Aggregating IaaS Service

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HP Laboratories
HPL-2011-22

Keyword(s):

Cloud computing, service management, IaaS

Abstract:

Infrastructure-as-a-Service (IaaS) is the most acceptable Cloud Computing delivery model that CIO and IT managers are exploring as they relook at their IT infrastructure. However, the adoption of IaaS faces challenge/concerns such as provider lock-in, reliability, and regulatory compliance for data locality. Our project, Aggregated IaaS Service, addresses this issue by providing a common interface and description of IaaS services across multiple IaaS service provider. We had developed an abstraction model for Iaas services and then provide the interface to the commercial IaaS providers: AWS and GoGrid. The Aggregated IaaS services are exposed to the users through a portal which allow users to subscribe, monitor, and manage the life-cycle of IaaS services from multiple providers. To meet the requirements of the enterprise users the IaaS Aggregator portal have modules such as corporate account management and policy enforcement modules which transform it from a single client user to corporate/company usage of IaaS service from multiple providers.

External Posting Date: February 21, 2011 [Fulltext] Approved for External Publication
Internal Posting Date: February 21, 2011 [Fulltext]
To be published in 2011 Annual SRII Global Conference, San Jose, California, March 29 - April 2, 2011.

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***Abstract*— Infrastructure-as-a-Service (IaaS) is the most acceptable Cloud Computing delivery model that CIO and IT managers are exploring as they relook at their IT infrastructure. However, the adoption of IaaS faces challenge/concerns such as provider lock-in, reliability, and regulatory compliance for data locality. Our project, Aggregated IaaS Service, addresses this issue by providing a common interface and description of IaaS services across multiple IaaS service provider. We had developed an abstraction model for Iaas services and then provide the interface to the commercial IaaS providers: AWS and GoGrid. The Aggregated IaaS services are exposed to the users through a portal which allow users to subscribe, monitor, and manage the life-cycle of IaaS services from multiple providers. To meet the requirements of the enterprise users the IaaS Aggregator portal have modules such as corporate account management and policy enforcement modules which transform it from a single client user to corporate/company usage of IaaS service from multiple providers.**

Keywords-cloud computing; IaaS;service management

I. INTRODUCTION

Over the past year we have seen the emergence of Infrastructure-as-a-Service (IaaS) providers. IaaS model is extremely attractive to IT managers and CIO when it comes to outsourcing IT resources. CIO and IT managers see the possible benefits in terms of reducing capital cost, global accessibility and flexibility on top of others advantages. However, there are also many concerns such as security, vendor lock-in, etc. The availability of the services is totally dependent on the IaaS provider. To build in some resilience, customers may choose to subscribe to more than one IaaS service provider. Data security is another major concern around cloud computing because the security should not be compromised. Enterprise customer may want to keep some sensitive data within their private cloud or some IaaS provider who can provide more secured cloud. Different IaaS providers also have different flavors of infrastructure support, e.g., Amazon Web Service (AWS) [1] provides a more generic and lower cost infrastructure resource service through its Elastic Compute Cloud (EC2) & Simple Storage Service (S3) while HP Cells-as-a-Service [2] provides a very strong security service. We can see that multi-sourcing IaaS will be an interesting choice and applicable for many enterprise users. This also enables the enterprise users to meet the requirements of the regulatory compliances in some countries and industries such as financial service and healthcare industry.

However, the problem of managing IaaS from multiple IaaS provider is that each IaaS provder has its own management portal or tools. If the users want to have their own management tool for different IaaS providers, it requires additional investment to integrate with IaaS providers by using their APIs and therefore reduces the advantages of cloud computing offerings.

We have developed a tool called Infrastructure-as-a-Service Aggregator (IaaSA) to provide IT managers with the ability to subscribe to resources from different IaaS providers and at the same time have a common interface to manage the resources. The IT manager would be able to partition and deploy IT services across the multiple IaaS providers transparently. IaaSA model uses DMTF Common Information Model (CIM) [3], which is information model describing entities and their attributes. As part of the modeling of IaaS resources, we have defined core elements and attributes as well as extension to cover the additional services provided by different IaaS providers. On top of managing individual entity, the manager can group resources and label them to describe their function. Thus, IaaSA enables the effective and efficient management of the resource.

Currently the tool is integrated with the Web2Exchange system [4] managing resource from AWS and GoGrid [5]. A portal front-end was developed to enable managers to easily manage the resources. On top of this because it is modeled as a service and integrated in to Web2Exchange we can incorporate other services that are integrated to the system, e.g., Data analytic tools, etc.

