Analysis of Frameworks for Building IaaS Cloud Using by Cloud Computing Providers

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Abstract. A lot of companies are considering to use some cloud services and move their infrastructure into the cloud. This opens up many possibilities for providers of cloud services and IaaS (Infrastructure as a Service) services. From this reason, smaller service providers have to build their own cloud which will be offer the same capabilities like cloud services from large service providers (Microsoft Azure, VMware's vCloud Air, Amazon Web Services and others).

This article describes benefits of using IaaS clouds and available frameworks on market, includes and describes some frameworks for building IaaS cloud, which can be offered to customers via self-managed portals and tools. There is mainly described the Azure Pack solution from Microsoft, the vCloud Suite solution from VMware and possibilities of free open-source software platform OpenStack.

Keywords: IaaS · Cloud · Microsoft · VMware · OpenStack

1 Introduction

Companies are forced nowadays most effectively spend with their means, and in recent years there has been a great process of streamlining and improving the efficiency of funds spent on IT environments, services and infrastructure [1, 3].

Traditional IT previously worked as the company owned all their IT infrastructure and take care of it yourself or with the help of service companies. Such an environment has been very conservative, inflexible and inefficient [4].

One of the trends of recent years is the disengagement from the physical IT environment and use environment of providers, when companies rent computing power in cloud provider's data centers and more efficiently spend money [3].

This efficiency is based on an assumption that has been repeatedly demonstrated, the operation of data centers and the physical hardware is one of the highest IT costs, thus mainly the physical hardware acquisition and workforce, which has to take care of hardware, software and facilities. Other benefits of using infrastructure service providers includes cost model change. Costs are spread continuously and does not need to have a high expenditure on the purchase of hardware and software at the beginning of the investment. Another benefit is using of continuous and flexible response to the need for

physical resources and real purchasing only the effective use of resources or even paying only for the computing power actually consumed.

1.1   Cloud Computing

Cloud Computing is a model, which is based on the Internet principle and providing services and computer technology over the Internet and customer accesses their services via the Internet and pay regular fees to cloud service provider, either on a subscription or consumed computing environment basis (typically processor time, operation memory, data storage, software licenses, etc.) [12, 18, 19].

Cloud environment should be properly dimensioned and correctly built to meet the characteristics that should be properly constructed typical cloud infrastructure and therefore it was really a cloud. Such properties include [1, 10, 11]:

- Self-service provisioning and operation on demand by the customer;
- The ability to access via the Internet from anywhere and from any device;
- Utilization and separation of resources among several customers;
- Scalable and flexible environment and the possibility of capacitive extension, either on side of the customer and side of the provider;
- Minimal input costs for customer for service building and configuration;
- Measurement of services and billing.

For the cloud computing area is also important transition of IT functions between the traditional IT solutions to providing IT as services.

In the last few years, the provision of IT has been changed mostly to delivering IT as a service, when a customer orders the service and then pay for it. This concept is called Anything as a Service (XaaS), where for anything can be put almost any service, not just IT service. Between basic IT and cloud services and cloud solutions from XaaS concepts belongs [7, 14]:

- Infrastructure as a Service, when the infrastructure is provided as a service and the customer rent this infrastructure to build its own IT infrastructure and take care yourself or can even rent some service supervision;
- Platform as a Service, when a customer rents ready runtime environment, a typical example is the Microsoft Azure Services, where customers can rent, e.g. database instance and there has its own data;
- Software as a Service, when entire software is provided as a service for user and a typical example is Office 365.

These cloud services differ mainly in layers, which are administered by the provider and by customer. Each such type of service has its own different uses and properties, and according to the characteristics advantages and disadvantages.

1.2   Infrastructure as a Service

Infrastructure as a Service Cloud is a service, which provides virtual machines, storage and network resources. These resources can be managed by cloud's customers and they

can deploy their own operating systems, applications, tools and others or they can use any preformed templates from provider [4, 6]. These resources should be centrally managed and built with respect to be built with cloud computing requirements, which are defined in Chapter 1.1 and providers can use preformed solutions for building of IaaS cloud or they can create their own solution or use some a ready solution and add additional functions [8].

