ISSN-2320-7884 (ONLINE)
ISSN-2321-0257 (PRINT)

Cloud Outsourcing Solutions for Tackling Malicious Mobile Activities

B.Pavani[1], Dr S.Satyanarayana[2]

[1] Student, K.L.University,Vaddeswaram,Guntur(dt), Andhra Pradesh, India

[2] Professor, K.L.University,Vaddeswaram,Guntur(dt), Andhra Pradesh, India

Abstract: Native Mobile apps are written specifically for the Smartphone that they live on, and are downloaded and installed directly in to the phone. Considering the resource constrained nature of smart phones (less cpu,memory and importantly battery), not all types of applications are suited for native mobile applications. Recent trend involving cloud-based mobile solutions benefits users through enriched communications such as message spam filtrations, enhanced phonebooks, messaging with push notifications, content sharing with pc syncing etc. But the rise of anomalous activities and the abuse of cloud infra poses new problems to Cloud Service Providers(CSP). Earlier, Machine Learning driven activity filters reduced such anomalies to an extent. Besides activity monitoring, performance monitoring solutions of the cloud can aid the CSP further in improving the service. So we propose that by using the elastic provisioning capability of the cloud, a cloud application can ideally provision its infrastructure dynamically based on cloud users requirements using optimal cloud resource provisioning (OCRP) algorithm. The OCRP algorithm can provision computing resources for being used in multiple provisioning stages thus providing an opportunity for performance measurements. From the results, the algorithm can optimally adjust the tradeoff between reservation of resources and knowing the load created by the resources. A practical implementation of the proposed system validates our claim.

Index Terms: *mobile cloud infrastructure, mobile cloud service scenarios, abnormal behavior monitoring, machine learning, resource provisioning, stochastic programming.*

I. INTRODUCTION

Cloud computing is a large-scale distributed computing paradigm in which a pool of computing resources is available to users (called cloud consumers) via the Internet. Computing resources, e.g., processing power, storage, software, and network bandwidth, are represented to cloud consumers as the accessible public utility services. Infrastructure- as-a-Service (IaaS) is a computational service model widely applied in the cloud computing paradigm. In this model, virtualization technologies can be used to provide resources to cloud consumers. The consumers can specify the required software stack, e.g., operating systems and applications; then package them all together into virtual machines (VMs). The hardware requirement of VMs can also be adjusted by the consumers. Finally, those VMs will be outsourced to host in computing environments operated by third-party sites owned by cloud providers. A cloud provider is responsible for guaranteeing the Quality of Services (QoS) for running the VMs. Since the computing resources are maintained by the provider, the total cost of ownership to the consumers can be reduced.

Through the convergence of mobile devices and cloud services, we expect that new mobile cloud services will be provided with the virtualization of mobile devices in cloud infrastructure. Virtual smart phone over IP is one example of provisioning virtual mobile instances to users. Each virtual instance in cloud infrastructure represents a mobile device, and users can connect to and use this instance. However, their architecture does not reflect virtualization of each node when virtual instances are provided to

ISSN-2320-7884 (ONLINE)
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users through cloud computing infrastructure. Moreover, their analysis is performed in service nodes, which can influence on the performance of cloud computing.

In this paper, minimizing both under provisioning and over provisioning problems under the demand and price uncertainty in cloud computing environments is our motivation to explore a resource provisioning strategy for cloud consumers. In particular, an optimal cloud resource provisioning (OCRP) algorithm is proposed to minimize the total cost for provisioning resources in a certain time period. To make an optimal decision, the demand uncertainty from cloud consumer side and price uncertainty from cloud providers are taken into account to adjust the tradeoff between on-demand and oversubscribed costs. This optimal decision is obtained by formulating and solving a stochastic integer programming problem with multistage recourse. Benders decomposition [3] and sample-average approximation are also discussed as the possible techniques to solve the OCRP algorithm. Extensive numerical studies and simulations are performed, and the results show that OCRP can minimize the total cost under uncertainty.

