DISTRIBUTED MANAGEMENT TASK FORCE
Technical Note
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Cloud Infrastructure Management Interface (CIMI)

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This technical note discusses the basic concepts behind the Cloud Infrastructure Management Interface (CIMI) standard for Infrastructure as a Service (IaaS) management. This specification is the result of over a years worth of effort from multiple cloud vendors participating in the Cloud Management Working Group of the Distributed Management Task Force (DMTF).

DMTF CIMI

Introduction

CIMI addresses the management of the lifecycle of infrastructure provided by a Provider (cloud server). CIMI does not extend beyond infrastructure management to the control of the applications and services that the Consumer (cloud client) chooses to run on the infrastructure provided as a service by the Provider.

Although CIMI may be to some extent applicable to other cloud service models, such as Platform as a Service ("PaaS") or Storage as a Service ("SaaS"), these uses are outside the design goals of CIMI..

How CIMI Works

CIMI allows interoperability between a Consumer and multiple Providers that all offer the standard CIMI interface for managing a cloud infrastructure. The interface uses the Hyper Text Transfer Protocol (HTTP) to send and receive messages that are formatted using either Java Script Object Notation (JSON) or the eXtensible Markup Language (XML).

CIMI uses a convention called Representational State Transfer (REST) as the basis for the operations that are standardized through this interface. REST is a set of principles first proposed in a Phd. thesis by Roy Fielding and is as an alternative to SOAP-based web services protocols.

CIMI models the kinds of resources that are typically available in an infrastructure cloud and represents each resource with a set of key/value pairs of various types such as:

- Boolean
- dateTime
- duration
- integer
- string
- ref
- map
- structure
- byte[]
- URI
- Array
- Collection

These key/value pairs represent aspects of the resource's management such as configuration of the resource, operations on the resource, instrumentation of the resource metrics and relationships between resources.

The model for CIMI is independent of the HTTP protocol, although only the HTTP protocol is defined. A CIMI Consumer sends an HTTP message body using one of the HTTP verbs such as:

- GET
- PUT
- POST
- DELETE

to fetch, update, create or delete the representation of the management resource, thus affecting the underlying cloud infrastructure resources as a result.

The CIMI Model

The CIMI Model is documented in Chapter 5 of the CIMI standard (DSP0263) and consists of 58 resources organized into:

- **Cloud Entry Point** – the starting point for finding all the other resources as well as the capabilities of this particular cloud
- **Machine Resources** – resources associated with the compute infrastructure
- **Volume Resources** – resources associated with the storage infrastructure
- **Network Resources** – resource associated with the networking infrastructure
- **System Resources** – the resources related to aggregate relationships of Machines, Volumes and Networks
- **Monitoring Resources** – the resources associated with metering and eventing of resources

The CIMI Model is also documented as a XML Schema in DSP8009 and as a CIM Model in DSP0264. For a developer oriented introduction to typical operations of CIMI, the CIMI Primer DSP2027 documents a number of examples.

Implementing CIMI In Your Cloud

The architecture of a typical cloud deployment explains the application of various standards in the appropriate places. Figure 1 shows the various elements of an infrastructure cloud deployment and the actors. The Hypervisor, Virtual Machine (VM), Operating System (OS), and Applications/Services as well as underlying resources are shown being orchestrated (pooled and provisioned) by the IaaS API implementation as well as being managed through Systems Management.

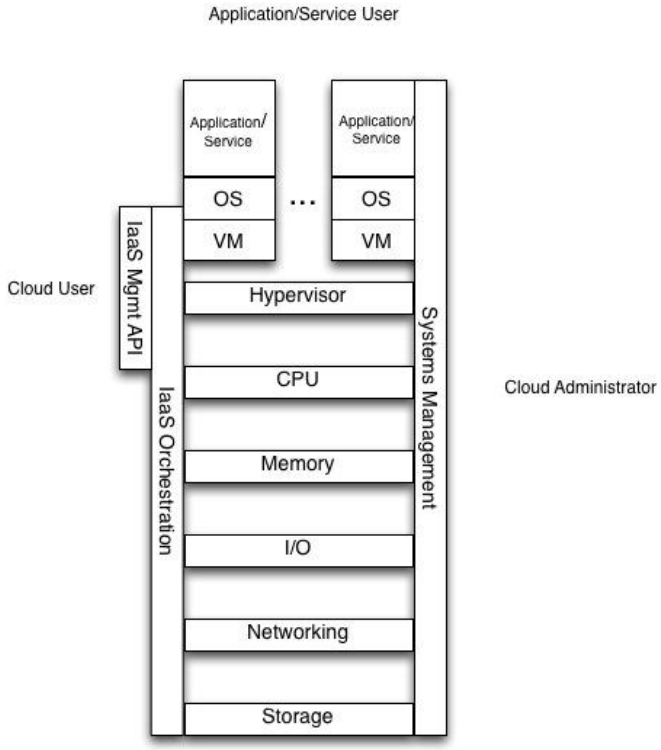

Figure 1: Infrastructure Cloud Elements and Actors

Cloud User

The Cloud User is the customer of the infrastructure cloud offering and is responsible for using the IaaS Management API to allocate cloud resources, install software and manage the operation of the virtual infrastructure.

