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Virtual machine monitoring in cloud computing

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Abstract

Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a utility (like the electricity grid) over a network (typically the Internet). Clouds can be classified as public, private or hybrid. Cloud computing, or in simpler shorthand just "the cloud", also focuses on maximizing the effectiveness of the shared resources. Cloud resources are usually not only shared by multiple users but are also dynamically reallocated per demand. This can work for allocating resources to users. For example, a cloud computer facility that serves European users during European business hours with a specific application (e.g., email) may reallocate the same resources to serve North American users during North America's business hours with a different application (e.g., a web server). This approach should maximize the use of computing power thus reducing environmental damage as well since less power, air conditioning, rack space, etc. are required for a variety of functions. With cloud computing, multiple users can access a single server to retrieve and update their data without purchasing licenses for different applications.

Proponents claim that cloud computing allows companies to avoid upfront infrastructure costs, and focus on projects that differentiate their businesses instead of on infrastructure. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability and less maintenance, and enables IT to more rapidly adjust resources to meet fluctuating and unpredictable business demand. Cloud providers typically use a "pay as you go" model. This can lead to unexpectedly high charges if administrators do not adapt to the cloud pricing model

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Keywords: Automation with Cloud; Multiple Cloud Hosting; Common platform for multiple clouds; Cross platform cloud API

1. Introduction

Cloud computing, or in simpler shorthand just "the cloud", also focuses on maximizing the effectiveness of the shared resources. Cloud resources are usually not only shared by multiple users but are also dynamically reallocated per demand. This can work for allocating resources to users. For example, a cloud computer facility that serves

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Amazon Web Services (AWS) is a collection of remote computing services (also called web services) that together make up a cloud computing platform, offered over the Internet by Amazon.com. The most central and well-known of these services are Amazon EC2 and Amazon S3. The service is advertised as providing a large computing capacity (potentially many servers) much faster and cheaper than building a physical server farm.

Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. It provides both PaaS and IaaS services and supports many different programming languages, tools and frameworks, including both Microsoft-specific and third-party software and systems. Azure was released on 1 February 2010.

1.1. Cost saving for cloud consumers

Opting for the cloud helps a business save money in several ways. For instance, it eliminates the necessity to invest in storage hardware and other physical infrastructure like servers. Besides, a business does not need to hire technical personnel to maintain and service the infrastructure. With cloud service, you pay after certain duration of time depending on the plan you opt for.

1.2. Focusing on core business

In the past, business enterprises which needed large storage spaces found it necessary to hire IT professionals who managed and maintained the infrastructure. Cloud computing is however convenient in the sense that you only concentrate on what means most to you. Since your applications will be run over the internet, you do not have to worry about technical problems and other inconveniences associated with physical unified storage solution spaces. Additionally, you do not have to worry about backup which gives you peace of mind and time to run your business effectively.

1.3. Performance and support

One of the things which make cloud computing so popular to business enterprises is the fact that all your software and applications update automatically. With regards to performance, the cloud service allows employees to work from whatever locations as long as they have reliable internet connection. If the business is going to used shared apps, the employees can sync up their documents so that it looks like they were working from a single office room. Although it’s rare, most companies which offer cloud computing services are willing to attend to any of their clients should they experience technical problems or in the case devastating scenarios such as data loss. And this web application should also support upcoming emerging services which service providers are merging in for their end users. This should solve compatibility issue as well.

