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AN ARCHITECTURE FOR AN AUTOSCALING CLOUD-BASED SYSTEM FOR SIMULATION EXPERIMENTATION

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ABSTRACT

More and more simulation applications need high performance computing to deliver the results from experimentation in a timely manner. Cloud computing presents an attractive cost-effective alternative to using a local computing cluster. Normally a user would decide how many cloud computing resources to hire, provision them and then use them for experimentation. However, it may be the case that the user has paid for many instances that were not used. We have proposed the Microservice-based Cloud Application-level Dynamic Orchestrator (MiCADO) to automatically orchestrate and scale cloud computing applications. This article describes the architecture of an version of MiCADO that has been adapted for simulation experimentation.

1 INTRODUCTION

There is a growing demand for faster simulation experimentation and optimisation. Cloud computing presents an attractive alternative to expensive computing clusters. Based on experiences from developing a cloud computing platform for simulation (Taylor et al. 2018), we have produced a platform that enables cloud resources to be automatically increased, or scaled, according to the needs of an application. This is the Microservice-based Cloud Application-level Dynamic Orchestrator (MiCADO) (Kiss et al. *in press*). This paper describes how MiCADO is being used to support simulation experimentation.

2 THE MICROSERVICE-BASED CLOUD APPLICATION-LEVEL DYNAMIC ORCHESTRATOR (MICADO) AND SIMULATION EXPERIMENTATION

MiCADO is based on microservices that decouple independent components from a monolithic application. The concept of MiCADO is to monitor the needs of a microservice (e.g. the time being taken for a simulation experiment to complete) and then to launch new instances of that microservice on cloud to cope with demand (e.g. multiple cloud-based simulation microservices that process experiments in parallel). Figure 1 shows the MiCADO architecture.

The Application layer contains the application that requires cloud resources (the simulation package or frontend). The Application Definition layer defines a functional architecture of the application using an application template that defines the required infrastructure, interconnectivity and Quality of Service specifications. The Orchestration layer consists of four horizontal and one vertical sub-layers: a Coordination interface API for orchestration control (e.g. control over how microservices are run), a Microservices discovery and execution layer to manages microservices execution, a Microservices coordination logic layer that decides when to launch/shut down cloud instances to run new microservices, a Cloud interface API that abstracts cloud access from the above layers (MiCADO can use many different clouds), and a Security layer providing support for advanced security policy management. The Cloud access API is used to actually launch and shut down cloud instances (potentially on multiple clouds). Finally, the Cloud instance layer contains the actual cloud instances provided by IaaS cloud providers.

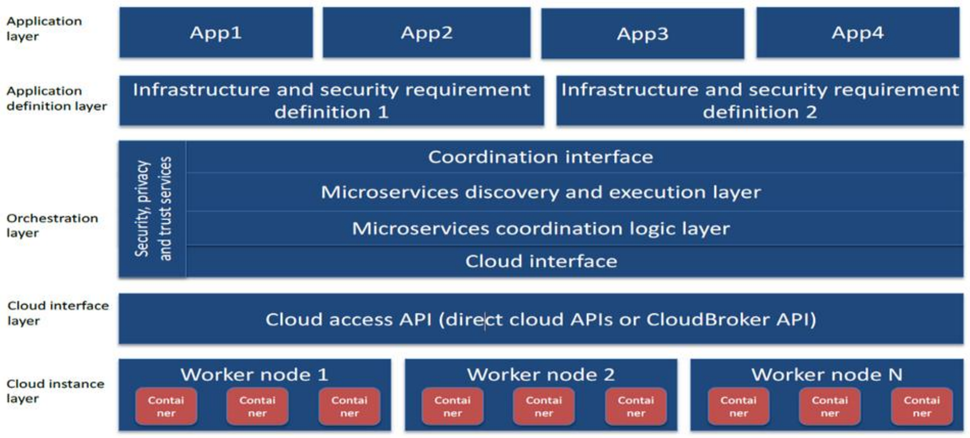
Application layer
App1
App2
App3
App4
Application definition layer
Infrastructure and security requirement definition 1
Infrastructure and security requirement definition 2
Orchestration layer
Security, privacy and trust services
Coordination interface
Microservices discovery and execution layer
Microservices coordination logic layer
Cloud interface
Cloud interface layer
Cloud access API (direct cloud APIs or CloudBroker API)
Cloud instance layer
Worker node 1
Worker node 2
Worker node N
Container

Figure 1: The MiCADO Generic Architecture.

To use MiCADO for simulation experimentation a developer would first create a simulation microservice. An application template would then be specified and would include the maximum runtime for a particular set of experiments. MiCADO would then launch one instance of the microservice and montor how long simulation experimentation was taking. If the deadline was not going to be met, MiCADO would launch a new microservice/instance. This process would continue until experimentation was complete. In this way the optimum number of cloud instances (and cost) would be used.

3 SUMMARY

This paper has briefly described the MiCADO architecture and how it is used for simulation experimentation.

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