NordiCloud 2013: A Nordic and Baltic Gathering for Supporting Cloud Computing and Internet Technologies

Muhammad Ali Babar
Lancaster University &
IT University of Copenhagen
Copenhagen, Denmark
(+45) 7218 5107
malibaba@itu.dk

Marlon Dumas
University of Tartu
Tartu, Estonia
(+372) 7375473
Marlon.dumas@ut.ee

Arnor Solberg
SINTEF
Oslo, Norway
(+47) 95900741
Arnor.Solberg@sintef.no

ABSTRACT
This is an introduction to the second edition of the NordiCloud Symposium held on 2-3 September 2013 in Oslo, Norway.

Categories and Subject Descriptors
A.0 [**General**]: Conference Proceedings

General Terms
Measurement, Performance, Design, Security, Standardization.

Keywords
Cloud Computing, Utility Computing, Software Services, Internet of things (IoT), SaaS, PaaS, IaaS.

1. INTRODUCTION
Cloud Computing is an emerging computing paradigm that promises to be a major driver of business innovation by exploiting the technological advances of Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Like in other areas of the world, Nordic countries have established several initiatives and networks to promote cloud computing research and education. In parallel, a significant and increasing number of companies in Nordic and Baltic regions have embraced cloud computing and are facing broad challenges such as how to engineer, test and optimize cloud services? how to avoid cloud vendor locking, manage multi-cloud environments and migrate to various cloud platforms? how to manage security on the cloud? and how to adhere to national and international regulations and laws applicable to data and services on the cloud?

In this context, the Nordic Symposium on Cloud Computing and Internet Technologies (NordiCloud) was founded as platform for scientific, professional, and social networking and knowledge sharing activities to support research and practice surrounding the

broader themes of cloud computing and Internet of Things (IoT). The key objective of founding NordiCloud was to set up a venue of knowledge creation and dissemination for enhancing collaboration between industrial and academic communities from Nordic and Baltic countries in the area of cloud computing and Internet technologies. The symposium aims to bridge between cloud computing researchers and practitioners from Nordic and Baltic countries as well as other areas of the world. The first meeting of NordiCloud symposium was successfully organized along with WICSA/ECSA on August 20 and 21, 2013 in Helsinki, Finland.

This year, the symposium's call for papers attracted 15 submissions. Each submission received at least three reviews. Based on the reviews and discussions within the program committee, nine papers were selected for presentation at the symposium. The selected papers cover a broad spectrum of research topics in cloud computing, from modeling and design to deployment and monitoring, including research on security and interoperability issues, which are well known to be the key concerns in the field and constitute important enablers for the widespread adoption.

The program also includes two keynote talks by active members of the cloud computing community: Geir Horn and Keith Jeffrey. Geir Horn's keynote will discuss perspectives in the field of cloud brokerage, which he positions as a key enabler for more widespread cloud usage. Keith Jeffery's keynote, on the other hand, will discuss more broadly various challenges and opportunities in the field of cloud and multi-cloud computing. Like in other areas of the world, Nordic countries have established several initiatives and networks to promote cloud computing research and education. An increasing number of companies from Nordic and Baltic regions have also started offering different types of cloud services. Given the increasing relevance of cloud computing, Nordic and Baltic countries will greatly benefit from a network of excellence which aims to strengthen the local and international collaboration for achieving much-needed advances in both technical and socio-technical aspects of cloud computing. A highly relevant arena for building such networks and perform collaborative research is the European research programs. The Horizon 2020 Programme is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. H2020 will run from 2014 to 2020 with an e80 billion bud- get. In this context, the NordiCloud symposium will include a session named "From FP7 to Horizon 2020" to foster future collaboration and initiate project ideas. The session will include presentations of some ongoing FP7 cloud projects as well as a workshop to discuss

opportunities for research collaboration in the Horizon 2020 Programme.

We take this opportunity to thank the program committee for their commitment to ensuring the integrity and quality of the refereeing process. We also thank everyone at SINTEF who has contributed to the symposium's organization, particularly Alessandro Rossini, for the tremendous effort they have put to ensure the smooth organization of the symposium. Finally, we thank the keynote speakers, Keith Jeffery and Geir Horn for accepting to present their visions for future developments in the field. We a confident that the selection of papers and keynotes will provide an excellent background for the exchange of ideas and experiences and foster further research and collaboration in the field.