For this article propose, should be defined a framework for building Infrastructure as a Services solution. This Framework should offer a solution for building virtual infrastructure, be multi-tenant solution for more costumers and offer self-service portal for management, billing and reporting [2, 17].

Infrastructure as a Service consist these parts: compute, which delivers computing resources (virtualization platform), storage, which delivers places for data storing, networking, for network interconnecting virtual and physical networks [14].

2 Problem Definitions

As described in Chapter 1, the use of cloud services business provides benefits for these companies and thereby opens the demand for services providers.

On the market there are several major worldwide cloud service providers and products, for example Amazon Web Services (AWS), Microsoft Azure [14], VMware vCloud Air [23], Google Cloud Platform [7], Rackspace [20] and more.

These companies are true leaders, but there is still enough space in the market for smaller companies, which can offer better conditions for customers, linkage with other services, superior customer support and implementation options and much more. But smaller local companies can also offer's equivalent service using the tools that are available on the market that can be deployed in a production environment and for their use also offer Infrastructure as a Services cloud solution [3].

This article deals with the possibilities Infrastructure as a Services platform for creating cloud services, which can then be offered to customers by cloud service providers, mapping options from virtualization platforms leaders: Microsoft and VMware, as well as the possibilities of using open-source OpenStack technology.

Company Microsoft offers a framework called Windows Azure Pack, which in conjunction with Hyper-V virtualization and System Center, can provide partial opportunities this company offers its products and Microsoft Azure cloud platform.

In contrast, company VMware offers VMware vCloud Suite, offering the possibility of creating a vCloud environment based on VMWare's virtualization and also offers other tools that can be used for creating cloud environment and its management.

The created cloud solution does not necessarily serve for cloud service environment and providers, but larger companies can also build such a cloud and use within your enterprise to benefit from a private cloud model.

3   Frameworks for Infrastructure as a Service Cloud

Companies that want to offer Infrastructure as a Service solution, thus offering infrastructure services to their customers, such a solution must build a cloud and there are several ways in which such a company may issue. Might use some ready-made solutions from companies that offers such a solution or build a whole solution on open-source tools. Another option is to use a finished solution which is possible expand by yourself, thanks to its openness [3, 7].

Microsoft offers a framework which is called Windows Azure Pack (further WAP) and which is based on the Hyper-V virtualization platform and System Center, which serves primarily for the management and automation infrastructure [3, 22]. WAP is based on product Microsoft Azure and offers similar services, such as cloud services, public cloud this company and WAP is opened for further expansion using open Application Programming Interface (API) and companies can develop services that it is possible to customers through their portal to offer WAP [24].

Additionally, Microsoft is currently developing a new product called Azure Stack, which will offer even more options, than now offers WAP and which will offer services for Microsoft Azure from Data Centers of cloud service provider [13].

In contrast, VMware has a ready solution for the creation of IaaS Cloud, which is called VMware vCloud Suite, a suite of tools you can use to create and manage a cloud environment, which is also available to customers [9, 23]. VMware vCloud Suite is built on virtualization platform called vSphere and vRealize Suite Cloud Management Platform suite, which helps with managing and automatization of this cloud. This product is based on the other VMware's product vCloud AIR, the public cloud and VMware to offer customers service public cloud.

Another options for creating IaaS cloud solution and other components is using other products or tools, for example OpenStack, Apache CloudStack, OpenNebula, HPE Helion Eucalyptus, but some of these solutions are based on OpenStack.

This article deals mainly with technologies from Microsoft and VMware, thus tools Windows Azure Pack and VMware vCloud Suite.

4   Windows Azure Pack

Company Microsoft offers Windows Azure Pack (further WAP), which is built on Windows Server, System Center on instruments and is based on the same foundation of Microsoft's public cloud product - Microsoft Azure [15, 24].