2. Existing architecture

Towards a Cross Platform CLOUD API, This technique was researched by Dana Petcu and Ciprian Craciun at Institute e-Austria & West University of Timis¸ Oara, Romania from Second University of Naples, Italy. This general paper states that Cross platform APIs for cloud computing are emerging due to the need of the application developer to combine the features exposed by different cloud providers and to port the codes from one provider environment to another. Such APIs are allowing nowadays the federation of clouds to an infrastructure level, requiring a certain knowledge of programming the infrastructure. Cross platform APIs for cloud computing are emerging due to the need

of the application developer to combine the features exposed by different cloud providers and to port the codes from one provider environment to another. Such APIs are allowing nowadays the federation of clouds to an infrastructure level, requiring certain knowledge of programming the infrastructure. We describe a new approach for a cross platform API that encompass all cloud service levels. We expect that the implementation of this approach will offer a higher degree of portability and vendor independence for Cloud based applications [11]

Toward an Architecture for Monitoring Private Clouds, Cloud computing is rapidly emerging as a new model for service delivery, including for telecommunications services (cloud telephony). Although many solutions are now available, cloud management and monitoring technology has not kept pace, partially because of the lack of open source solutions. To address this limitation, this article describes our experience with a private cloud, and discusses the design and implementation of a private cloud monitoring system (PCMONS) and its application via a case Study for the proposed architecture. An important finding of this article is that is possible to deploy a private cloud within the organization using only open source solutions and integrating with traditional tools like Nagios. However, there is significant development work to be done while integrating these tools. With PCMONS we took the first steps toward this goal, opening paths for new development opportunities as well as making PCMONS itself an open-source tool. [14]

State Monitoring in Cloud Datacenters, Monitoring global states of a distributed cloud application is a critical functionality for cloud datacenter management. State monitoring requires meeting two demanding objectives: high level of correctness, which ensures zero or low error rate, and high communication efficiency, which demands minimal communication cost in detecting state updates. Most existing work follows an instantaneous model which triggers state alerts whenever a constraint is violated. Countermeasures of such alerts may further cause problematic operations. In this paper, we present a Window-based State monitoring (WISE) framework for efficiently managing cloud applications. Window-based state monitoring reports alerts only when state violation is continuous within a time window. [15]

3. Motivation for current research

Cloud computing is gaining popularity across a variety of industries for basic business support functions. In fact, many industries are now viewing cloud computing in the context of how it can help them succeed in an evolving marketplace. It's been also observed that not only regulated industries like Government, Banking, and Insurance but also unregulated industries like Retail, Media and Manufacturing are adopting cloud technology to either improve their existing process of operation or to delegate their work so that they can focus on critical function of operation.

While adopting to cloud computing platforms industries become aware that there are some other computing platforms as well, which are more suitable, easy to use, flexible, Cost-effective, reliable, secure and scalable for their way of operation, so to adapt to newer once and more comfortable cloud platforms, industries wanted to remain intact with current cloud solution and the newer once as well. Now problem that comes into the picture is industries has distributed their operations, storage and other means of cloud use across different platforms. Which is again difficult to manage and co-ordinate when industries have decentralize their operational system.

This problem become an opportunity for "VM monitoring in cloud computing" study. To automate the process for which user will only have to configure their work environment which are deployed on cloud and monitoring application will automatically take care of all the activity that user wants with their work environment regards with monitoring.

4. Proposed Architecture

With the advancement of modern society, basic essential services (utilities) are commonly provided such that everyone can easily obtain access to them. Today, utility services, such as water, electricity, gas, and telephony are deemed necessary for fulfilling daily life routines. These utility services are accessed so frequently that they need to be available whenever the consumer requires them at any time. Consumers are then able to pay service providers based on their usage of these utility services.

The creation of the Internet has marked the foremost milestone towards achieving this grand 21st century vision of 'computer utilities' by forming a worldwide system of computer networks that enables individual computers to

communicate with any other computers located elsewhere in the world. As such, over the recent years, new computing paradigms have been proposed and adopted to edge closer toward achieving this grand vision. Applications making use of these utility-oriented computing systems emerge simply as catalysts or market makers, which brings buyers and sellers together.

4.1 Monitoring

Main objective of Cloud automation is that it should properly identify and monitor the use of cloud and its resources. The users should realize whether the system under their use is fully functional or not. If not, possible solutions to the issue should be provided. The privacy of the users and the service providers should not be compromised in any ways during this process. Monitoring will be undertaken to observe the resources under use, virtual machine (instances created), and time it takes to complete processing of task.