We hope that the presenters and attendees would find the program of NordiCloud interesting and insightful. We look forward to having a fruitful meeting spanning over two days in Oslo. We anticipate continuously growing interest and momentum to strengthen this platform for mobilizing the efforts aimed at findings solutions and disseminating to help accelerate the adoption of cloud computing and Internet technologies.

2. THE SYMPOSIUM THEMES AND ORGANIZATION

2.1 Main Themes for Contributions

The symposium sought contributions on the topics related to cloud computing and Internet Technologies (IoT). The areas of coverage of this symposium were quite broad and encompassing technological, economic, social, and regional challenges and solutions required for successfully leveraging cloud computing and Internet Technologies for societal value and advantages. Some example topics for which we sought contributions were:

- Service and deployment models of Cloud computing

- Design and evaluation of systems for cloud-based technologies

- Service-oriented architectures

- Monitoring and adaptation challenges and solutions

- Software development paradigms for cloud computing

- Evaluation approaches for cloud providers and cloud-based systems

- Energy efficiency of cloud based system and data centres

- Economic and business perspectives on cloud computing

- Socio-technical issues

- Internet-of-Things (IoT) for smart offices and homes

- cloud computing and Internet technologies for social computing

- Privacy and security issues and solutions

- Training and education programs for cloud computing

- Programming paradigms for cloud computing

- Cloud computing for supporting software development paradigms and organizational structures

2.2 Organization

The organization of the symposium was as follows:

General Chair

- Arnor Solberg, SINTEF, Norway

Program Chairs

- M. Ali Babar, IT University of Copenhagen, Denmark
  & The University of Lancaster, UK

- Marlon Dumas, University of Tartu, Estonia

Publicity Chair

- Alessandro Rossini, SINTEF, Norway.

Proceedings Chair

- Carlos Cuesta, Rey Juan Carlos University, Spain.

Program committee

- Ajith Abraham, MIR Labs, USA

- Åke Edlund, KTH/CSC/PDC, Sweden

- Klaus Marius Hansen, University of Copenhagen, Denmark

- Marite Kirikova, Riga Technical University, Latvia

- Peep Küngas, University of Tartu, Estonia

- Peter Kunszt, SystemsX.ch, Switzerland

- Lars Lundberg, BTH, Sweden

- Tomi Männistö, University of Helsinki, Finland

- Mihhail Matskin, KTH, Sweden

- Tommi Mikkonen, Tampere University of Technology, Finland

- Parastoo Mohagheghi, NTNU, Norway

- Dana Petcu, Western University of Timisoara, Romania

- Ivan Porres, Åbo University, Finland

- Sébastien Mosser, Université Nice-Sophia Antipolis, Polytech Nice-Sophia, France

- Juan M. Murillo, University of Extremadura, Spain

- Boris Novikov, St-Petersburg University, Russia

- Eila Ovaska, VTT, Finland

- Jakob Illeborg Pagter, Alexandra Institute, Denmark

- Romain Rouvoy, INRIA Lille-Nord Europe, France

- Sherif Sakr, National ICT Australia

- Satish Srirama, University of Tartu, Estonia

- Sasu Tarkoma, University of Helsinki, Finland

- Johan Tordsson, Umeå University, Sweden

3. Details of the Accepted Papers

Following are the details along with the abstracts of the peer-reviewed contributions accepted in this year's NordiCloud Symposium.

Gejibo, S., Grasso, D., Mancini, F., Mughal, K.A. "Secure Cloud Storage for Remote Mobile Data Collection"

Security and privacy are two of the major concerns when using cloud computing. That is why "*secure cloud storage is a hot topic nowadays. However, most solutions are user-centric, i.e., they focus on private data owned by a single individual. In the case of Remote Mo- bile Data Collection, we have many collectors continuously uploading data to a central cloud storage on one hand, and several data analysts or decision makers that require this data in real time on the other. In this paper we investigate the challenges related to this model and discuss possible solutions.*"

Aho, T., Koskinen, J., Nieminen, A. "A Secure OSGi Environment for Untrusted Web Applications"