The basic building component includes Windows Server, thus mainly virtualization platform Hyper-V and other services such as DHCP and DNS server, Active Directory Domain Services, Federation Services, Certificate Services, and more.

Another important part of tools of the System Center family are Virtual Machine Manager, for virtualized solutions deployment and management, and Operations Manager, for measurement and usage of the services in WAP.

An important component is the Service Provider Foundation, which provides services and connectivity to ensure the Infrastructure as a Service Cloud for a set of WAP.

This component provides management portals and binding via API interfaces to other infrastructure components, namely Windows Server and System Center.

Environment management is possible via Admin Portal, which offers the ability to manage and configure through a Web interface that public cloud. But for the next administration are available and the need for individual components and interfaces - especially console tools from the System Center family. The solution includes Customer Portal, which customers access to the leased funds, have the ability to deploy and manage services, for example, connect to each virtual machine.

Furthermore, even the SQL server that is hosting the database needed for the WAP. Among the services, which features are included in WAP, are:

- Web sites, which can be used for creating a Platform as a Services, which can be integrated with many open source applications and tools (e.g. ASP.NET, PHP, DropBox and many more);
- Virtual machines, which offers self-service deployment and management of virtual machines, which can run Windows or Linux based operating system, including server or client operating systems;
- Virtual Networks, for creating network infrastructure and network connection to existing different infrastructure;
- Service bus, which enables reliable asynchronous messaging between applications, when sender needs to ensure that messages will be delivered;
- Database, which enables us to offer customers access to an existing SQL and MySQL databases for their applications.

Thanks to large number of API's, WAP can be more developed in-house or expanded to other third-party tools and can be more customizated.

5   VMware

VMware vCloud Suite is a package of products that serve to create a platform and cloud solution using Infrastructure as a Service. VMware's products which are included in VMware vCloud Suite are [23]:

- ESXi, which is VMware's virtualization platform (hypervisor);
- vSphere, which is used for ESXi server managing and environments;
- vRealize Operations, which is solution for managing of operations and capacity and configuration management of the solution;
- vRealize Automatization, which is solution for automation and self-service of the entire provisioning managed and deployed services;
- vRealize Business, which provides resource management and reporting.

On the figure there are a few elements, which are helping with creating whole solution [23] and these elements are vCenter Operations Management Suite, which includes vRealize Operations, Automatization and Business, vFabric Application Director, which helps with creating some templates of services, which will be offered via a portal to customers, vCloud Director, which allows construction of different cloud services in

data center and offer customers a variety of parameterized, vCloud API, which is opened interface based on protocol REST (Representational State Transfer), which allows development and customizations and creating of additional services, vCloud Connector, for bulding hybrid cloud solution and connection to private or public cloud environments across multiple clouds, vCenter Orchestrator, which helps with automation of the entire environment, in terms of operations and in terms of service provisioning.

In this solution there is for customers routinely generated virtual data center (VDC), which is a logical grouping of computing resources and storage and within that VDC then the customer has the option to create their own virtual servers and other services. All the services that offers customers specific vCloud are called vApps, which may include, for example, simple or complex server system or application and these service templates are located in place, which is called vApp catalog and users have options to choose which vApp can be installed into your virtual data center [23].

In order to enable access to the same resources multiple customers or entities there can be created organization, what is collection of users and groups, and are used to separate one customer access only to its organization and its systems.

6   OpenStack

A relatively new open-source OpenStack platform also offers opportunities for cloud service providers [5, 16]. OpenStack is cloud computing platform that supports all types of cloud environments and aims to implement a single, massive scalability and rich feature set collaborating and experts from around the world.

Basic OpenStack architecture consist compute component, network component and storage. These services are connected via OpenStack Shared Services [15].

OpenStack offers the possibility to use in many areas, e.g. to provide High Performance Computing (HPC), for using in the fields of IT as a Service, Big Data, providing network topologies and services and many other areas.

