

VOLUME 5 NO 4, 2017 ISSN 2054-7390

SOCIETY FOR SCIENCE AND EDUCATION

Implementation of the Flexible "Private - Public" Cloud Solution based on OpenStack

M. Elmahouti, O. Achandair, S. Khoulji, M.L. Kerkeb

Laboratory ISERG, Abdelmalek Essaadi University, Tétouan, Morocco mouradelmahouti@gmail.com, o.achandair@gmail.com, khouljisamira@gmail.com, kerkebml@gmail.com, acmlis.conference@gmail.com

ABSTRACT

Cloud computing is a model that facilitates access to and manipulation of resources on demand. It is a technology that is unique today to meet the needs and demands of customers by guaranteeing a high quality of service rendered. This new model provides convenience to reorganize the current revolt in the information technology industry by ensuring cost effective and less costly solutions to meet the constraints of technical capabilities and their extension.

This article will present the technical implementation of a flexible "private - public" cloud computing, based on the Openstack solution, to ensure the business needs in terms of performance, and a response time of treatments tailored to customer demand with a Availability.

This approach, followed by a "private-public" flexible cloud, will be able to communicate two clouds, the Cloud A, which includes the entire physical infrastructure of the company, while cloud B will be provided by a service provider that does not Will be called once the configurable load threshold is exceeded on the cloud A, and as soon as the resources on the private cloud A are released, the instances migrated to the Cloud B will be again remigrated to the Cloud A to minimize even the times Allocation.

Keywords—Cloud computing, Private cloud, Public cloud Information resources, Information security, OpenStack

Introduction 1

Today, cloud computing technology has marked an intrinsic transformation in improving the quality of services rendered, minimizing response times and processing on exponential quantities of dynamic data.

It is not easy today to master the growing difficulties for the proper functioning of the different architectures, which have to adapt with the required load to meet a certain level of performance within the company, this new concept of Cloud computing offers fascinating proposals to companies to choose the optimal configuration to outsource some or the entire infrastructure.

The article addresses the different concerns of information systems managers who want to join this new cloud computing technology and have slowed down because of the significant investment in their current infrastructure by offering a smart and flexible solution based on free software "OPENSTACK", which

consists of creating two clouds, a private cloud that supports the company's current platform, and a public cloud that will be auxiliary once the load threshold exceeds the capabilities of the internal platform.

The article is considered a continuation of the previous article [19], or we will detail the technical implementation of this flexible private cloud solution "private - Public", giving the necessary screenshots.

2 Proposed Solution: Private-Public Cloud Model Based On Openstack

To encourage companies to adopt this new cloud computing technology, minimizing budgets in the future and taking advantage of the state of the existing and existing platforms, our proposal is to create two models "Private : Cloud A"And" public : Cloud B "cloud based on a free solution that is the OpenStack[1].

Our approach is to create a "private - public" cloud: a private cloud (Cloud A) that supports the existing platform, and once the number of requests exceeds the capacity of the private platform, these requests will be refused internally by routing them to the Cloud to satisfy them by the public cloud (Cloud B) by paying just the rental costs, And once the internal resources are released, automatically some of the applications running on the public cloud will be supported again by the private cloud by minimizing rental costs[2].

2.1 Architecture proposed for the cloud "Private - Public"

The "Figure 1" shows the mechanism to be used by proposing the three algorithms to follow in order to pass the two-way passage between the two clouds, private and public [3], to ensure this proposition:



Figure 1: Cloud integration

2.2 Presentation of the three algorithms used:

The main brick of Openstack is Nova. Its purpose is to manage the resources of calculation of the infrastructure used, using the command NOVA BOOT to attack our platform [4], with its syntax below:

nova boot --image *imageID* --flavor *flavorID* --nic net-id=*nicID*

imageID :To select the operating system.

net-id=nicID : To tell the cloud which subnet is used for an instance.

flavorID :Reflects memory, disk and virtual process requirements.

To check the actual load on the cloud A, an implementation of the load analysis function is done, the functioning of the "analyze load" function will be explained in the algorithm 1 below[16].

Once the "analyze load" function is called, all information from all compute nodes of a controller on cloud A is received, if the load on the A cloud is below the configurable threshold, the instance will be created On cloud A, but if the load is greater than the threshold, the instance will be created on the cloud B[5].