4.2 Platform to monitor

An individual platform under monitoring makes no sense because service provider may not provide alerting mechanism. However, they certainly provide usage count and amount of time the service was under use. But what if user is using more than one service provider? How will the services be managed then? For this very reason, this application needs to address not only service from only a single service provider but also a couple of services provided by other service providers. Multiple clouds are covered under this application. So that multiple cloud services that user uses can be put under monitoring and alerting mechanisms will placed for services from different cloud to improve accessibility and to stay safe of any additional utilization as well as underutilization of cloud resources.

Amazon web services, Proposal of cloud computing is tightly coupled with low cost, time. Reduction of time and increase in utilization is considered as an important advantage of cloud. However, there are no available tools proper for cost calculation and analysis in Cloud environment. This paper presents our efforts towards filling in the gap. This provides a foundation for evaluating economic efficiency of Cloud and provides indications for cost optimization of Cloud. We have developed our calculation and analysis approach into a web tool which is used in the internal Cloud environment and demonstrate initially its analysis capability on the cost distribution and utilization imbalance factor [4]

Microsoft Azure, Microsoft Azure (formerly Windows Azure before 25 March 2014) is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. It provides both PaaS and IaaS services and supports many different programming languages, tools and frameworks, including both Microsoft-specific and third-party software and systems. Azure was released on 1 February 2010. [13]

To make one common platform, so that different cloud service consumers does not have to go and log into different providers but they will have one common SaaS to manage and access their all service related data. To develop this common SaaS we will need to study all API's that are available by different cloud providers. That API's will give output and that will be fetched and given to consumer as well as system to monitor and understand outcome. To fill gap between different cloud service providers we will need SaaS system which will allow different service users to have one common platform. We have not planned to develop SaaS yet but we can add up this web application to SaaS future scope of the project.

5. Implementation and testing

5.1 Domain Driven Design (DDD)

The implementation phase takes the requirements and design phase products and implements them using appropriate technologies. Model–view–controller (MVC) and Domain driven design (DDD) are main focus of interest. MVC is a software architectural pattern mostly for implementing user interfaces. Whereas DDD is an approach to software development for complex needs by connecting the implementation to an evolving model. Which is necessary for implementation for extensibility perspective. It becomes really easy to extend project dynamically when it has

DDD strategy implemented. This means VM-Monitoring is scalable and robust even if behavior of different cloud service provider is unique.

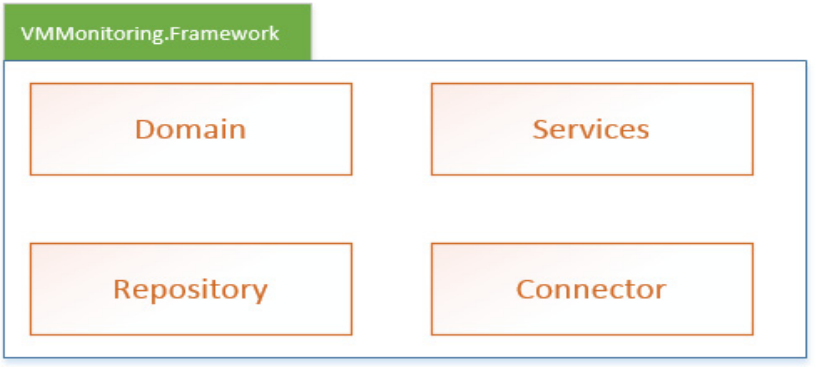

Fig. 1. Domain driven design of VM-Monitoring framework.

DDD places the project's primary focus on core domain and domain logic. Logical flow of program revolves around domain entities in the project. Domain is a sphere of knowledge, influence, or activity. The subject area to which the user applies a program is the domain of the software. Service area in DDD is combination of interface and their implementation, service area is mainly used when an operation does not conceptually belong to any object. Following the natural contours of the problem, you can implement these operations in services.

