

## Chapter 3

# EMOTIVE Cloud: The BSC's IaaS Open Source Solution for Cloud Computing

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## ABSTRACT

*This chapter introduces Elastic Management of Tasks in Virtualized Environments (EMOTIVE), which is the Barcelona Supercomputing Center (BSC)'s IaaS open-source solution for Cloud Computing. EMOTIVE provides users with elastic fully customized virtual environments in which to execute their applications. Further, it simplifies the development of new middleware services for managing Cloud systems by supporting resource allocation and monitoring, data management, live migration, and checkpoints. These features and its facility to be extended and configured make EMOTIVE especially appropriate to support research on Cloud Computing scenarios. Offering functionality comparable to its commercial counterparts allows EMOTIME to be used on production to set up small Cloud platforms.*

## INTRODUCTION

EMOTIVE (Elastic Management of Tasks in Virtualized Environments) (EMOTIVE, 2009) is the Barcelona Supercomputing Center (BSC)'s IaaS open-source solution for Cloud Computing, which

results from BSC's previous experience in European projects such as BREIN (BREIN, 2006-2009) and SORMA (SORMA, 2006-2009). EMOTIVE provides users with elastic fully customized virtual environments (supporting different hypervisors such as Xen, KVM, or VirtualBox) in which to execute their applications. Further, it simplifies

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the development of new middleware services for managing Cloud systems by supporting resource allocation and monitoring, data management, live migration, and checkpoints.

EMOTIVE enables the smart management of the virtual environments using different scheduling policies. Additionally, it is very easy to extend thanks to its modular Web Service architecture. This framework is being used by BSC to do research in Cloud Computing, as well as in some research projects such as VENUS-C (VENUS-C, 2010-2012), OPTIMIS (OPTIMIS, 2010-2013), and NUBA (NUBA, 2009-2012).

In this chapter, we will describe the main functionalities of EMOTIVE, how they are implemented, and how EMOTIVE can be used to set up a private, public, or hybrid Cloud solution.

## General Architecture of the Solution

EMOTIVE middleware can be categorized as an IaaS solution, since it provides the users with virtualized environments where they can execute their tasks without any extra effort. These VMs, which aim to fulfill the user requirements in terms of software and system capabilities, are transparently managed by EMOTIVE in order to exploit

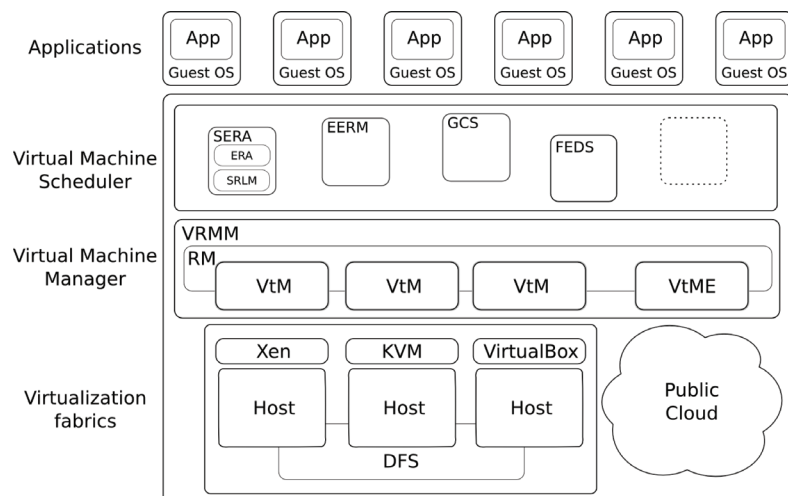
the provider's resources. EMOTIVE can easily be extended with multiple scheduling policies in order to manage the VMs using different criteria.

Figure 1 illustrates the EMOTIVE Cloud architecture, which is mainly composed by three different and modular layers: *Virtualization Fabrics*, *Virtual Machine Manager*, and *Virtual Machine Scheduler*.

The *Virtualization Fabrics* layer comprises the physical resources where the VMs will run. This layer wraps the virtualized resources and offers them to the upper layers. EMOTIVE makes use of the Libvirt JAVA API (Libvirt, 2005), which makes it able to use multiple virtualization technologies. Actually, EMOTIVE currently supports Xen, KVM, and VirtualBox hypervisors. Furthermore, it implements a distributed shared file system (DFS) that supports efficient VM creation, migration (to move VMs across provider's hosts without stopping the execution), and checkpointing (to resume VM execution upon hardware failure). This file system also supports a global repository where users can upload the input files needed by the applications (i.e. data stage-in) and retrieve the resulting ones (i.e. data stage-out).

The *Virtual Machine Manager* layer is implemented by means of the *Virtualized Resource*

Figure 1. EMOTIVE cloud architecture



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