Algorithm 1 Analyzing the load _____ Input Parameter: flavorid: flavor id of requested instance **Output Parameter:** val: 0 if cloud is overloaded, 1 otherwise. procedureAnalyzing the load (f lavor id) Oracle database connection is made to the nova database. Extract user's requirements using flavor id from the instance types table. totalmemory for all compute and total disk for all compute is initialized to 0. freememory for all compute and free disk for all_____ compute is initialized to 0. for each compute node c do Find the total memory and the free memory of c from the compute nodes table. Find the total disk space and the free disk space of c from the compute nodes table. totalmemory for all compute =total memory for all compute + total memory of c. total disk for all_compute =total disk for all compute + total disk of c. freememory for all compute = free memory for all c- _ _ ompute + free memory of c. _ free disk for all compute = free disk for all compute + free disk of c. end for if (total disk for all compute * disk threshold percentage>= users disk_requirement + (total disk for all compute-free disk for all _ _ _ compute) then if (total memory for all compute * ram threshold percentage) >= users memory requirement + (total memory for all compute-free memory_for _ all compute) then Return 1 end if end if Return 0 end procedure

Note that setting up an instance on another cloud requires some information on the Cloud B: Image-ID, Network-ID, which is used by algorithm 2 to position the instance on the cloud B[6].

705

Algorithm 2 Position the instance on the cloud B

Input parameter:

Network id: Subnet to start instance. Image id: OS launching an instance. Tasting Id: Specify required resources Instance Name: The name of the instance to be launched. Procedure INSTANCE positioning () When running the nova boot command, the function creation () calls up the load to check the load If Not exceeding threshold then The instance is created on cloud A. Other

It calls the createInstance () function. // Creating the instance on the cloud B CreateInstance () uses the new startup parameters We call the function creation () and extract the Id of the image for the cloud B. It Execute the NOVA command with the new parameters. This nova boot command is executed On the B cloud using the SSH connection. All instance information is stored in a file, retrieved later, and stored again in the array of migrating instances to the NOVA database End if End of procedure.

After each migration to the cloud B, the load on the cloud A is verified, once the load is below the configurable threshold, a remigration is made again to the cloud A, the instances that will be migrated back to the cloud A follow A FIFO order, algorithm 3 below explains the function of the remigration operation [7]:

Algorithm 3 Remigration

Input Parameter: Migratedinstancestable: Table regrouping the instances of remigration procedure REMIGRATION() The Analyzing the load() for remigration is Performed at Of the parameterized intervals. if the resource utilization falls below a configurable low threshold then do It finds the instance to be remigrated from the migratedinstances table using the FIFO : rule. It launches a new instance on cloud A using the information stored in the migrated instances table. It copies the disk image of the migrated instance from the cloud B to the newly launched instance on the cloud A, to: restore the current state. It finished the remigrated instance from the cloud B to free resources. It cleans the entry of the table of instances that have been migrated. whileResource usage is below the migration threshold and the migrated instance table is not empty end if end procedure

The communication between the two clouds (Cloud A and Cloud B) is secured with the use of an SSH public key, as noted in algorithm 2, [8].

3 The OpenStack SOLUTION

3.1 **OpenStack Architecture**

OpenStack is a set of open source software that enables deployment and manipulation of cloud computing infrastructures. This technology has a modular architecture that consists of several correlated subprojects (Nova, Swift, Glance), see "Figure 2", whose purpose is to control all the resources of virtual machines, such as computing power, storage or network [9].

The Openstack project is supported by the Openstack Foundation, a non-commercial organization whose goal is to promote the Openstack project by providing support and support to the entire OpenStack community. [10]



Figure 2: OpenStack Architecture and Components

3.2 The components of OpenStack

• Calculation / Nova: Nova is one of the main components of Openstack. Its role is to manage infrastructure calculation resources [11].

Nova's architecture is designed to evolve horizontally by adding hardware. Among the strengths of Nova is that it works with non-specialized hardware, which makes it possible to reuse existing servers for example [12].

• Object Storage / Swift: It is a dedicated system for storing redundant and scalable data, files are written to multiple hard disks spread across multiple servers, responsible for replication and data integrity within the cluster [13].

The Swift cluster evolves horizontally by adding new servers, once a server or disk fails, Swift takes care of replicating its content from active nodes.

As Swift is based on an application logic, it allows the use of inexpensive and non-specialized equipment [14].

• Block storage / Cinder:

This is the OpenStack block storage service; its role is to provide block-based persistent devices to OpenStack instances.