One of the major structural patter encountered in DDD (and one of the most argued about) is the repository pattern. Repository provides a centralized facade over some backing store, whether that backing store is a database, XML, SOAP, REST and so on. Connector comes in picture when you have to implement different behavior or logical.

5.2 Component in VM-Monitor

Fig. 2. Component diagram

VM-Monitoring.UI is consist of views that are shown to user it also includes graph showing data points of instance which is configured by cloud service consumer in this web application. For that user need to provide their Account keys (Access key and secrete key if account is associated with AWS, Subscription Id and certificate thumbprint if users account is associated with Microsoft Azure).

5.3 Classes in VM-Monitor

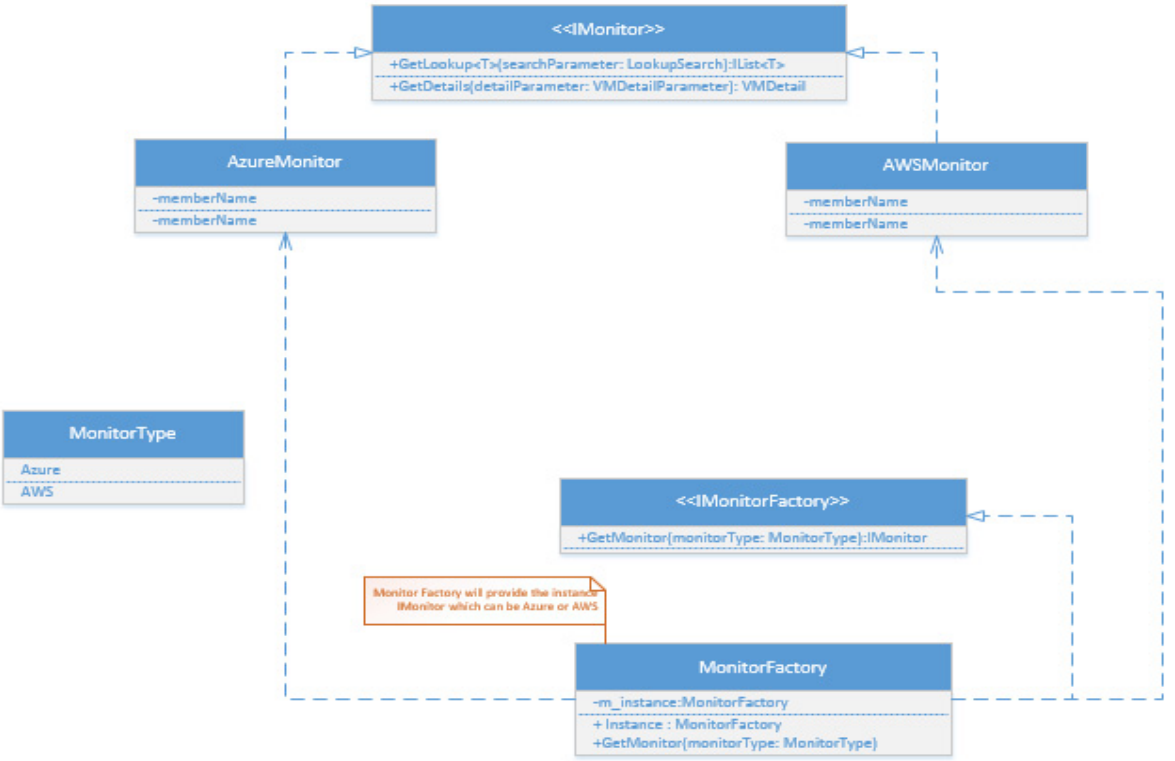

Fig. 3. Class structure implemented

This describes systems class structure by showing systems classes, their attribute, operations, and relationship among object. This diagram is main building block of VM-monitoring's object oriented modelling.

