Proclamation

I declare that this thesis was mady by myself with assistance of my supervisor. All parts taken over word by word from literature or other publications are referenced and identified. I approve publishing this thesis or any part of it with referencing author of original text.

In Prague at 2015-11-11 .....

Abstract

This master thesis deals with testing data networks in cloud environment. Techniques of inter and intra-cloud networks are described in theoretical part as well as virtual machine migrations. Practical part brings methodology and framework for testing virtual machine migration. Measurements are performed at OpenNebula cloud environment with KVM virtual machines.

Contents

Introduction

Theoretical part

2.1 Virtualization

Virtualization is, in my opinion, the most important technology in data centers which caused significant progress in this field. It is not technology itself, so it should rather be called model than technology.

Definition of virtualization as stated in [1] says that "virtualization is a technique for hiding the physical characteristics of computing resources from the way in which other systems, applications or end users interact with those resources. The concept of virtualization is very broad and can be applied to devices, servers, operating systems, applications and even networks." I brings basic suggestions, but also mention broad topic and blurred borders of virtualization.

The most common approach is virtualization of computers, because it is the oldest one and most widely used there days. It started in 1960s with mainframes as an attempt to employ resource sharing and the idea is still alive in current time. Virtual computer is logical representation of computer in software. [1] Virtual computers are usually called virtual machines (VM) and physical machine hosting VMs is called hypervisor. It is possible and very advantageous to run many virtual machines on one physical computer, because it brings technical and economical benefits. Decoupling computer and it's software from hardware is important advantage, because it brings additional level of abstraction and allows to shift virtual machines between hypervisors. Economical benefit is quite obvious, since it is not necessary to buy physical server for every service and electricity saving are also appreciable.

Virtualization of networks

Virtualization of services

2.1.1 Types of virtualization

2.1.2 Levels of virtualization

Cloud based systems depends on virtualization, as it was already mentioned before, and it is necessary to think about different usages of virtualization. There are tree approaches how to categorize virtualization: service virtualization, computer virtualization and

2.1.3 Advantages of virtualization

2.2 Cloud computing

It is possible find many services called "cloud based" and it is important to agree on accurate definition of these services. It is quite clear, that cloud based service will use principle of cloud computing. Definition of cloud computing by NIST says,

that "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) than can be rapidly provisioned and released with minimal management effort or service provide interaction." [TODO: cite NIST definition]. This definition clarifies what cloud computing is, but says nothing about parameters and used technologies.

I think, that it would be more convenient to start definition from lower levels, which provides elementary parts, and get to the cloud service afterwards. This definition gives different look at cloud computing than NISTs, but it uses same conditions and therefore results are basically same. It focuses on currently used principles, which may change during time, so it may not be valid after some time, but it provides more technical overview on operation of cloud services.

Cloud computing services are nowadays heavily dependent on virtualization, because it allows to replace physical machines with virtual machines (VMs) and brings a lot more flexibility than physical machine can ever provide.

Basic part of cloud computing system is virtual machine. Physical machine can also be part of the cloud system, but it is not able to deliver required rapid provisioning and it is not possible to deploy physical machine without service provider interaction. Virtual machine is elemental resource and also use some additional resources. These resources can be for example networking, which is used for interconnection between VMs as well as for reaching customers, storage used for system internal or customer data. It is important do employ some configuration management and orchestration, because it is able to deliver rapid provisioning of virtual machines and minimizes effort required for administration.

Virtual machines together provides the service, which is exposed to users via any kind of networking. It doesn't matter whether customers access the service directly at virtual machines or via a proxy, but hiding worker VMs brings additional flexibility for migration and scalability.

Difference between cloud computing and bare virtualization is intelligence included in cloud, because it may be controlled automatically according to events or monitoring observed at cloud system. It is common to supply customers with configuration interface, which allows to tune service parameters and provides user friendly interface for administration. Bare virtualization does not offer any intelligence, even if it is equipped with shiny user interfaces with opportunity to scale virtual machines up or down, because all change performed manually.

2.2.1 Network in cloud

2.2.2 Storage in cloud

2.2.3 Orchestration software

OpenNebula

2.3 Migration of VMs

2.4 Distributed datacenter

Practical part

Methodology overview [2]
Framework
Results

List of Abbreviations

NIST	National Institure of Standards and Technology.
VM	Virtual Machine.

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Bibliography

[1] IBM Corporation. Virtualization in education. http://www-07.ibm.com/solutions/in/education/download/Virtualization%20in%20Education.pdf, 2007. [Online; retrieved 2014-09-17].

[2] N.R. Katsipoulakis, K. Tsakalozos, and A Delis. Adaptive live vm migration in share-nothing iaas-clouds with livefs. In *Cloud Computing Technology and Science (CloudCom), 2013 IEEE 5th International Conference on*, volume 2, pages 293–298, Dec 2013.