It manages the creation, attachment, and detach operations of these devices on servers.

This bulk storage mode is used for high-performance scenarios such as database storage, but also to provide the server with low-level access to the storage device [15].

• Network / Neutron:

The Neutron service allows you to manage and manipulate networks and IP addressing within OpenStack, allowing users to create their own networks by controlling traffic and connecting their instances to one or more networks.

Neutron also provides different types of network deployment based on the target infrastructure.

- Dashboard / Horizon: This is a WEB application that allows users and administrators to have a dashboard to manage their clouds through a GUI [16].
- Identity service / Keystone: This service provides a central directory containing the list of services and the list of OpenStack users as well as the roles and permissions.

Within OpenStack, Keystone is used by all users and services to authenticate with each other.

- Image service / Glance: This is the OpenStack image service, which allows the discovery, sending and distribution of disk images to instances. The glance service also allows you to store backups of these disks. Glance can store these disk images in several ways: in a folder on server, but also through the object storage service of OpenStack or in decentralized storage [17].
- Telemetry / Ceilometer: It is the service that collects different metrics on cloud usage. For example, the number of instances launched in a project and for how long.
 These metrics can be used to provide information needed for a billing system, for example. These metrics are also used in applications or other Openstack components to define actions based on certain thresholds as with the orchestration component.
- Orchestration / Heat: It is the component that ensures the orchestration of OpenStack, it allows to describe an infrastructure in the form of models. It can also use the metrics provided by Ceilmeter to decide to create additional instances according to the load of an application for example [18].

4 Implementation of the Solution: Private-Public Cloud Model Based on Openstack

To implement the proposed solution of creating two clouds, a private cloud A that supports the company's internal infrastructure, and a public cloud B at our service provider, which will be called as an ancillary platform, Once the load threshold is exceeded in the cloud A, the newly launched instances will be migrated to the cloud B for execution, once the load threshold on the cloud A arrives at its configured value, executing instances and Loaded by the public cloud B will be migrated back to the private cloud A.

An automatic load metering is initiated every 20 seconds to evaluate the load threshold in the cloud A to make the right decision on new instances arriving at cloud A and those running on public cloud B to ensure Either a migration to the B cloud when the threshold is exceeded or a remigration to the private cloud A.

In order to technically ensure this solution, two DELL Poweredge 2950 servers were used (one server is bought by our company, the other is leased since it is provided by our service provider, the same range was required to ensure efficient compatibility Between services), each having a memory of 1.8 TB, which acts as one of the compute nodes.

100 machines were assigned which function as calculation nodes for the two clouds, respectively. Knowing that the two clouds belong to a single subnet.

The OpenStack solution was installed on both servers, an installation based on Ubuntu 16.04, and then two clouds, a private cloud on the first server, all the internal servers in the company, and a second public cloud at the provider that will be used after the configurable threshold is exceeded.

The private cloud A is used by all production departments to execute their instances, they can create instances with different dimensions of 20 GB, 40 GB or 80 GB. Once 80% of the disks are allocated and 75% Of memory is busy, Cloud A is said to be overloaded, and all other requests will be satisfied by the cloud B.

Since both clouds belong to the same subnet, migrating an instance of cloud A to cloud B takes almost 17 seconds (for example, for an instance of 20GB). This time varies depending on the size of the instance.

The "Figure 3" shows the initial state of the public cloud B which initially contains four instances.

	Ins	tances							Log	ged in as: us	erjane Sethys Help Sign Out	
openstack	Ins	tances			Filter Q			Fiter + Launch Instance		Scheele	Suff-States Instances	
		Instance Name	Image Name	IP Address	Size	Keypair	Status	Task	Power State	Uptime	Actions	
hoject		chroot_live_310115	chroc_ke4	50.501.12	m1.email (2GB RAM (1 VCPU) 20 DOELDUA	mykey	Active	None	Running	6 days, 2 hours	Greate Shippshat Mare *	
project_one	8	inst_sty_20115	Ubuntu	192.100.10.53	m1.email (2GB RAM (1 VOPU) 20.068 Disk	mykey	Active	None	Running	2 weeks, 2 days	Orando Stragoshol Mares *	
Ianage Compute	в	gret_inst	gest_custom	58.50.1.9 152.188.18.57	m1.smail [2GB RAM 1 VCPU] 20.008 Disk		Activ	None	Running	3 weeks, 4 days	Grandel Strapphent More *	
Instances		My_first_inst_fp	ubuntu_costom	50.50.1.8 192.168.18.61	m1.madium 4GB RAM 2 VCPU 40.0GB Disk		Active	None	Running	3 weeks, 4 days	Greade Snapshall Mare *	

Figure 3: Initial Public Cloud

The "Figure 4" depicts the placement process of an instance; the terminal at the bottom of the "Figure 4" shows the execution of the new start command on the private cloud A.