Under development is incorporating support for HP Cells-as-a-Service into the IaaSA. This extension would expand the number of IaaS providers support. An interesting challenge would be the extension is the abstraction of a "Cell" into our tool.

Thus, IaaSA provides critical tool to meet the need and challenges of IT manager and CIO as they explore the outsourcing resources to the Cloud IaaS providers. It enables the manager to source from multiple IaaS providers to run their IT service.

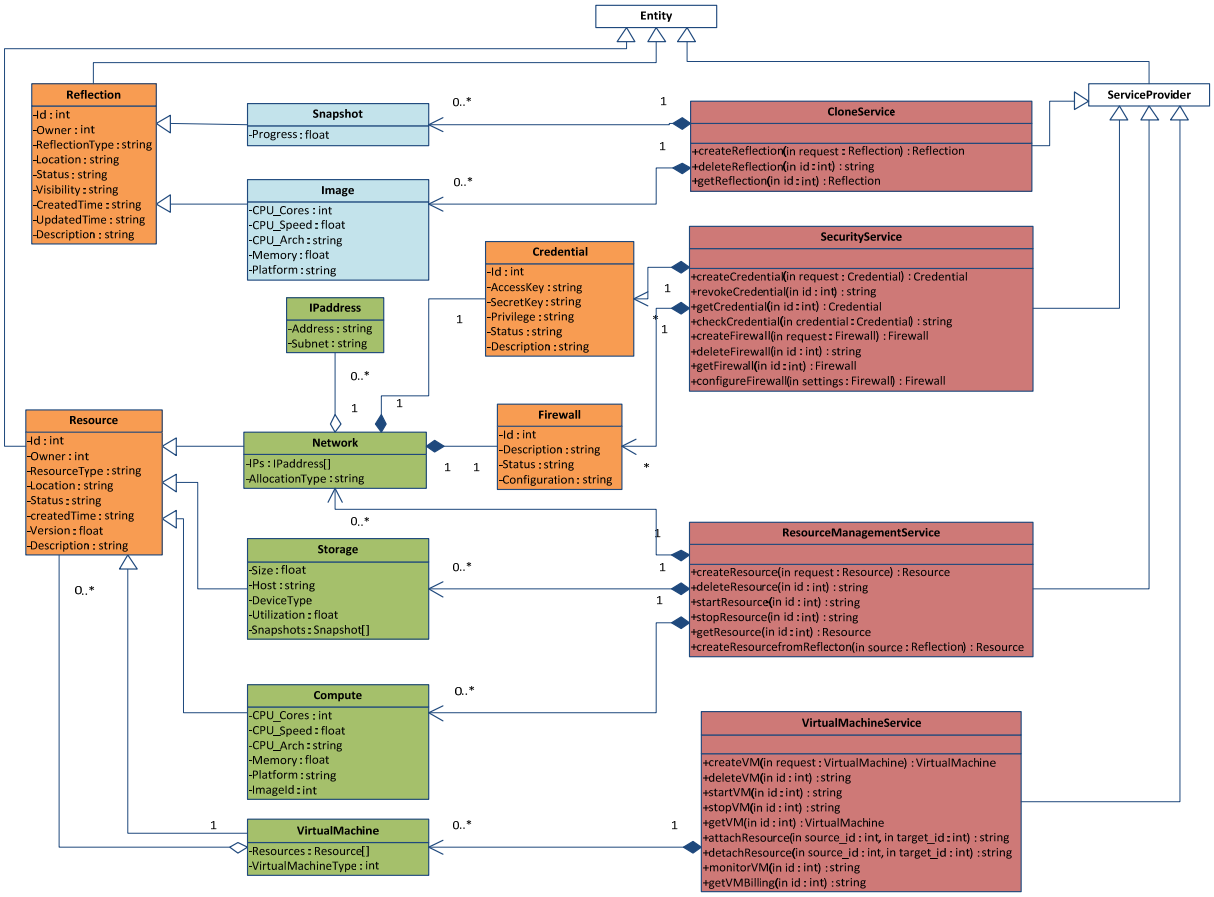

Figure 1. Abstraction Models of Iaas Service

II. COMMON IAAS INTERFACE

A. *Services Models of IaaS*

Since each IaaS service provider has similar provision of cloud computing service, it is possible to design a generic model for each category of service. The proposed service models abstract the commonly used operations from existing key service providers, and are designed with full coverage of functionalities, which can satisfy IaaS users' requirements.