It is becoming quite common practice to choose OSGi specifications for Java based web applications in order to run multiple applications on a single Java virtual machine. However, OSGi by default does not provide answers to all the potential security threats and vulnerabilities in the context of cloud computing and IoT. "*For instance, computer resource usage is only marginally con- trolled. In this paper, we discuss the security of the OSGi environment. In particular, we introduce a solution for running untrusted OSGi applications. In our case, controlling the permissions of the applications is fairly simple. A more challenging task is to manage the computer resource usage. We present a moderately straightforward solution that still grants a reasonable level of security. Unlike other similar OSGi resource managers and monitors, our solution does not need any modifications to the web applications or OSGi components. Moreover, we distinguish each web session of an application while competing methods only monitor complete applications as single entities.*"

Tómasson, H., Neukirchen, H., " Distributed Testing of Cloud Computing Applications Using the TTCN-3-based Jata Test Framework"

This paper reports the work aimed at investigating "*the challenges of software testing in elastic cloud computing environments as well as the applicability of concepts of the Conformance Testing Methodology and Frame- work (CTMF) and the open-source test framework Jata for distributed testing of cloud computing applications. Jata provides concepts from the standardised test language Testing and Test Control Notation version 3 (TTCN-3) to implement distributed test cases directly in Java. As the main contribution, a case study of testing a distributed cloud application has been conducted. It reveals that there are specific considerations to be made to deal with the elastic nature of a cloud environment which advises automated run-time configuration of the test cases to adjust to the current environment.*"

Guillén, J., Miranda, J., Murillo, J.M., Canal, C. "Developing migratable multicloud applications based on MDE and adaptation techniques"

Migration to cloud computing or migration between cloud infrastructure is an important area of research and practice. This paper reports the work aimed at reporting solution to the problems such as vendor lock-in that can cause several kinds of challenges in multicloud applications as "*they require multidisciplinary teams with expertise on multiple platforms, and the redevelopment of some components if the cloud deployment scenario is altered. The MULTICLAPP framework described in this paper tackles these issues by presenting a three-stage development process that allows multicloud applications to be developed without being coupled to any concrete vendor. MDE and adaptation techniques are used throughout the software development stages in order to abstract the software from each vendor's service specifications. As a result of this, multicloud applications or their subcomponents can be reassigned to different cloud platforms without having to undergo a partial or complete redevelopment process.*"

Ferry, N., Chauvel, F., Rossini, A., Morin, B., and Solberg, A. "Managing multi-cloud systems with CloudMF"

This paper report the work aimed at providing a framework based approach to model, develop, and mange using model-driven engineering approaches. Authors state that "*dynamically adaptive systems (DAS) enable the continuous design and adaptation of complex software systems, but their main focus is limited to the application itself rather than the underlying platform and infrastructure. Cloud computing, in contrast, enables the management of the complete software stack, but it lacks integration with software engineering approaches, techniques, and methods from DAS. Model-based approaches have been success- fully adopted for modelling DAS at design-time and facilitate their adaptation at run-time. Therefore, a natural next step is to adopt model-based approaches to enable cloud-based DAS. In this paper, we present CloudML, a model-based framework to address this is- sue. It consists of (i) a tool-supported domain-specific modelling language to model the provisioning and deployment of multi-cloud systems, and (ii) a models@run-time environment for enacting the provisioning, deployment and adaptation of these systems.*"

Horn, G. "A Vision for a Stochastic Reasoner for Automatic Cloud Deployment"

This paper gives a vision to the types of work that needs to be undertaken in order to address critically important problem of automatic deployment and monitoring of cloud enabled application. The author writes that "*Applications deployed in multi-clouds will face issues like where to deploy the different artefacts, how to scale the application in case of performance problems, and how to adapt the application deployment. For complex applications it may be difficult to find manually the best allocation of the artefacts on the available infrastructures. This paper presents a vision for an autonomic deployment system. In particular, it details the architecture of a learning automata based reasoning component envisioned to be able to provide feasible allocations and discusses the research challenges originating from this approach.*"

Lundberg, L., Shirinbab, S., "Real-Time Scheduling in Cloud-Based Virtualized Software Systems"

With the increasing adoption of cloud computing, there is an intense interest in using cloud computing for real-time applications with hard deadlines. Such system require "*scheduling on two levels in real-time applications executing in a virtualized environment: traditional real-time scheduling of the tasks in the*

real-time application, and scheduling of different Virtual Machines (VMs) on the hypervisor level. Traditional real-time scheduling is well understood, and most of the existing results calculate schedules based on periods, deadlines and worst-case execution times of the real-time tasks. In order to apply the existing theory also to cloud-based virtualized environments we must obtain periods and worst-case execution times for the VMs containing real-time applications. In this paper, we describe a technique for calculating a period and a worst-case execution time for a VM containing a real-time application with hard deadlines. This new result makes it possible to apply existing real-time scheduling theory when scheduling VMs on the hypervisor level, thus making it possible to guarantee that the real-time tasks in a VM meet their deadlines."

