

# EASI-CLOUDS - Extendable Architecture and Service Infrastructure for Cloud-Aware Software

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Research: Cost and Business Model Development for hybrid federated Clouds

**Keywords:** Cloud computing, hybrid federated Clouds, Cloud cost modeling, VM placement, service placement optimization, Cloud economics, Cloud business modeling.



## 1. Research Background & Goal

The EASI-CLOUDS project aims at advancing federated cloud computing. Cloud Computing, which emerged as a new computing service paradigm, appeals to an overwhelming majority of information technology decision makers. However, it still suffers from low interoperability between clouds. The project, which is funded by the national research foundation of 4 European countries, Egypt, and South-Korea, addresses this issue by providing an infrastructure for federated clouds. The Korean EASI-CLOUDS consortium partners (SNU, ETRI, and InnoGrid) are funded by KIAT.

Despite the attraction towards cloud computing, there are still several great technological challenges to be addressed. Current solutions are far from satisfying the needs of all stakeholders: cloud providers, applications developers, and end-users. One of the issues is the interconnection of different clouds. The objective of EASI-CLOUDS is to provide a comprehensive infrastructure for federating clouds. This federation will address the three classical categories of cloud computing: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). In particular, our target is to facilitate capacity planning, provisioning, accounting, and billing for federated clouds with high reliability and security. They are needed to operate a true cloud services marketplace and an efficient pay-per-use

business model. Our objective is finally to bypass all market barriers and to create a dynamic user-centric market for cloud services.

In particular, the major goals of the SNU part of the project are: Development of cost model for hybrid single clouds and hybrid federated clouds; Development of a model for virtual machine (VM) placement in clouds using the cloud cost model.

## **2. Research Outcome**

Within the first year of the project, SNU successfully contributed to all deliverables delivered to KIAT and ITEA2 as the funding agencies. The contributions also resulted in four research papers.

In particular, SNU has contributed to the development of a cost model for hybrid single Clouds. For this work, all cost factors of Cloud computing, which had been considered in the research community, were reviewed and have been represented in a categorized form. In a second step, an extension to this cost model has been proposed to cover the case of hybrid federated Clouds. In addition to this, the application of these cost models has been demonstrated in an example.

Moreover, it's essential for Cloud users to find the optimum placement of their services on all service providers available. For that, the third work of SNU comprised the development of a cost optimization algorithm for virtual machine (VM) placement in Clouds using the cost model for hybrid federated Clouds.

Besides, SNU has also contributed to the work on business modeling for federated Clouds. We proposed a detailed definition of a broker in the context of Cloud federation as the most important entity of the federated Cloud environment.

In the coming two years, we expect to extend this work in the direction of economic-based resource allocation.