection and loading of bundles in a distributed system on basis of the peer-to-peer platform JXTA. By providing extended bundle descriptions, non-functional properties can be automatically evaluated for bundle selection and dependency resolution.

#### **2.5.4 Policy-based management of middleware for distributed sensor applications**

Contemporary distributed software systems have become extremely heterogeneous, dynamic and large-scale. They include back-end servers, regular PCs and various mobile and embedded devices, as well as diverse network infrastructures, such as sensor networks. However, these factors make manual management of the distributed system and its installed software extremely complex. In this position paper we seek for an architectural solution for a middleware that supports autonomic management of these distributed software systems through a policy-based approach. This middleware architecture suggests the introduction of a closed control loop on top of a highly customizable middleware architecture. We describe the key research challenges that still remain open for discussion and propose a plan to tackle them.

#### **2.5.5 Tailoring a broadcast algorithm to particular network conditions**

The broadcast of a message in Mobile Ad Hoc Networks requires its retransmission by multiple devices, consuming both bandwidth and power. The goal of broadcast algorithms is to select the most adequate nodes to retransmit so that the cost of the operation is reduced. Pampa is a broadcast algorithm that has been shown to perform well when the node distribution is uniform. This position paper identifies and discusses some cases where the performance of Pampa can be improved and presents the research directions that will be pursued to address them.

### **3 Assessment of results**

The workshop clearly reached the research field and succeeded in attracting a diverse public from academic institutions as well as industry. 36 people attended the workshop, of which 18 (50%) members of the MiNEMA scientific network, 9 (25%) from industry and 27 from academia, from 10 countries and 21 institutions.