The dashboard on the right side of the figure shows multiple instances that run on the private cloud.

The private cloud is overloaded because of these instances, so an instance named inst6 will be created on public cloud B as shown in the dashboard on the left side of the figure.

tances												
				openstack	Instances							
Instance Name	Imaga Name	IP Address	Size	ACCOUNT OF THE OWNER	0	Instance Name	lmage Name	IP Address	Skre			
105 K	Ubertu	50.50.1.10	m1.small(26B R/ 20.058 Disk	hoject	0	inst4	Uburts	50.501.15	m1.smat 200 FiA Disk			
chmid_lk9_310115	the Direct	50.60.1.12	m1.email/208 R/ 20.008 Disk	project_one *	8	nat2	USunts	\$0.601.14	m1.smail 208/RA Disk			
inst_try_20116	Ubertu	192.168.18.53	et small 268 R/ 20058 Pisk	fanage Compute	0	nst2	Uburts	50.501.13	m1.smail 208 PM4 Disk			
pest_init	gret_custom	50.50.1.9 152.168.18.57	m1.small[26B R/ 20.05B Disk	Instances	0	nati	Usunte	50.501.12	m1.email 2GB RP Disk			
My_fest_inst_fp	ubuntu_oustam	50.50.1.0 192.168.18.61	m1.medium (468 40.0GB Disk	Valueeo	-	1	Usunts	50.501.11	m1.smail 2GB RA Disk			
why 6 tens				Imageo & Stepshito Access & Security		85112	sauti	50.501.10	m1.smail 2GB RA Disk			
	Instance Name isof Chand Jav 31015 inst Jav 2015 pert_inst My_Sec_jas_fe www.sist.fe	Interact Name Incep Rame INIE Under Chard, Jun, 2010 Samily Chard, Jun, 2010 Samily Chard, Jun, 2010 Samily Chard, Jun, 2010 Samily Chard, Jun, 2010 Under Samily Chard, Jun, 2010 Samily Chard, Jun, 2010 Samily Chard, Jun, 2010 Samily Chard, Jun, 2010	balance Stans long tune P Advent NS Ukers 85.01.9 Add_S_2_1001 Adv2_2_1 85.01.9 add_S_2_1001 Adv2_2_1 85.01.9 add_S_2_1001 Adv2_2_1 87.01.9 add_S_2_1001 Adv2_2_1 87.01.9 add_S_2_1001 Adv2_2_1 87.01.9 add_S_2_1001 Adv2_2_1001 87.01.01.9 add_S_2_1001 Adv2_1001 87.01.01.9 add_S_2_1001 Adv2_1001 87.01.01.9 adv2_1001 Adv2_1001 87.01.01.9	Name Importance P. Altrom Name Not Name Name	Instance Ingel P Addres Tot Mail Marcin Status Status Status Mail Marcin Status Status Status Status Mail Marcin Status Status Status Status Status Marcin Marcin Status Status Status Status Status Status Marcin Marcin Status Status	Name Implet P Advin Stat Mail Users 9,93,13 20,000 GW 00 Mail American 00,000 GW 00 00 00 Mail Mail 00,000 GW 00,000 GW 00 00 00 Mail Mail 00,000 GW 00,000 GW 00	Nature Nature<	Name Import P Advo: En Import P Advo: En Add Mark 90.01 30.01 30.01 10.01 0 <td< td=""><td>Name Name Point Source Name Name</td></td<>	Name Name Point Source Name Name			

Figure 4: Placement of the instance on public cloud B.

