Guest Editors’ Introduction: Special Issue on Economics and Market Mechanisms for Cloud Computing

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A cloud is an emerging computing market where cloud providers and users are the players. Those players share, trade and consume computing resources in the cloud. On the other hand, economic mechanisms (such as auctions and tiered pricing) have been designed for shaping cloud computing into a diversifying pay-as-you-go paradigm. The next generation revolution in this domain, whose developments and realizations started to manifest already, is referred to as Cloud of Clouds wherein the computational and data infrastructure for handling scientific, business and enterprise applications span across multiple clouds and Data-Centers (DCs). Since its inception, cloud computing research has provided a range of services (PaaS, SaaS, IaaS) to cloud users and building cloud applications. The cloud paradigm is also increasingly being used to support more traditional high-performance applications. As cloud computing is still an emerging and evolving paradigm, challenges and opportunities co-exist for new research directions and applications for economics and market mechanisms in cloud computing. As the complexity, heterogeneity and scale of resources appear, it will be increasingly important to develop economics and market mechanisms for managing, trading and pricing those resources. Further, business ventures operating across multiple clouds may need to set and oblige policy driven schemes, which may become prohibitively expensive for ordinary users. In addition, pricing models, trust and security based research are added issues that need to be addressed. For example, new hardware components (e.g., GPUs and SSDs) are being added to the cloud, which poses new issues for pricing models.

As the complexity, heterogeneity and scale of applications grow, it will be increasingly important to be able to consider designing cross-platforms that can address the issues that are prevalent to realize market driven mechanisms. As an example, with an anticipated growth of mobile users of cloud services in the near future, issues related to the interoperability between cloud service providers, cloud technologies and users become challenging. Business ventures operating across multiple clouds may need to set and comply with policy driven schemes, which may become prohibitively expensive for ordinary users. In addition, pricing models, trust and security based research are added issues that need to be addressed.

IEEE Transactions on Cloud Computing has recognized this important and timely concerns in this special issue. This special issue is motivated by these compelling requirements and challenges, and aims to compile research that fundamentally addresses them. It has attempted to address a broad range of related research issues that can bring in confidence to the users and organizations to rely on cloud platforms to realize business solutions in a much more flexible manner than by conventional means. We received an overwhelming response from the community of researchers that include, system theorists, experimentalists, cloud based solution providers, and practitioners. The accepted papers reflect the diversity of the research areas underlying the cloud paradigm and can be grouped under three different and distinct categories, viz., Resource management and provisioning, cloud pricing and resource trading and Cloud of Clouds. Collectively, the twelve selected papers attempt to strike a balance between system theory and practical utility in their respective contributions. The 12 papers can be categorized into three distinct categories—Resource management and provisioning, Cloud pricing and resource trading, and Cloud of Clouds, which are kind of primary pillars in cloud research that assure users and service providers to carry out successful realizations of market-driven mechanisms and strategies.

The first category (Resource management and provisioning) includes six papers. The topics reflect the novel integration between economic and market mechanisms and resource management in the cloud. Mashayekhy et al. proposed a design approach for physical machine resource management. Toosi et al. attempts to maximize the revenue of cloud provider with optimal capacity control. Wang et al. proposed an intelligent combinatorial double auction based approach for dynamic resource allocation. Candeia developed a business driven approach for planning the long-term resource capacity. Zhao et al. studied fine-grained resource rental planning for application service providers in the cloud, with Amazon EC2 as a case study. Rebeish et al. studied web service allocations in the cloud with portfolio thinking.

The second category (Cloud pricing and resource trading) includes two papers. Sharma et al. developed a risk-aware pricing model with financial option theory. Bonacquisto et al. proposed a procurement auction market for trading residual the resource capacity.
The third category (Cloud of Clouds) has four papers, covering interaction, negotiation, data migration, and load balancing among multiple clouds. Sim developed an agent-based approach for studying "Cloud of Clouds" in terms of interaction protocol and negotiation strategies. Zhang et al. reduced the cost of data hosting among multiple clouds. Luo et al. developed spatio-temporal load balancing schemes for multiple cloud data centers. Petri et al. studied market models for federating multiple clouds.

Although the selected papers contribute and address only a limited set of issues related to cloud driven market mechanisms, the papers clearly demonstrate how the technology can influence and warrant realizations of market mechanisms on this cloud cyber space. The authors would like to thank all the researchers who had responded to this call and acknowledge the efforts that went into their submissions. They also thank the inaugural Editor-in-Chief Professor Rajkumar Buyya and current Editor-in-Chief Professor Irena Bojanova, for supporting this timely topic as a special issue. Finally, they thank the TCC administrator, Ms. Joyce Arnold, for her relentless support without which this special issue would not have been completed in time!

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