Albert, E., Boer, F.d., Hähnle, R., Johnsen, E.B., Laneve, C. "Engineering Virtualized Services"

This paper suggests that there are at least two important issues to be sufficiently addressed in order to "*foster the industrial adoption of virtualized services: (1) the efficient analysis, dynamic composition and deployment of services with qualitative and quantitative service levels and (2) the dynamic control of resources such as storage and processing capacities according to the internal policies of the services. The position supported in this paper is to overcome these problems by leveraging service-level agreements into software models and resource management into early phases of service design.*"

Jakovits, P., Srirama, S.N., "Clustering on the Cloud: Reducing CLARA to MapReduce"

This paper raises important points about implementing complex algorithms in MapReduce framework to support large scale resource intensive computing for machine learning and data mining domains. Authors claim that "*MapReduce offers both automatic parallelization and fault tolerance on the cloud commodity hard- ware. However, it is not trivial to adapt complex algorithms to MapReduce model, as often it is more suited for simple and embarrassingly parallel algorithms. Yet, there are some types of more complex algorithms that are suitable for MapReduce and in this work we look at one such algorithm, Clustering LARge Applications (CLARA), which can be used for clustering extra large number of objects. The paper provides the details of how CLARA is reduced to MapReduce model along with a detailed analysis in the Hadoop MapReduce implementation. The paper also pro- vides a case study where the algorithm is successfully applied in clustering pen-based recognition of handwritten digits data set.*"

4. The Symposium program

Monday 2 September

9:00-9:30 **Opening Remarks**

9:30-10:30 **Keynote: Cloud Brokerage: A key enabler for widespread Cloud usage**
Geir Horn, University of Oslo

10:30-11:00 **Break**

11:00-12:30 **Security and Verification**

Secure Cloud Storage for Remote Mobile Data Collection
Samson Gejibo, Daniele Grasso, Federico Mancini, and Khalid A. Mughal

A Secure OSGi Environment for Untrusted Web Applications
Timo Aho, Johannes Koskinen and Antti Nieminen

Distributed Testing of Cloud Computing Applications Using the TTCN-3-based Java Test Framework
Hlödver Tómasson and Helmut Neukirchen

12:30-14:00 **Lunch**

14:00-15:30 **Multi-Cloud Systems**

Developing Migratable Multi-Cloud Applications Based on MDE and Adaptation Techniques
Joaquín Guillén Melo, Javier Miranda, Juan Manuel Murillo Rodríguez and Carlos Canal

Managing Multi-Cloud Systems with CloudMF
Nicolas Ferry, Franck Chauvel, Alessandro Rossini, Brice Morin and Arnor Solberg

A Vision for a Stochastic Reasoner for Autonomic Cloud Deployment
Geir Horn

15:30-16:00 **Break**

16:00-18:00 **European Cloud Computing Research: From FP7 to Horizon 2020**

16:00-17:00 **Presentations of cloud-related FP7 projects including REMICS, PaaSage, MODAClouds, CloudScale and Broker@Cloud**

17:00-18:00 Collaboration **opportunities towards Horizon 2020**

19:30 **Dinner**

Tuesday 3 September

9:15-10:30 **Keynote: CLOUDs: Hype, Problems and Opportunities**
Keith Jeffery, Keith G. Jeffery Consultants

10:30-11:00 **Break**

11:00-12:30 **Scheduling, Control and Clustering**

Real-Time Scheduling in Cloud-Based Virtualized Software Systems
Lars Lundberg and Sogand Shirinbab

Engineering Virtualized Services
Elvira Albert, Frank de Boer, Reiner Hähnle, Einar Broch Johnsen and Cosimo Laneve

Clustering on the Cloud: Reducing CLARA to MapReduce
Pelle Jakovits and Satish Narayana Srirama

12:30-13:00 **Closing Remarks**

13:00-14:00 **Lunch**

5. ACKNOWLEDGEMENT