The "Figure 5" shows that once the private cloud is overloaded with reaching the configurable threshold, the creation of the four instances (from inst6 to inst9) is supported by the public cloud.

	ins	Instances												
openstack	Ins	tances			Filter Q Inte			Titer + Leunch Instance			Schifteloci listances			
		Instance Name	image Name	IP Address	Sire	Keypair	Status	Task	Power State	Uptime	Actions			
ecl		1949	Uburto		m1.small 268 RAM 1VCPU 20.058 Diek		Build	Spawning	No Stine	0 minut es	Associate Fixeding P – Hore *			
roject_one	8	instB	Ubunta	50.50.1.13	n1.small 268 RAM 1 VCPU 20.0GB Disk		Active	Nose	Running	0 minutes	Crosto Seapohat Nore *			
nage Compute		inst?	Uburte	50.50.1.11	m1.email() 2G8 RAM () 1 VCPU () 20.008 Disk	•	Active	rione	Running	0 minutes	Crosto Seapolist. Nore *			
notances	0	instü	Ubunte	50.50 1.10	m1.small(268 R4M(11VCPU) 20.058 Disk		Active	None	Running	10 minutes	Orade Stepatet Nore *			
/alumes	•	checot_8ve_3100.16	fiel_teouta	50 50 1.12	m1.email) 208 RAM (1 VOPU) 20.0GB Disk	myksy.	Activo	Nose	Rureing	5 days, 2 hours	Orede Seaschol Intere *			
rapea & Brapshets zoros & Socarty	6	inst_by_28115	Uburte	192,168,16,53	m1.small) 2G8 RAM 1 VCPU 20.038 Disk	түкеу	Active	None	Running	2 weeks, 2 days	Oroido Saraponet Nore *			
1age Network		geet_inst	geet_custom	90.50.1.9 192.160.10.57	ert. svall 208 RAM 1 VCPU 20.058 Diek		Active	None	Running	3 weeks, 4 days	Oreado Sirepathat Nore *			
etwork Tepplagy	0	My_frat_inst_fip	shurtu_custom	50.50.1.8 192.169.18.61	m1.medium 408 RAM 2 VCPU 40.008 Disk		Activo	None	Running	3 weeks, 4 days	Orele Stapshit Incre *			

Figure 5: The public cloud after overloading condition of private cloud.

Some instances from private cloud are terminated to reduce the load on it, till it reaches the configurable low threshold as show in the "Figure 6".

→ C # 192.168.1	12/horiz	orv/project/in	stances/								1 S S S	
	Ins	tances								Success	r Scheduled termination of X e: inot4, inst3, inst2, inet1, 1	
openstack	Instances Q Ferr + Lawerhinstere								Software	Sofficial Inflations 🔹 🕯 To most inclusions		
DEBUT		Instance Name	lmage Nome	IP Address	Size	Koypair	Status	Task	Power State	Uptiesa	Actions	
njed	0	inst4	Ubustu	50.50,1.15	mf.smail 268 RAM 1 VCPU 20.068 Disk		Active	Deleting	Running	14 minutes	Terrende national	
project_one *	8	inst3	Uburtu	50.50.1.14	mf.small) 258 RAM (1 VCPU 20.058 Disk		Active	Deleting	Running	15 minutes	Tenande Indunce	
fanzge Compute		inst2	Uburtu	50.60.1.13	mf.smail 268 RAM 1 VCPU 20.068 Disk		Active	Daking	Running	15 minutes	Terminale Indusore	
Instances	8	inst	Uburtu	90.60.1.12	ml.smail)268 RAM (1 VCPU)20.068 Disk		Activa	Dekting	Running	15 minutes	Terrerde Industre 🌸	
Volumes	в		Ubuntu	50.50.1.11	ml.smail 268 RAM 1 VCPU 20.068 Disk		Shuteff	Dekting	Shutdown	2 meeks , 1 day	Dativitance Nov *	
Images & Snapphots Access & Security		inst12	Ubuntu	50.58.1.10	mt.small 268 RAM 1 VCPU 20.068 Disk		Activo	Nane	Running	2 maaks , 1 day	Create Snapshot More *	
lanage Network	8	inst10	Uburtu	50.50,1.8	ml.anali 258 RAM 1 VCPU 20.058 Disk		Active	Nate	Running	2 weaks , 1 day	Greate Snapshet More *	

Figure 6: Reducing load on the private cloud.

Once the load is reduced on the private cloud, and we arrive below the reconfigurable threshold, the migration process is triggered.



The "Figure 7" shows the remigration of the instance inst5.



Figure 7: The remigration process.

The "Figure 8" and "Figure 9" show the state of both private and public clouds after re-migration.

Once the load is reduced on the private cloud, four instances (De inst6 to inst9) have been remigrated to the private cloud by releasing the public cloud.