Inherited from the model-based approach, our abstraction models of IaaS contain models for both types and services. Both models extend *Entity*, and services further extend *ServiceProvider* which itself extends *Entity*. The type models provide necessary parameters as well as information about instances of types which are exposed by a set of services during service invocations. Service models cater for basic functionalities which are required to fulfill operational requests.

There are various types in the proposed abstraction models of IaaS. Resource type includes compute, storage, network and virtual machine, which are a composite of various resources; Reflection type is mainly for backup and disaster recovery, which includes image for compute and snapshot for storage; other types support security purposes, including credential and firewall. Virtual Machine is a particular type of resource which is a collection of individual resources, and this kind of modeling is generic in the sense that it supports modeling of virtual machines composed of multiple computes, multiple storages and networks, and even multiple virtual machines. A collection of virtual machines known as virtual clusters can also be modeled in this approach.

According to the types in the common IaaS models, the proposed service model comprises four categories of services, including Resource Management Service, Virtual Machine Service, Clone Service and Security Service.

Resource Management Service defines operations for lifecycle management, such as creating, deleting, starting and stopping a resource. It also defines the operations for querying and searching, and special functional operations, such as creating compute from an image and restoring data from snapshots.

Virtual Machine Service not only defines operations for virtual machines in the context of lifecycle management and querying, but also specifies operations for flexibly attaching or detaching resources as well as for monitoring and billing purpose.

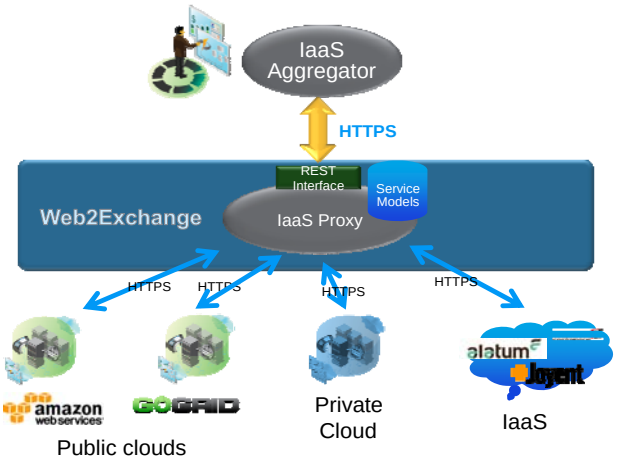

Figure 2. High Level System Architecture of Iaas Aggregator

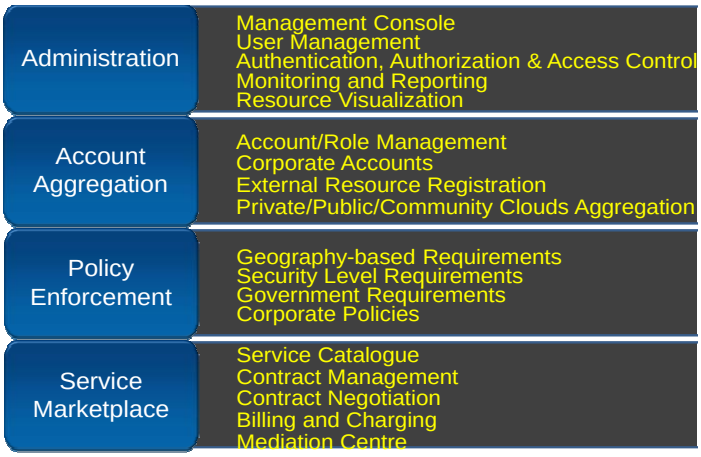

Figure 3. Key Modules of IaaS Aggregator

Clone Service achieves both creation and deletion of compute images and storage snapshots, so that at the time of disaster recovery, appropriate images or snapshots can be restored to computes and storages.

Finally, Security Service provides functionalities of generating credentials and firewall settings, and supports revoking credentials as well as updating firewall configurations.

The detailed implementations for invocations between services and various IaaS providers are transparent to end users. The user will only need to be aware of the common interface provided by IaaS proxy to communicate with all the supported IaaS providers. At the back end, invocations to a concrete service provider are designed so that it is possible to support arbitrary type of concrete service providers without modifying service models.

The proposed abstraction service models of IaaS are shown in Fig. 1.

