

Preface

The spread of new Data Center facilities around the world is an accompanying phenomenon of the twenty-first century always-on-connected-everywhere lifestyle. New Data Centers are being opened up both in Iceland and in urban conglomerations like Frankfurt in Germany and New York in the USA. Legacy Data Centers are being enlarged and continually updated with new equipment and management frameworks. Globally, this evolution results in an ever-increasing energy consumption of Data Centers, stipulating climate change and human impact on the earth's surface. The concept of energy efficiency in Data Centers that only a few years ago was restricted to enhancing IT equipment and cooling, is today addressed to a variety of system level technologies and associated services that will improve energy and environmental performance. The attention is furthermore focused on software running in Data Centers and the way that workload is being processed. However, as power consumers Data Centers additionally need to be viewed as part of a greater system. This applies for instance to the role Data Centers play in the context of Smart Cities. Data Centers form an important part of cities and play a leading role as an enabler of city services, but they are also huge power consumers. This pertains also to Data Centers as major players in the power grid. Reducing the carbon footprint of Data Centers worldwide is therefore a huge challenge considering the pressure of rocketing data amounts. However, promising starting points can be found both in academic and commercial research projects, as the International Workshop on Energy Efficient Data Centers E²DC 2014 was able to show once again. For the third time, researchers from around the world met in order to commonly advance knowledge and experience of reducing Data Center energy and power consumption and aligning Data Center power profiles to the availability of renewable power resources or constraints from the power grid. The workshop was collocated with the ACM SIGCOMM e-Energy 2014 conference on June 10, 2014 in Cambridge, UK and organized by the EU FP7 project DC4Cities¹.

These proceedings of the workshop give an account on high quality papers from a huge range of relevant technologies within Data Centers as well as regarding the interaction of a Data Center with its environment aimed at saving energy and integrating renewable energy sources.

The first part of the proceedings contains four papers devoted to energy optimization algorithms and models. Yi and Singh proposed a greedy algorithm capable to find a near optimal flow assignment for large-scale Data Center networks. The suggested approach of traffic merging can reduce energy consumption of active switches. With very light load, this kind of traffic merging can save 20–40% energy cost compared to the well-established elastic tree approach. Kuehn introduced a novel method to reduce task graphs with generally distributed task processing times to a single virtual job processing time. Looking at a very different problem, i.e., the challenge of dealing with

¹ FP7 STREP # 609304, www.dc4cities.eu.

frequent blackouts from an unstable power grid, Al-Salim et al. proposed a cyclic blackout mitigation through shifting of HVAC loads by means of queuing optimization. Finally, in a work by Postema and Haverkort a set of stochastic petri net models was applied to the analysis of trade-offs between performance and power consumption of Data Center. This modeling approach is meant to support decisions in the early design stage of a Data Center.

The second part of the proceedings contains four papers focused on the future role of Data Centers in Europe. In this session Anghel et al. presented the European project GEYSER. This project is aimed at integrating Data Centers into Smart Grids and Smart Cities and its scope is to realize an optimized intelligent pervasive sensing and monitoring infrastructure. Gribaudo et al. in their paper proposed an analysis of the influence of application deployment on energy consumption based on the European project ECO2Clouds. The authors investigated different ways to deploy an application in clouds and analyzed simultaneously energy consumption and system performances for each deployment configuration. In their paper “Minimization of Costs and Energy Consumption in Data Centers by a Workload Based Capacity Management” Da Costa et al. proposed a holistic view to Data Center modeling including workloads and cooling. They introduced dynamic power capping to Data Center energy management. Dupont’s objective for Data Center energy management was to give a contribution for making Data Centers more energy aware with regard to the availability of renewable energy. To this purpose an energy-aware virtual machines manager based on Constraint Programming (Plug4Green) was applied.

The third part of the proceedings discusses energy efficiency metrics for Data Centers. Capozzoli et al. presented a critical review of performance metrics for energy efficiency in Data Centers aiming to demonstrate the crucial role of thermal management for energy saving. Schlitt et al. in their paper suggested new metrics beyond PUE, capable to consider the adaptability of infrastructure to IT power: the infrastructure power adaptability (IPA) metric representing the power adaptability of the Data Center infrastructure in combination with the power variability (PVar).

The workshop also included three additional presentations: an introduction to the EU projects All4Green by Sonja Klingert (University of Mannheim) and DC4Cities by Marta Chinnici (ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy), as well as a keynote speech by Ian F. Bitterlin (CTO Emerson Network Power Systems, Visiting Professor at University of Leeds) about the problem of mushrooming data growth which is spurring the energy growth of the global Data Center industry and can only partly be offset by technical evolution and innovation.

We would like to thank Ian F. Bitterlin and all authors for their contributions to the third volume of the E²DC proceeding, and also the reviewers for their effort: they both helped in selecting the best papers and improving the initial submissions. Also, thank you to the Session Chairs Hermann de Meer (University of Passau), Jaume Salom (IREC), and Alfonso Capozzoli (Politecnico di Torino). And we are grateful for an

interested and interesting audience, who with lively discussions helped in turning the workshop yet again into a successful event.

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