Application/Service User

The Application/Service User is unaware that a cloud is being used to host the application or service. They may however see benefits of uptime, scalability and availability that are a result of using the cloud.

Cloud Administrator

The Cloud Administrator is responsible for the management and operation of the actual resources that make up an infrastructure cloud. The Cloud Administrator uses Systems Management software to do this management. DMTF provides a rich set of interoperable standards for Systems Management that will be detailed further in this note.

IaaS Management API

This is the interface used to provision virtual resources in the cloud and manage their lifecycle and operation. This interface is the one standardized by CIMI. The interface itself is

typically implemented by an IaaS Orchestration layer that coordinates the allocation and lifecycle of resources from available pools.

IaaS Orchestration

The IaaS Orchestration is software that is able to manage multiple hypervisors and the physical resources that are used by the hypervisors such as servers, networks and storage. This layer is where the IaaS Management API is typically implemented in order to service the requests coming from the cloud user.

Systems Management

Systems Management is software that is managing the actual resources used to implement the infrastructure cloud. These resources can include: Applications, Services, Middleware, Operating Systems, Hypervisors, CPUs, Memory, I/O, Networks and Storage. The use of DMTF standards for systems management allows a cloud infrastructure to be built from heterogeneous, best of breed, components from multiple vendors.

Mapping to CIM and WBEM

A shown below, DMTF standards such as CIM and WBEM can be leveraged for systems management by the cloud administrator. CIM and WBEM can also be used by the IaaS Orchestration layer as well, either as a client of the same instrumentation that the systems management software is using, or as a built-in extension of the systems management software itself.

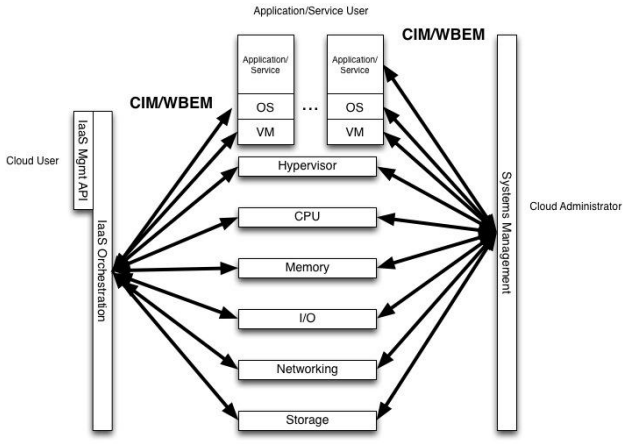

Figure 2: Architecture showing use of CIM/WBEM

Moving Workloads from Cloud to Cloud

CIMI allows the import of an OVF package to create multiple CIMI resources. This is done by specifying a reference to an OVF package in the import operation of a System Collection or System Template Collection (the Media Type at that URI shall be "application/ovf"). Please reference DSP0243 for more information about OVF. Support for OVF import and export is optional for a Provider and it is an implementation choice as to how many of the attributes in the OVF package are exposed through CIMI resources. A Provider may support the import of OVF package for only Systems, only System Templates or both. Support for the actual import and export of OVF packages will typically be handled by a hypervisor under the management of the CIMI implementation, and thus the CIMI resources that are created reflect what the hypervisor did upon import and form a "View" into the results.

The import of an OVF package can be reflected in the creation of templates that can be later used to create Systems, Machines and other component resources. The import of an OVF package can also be used to directly create Systems, Machines and other component resources, bypassing the step of creating templates.

CIMI details how to import an OVF file to create a System Template (and component resources). Annex A of CIMI has the complete description of the steps required to support OVF in your CIMI implementation.

Summary

CIMI is a self service interface for infrastructure clouds, allowing cloud users to dynamically provision, configure and administer their cloud usage using a high level interface that abstracts away much of the complexity of systems management. More detailed technical information on CIMI can be found at www.dmtf.org/cloud.

About DMTF

With more than 4,000 active participants representing 43 countries and more than 160 organizations, the Distributed Management Task Force, Inc. (DMTF) is the organization bringing the IT industry together to collaborate on systems management standards development, validation, promotion and adoption. DMTF management technologies are critical to enabling management interoperability among multi-vendor systems, tools, and solutions within the enterprise. By deploying solutions that support DMTF standards, IT managers can choose to deploy a mix of systems and solutions that best meet their users' needs, while reducing management complexity and total cost of ownership. Information about the DMTF technologies and activities is available at www.dmtf.org.