For the area of Infrastructure as a Service can be OpenStack used to create a similar environment offering Microsoft and VMware as a commercial product, saving costs for these products, but this is reflected in the cost, which the state will build solutions based on OpenStack, because OpenStack as such offer no ready-made solutions and is rather an open framework for own development. OpenStack is a collection of several projects that have open APIs and that working together. These projects include for example [5]:

- Nova for compute management and communication with virtualization platform;
- Neuron for virtual a physical network management;
- Heat for cloud orchestration;
- Horizon for creating self-service portal for management;
- And many others.

OpenStack is most often used with KVM virtualization platform, but also can be used with VMware's ESXi, Microsoft's Hyper-V or Citrix Xen.

7   Comparison and Collaboration

Both solutions deliver a similar solution for building Infrastructure as a Service Cloud, but Service Provider can develop own services, which can be used with collaboration with these solutions or delivered via portal to customer.

The comparing and the decision to implement solution should be based primarily on the knowledge and the architecture of the current solution and state and comparison should be also targeted to virtualization platform, because it is core point of decision. Each of these solutions is based on the individual tools of both companies and the following Table 1 various tools are shown that are primarily used in the solution.

Table 1.   Both company technologies and solutions

Area	Microsoft	VMware
Virtualization	Hyper-V	vSphere ESXi
Virtual machine management	System center virtual machine manager	vCenter Server
Monitoring	System center operation manager	vCenter Operations Management Suite
Self-Service	WAP or app controller	vCloud Director
Service management	WAP or system center service manager	vCloud Automation Center
Automatization	System center orchestrator	vCenter Orchestrator
Monitoring	System center operation manager	vCenter Operations Management Suite
Protection	System center data protection manager	vSphere Protection Manager

Microsoft's Windows Azure Pack
The advantages of WAP belong:

- A simple link to other Microsoft's technologies and systems;
- The well-known environment like in Microsoft Azure;
- Simple connection to the Microsoft Azure;
- Windows Azure Pack is more opened for development of extensions;
- Windows Server license for hosted operating systems are included;
- Suitable for Microsoft's virtualization.

In contrast, the disadvantages are:

- Some limitation in network virtualization and software defined networks;
- Only basic services are included;
- Less customized for customers;
- Development of this product has been stopped, because will be replaced by Microsoft Azure Stack product in the coming months.

VMware vCloud Suite

The advantages of VMware vCloud Suite belong:

- VMware vCloud Suite is more sophisticated complete solution for creating Infrastructure as a Services Cloud;
- Suitable for VMware's virtualization;
- High level of customization for customers;
- A networking can be expended and more complex thank of implementation of VMware NSX technology.

In contrast, the disadvantages are:

- More expensive for basic solution and deployment;
- Solution can get expensive because Windows licenses are not included.

As the advantages and disadvantages of both solutions clear, Windows Azure Pack is technically simpler and cheaper but less complex and VMware is more complex but expensive for basic deployment, but it can be said, that when company uses Microsoft's virtualization and tools (System Center), company should use Windows Azure Pack, and when company uses VMware's virtualization, that VMware vCloud Suite should be used, because these implementations will be cheaper and there will not be not implement some new and not verified technology for company.

8   Conclusion

In this article were presented solutions of the two companies, which deal with virtualization and deliver IT services and systems - Microsoft and VMware, and their frameworks - Microsoft's Windows Azure Pack and VMware's vCloud Suite.

Both of these companies offer tools or products, which can be used for creating an Infrastructure as a Service Cloud and cloud services that offer customers. These products are primarily based on instruments and other products of these companies, but are also established and based on public cloud services, which both companies offer - Microsoft Azure and VMware vCloud AIR.

In the article, the two products are compared and outlined deployment options and their potential use, whether in the area of creating a cloud that subsequently the company will be offered as a Cloud Service Provider to external customers in the area of cloud computing to create a company that will offer this cloud to internal customers. But both models are essentially identical.

The article also discussed possibilities of using open-source OpenStack, which offers the possibility to create a public cloud. OpenStack has also been described as a possible solution that combines parts of solutions from Microsoft and VMware.

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