gle platform. However, when the input data of the workflow task must be transferred from other locations, e.g. other Clouds, to the target platform, the multi-Cloud workflow framework may work better in terms of execution time. We found also that clustering is a necessary technique for running workflows on multiple Clouds because it reduces the number of tasks and hence reduces the amount of data to be transferred between the tasks. Finally, the broker-based workflow framework generally introduces better QoS while reducing the user payment by selecting Clouds with lower cost and better service quality.

## 6. CONCLUSIONS AND FUTURE WORK

This work implemented a workflow framework for running workflow applications on a multi-Cloud environment. The framework is based on a Cloud Service Broker we developed to help users choose the target platform with respect to their requirement on hardware, cost, performance, etc. The developed framework was validated with a large scale workflow application in different scenarios. The experimental results show the advantages of running workflows with multiple Clouds, in contrast to the case of using a single Cloud platform.

In the next step of this research work, we will take care of the data locality issues in the multi-Cloud environment. A locality mechanism will be implemented to bring the computation to its data for use cases where the input data of the workflow tasks are distributed across different Clouds. The mechanism aims to reduce the time for data transfer between the Clouds. Furthermore, we will extend the framework to support Storage as a Service (STaaS) Clouds like S3 and to consider the cost for network traffic and storage usage. Finally, we will try different brokering and scheduling policies (e.g. MCT scheduling) in order to improve the workflow execution performance.

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