8th MiNEMA Workshop Scientific Report

Luís Rodrigues
INESC-ID / IST
ler@ist.utl.pt

September 24-25, 2008
Turin, Italy

1 Workshop Details

Title: 8th MiNEMA Workshop
URL: http://www.gsd.inesc-id.pt/~jmocito/minema8th/
Date: September 24-25, 2008 (co-located with Autnomics 2008)
Location: Telecom Italia Labs, Turin, Italy
Duration: 2 days
Organizers: Luís Rodrigues (INESC-ID/IST) and Kolos Esztergalyos (ICST)

2 Summary

Th 8th MiNEMA Workshop was a joint organization between the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering (ICST) and the Distributed Systems Group (GSD) of the INESC-ID research lab in Portugal. The workshop took place in Turin, Italy on September 24-25 2008 and was co-located with the Autonomics 2008 conference.

The 8th MINEMA Workshop was planned as one of the periodic events in 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 workshop aimed at fostering further collaboration between existing MINEMA members, and to advertise and widen participation in the MINEMA network.

The Autonomics conference provides an international forum driving the emergent science of autonomic systems, bringing together research communities in communication and computing, promoting cross-fertilization among the different disciplines involved.

The programme of Autonomics 2008 included several workshops centered around different European research projects, namely in the area of communications and mobile ad

hoc networks (such as SAC-FIRE, INSERTech). Therefore, it provided an excellent vehicle to disseminate the results of the MiNEMA programme in the scientific community that is working in related fields.

The scientific program of the workshop was organized by Luís Rodrigues from INESC-ID/IST (Portugal). Local arrangements were handled by the Autonomics 2008 organization (Kolos Esztergalyos from ICST).

3 Scientific Content

3.1 Research Scope

The research scope of the workshop was the design, implementation, analysis, evaluation, and deployment of autonomic middleware for mobile environments.

Topics of interest include, but are not limited to:

- Theoretical foundations of autonomic systems
- Models and metrics
- Energy-efficient algorithms
- Programming paradigms
- Middleware for pervasive systems
- Software architectures and toolkits
- Positioning and tracking technologies
- Architectures & algorithms for self-* systems
- Privacy, security, dynamic trust and social issues
- Location- and context-awareness
- Tools, languages and platforms
- Applications and systems
- Resource, network and service (self)-management
- Enabling technologies for pervasive environments

3.2 Program Organization

The workshop program was organized as a set of invited talks from speakers actively involved in the MiNEMA scientific network activities with a recognized scientific track record.

Luís Rodrigues was in charge of the invitation process and invited seven speakers to present works on middleware for mobile computing and communication that possess autonomic features (e.g. self-tuning) or can be used to build autonomic systems for mobile environments.

3.3 Paper Abstracts

3.3.1 Tracking and Tracing Containers through Distributed Sensor Middleware

Authors: Klaas Thoelen, Sam Michiels and Wouter Joosen (Katholieke Universiteit Leuven)

Speaker: Sam Michiels

Abstract: In a container transport system, wireless sensor networks (WSNs) can be used for monitoring products while they are being transported. To be commercially interesting, these WSNs must be integrated with enterprise systems of various actors in the supply chain. The need for interoperability between networks and partners, the heterogeneity of WSN technologies being used, and the mobility of sensor nodes make this integration far from trivial. This paper presents lessons learned from a research project in collaboration with industry in which we developed a prototype middleware solution for container transport. The prototype triggered valuable feedback which is highly relevant to consider when designing middleware for realistic sensor applications.

3.3.2 Building Mulsticast Trees in Ad-hoc Networks

Authors: Raphael Kummer, Peter Kropf and Pascal Felber (Université de Neuchâtel)

Speaker: Peter Kropf

Abstract: Multicast trees are used in a variety of applications, such as publish/subscribe systems or content distribution networks. Existing algorithms for ad-hoc networks typically produce multicast trees requiring many nodes to act as relays even though they are not part of the multicast group. In this paper, we propose an algorithm for building efficient multicast trees that strives to minimize the number of non-member relay nodes and the number of transmissions required to reach all the group members, and to balance the degree of members when acting as internal nodes of the multicast tree. Our algorithm relies upon a lightweight distributed hash table (DHT) to construct and optimize the multicast trees. We evaluate the efficiency and scalability of our algorithm by simulations with various network configurations and sizes.

3.3.3 Engineering Complex Adaptations in Highly Heterogeneous Distributed Systems

Authors: Paul Grace, Gordon S. Blair, Carlos Flores Cortes and Nelly Bencomo (Lancaster University)

Speaker: Paul Grace

Abstract: Distributed systems now encounter extreme heterogeneity in the form of diverse devices, network types etc., and also need to dynamically adapt to changing environmental conditions. Self-adaptive middleware is ideally situated to address these challenges. However, developing such software is a complex task. In this paper, we present the Gridkit self* approach to the engineering of reflective middleware; this embraces state of the art software engineering practices, and flexible dynamic adaptation mechanisms to better support system developers. Domain specific frameworks are modeled and developed to enhance configurability and reconfigurability. We evaluate this approach using case studies in the domains of service discovery and network overlays. These demonstrate the benefits of the approach in terms of aiding and simplifying the process of creating self-configuring and self-adaptive software.