6	Ins	tances							Log	ged in ais: ou	erjane Sellings Heij Sijn (
openstack	Ins	tances		Filter	Filter Q Fase			wh instance	Surt Report Adapters		
		Instance Name	Image Name	IP Address	Sice	Keypeir	Status	Task	Prover State	Uptime	Actions
reject	0	chicat_box_310115	chroat_beek	50.50.1.12	ml.small(208 RAM)(1VCPU) 2009B Disk	mykay	Active	None	Running	1 week	Oreale Shapshot Hore *
project_one	0	inst_try_20116	Üburta	192,168,18,63	mf small (208 RAM (1 VCPU) 20.068 Disk	mikaj	Active	None	Ranning	2 weeks, 3 days	Create Snapshak More *
Hanage Compute	8	geet_inst	geel_custern	50.50.1.9 192.168.18.57	m1 small (2GB RAW (1 VCPU) 20.0GB Diek		Active	None	Ranning	3 weeks, 5 days	Grade Stagsshot Hore *
Instances	0	My_Rel_Ind_R	ubarte_custom	50.50.1.8 192.168.19.61	ml.medum (438 RAM (2 VCPU) 41.068 Disk		Active	None	Ranning	3 weeks, 5 days	Oreste Snepshak More *

Figure 8: The public cloud after remigration.

	Ins	tances								Lagged in ast us	or_ono Settinge Heb Sen	
openstack	Ins	tances			Filter	Filter Q rear			+ Lasenth Bostance Cost Polyce Andrews			
1710031		Instance Nome	lmage Name	ip Address	Size	Keypair	Status	Task	Power State	Uptime	Actions	
Project		inst9	Uburbu	50.58.1.15	mil.small (2GB RAM) 1 VCPU (20068 Disk		Active	Pione	Running	21 hours, 11 minutes	Greate Snapphit More *	
project_one	в	me®	Uburdu	50.51.1.14	mf.small (268 RAM (1 VCPU (20068 Disk		Active	Nane	Runito	21 hours, 12 minutes	Orada Shapehat Mane *	
danage Compute		inst	Uburnu	60 58 1 13	init small (268 RAM) 1 VCPU (20068) Disk		Active	Nare	Running	21 hours, 14 minutes	Orada Snapshat Mire *	
katances		iref5	Uburnu	50 50 1 12	inil small (268 RAM 1 VCPU (20068 Disk		Active	None	Running	21 hours, 15 minutes	Create Scientific More -	
Vduras		Haf5	Ubuntu	50.51.1.11	ml.smail (208 RAM 1 VCPU (20068 Dak		Active	fstare	Running	21 hours, 17 minutes	Greate Snepchat More *	
Access & Security		inst12	Uburdu	50.51.1.10	mit amali (208 RAM (1 VCPU (20068 Disk		Active	Nore	Running	2 weeks, 2 days	Create Snepchit More *	
Vanage Network		inst10	Ubuntu	50.51.1.0	m1.small [266] RAM [1 VCPU [20.068] Dide		Active	Nano	Raming	2 weeks, 2 days	Create Scopetest Nerve *	

Figure 9: The private cloud after remigration.

5 Conclusion

In this paper, we proposed an effective solution to accompany the change in information systems management, especially to encourage the adoption of new cloud computing technology based on the free OpenStack solution to create a private cloud Which consolidated the entire enterprise infrastructure and another public cloud at the service provider that is called whenever internal capabilities are exhausted and the only configurable is outdated. This solution has been definitively deployed and has shown these added values in terms of performance, quality of service rendered and associated costs.

711

The current implementation is considered the first pilot site, the next step will be to generalize the same architecture for all the subsidiaries.

ACKNOWLEDGMENT

This work was carried out with the support of our company, for the implementation of the project.

We thank all members of the project team who contributed to the success of this proposal.

