The eCloudManager Intelligence Edition
Semantic Technologies for Enterprise Cloud Management

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Abstract. Enterprise clouds apply the paradigm of cloud computing to enterprise IT infrastructures, with the goal of providing easy, flexible, and scalable access to both computing resources and IT services. Realizing the vision of the fully automated enterprise cloud involves addressing a range of technological challenges. In this demonstration, we show how semantic technologies can help to address the challenges related to intelligent information management in enterprise clouds. In particular, we address the topics of *data integration*, *collaborative documentation and annotation* and *intelligent information access and analytics* and demonstrate solutions that are implemented in the newest addition to our eCloudManager product suite: The Intelligence Edition.

1 Introduction

Cloud computing has emerged as a model in support of "everything-as-a-service" (XaaS). Cloud services have three distinct characteristics that differentiate them from traditional hosting. First, they are sold on demand, typically by the minute or the hour; second, they are elastic – users can have as much or as little of a service as they want at any given time; and third, cloud services are fully managed by the provider [3]. While the paradigm of cloud computing is best known from so called public clouds, its promises have also caused significant interest in the context of running enterprise IT infrastructures as private clouds [2]. A private cloud is a network or a data center that supplies hosted services to a limited number of people, e.g. as an enterprise cloud. Like public clouds, enterprise clouds provide easy, scalable access to computing resources and IT services.

Realizing the vision of the fully automated data center – the enterprise cloud – involves addressing a range of technological challenges, touching the areas of infrastructure management, virtualization technologies, but also distributed and service-oriented computing. In our conference paper [1], we have described the challenges related to intelligent information management in enterprise clouds and discussed how semantic technologies can help to address them. In particular, we have addressed the topics of *data integration*, *documentation and annotation*, and *intelligent information access and analytics*. Summarizing the main contributions, our RDF-based approach to data integration allows us to deal with the highly heterogeneous and changing set of resources encountered in enterprise

data centers. Semantic wikis provide an end-user oriented interface for creating structured and unstructured annotations, supporting the main use cases for documentation and knowlegde management, seamlessly integrating automatically obtained data with user-generated content. This data can be searched, explored, and analyzed without system boundaries, supported by state-of-the-art techniques of semantics-based information access.

This demonstration complements the conference paper with a live demo of the implementation of our solution in the eCloudManager Intelligence Edition[1]. In the remainder, we present a brief solution overview of the eCloudManager, followed by a description of the demonstration scenario.

2 Solution Overview

The eCloudManager Product Suite is a Java-based software solution that is targeted at the management of enterprise cloud environments. The eCloudManager's overall architecture is depicted in Figure 1. The bottom of the figure shows the two dimensions of information relevant to the eCloudManager, namely *Data Center Resources* and *Business Resources*. The data center resources are divided along the IT stack into (i) a *Hardware Layer* that consists of physical storage, network and compute infrastructure, (ii) a *Virtualization Layer* built on top of the hardware layer that is made up of hypervisors with appropriate management capabilities, and finally (iii) the *Application Layer* built on top of the virtualization layer, comprising applications on top of the virtualized resources. These data center resources are complemented by associated business resources, like customer data, hardware catalogs, or related project information.

Built on top of this infrastructure, the eCloudManager comes with four complementary editions for *Infrastructure Management*, *Virtual Landscape Management*, and *Self-Service*. In the demonstration, we will focus on the features of the fourth edition, namely the *Intelligence Edition*, which makes use of innovative semantic technologies to integrate available resources into a semantic store, investigate this data, and collaboratively interact with the integrated data.

At the bottom of the Intelligence Edition is the *Data Integration Layer*, which relies on the concept of so-called *data providers* that extract data from a physical or logical resource, convert it into RDF and integrate the resulting RDF data into the central repository. The central repository where the provider data is stored is settled in the *Data Management Layer*. Technically, it is realized as a Sesame triple store that adheres to a predefined (yet extendable) OWL ontology. In addition to the repository, the layer provides components for search and intelligent, semantics-based information access. A central component in this layer are also semantic wiki pages that are associated with the resources in the repository; they offer an entry point to the eCloudManager users, allowing to add new and complement existing information. The uppermost layer in the Intelligence Edition is the *Presentation Layer*. Located on top of the Data Management Layer, it

[1] The product including additional material such as screencams is available at `http://fluidops.com/eCM_INT.html`

