AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer and Systems Engineering Department

An Efficient Cloud Bursting Framework

A Thesis submitted in partial fulfillment of the requirements of the degree of
Master of Science in Electrical Engineering
Computer Engineering and Systems

by
Mohammad Abd-Alwahed Ismail Ibrahim
Bachelor of Science in Electrical Engineering
(Computer Engineering and Systems)
Faculty of Engineering, Zagazig University, 2004

Supervised By

Prof. Dr. Hoda K. Mohammad
Professor at Computer and Systems Engineering Department
Faculty of Engineering, Ain Shams University

Dr. Gamal A. Ebrahim
Associate Professor at Computer and Systems Engineering Department
Faculty of Engineering, Ain Shams University

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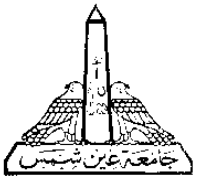

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Examiners' Committee

Name and Affiliation	Signature
Prof. Fatma Abdel Satar Hassan Omara Faculty of Computer and Information Cairo University	…….
Prof. Hoda K. Mohammad Computer and Systems Engineering Department Faculty of Engineering - Ain Shams University	…….
Prof. Ashraf Mohamed Mohamed Elfarghaly Computer and Systems Engineering Department Faculty of Engineering - Ain Shams University	..……

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering(Computer and Systems Engineering), Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Mohammad Abd-Alwahed Ismail Ibrahim

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Researcher's Data

Name	: Mohammad Abd-Alwahed Ismail Ibrahim
Date of birth	: 6 / 9 / 1980
Place of birth	: Cairo - Egypt
Last academic degree	: Bachelor of Science in Electrical Engineering
Field of specialization	: Computer and System Engineer
University	: Zagazig University – Banha Brunch
Date of issued degree	: May 2004
Current job	: Network and System Engineer

Thesis Summary

The emergence of cloud computing over the past few years is potentially one of the major advances in the history of computing. The evolution of cloud computing represents a fundamental change in the way Information Technology (IT) services are developed, deployed, scaled, updated, and paid for. Cloud computing service models can be classified into three main categories; Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). One of the major challenges in cloud computing environments is *cloud bursting*. This term refers to how to integrate public cloud resources along with internal IT infrastructure (private cloud or internal data center). Hence, cloud resources are provisioned when local resources are insufficient to meet their load spikes. In this case, extra workloads will be offloaded to public cloud on demand while private cloud owners are charged on a Pay-As-You-Go (PAYG) basis. Several factors should be determined accurately before and during the bursting process such as the type of resources to be gained from public cloud, the amount of resources needed to cover the needs of cloud clients, and the quality of service of the private cloud owners … etc. However, several hurdles stand in the way of deploying cloud bursting such as private and public clouds are located in different administration domains. Additionally, IaaS services have different technical requirements and may require different Application Programming Interfaces (APIs) for cloud bursting.

There is no comprehensive approach for treating the issues of cloud bursting. Most researches try to develop one of the aspects of bursting process, either by suggesting different frameworks for utilization to solve problems such as administration or security, or through reusing certain techniques to enhance the performance and throughput of the process by focusing on a specific metric such as resource balance or responsiveness. Hence, several cloud bursting issues are left unsolved.

In this thesis, a new cloud bursting framework named “Platypus” is introduced mainly to resolve some of the unresolved issues in cloud bursting. Platypus framework achieves the utter ratio of applying the pre-copy technique and supporting the automation procedures of implementing the cloud bursting approach. In addition, experimental studies based on real values from Amazon Web Services (AWS) has been conducted for applying this new framework, and the framework succeeds in answering the question "which application will be pre-copied and consequently bursted to the cloud?" Moreover, it achieves the trade-off between the time saving and the cost reduction.

Key words: *cloud computing; hybrid cloud; cloud bursting; pre-copy.*

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List of Abbreviations

API	Application Programming Interface
AWS	Amazon Web Services
CAPEX	Capital Expenditure
HEP	High Energy Physics
HPC	High Performance Computing
IaaS	Infrastructure as a Service
IoT	Internet of Things
ISP	Internet service providers
IT	Information Technology
NIST	National Institute of Standards and Technology
OPEX	Operational Expenditure
OS	Operating System
PaaS	Platform as a Service
QoS	Quality of Services
SaaS	Software as a Service
SLA	service-level agreements
SOA	Software Oriented Architectural
SSD	Solid State Disk
VDC	Virtual Data Center
VM	Virtual Machine
VMM	Virtual Machine Monitor
VO	Virtual Organizations

Chapter 1

Introduction to Cloud Computing

The emergence of cloud computing over the last few years is definitely one of the major advances in the history of computing [1]. Some of the experts consider the cloud computing as the second revolutionary evolution in the history of computing after inventing the Internet [2].

The Cloud Computing and its huge capabilities and resources represent fundamental base for optimizing existing services and launching new developed techniques such as the Big Data [3] and the Internet of things (IoT) [4] [5] [6]. The advent of cloud computing represents a substantial change in the way information technology (IT) services are developed, deployed, scaled, updated, and paid for (7).