II. RELATED WORK

A Monitoring Abnormal Behavior in Mobile Devices

According to the previous techniques presented on the detection of malware in Mobile Cloud Infrastructure using mobile devices. In the detection process they are extracted the features of cpu usage, network usage, monitored use their mobile applications.

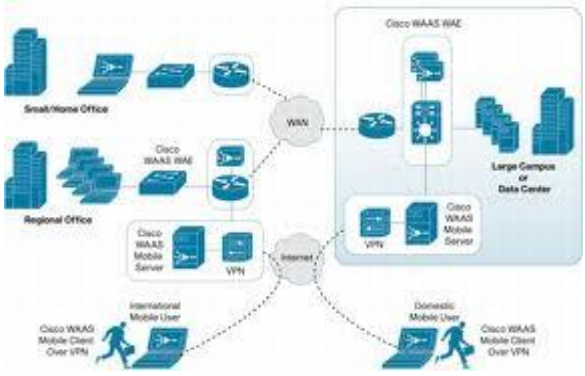

Fig 1: Mobile Cloud Infrastructure using mobile devices.

They defined the behavior of mobile devices as web browsing, SMS, phone calls, and were able to detect abnormal behavior using machine learning algorithms available in Weka with high accuracy.

B Abnormal Behavior in Cloud Computing Infrastructure.

They identified Intrusion Detection System (IDS) management issues in the cloud considering both Host IDS (HIDS) and Network IDS (NIDS). However, their study does not focus on how those malicious behaviors are defined and detected in cloud infrastructure. *Vieira et al.* [20] proposed architecture for grid and cloud computing intrusion detection. However, their architecture does not reflect virtualization of each node when virtual instances are provided to users through cloud computing infrastructure. Moreover, their analysis is performed in service nodes, which can influence on the performance of cloud computing. Stochastic programming has been developed to solve resource planning under uncertainty in various fields, e.g., production planning, financial management, and capacity planning. For example, in the authors applied the stochastic programming approach for planning of electrical power generation and transmission line expansion while some uncertainties affecting to the planning are taken into account. It is shown that stochastic programming is the promising mathematical tool which is able to address the optimal decision making in the stochastic environment. However, to the best of our knowledge, the application of stochastic programming to computing resource provisioning has never been exclusively studied.

III. EXISTING SYSTEM

Abnormal Behavior Detection Methodology

We propose a monitoring and detecting methodology for abnormal behavior of virtual mobile instances and applications. If abnormal behavior is detected in one virtual mobile instance, it means that something is wrong or changed in this virtual mobile instance. At such a point a detection alarm would be notify the mobile cloud infrastructure or the actual user of this virtual mobile instance.

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In our example we are developed mobile devices such as smart phones and tablet PCs. On such normal mobile devices, most current vaccine applications detect malware through a signature-based method. Signature-based methods can detect malware in a short space of time with high accuracy, but they cannot detect new malware whose signature is unknown or has been modified.

IV. PROPOSED METHODOLOGY

a) Collecting Behavior Data

We used two nodes and ran a total of 10 virtual mobile instances from them. To virtualized mobile instances, we installed a Xen hypervisor on each physical node. For virtual mobile instances, we created virtual images by compiling Android x86 kernel sources.

Features	Contents
OS (Privileged Domain)	CentOS 5.6 (x86_64)
Kernel	2.6.18-194.el5
Hypervisor	Xen 4.0.0
Libvert	0.8.1
Android x86 Version	Gingerbread 2.3.6 (Kernel 2.6.39)
Virtual Router	Open vSwitch 1.2.2

Software Specification Of Our Test Bed.

