Chapter 7

Decentralised Repositories for Transparent and Efficient Virtual Machine Operations: Architecture of the ENTICE Project

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ABSTRACT

ENTICE is an H2020 European project aiming to research and create a novel Virtual Machine (VM) repository and operational environment for federated Cloud infrastructures to: (i) simplify the creation of lightweight and highly optimised VM images tuned for functional descriptions of applications; (ii) automatically decompose and distribute VM images based on multi-objective optimisation (performance, economic costs, storage size, and QoS needs) and a knowledge base and reasoning infrastructure to meet application runtime requirements; and (iii) elastically auto-scale applications on Cloud resources based on their fluctuating load with optimised VM interoperability across Cloud infrastructures and without provider lock-in, in order to finally fulfil the promises that virtualization technology has failed to deliver so far. In this chapter, we give an inside view into the ENTICE project architecture. Based on stakeholders that interact with ENTICE, we describe the different functionalities of the different components and services and how they interact with each other.

INTRODUCTION

Virtualisation is a key technology in Cloud computing that allows users run multiple virtual machines (VM) with their own application environment on top of physical hardware. Virtualization enables scaling
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up and down of applications by elastic on-demand provisioning of VMs in response to their variable load to achieve increased utilization efficiency at a lower operational cost, while guaranteeing the desired level of Quality of Service (QoS), such as response time to the end-users. Typically, VMs are created using provider specific templates, so-called VM images (VMI) stored in proprietary repositories, leading to provider lock-in and hampering portability or simultaneous usage of multiple federated Clouds.

In this context, optimization at the level of the VMIs is needed both by the applications and by the underlying Cloud providers for improved resource usage, operational costs, elasticity, storage use, and other desired QoS-related features. The project team identified in this projective critical barriers that prevent many users from industry, business and academia to effectively use Cloud resources and virtualized environments for their computing and data processing needs:

- Manual, error-prone and time consuming VM image creation;
- Monolithic VM images with large deployment and migration overheads;
- Proprietary un-optimized VM repositories;
- Inelastic resource provisioning;
- Lack of information to support effective VM image optimization.

The goal of this chapter is to present a comprehensive overview of the common requirements, a high-level architecture, and initial use cases for the three main technological components of ENTICE: Decentralised repositories for transparent and efficient virtual machine operations, an H2020 EU project:

1. The distribution of Virtual Machine images, Container Images, or any other complete application representation (in short VMIs) that can be applied in the scope of the ENTICE project.
2. The VMI analysis and synthesis;
3. The VMI images portal and its associated knowledge base, acting as glue for the distributed, highly optimised repository.

In this chapter, the project partners made every effort to analyse and present the high-level architecture that gives a preview of the ENTICE functionality to be expected towards the end of the project. The ENTICE environment will let Cloud federations benefit by delivering VMIs in a faster way and in the right format for different hypervisors that are in use within a Cloud federation.

STATE OF THE ART

The following sections describe the state-of-the-art of the key technologies to be developed in the ENTICE project: lightweight creation of VMIs and storage. This is the key technology that Cloud federations will be able to utilize to provide faster and more portable VMIs that can be exchanged fast from one individual Cloud host to another.

Image Format and Interoperability

Tang et al. (Tang 2011) present Fast Virtual Disk (FVD) as a new virtual machine VMI format and the corresponding block device driver developed for QEMU, an emulator for multiple hypervisors, including