B. *Implemetation in Web2Exchange*

Web2Exchange provides a model-based service integration environment to facilitate the service deployment, discovery, and integrations. The models of services on Web2Exchange are described by Managed Object Format (MOF) which is a readable and writable syntax with extension of the DMTF CIM meta-model [3]. In Web2Exchange the service developers can define service models directly in MOF or use source-code annotations to have Web2Exchange to define the service logic [4].

We implemented our service models for IaaS as a unified IaaS Proxy in Web2Exchange. The IaaS proxy provides a common interface to manage IaaS environments across public clouds and private clouds, so the users only need to interface with our IaaS proxy but not specific APIs from IaaS providers [6]. The IaaS proxy can be discovered and made available to other services running on Web2Exchange, and it also provides REST interface to the users and services situated outside of Web2Exchange.

III. IAAS AGGREGATOR

A. *Design of IaaS Aggregator*

With the common interface provided by our new IaaS proxy which has been described in Section II, a new IaaS Aggregator is further developed to provide users a comprehensive management console to subscribe, provision, monitor and manage IaaS resources from multiple providers. The high level system architecture is shown in Fig. 2.

User can use his login to access IaaS Aggregator portal from their web browser, and the portal server will invoke the REST APIs provided by IaaS proxy service running on Web2Exchange to communicate with various IaaS providers. The user is able to partition and deploy IT services across the multiple IaaS providers transparently through our portal.

IaaS Aggregator will help its users to aggregate IaaS services from different service providers including public and private clouds. The main modules of the IaaS Aggregator are shown in Fig. 3. We can see that it not only provides essential management console for users to provision and manage the IaaS resources, but also provides monitoring and reporting module and resource visualization which may incorporate business intelligence tools.

In Fig. 3 we can see that many advanced features are also provided by IaaS Aggregator. For example, the concept of Corporate Account is very appealing for enterprise users because they can subscribe to cloud services and allocate users in their organization to different roles. However, Corporate Account has not been implemented by major IaaS providers in the market. Our IaaS Aggregator Portal will have Account/Role management module to support user create Corporate Account to manage IaaS services from multiple providers. Policy Enforcement engine is another important module of IaaS Aggregator which will allows user to define the geography-based requirements, security level, government regulations and corporate policies. The policies defined by the users will be enforced to conform to the compliances for the subscription and deployment on IaaS resources.

Figure 4. Screenshot of IaaS Aggregator

B. Prototype of IaaS Aggregator

We have developed the IaaS proxy service in Web2Exchange using our abstraction IaaS models. Currently, the IaaS proxy supports AWS, GoGrid and other IaaS providers whose interface is compatible with AWS or GoGrid. The current version of IaaS Aggregator provides administration modules to support the life cycle management of IaaS services by using the common interface provided by IaaS proxy. A screenshot of IaaS Aggregator is shown in Fig. 4. We can see that the IaaS resources from AWS and GoGrid are monitored and managed in our management console. In Fig. 4 it is shown that user can group resources and label them to describe their function which makes the management of IaaS more efficient and effective.

IV. RELATED WORK

Open Cloud Computing Interface Working Group (OCCI-WG) from Open Grid Forum is developing a practical solution which covers the provisioning, monitoring and definition of IaaS [7]. The work on OCCI specification is still ongoing, and it requires service provider to adopt OCCI standard. RightScale is focusing on the deployments of multiple servers and the connections between them across one or more clouds [8]. Cloudkick provides very nice monitoring and visualization for user's IaaS resources. However, it requires and only supports the servers which has their Cloudkick Agent installed [9]. Our IaaS Proxy provides a common interface which does not need service providers modify their system, and IaaS Aggregator Portal will provide comprehensive management capability.

V. CONCLUSION AND FUTURE WORK

We defined generic service models for IaaS by abstracting the commonly used operations from leading IaaS providers, and make our models with full coverage of functionalities to satisfy IaaS users' requirements. The IaaS proxy service is implemented in Web2Exchange to provide common IaaS interface. It currently supports AWS and GoGrid. The IaaS Aggregator has been prototyped to manage multiple IaaS resources from multiple providers.

We will extend the IaaS aggregator to support HP Cell-as-a-Service and other IaaS providers. More features will also be defined and developed to provide comprehensive tools for IaaS users.

Another area of development is building new value added tools, e.g., analytics that makes use of the IaaS proxy to gather the information. Thus, we can enhance the system by progressively adding new services.

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