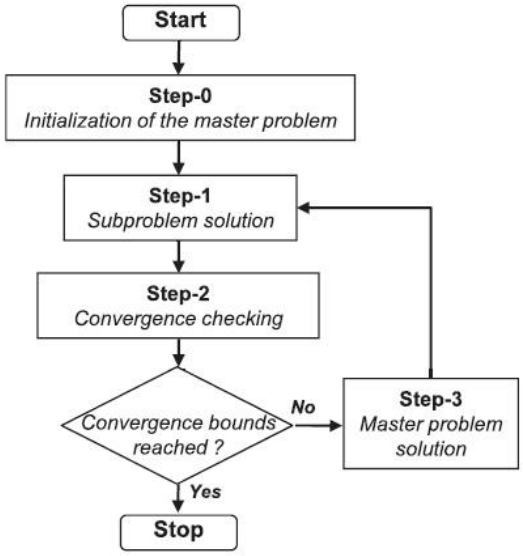
We implemented an agent mobile application for virtual mobile instances. This agent program runs as a service mode in Android x86 to collect host data. The feature extractor also extracts network behavior information every minute from the flows that are generated just one minute before.

Stochastic Programming Model

In this section, the stochastic programming with multistage recourse is presented as the core formulation of the OCRP algorithm. First, the original form of stochastic integer programming formulation is derived. Then, the formulation is transformed into the deterministic equivalent formulation (DEF) which can be solved by traditional optimization solver software. The objective function is to minimize the cloud consumer's total provisioning cost.

Benders Decomposition

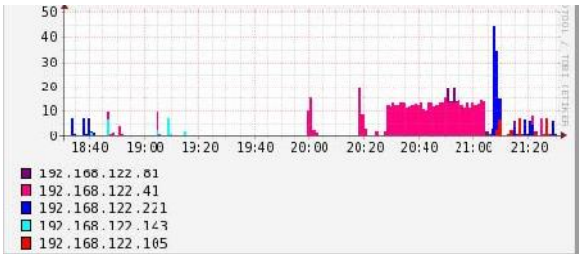
The goal of this algorithm is to break down the optimization problem into multiple smaller problems which can be solved independently and parallelly. As a result, the time to obtain the solution of the OCRP algorithm can be reduced. The Benders decomposition algorithm can decompose integer programming problems with complicating variables.



Flowchart of Benders decomposition algorithm

V. PERFORMANCE ANALYSIS

Clearly, even in this small setting (one VM class and one provider), the optimal solution is not trivial to obtain due to the demand uncertainty. Therefore, the OCRP algorithm would be required to guarantee the minimum cost to the consumer.



Besides activity monitoring, performance monitoring solutions of the cloud can aid the CSP further in improving the service. Using the elastic provisioning capability of a cloud, a cloud application can ideally provision its infrastructure dynamically based on cloud users requirements using optimal cloud resource provisioning (OCRP)

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algorithm The OCRP algorithm is a derivative of stochastic programming model The OCRP algorithm can provision computing resources for being used in multiple provisioning stages thus providing an opportunity for performance measurements.

The optimal cloud resource provisioning algorithm is proposed for the virtual machine management. The optimization formulation of stochastic integer programming is proposed to obtain the decision of the OCRP algorithm as such the total cost of resource provisioning in cloud computing environments is minimized. The formulation considers multiple provisioning stages with monitoring performance. For an efficient solution methods based on Benders decomposition and sample-average approximation algorithms are used to obtain the cloud optimization parameters. OCRP algorithm for clouds in combination with elastic provisioning can successfully minimize total cost of resource provisioning in cloud computing environments. From the results, the algorithm can optimally adjust the tradeoff between reservation of resources and knowing the load created by the resources.

VI. CONCLUSION

This paper focuses on the abnormal behavior detection in mobile cloud infrastructure. Behavior-based abnormal detection can address those problems by observing activities in the cloud infrastructure. There are 3 types of malware that use network resources. **Type 1** steals data in virtual mobile instances from behind the user and sends them to an external server. **Type 2** infects virtual mobile instances as zombie and uses them to build botnet and DDoS attack. **Type 3** increases network usage so that communication fare is over-charged. We will consider other monitoring features to improve the accuracy of detecting abnormal behavior. Using the elastic provisioning capability of a cloud, a cloud application can ideally provision its infrastructure dynamically based on cloud users requirements using optimal cloud resource provisioning (OCRP) algorithm. The optimization formulation of stochastic integer programming is proposed to obtain the decision of the OCRP algorithm as such the total cost of resource provisioning in cloud computing environments is minimized. The formulation considers multiple provisioning stages with monitoring performance.

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