

Preface

Cloud computing is a major IT paradigm of our time. It has changed the way how IT resources are shared and used. By shifting the tasks and responsibilities for managing these resources to the provider side and by delivering these resources as a service to consumers on-demand over the Internet, several new challenges arise and affect cloud adoption. One major issue for cloud consumers is the loss of control over non-functional properties of the cloud resources. Today's cloud providers aim to address that issue by offering quality guarantees in terms of service level agreements and perform for themselves corresponding monitoring solutions.

Dr. Melanie Holloway thoroughly **analyzes the shortcomings** of existing approaches related to the process of service level management **from the consumer's perspective**. Based on her results, she develops new approaches for service level agreement negotiation and monitoring by integrating in a very elegant way concepts from the fields of economics, computer science, mathematical optimization, and statistics.

Since service level agreements offered by today's cloud providers are usually fixed (i.e. static), consumers of cloud services are not able to efficiently align their individual business requirements with the non-functional properties of the cloud resources. Therefore, appropriate approaches for automatic IT-based negotiations of individual service level agreements are required. Having this as her target, Dr. Melanie Holloway elaborates a new very elegant negotiation mechanism which allows to approach Pareto-efficient agreements taking into account the results of concurrent negotiations with multiple providers. In contrast to existing approaches, the negotiating parties are able to achieve such an **efficient solution without revealing private information** and not depending on the proposed values of the other involved parties. By simulations, Dr. Melanie Holloway demonstrates the high quality of her negotiation mechanism.

In order to verify whether the formerly negotiated service level agreements are maintained on the provider side, cloud consumers are also in the need of reliable monitoring solutions. In her thesis, Dr. Melanie Holloway focuses on availability monitoring techniques, since most of today's service level agreements only define some type of guarantees. As a major contribution, she presents a **monitoring approach** that places monitoring units on the provider and the consumer side. This is done in conjunction with two mathematical models. These models provide decision support for monitoring configuration in two ways: While the first model enables to determine an appropriate monitoring frequency and the required sample size in order to obtain

monitoring results at a certain level of confidence, the second model facilitates the adjustment of the monitoring frequency in the presence of network impairments. The work of Dr. Melanie Holloway is the first one I have come across which considers the **accuracy of the monitoring data in conjunction with the monitoring frequency** taking into account key issues in the underlying network. Dr. Melanie Holloway shows the accuracy of her models by performing testbed experiments based on a prototypical implementation of her monitoring approach.

The whole work also demands a reliable monitoring infrastructure. In this respect, Dr. Melanie Holloway identifies the new robust cloud monitor placement problem and formalizes this problem as a mathematical optimization model. This is the first time that probabilistic reliability values of all involved entities within one monitoring infrastructure are considered. Based on her mathematical model, Dr. Melanie Holloway shows the exact solution. Due to the exponential time complexity of the computation of the exact approach, she further proposes two heuristics with polynomial time complexity. In simulations, Dr. Melanie Holloway shows that a random placement of monitoring units is not appropriate and that her solution approaches are all able to reduce the maximum overall downtime of the monitoring units by more than ninety percent.

Concluding her thesis, Dr. Melanie Holloway focuses on a scenario in which a broker acts as an intermediary between cloud providers and cloud consumers. The broker offers her solution approaches as a service and increases market efficiency by successfully mediating service level agreement negotiations and by acting as a trusted third-party whenever cloud service monitoring is used. In doing so, the thesis contributes to a foundation for market-based cloud service provisioning.

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Let me conclude mentioning the following: I had the pleasure to supervise the thesis and to work with Dr. Melanie Holloway. She managed to have a lot of interaction with experts related to several issues of her work: At this point I just want to mention Dr. Amr Rizk and Dr. Dieter Schuller who provided valuable feedback at various stages of this outstanding thesis.

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