5.4 Testing in VM-Monitor

- Functionality Testing
- Usability Testing
- Interface Testing
- Security Testing

Security testing is very much essential than any other testing because user will be going to provide confidential keys to access their instance specific data by third party (Web application).

- Confidentiality - Information should be accessible to only those with authorized access
- Integrity - A measure intended to allow the receiver to determine that the information which it is providing is correct
- Authentication - Establishes the identity of the user

6. Result

User interface of this web application shows what different cloud accounts can be added to system. User can add number of accounts and they will be displayed like this. Once Accounts are added, user is ready to create or configure

environment (adding instances and instance specific information). While creating AWS instance user will need to provide details like Region and Zone in which instance is deployed and for Azure instance user may or may not provide details such as Service name and Instance name. Following screen shows how environment can be configured.

Note: Two different Instance specific processes are followed for AWS and Azure

6.1 Azure and AWS Instance price comparison

Table 1. Azure Prices on general purpose compute [18]

Instance	Core	RAM (GB)	Disk size	Price (Rs.)
A0	1	0.75 GB	20 GB	1.09 /hr
A1	1	1.75 GB	40 GB	4.63 /hr
A2	**2**	**3.50 GB**	**60 GB**	**9.26 /hr**
A3	4	7.00 GB	120 GB	18.51 /hr
A4	8	14.00 GB	240 GB	37.02 /hr

Table 2. AWS Prices on general purpose compute [17]

Instance	vCPU	RAM (GB)	Disk size	Price (Rs.)
t2.nano	1	0.50 GB	EBS only	0.58 /hr
t2.micro	1	1.00 GB	EBS only	1.19 /hr
t2.small	2	2.00 GB	EBS only	2.38 /hr
t2.medium	**2**	**4.00 GB**	**EBS only**	**4.77 /hr**
t2.large	2	8.00 GB	EBS only	8.87 /hr

If we compare two cloud service provider for the service of Virtual Machine based on their configuration and price we get following data.

Considering two highlighted rows from above tables, AWS user will have advantage in using EC2 instance of t2.medium over A2 instance of Microsoft Azure with better RAM. Even if we add basic storage which is EBS only (Amazon EBS General Purpose (SSD) volume) in case of t2.medium it adds cost of Rs.0.55 /hr to final charge. [16]

Total charges of t2.medium and EBS (SSD) = 4.77 + 0.55 = 5.32 / hr
Total charges of A2 = 9.26 /hr

Above total price clearly indicates that in case of t2.medium instance of AWS is always better than A2 instance of Azure in pricing. It also allows user to be free from initial storage allowed, if user wants to go with less or more storage capacity.

7. Conclusion and discussion

This application will allow organizations to proactively monitor the health and performance of their critical applications deployed on AWS as well as Microsoft Azure. This application not just monitor critical application deployed on cloud it even alerts user while system in process about utilization of resources and virtual machine (instances) created on cloud. This mechanism is not only limited to any one cloud based service provider but it is also capable of providing monitoring as well as alerting mechanism for multiple cloud based service provider.

While development cycle it was also seen iterative and increment methodology was a great support. The Incremental approach is a method of software development where the model is designed, implemented and tested incrementally (a little more is added each time) until the product is finished. It involves both development and maintenance. The product is defined as finished when it satisfies all of its requirements.

The Iterative Design is a design methodology based on a cyclic process of prototyping, testing, analyzing, and refining a product or process. Based on the results of testing the most recent iteration of a design, changes and refinements are made. This process is intended to ultimately improve the quality and functionality of a design. In iterative design, interaction with the designed system is used as a form of research for informing and evolving a project, as successive versions, or iterations of a design are implemented. [13]

Other system to which this project come across was AWS other services that are EC2 and S3Amazon Elastic Compute Cloud (EC2) is a central part of Amazon.com's cloud computing platform, Amazon Web Services (AWS). EC2 allows users to rent virtual computers on which to run their own computer applications. [9][10]

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