Performance Investigation and Tuning in the Interoperable Cloud4E Platform

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Abstract. The paradigm of Software as a Service (SaaS) offers an interesting option to vendors of simulation software for providing their applications to a wide circle of customers. However, this imposes a challenge to vendors whose applications exist only as classical desktop tools, so far: Interfaces for the remote control have to be provided which are as independent from the underlying cloud infrastructure as possible in order to avoid vendor lock-ins. We present an interoperable platform developed in the project Cloud4E (Trusted Cloud Computing for Engineering), which allows the provisioning of existing simulation software in form of a service in a cloud. The interoperability of the platform and of the services is achieved by the usage of the Open Cloud Computing Interface (OCCI) together with the Advanced Message Queuing Protocol (AMQP) where OCCI is not only used as interface to Infrastructure as a Service (IaaS) but also as interface to SaaS. Hence, the OCCI server plays a central role within the platform and can quickly become a bottleneck, which degrades the performance of the whole platform. We present detailed performance investigations and suggest options to improve the performance. The investigations were performed on the widely used OCCI server implementation called rOCCI server connected to the OpenNebula cloud middleware.

Keywords: Cloud4E, OCCI, rOCCI server, OpenNebula, CAE, cloud.

1 Introduction

Today, the design of technical systems usually requires computer simulations like for example finite element method (FEM) computations. These computer-aided engineering (CAE) simulations are frequently very compute intensive and thus require an appropriate amount of computational power. Furthermore, are the licenses for professional simulation software usually very cost-intensive. In the publicly funded project Cloud4E [1] a platform was developed, which allows vendors of such simulation software to provide their software as a service in a cloud. This can be beneficial for the user as well as the software provider. The user is able to use the soft- and hardware on a pay-per-use basis, which can yield
significant cost savings and the simulation software provider is able to make its tools available to users who were previously not able to use them due to cost reasons.

In order to increase the user’s trust, it is envisaged that primarily regional compute centers act as providers of the cloud resources on which the Cloud4E services are deployed. Hence, it has to be ensured that the Cloud4E platform and services are portable between different cloud middlewares. This is achieved by the usage of OCCI [23], which is not only used as interface to IaaS but also as interface to the services.

Since regional compute centers have only limited resources available, it has to be possible to outsource computations to resources of other cloud providers if necessary and if the user agrees. Thus, hybrid or federated clouds have to be supported. This is enabled by the employment of OCCI together with AMQP [15]. Since the communication via AMQP is done over a central server, VMs or services can communicate, which can not directly reach each other. This makes it possible to distribute tasks or services over VMs of multiple clouds, without restricting the communication between them.

The Cloud4E platform was already used successfully to build services for the CAE simulation software SimulationX [6] and the free FEM solver UNA [7]. Although the platform is intended for the provisioning of simulation software as service, it can be used for the provisioning of other types of services as well. For example, there are services for the parameter sweep tool GridWorker [8] and the evolutionary algorithm framework FrogEA [8,9], which were both initially developed for the usage in grids.

The OCCI server is besides the AMQP server a central component of the Cloud4E platform, which acts as link among multiple service instances and between clients and services. In the project an open source Ruby implementation named rOCCI server [10], which was adapted to the needs of Cloud4E, is used. Experience has shown that the rOCCI server has a crucial impact on the performance of the Cloud4E platform. This has been investigated in detail in order to improve the performance. This manuscript presents the results of these investigations and describes possibilities to improve the performance.

But first, in Section 2 related work is discussed before Section 3 gives an overview of the complete Cloud4E platform. Then in Section 4 the rOCCI server and the functional adaptions we made to it in Cloud4E are described more in detail. Section 5 covers the performance investigation and tuning and finally, Section 6 gives a short summary and conclusion.

2 Related Work

A number of simulation tools can already be used in form of cloud services. Rescale [11] provides more then 30 simulation tools in form of services running on their own infrastructure. A lot of CAE tools from Autodesk [12] can also be used as cloud services.

Tsai et al. [13] developed SimSaaS – a framework and runtime environment that allows the execution of simulations in service-oriented architectures. The