3.3.4 Energy-efficient Gossiping in Mobile Ad Hoc Networks

Authors: Denis Rochat, Marco Tomassini and Benoît Garbinato (University of Lausanne)

Speaker: Denis Rochat

Abstract: In this paper, we present a novel gossiping protocol for disseminating information in static and mobile multi-hop ad hoc networks. Our protocol exhibits two interesting properties. First, it tends to decrease the power required to disseminate information, by reducing the transmission range each network node uses for gossiping. This property results in a longer life expectancy for the ad hoc network, when running on power-constrained devices. Second, mobility has no negative impact on the performance of our protocol, meaning that it is equally useful in a static context and in a mobile context. Both these properties are shown empirically, via a thorough performance evaluation. It is also noteworthy that our protocol retains the decentralized and stateless nature of traditional gossiping protocols.

3.3.5 Improving Scalability of Autonomic Systems: The Frequency-Aware Search Approach

Authors: Pedro Fonseca and Hugo Miranda (University of Lisboa)

Speaker: Pedro Fonseca

Abstract: Resource and data indexing in distributed, self-manageable systems can leverage on the experience gained from peer-to-peer networks, often built using distributed indexing. This paper presents FASE, a distributed indexing algorithm for unstructured overlays with flat topologies. FASE combines a replication policy and a search space division technique to achieve low hop counts using a small number of messages. The unexpected departure of nodes from the overlay, which may be observed in heterogeneous networks

built over an unreliable medium, is mitigated by a distributed monitoring algorithm designed with FASE in mind. Simulation results validate FASE efficiency when compared to other search algorithms. The evaluation of the distributed monitoring algorithm shows that it maintains FASE performance when subjected to a constant arrival and departure of nodes.

3.3.6 Strategies for Repeated Games with Subsystem Takeovers

Authors: Shlomi Dolev (Ben-Gurion University of the Negev), Elad M. Schiller (Chalmers University of Technology), Paul G. Spirakis (University of Patras) and Philippas Tsigas (Chalmers University of Technology)

Speaker: Elad M. Schiller

Abstract: Systems of selfish-computers, such as the Internet, are subject to transient faults due to hardware/software temporal malfunctions; just as the society is subjected to human mistakes due to a moment of weakness. Game theory uses punishment for deterring improper behavior. Due to faults, selfish-computers may punish well-behaved ones. This is one of the key motivations for forgiveness that follows any effective and credible punishment. Therefore, unplanned punishments must be proven to have ceased in order to avoid infinite cycles of unsynchronized behavior of "tit for tat". We investigate another aspect of selfish-computer systems. We consider the possibility of subsystem takeover, say, by the use of hostile malware. The takeover may lead to joint deviations coordinated by an arbitrary selfish-computer that controls an unknown group of subordinate computers. We present strategies that deter the coordinator (and its subordinates) from deviating in infinitely repeated games. We construct deterministic and finite automata that implement these strategies with optimal complexity. Moreover, we prove that all unplanned punishments eventually cease by showing that the automata can recover from transient faults.

3.3.7 Collaborative Microdrones: Applications and Research Challenges

Authors: Markus Quaritsch, Bernhard Rinner, Christian Bettstetter, Gerhard Friedrich, Hermann Hellwagner, Emil Stojanovski (University of Klagenfurt), Michael Hofbaur (Graz University of Technology) and Mubarak Shah (University of Central Florida)

Speaker: Markus Quaritsch

Abstract: Microdrones are small-scale unmanned aerial vehicles (UAVs) carrying payloads such as cameras and sensors. Such microdrones enable us to obtain a bird's eye view of the environment which is helpful in many applications such as environmental monitoring, surveillance or disaster management. This position paper reports on our recently launched project "collaborative microdrones" where we are developing a system for aerial imaging based on cooperating, wireless networked microdrones that can be used in disaster management applications. Several microdrones will fly in formation over the area of interest and deliver sensor data which is fused, analyzed and delivered to the user in real-time. In

this paper we briefly discuss applications for UAVs, present related projects, introduce our research focus and report on preliminary results.

4 Meeting Program

Wednesday 24 [16h30 - 18h30]

16h30 *Tracking and Tracing Containers through Distributed Sensor Middleware*
Klaas Thoelen, **Sam Michiels** and Wouter Joosen (Katholieke Universiteit Leuven)

17h00 *Building Mulsticast Trees in Ad-hoc Networks*
Raphael Kummer, **Peter Kropf** and Pascal Felber (Université de Neuchâtel)

17h30 *Engineering Complex Adaptations in Highly Heterogeneous Distributed Systems*
Paul Grace, Gordon S. Blair, Carlos Flores Cortes and Nelly Bencomo (Lancaster University)

18h00 *Energy-efficient Gossiping in Mobile Ad Hoc Networks*
Denis Rochat, Marco Tomassini and Benoît Garbinato (University of Lausanne)

Thursday 25 [14h00 - 15h30]

14h00 *Improving Scalability of Autonomic Systems: The Frequency-Aware Search Approach*
Pedro Fonseca and Hugo Miranda (University of Lisboa)

14h30 *Strategies for Repeated Games with Subsystem Takeovers*
Shlomi Dolev (Ben-Gurion University of the Negev), **Elad M. Schiller** (Chalmers University of Technology), Paul G. Spirakis (University of Patras) and Philippas Tsigas (Chalmers University of Technology)

15h00 *Collaborative Microdrones: Applications and Research Challenges*
Markus Quaritsch, Bernhard Rinner, Christian Bettstetter, Gerhard Friedrich, Hermann Hellwagner, Emil Stojanovski (University of Klagenfurt), Michael Hofbaur (Graz University of Technology) and Mubarak Shah (University of Central Florida)

5 Conclusions

The workshop's goal of gathering a set of recognized speakers, previously involved in MiNEMA activities, to present and discuss their recent works inside the Autonomic computing community was a success. Presentations originated fruitful discussions that will hopefully contribute to the widening of the network's visibility outside its natural environment.