REFERENCES

- [1] Haifeng Li, Huachun Zhou, Hongke Zhang, Bohao Feng, "EmuStack: An OpenStack-Based DTN Network Emulation Platform", 2016 International Conference on Networking and Network Applications (NaNA), vol. 00, no., pp. 387-392, 2016, doi:10.1109/NaNA.2016.24
- [2] Dinkar Sitaram, Sudheendra Harwalkar, K.V. Suchith Kumar, "Standards Based Integration of Intercloud for Federation with OpenStack", 2016 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM), vol. 00, no., pp. 113-118, 2016, doi:10.1109/CCEM.2016.028
- [3] Pooya Musavi, Bram Adams, Foutse Khomh, "Experience Report: An Empirical Study of API Failures in OpenStack Cloud Environments", 2016 IEEE 27th International Symposium on Software Reliability Engineering (ISSRE), vol. 00, no., pp. 424-434, 2016, doi:10.1109/ISSRE.2016.42
- [4] M. Abhishek Sharma, Monica O. Joshi, "Openstack Ceilometer Data Analytics & Predictions", 2016 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM), vol. 00, no., pp. 182-183, 2016, doi:10.1109/CCEM.2016.045
- [5] Ali Babar, Ben Ramsey, "Tutorial: Building Secure and Scalable Private Cloud Infrastructure with Open Stack", 2015 IEEE 19th International Enterprise Distributed Object Computing Workshop (EDOCW), vol. 00, no., pp. 166, 2015, doi:10.1109/EDOCW.2015.23
- [6] Dario Bruneo, Francesco Longo, Giovanni Merlino, Nicola Peditto, Carmelo Romeo, Fabio Verboso, Antonio Puliafito, "A Modular Approach to Collaborative Development in an OpenStack Testbed", 2015 IEEE Fourth Symposium on Network Cloud Computing and Applications, vol. 00, no., pp. 7-14, 2015, doi:10.1109/NCCA.2015.12
- [7] Vojtech Cima, Bruno Grazioli, SeÃin Murphy, Thomas Michael Bohnert, "Adding energy efficiency to Openstack", 2015 Sustainable Internet and ICT for Sustainability (SustainIT), vol. 00, no., pp. 1-8, 2015, doi:10.1109/SustainIT.2015.7101358
- [8] D. Thomas Erl, D. Zaigham Mahmood, D. Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture" September 2015

- [9] Yun Zhang, Farhan Patwa, Ravi Sandhu, Bo Tang, "Hierarchical Secure Information and Resource Sharing in OpenStack Community Cloud", 2015 IEEE International Conference on Information Reuse and Integration (IRI), vol. 00, no., pp. 419-426, 2015, doi:10.1109/IRI.2015.71
- [10] Robayet Nasim, Andreas J. Kassler, "Deploying OpenStack: Virtual Infrastructure or Dedicated Hardware", vol. 00, no., pp. 84-89, 2014, doi:10.1109/COMPSACW.2014.18
- [11] David Bernstein, "Cloud Foundry Aims to Become the OpenStack of PaaS", IEEE Transaction on Cloud Computing, vol. 1, no. , pp. 57-60, July 2014, doi:10.1109/MCC.2014.32
- [12] Juan Angel Lorenzo del Castillo, Kate Mallichan, Yahya Al-Hazmi, "OpenStack Federation in Experimentation Multi-cloud Testbeds", vol. 02, no., pp. 51-56, 2013, doi:10.1109/CloudCom.2013.103
- [13] Yang Wang, Xiaomin Wang, Jianyong Chen, "On-Demand Security Architecture for Cloud Computing", IEEE Computer, vol. 45, no., pp. 73-78, July 2012, doi:10.1109/MC.2012.120
- [14] V.KRISHNA REDDY1, Dr. L.S.S.REDDY, "Security Architecture of Cloud Computing", International Journal of Engineering Science and Technology (IJEST), ISSN: 0975-5462 Vol. 3 No. 9 September 2011 pp.7149-7155.
- [15] A Beloglazov, J Abawajy, R Buyya Future generation computer systems, Future Generation Computer Systems, Elsevier, Volume 28, Issue 5, May 2012, Pages 755–768
- [16] Ian Foster, Rubén S. Montero, Borja Sotomayor, Ignacio M. Llorente, "Virtual Infrastructure Management in Private and Hybrid Clouds", IEEE Internet Computing, vol. 13, no., pp. 14-22, September/October 2009, doi:10.1109/MIC.2009.119
- [17] Wen-Hwa Liao, Shuo-Chun Su, "A Dynamic VPN Architecture for Private Cloud Computing", 2011 IEEE 4th International Conference on Utility and Cloud Computing (UCC 2011), vol. 00, no., pp. 409-414, 2011, doi:10.1109/UCC.2011.68
- [18] Sumit Goyal, "Public vs Private vs Hybrid vs Community Cloud Computing: A Critical Review", I.J. Computer Network and Information Security, 2014, 3, 20-29.

713