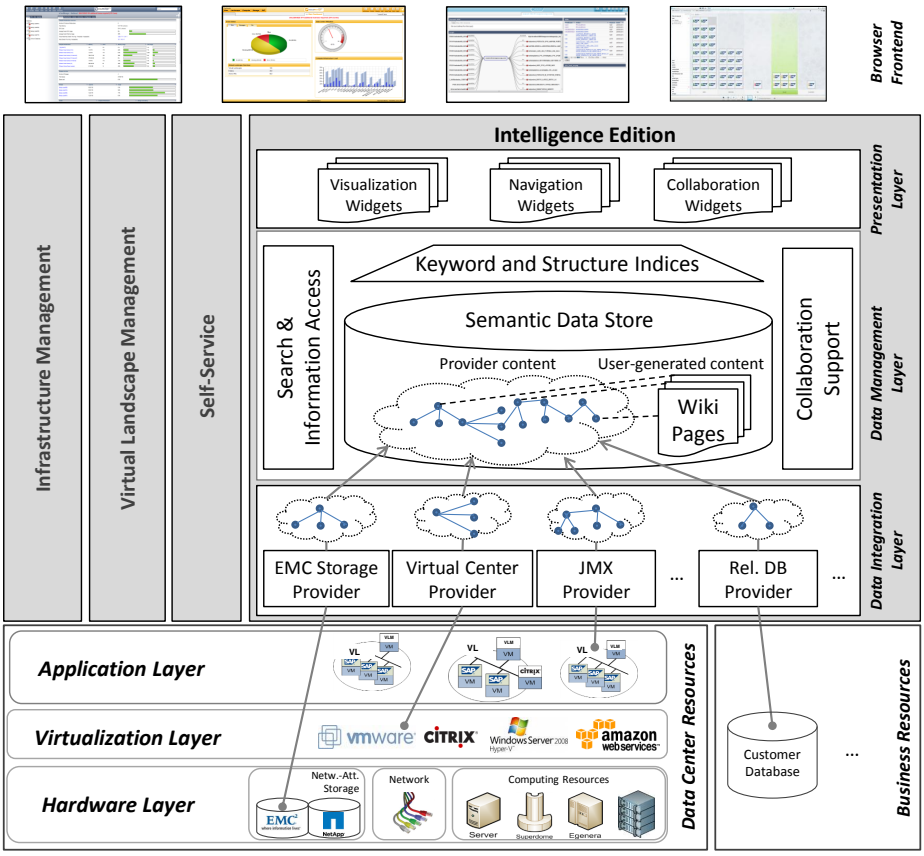

Fig. 1. eCloudManager Architecture

comes with a predefined set of widgets with varying functional focus, e.g. offering support to display wiki pages, visualize the underlying data using charts, navigate through the underlying RDF graph, and collaboratively annotate resources using both semantic annotations as well as free-text documentation.

3 Demonstration Scenario

We now give a brief overview of the demonstration, in which we show how the Intelligence Edition addresses the challenges in the administration of a real enterprise cloud. It is structure along the main features of the system.

Data Integration. Being able to automate data center operations via low level APIs is the prerequisite for achieving the vision of a fully automated enterprise cloud. Many layers play a role in this picture and one is faced with a large set of provider APIs ranging from storage to application levels. In the demo, we will show an enterprise cloud with heterogeneous multi-vendor resources. We show how we use RDF as a data model for integrating semantically heterogeneous information to obtain a unified view on the entire data center, both horizontally – across different product versions and vendors – and vertically – across storage, compute units, network, operating systems, and applications.

Collaborative Documentation and Annotation. In order to have a complete picture, organizational and business aspects need to be added to the technical data. Consider the following examples: The decision whether to place a

Fig. 2. Visual exploration of query results in the Intelligence Edition

workload on a redundant cluster with highly available storage is strongly affected by the service level the system needs to meet, data center planning tools must take expiring warranties of components into account, and having a relatively mild punishment for SLA violations may lead a cloud operator to take a chance and place workloads on less reliable infrastructure. In the demonstration, we will show how administrators can extend the data fed from infrastructure providers by documenting and annotating the respective items. The administrator can e.g attach best practices for error handling to storage resources, connect infrastructure level resources with project and customer information etc.

Intelligent Information Access and Analytics. Efficient management of a data center requires providing data center managers with the information they need to make intelligent, timely and precise decisions. We will demonstrate specific information needs, including the generation of reports about status and utilization of data center resources over time, the visualization of key performance metrics in dashboards, the search for specific resources etc. Many of these information needs require multi-dimensional queries that span across both IT-related and business aspects, and therefore cannot be answered by a single data source alone. As an example, Figure 2 shows an intermediate step in the visual exploration process for customers with gold service level who are affected by the failure of a storage filer. Similar in spirit, we will demonstrate different queries and result visualizations that overcome the borders of data sources.

References

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