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Secure Live Migration in Cloud Computing

A Thesis

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Abstract

Cloud computing offers an exceptional elasticity of resources and remarkable economic advantages in the information technology sector. It also provides an infrastructure for processing large and complex scientific data for data mining applications. While offering compelling throughput gains, it also introduces several challenges related to security.

The main goal for which cloud computing came into existence was to share the cloud resources among the cloud consumers, cloud vendors and even cloud partners. The few promising characteristics of cloud computing involve transparent resource distribution, efficient extensibility and virtualization.

Virtualization plays a leading role in helping cloud computing to achieve its goal. Virtualization allows a single physical node to handle a plenty of virtual machines running to respond many cloud client requests.

The virtual machine sometimes needs to be changed by another virtual machine and this process is called live migration.

In this research, we discuss all attacks that hinder live migration and all the security solutions that have been proposed to secure live migration.

المستخلص

تقدم الحوسبة السحابية مرونة استثنائية في الموارد والمزايا الاقتصادية وتكون هذه المزايا ملاحظة في قطاع تقنية المعلومات. كما يوفر بنية تحتية لمعالجة البيانات العلمية الكبيرة والمعقدة و تطبيقات استخراج البيانات. من المكاسب انها تقدم نتائج مقنعة ، الحوسبة السحابية لها أيضا العديد من التحديات المتعلقة بالأمن ، في هذا البحث سوف نناقش واحدة من أكثر القضايا الأمنية لآلة افتراضية في الحوسبة السحابية.

والهدف الرئيسي الذي جاءت من اجله الحوسبة السحابية هو مشاركة الموارد السحابية بين المستهلكين، وبائع السحابة وشركاء السحابة. لهذا يكون توزيع الموارد بشفافية عالية. تسمح الافتراضية بأن تعالج عقدة (جهاز) فيزيائي واحد عدد كبير من الآلات الافتراضية التي تستخدم من قبل مستخدمين متعددين في نفس الوقت.

الجهاز الافتراضي في بعض الاحيان قد نحتاج لتغييره الي جهاز افتراضي اخر هذه العملية تسمى الهجرة الحية.

لتأمين اقتراحها تم التي الأمنية الحلول وجميع الحية الهجرة تعيق التي الهجمات جميع يناقش البحث هذا الهجرة الحية.



1.1 Introduction

In the early years between 1960 and 1961 John McCarthy, an American computer and cognitive scientist, came up with the idea of computer or information utility. In 1961 at MIT Centennial John McCarthy pointed out “If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility. The computer utility could become the basis of a new and important industry”. Cloud Computing (CC) has developed from McCarthy’s idea of utility computing which begins the commoditization process to a new service that is widely available and has become undistinguishable from others like it, which consumers make the decision to purchase it based on price [1].

Cloud computing technology has become a popular alternative to traditional computing technologies. This technology provides a new concept of a pay-per-use utility model of computing resources based mainly on virtualization technology. Numerous benefits result from these features, such as cost-effectiveness, time saving, scalability, and green information technology environment.

Despite these benefits, cloud computing faces many challenges and security issues that hinder the utilization of cloud computing.

Cloud security is the most important factor for the customer when he wants to use cloud services, because the data and services are not located on the customer devices and cannot be under her/his control [2].

Cloud computing has improved computation’s efficiency while reducing its cost for users. Virtualization is the key component of cloud computing for providing computing and storage services. Virtualization is a foundation technology platform fostering cloud computing. The term virtualization refers to the abstraction of computer resources (CPU, storage, network, memory, application stack, and database) from applications and end users consuming the service. Virtualization technologies enable multi-tenancy cloud business models by providing a scalable, shared resource platform for all tenants [3]. Live migration is an essential feature of virtualization that allows transition of a running virtual machine from one system to another without halting the virtual machine [4].

1.2 Problem Statement

Live migration is the process of transferring a virtual machine that attached to a specific physical device and dedicated to a client to another physical device without any interruption to the client or his running applications. During this migration an attacker could exploit this process to access resources of virtual machine. Providing secure migration is a key security issue in virtualization.

1.3 Research Objectives and Research Questions

The main objective of this research to survey the proposed security solutions for live migration security problem to help researchers in the area to benefit from this research. So the questions of this research are:

What are the reasons of secure live migration?

What are the expected attacks in live migration?

What are the proposed security solutions for secure live migration?

1.4 Motivations

Live migration is the movement of a virtual machine from one physical host to another without any interruption to the client or his running applications. This process opens several vulnerabilities that threaten virtualization for cloud computing, research must focus on how this migration can be done securely.

1.5 Research Methodology

The information for this thesis was basically collected from the research papers such as journals, conferences, and digital libraries. A survey of literature is used to answer the research questions. Chapter (3) gives the details of the survey methodology.

1.6 Research Scope

This research discusses only the security solutions that have been proposed to secure live migration.

1.7 Thesis contribution

Thesis contributions are:

- i. Identifying the needs of secure live migration.
- ii. Explaining the attacks against live migration.
- iii. Explain the possible security solutions to secure live migration.

1.8 Thesis Structure

The remaining contents of this thesis are organized as follows:

Chapter 2 explained important aspects of cloud computing, including its definition, essential characteristics, models of cloud services. The chapter also briefly stated the challenges and security issues that faces cloud computing. Chapter 3 presents the research methodology that being used to conduct this research. Chapter 4 gives a simple background about virtual machine in cloud, some definitions of virtualization, types of virtualization, techniques of virtualization, vulnerability in virtualization, virtual machine threat, virtual machine attack, and proposed solution of virtual machine attacks. Chapter 5 discuss the live migration and show the migration goals, process of live migration, live migration attacks and proposed solution of live migration. Chapter 6 presents conclusion for this research and recommendation for future work.