Guest Editors’ Introduction: Special Section on Cloud Computing Assessment: Metrics, Algorithms, Policies, Models, and Evaluation Techniques

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Dependability and performance issues are strategic in Cloud computing, especially in business context where they often become mandatory. To investigate such issues and present the most recent findings to the scientific community we arranged this special issue on Cloud computing assessment: metrics, algorithms, policies, models, and evaluation techniques. Due to the complexity of the subject and the high number of qualified papers, the special issue was organized into two parts. In the first issue (IEEE Transactions on Dependable and Secure Computing, Vol. 10, no 4, 2013) we highlighted the importance of Cloud security, dealing with aspects such as trustworthiness, privacy, security and vulnerabilities. Having in mind a service-oriented, heterogeneous Cloud scenario, we also presented new techniques, countermeasures and threats to deal with such problems, both at the physical (hardware) and logical (software, applications, data) layers.

This second part of the special issue mainly deals with performance and dependability issues in Cloud computing, ranging from infrastructure to application, from resource management to programming models, from consolidation strategies to content management. With this special issue we intend to provide an (noncomprehensive) overview of Cloud computing security and dependability, with the aim to rise the attention of new researchers on this topic. Before entering into technical details, we would like to thank all the Authors, the Reviewers, the IEEE Transactions on Dependable and Secure Computing Editorial Office, with specific regards to Pam Gimzo and Erica Hardison, as well as the Editor in Chief Ravi Sandhu for their valuable support.

Part II is composed of the following five papers. The first paper “A Hierarchical Approach for the Resource Management of Very Large Cloud Platforms,” by Bernadetta Addis, Danilo Ardagna, Barbara Panicucci, Mark S. Squillante, and Li Zhang, focuses on performance/energy-driven resource management in Infrastructure-as-a-Service (IaaS) Cloud. More specifically, it implements resource allocation policies for the management of multilayer virtualized Cloud systems, aiming at maximizing the provider incomes taking into account specific service level agreements while minimizing the infrastructure energy costs. A multiple time-scale hierarchical framework has been developed and tested also considering realistic workloads and management system interrelationships. The results obtained demonstrated the effectiveness and the scalability of the proposed technique.

The second paper, “BtrPlace: A Flexible Consolidation Manager for Highly Available Applications,” by Fabien Hermenier, Julia Lawall, and Gilles Muller, deals with consolidation of virtual machines into datacenter considering placement constraints on functional and nonfunctional properties. The placement constraints are expressed by specific configuration scripts, interpreted on the y to extend a composable reconfguration algorithm that is used to x nonviable placements. In depth experiments have been performed to demonstrate the flexibility of scripts and the effectiveness of the consolidation solution proposed. The results obtained shown adequate performance, fault tolerance and scalability of the approach adopted.

The third paper “A Cloud-Oriented Content Delivery Network Paradigm: Modeling and Assessment,” by Chrysa Papagianni, Aris Leivadeas, and Symeon Papavassiliou, characterizes the Cloud in the content delivery scenario, aiming at provisioning content delivery networks (CDNs) deployed on Cloud infrastructure. The problem is approached by decomposition into graph partitioning and replica placement subproblems, specifying a framework to identify potential customers of a Cloud CDN mapped into abstract content distribution graph and then investigated through graph partitioning heuristics to evaluate performance and costs. The paper also proposes a solution for replica management inspired by social network. The proposed approaches have been evaluated in the paper through specific models and simulation.

The fourth paper “On the Performance of Byzantine Fault-Tolerant MapReduce,” by Pedro Costa, Marcelo Pasin, Alysson Bessani, and Miguel P. Correia, proposes a fault tolerant algorithm to address Byzantine fault in...
MapReduce. The algorithm executes each task more than once and then compares the results obtained by the different executions disregarding nonmatching outputs. The effectiveness of this algorithm has been proven through in depth evaluation based on both analytical model and real experiments.

To optimize MapReduce application performance is also the objective of the last paper of the special issue Part II “Orchestrating an Ensemble of MapReduce Jobs for Minimizing Their Makespan,” by Abhishek Verma, Ludmila Cherkasova, and Roy H. Campbell. In particular a set of production MapReduce jobs periodically executed on new data is considered with the aim of implementing a scheduler minimizing the job completion time and maximizing the resource utilization. An extensive set of simulations on realistic workloads has been performed to evaluate the performance of a scheduler based on the Johnsons algorithm. To overcome the limitations of this algorithm a novel heuristic is proposed, demonstrating by simulation it overperforms the Johnsons one.

We believe that the papers included in Part II of this special issue provide a good, even if partial, overview of the state-of-the-art research on Cloud computing dependability and performance, addressing several open issues on the topic. All the papers included in this issue provide both significant advances to the state of the art and practical guidelines on how to deal with these problems on real applications.