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Research Article

Cost Effective Private Cloud framework for University

Keshav Kori [Á], Shraddha Masih[Á*] and Sanjay Tanwani[Á]

[Á]School of Computer Science & IT, DAVV, Indore, India

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Abstract

A private cloud solution for university is designed to maximize the utilization of hardware by combining workloads from various applications and services in a managed, secure, and reliable way. Cloud helps the institute to get the maximum computing capacity out of existing institution infrastructure. Private cloud solution is built through DevStack (for Platform as a Service offered by Openstack) and OwnCloud (for Storage as a Service). University private cloud solutions consolidate and optimize existing hardware to help reduce equipment, maintenance, and energy costs while enabling self-service, automation, scalability, and elasticity. A comparison of resource utilization in cloud and cost of infrastructure has been done and the benefits of using private cloud are identified.

Keywords: *Platform as a service (PaaS), Owncloud, Private cloud, Storage as a Service (SaaS), OpenStack.*

Introduction

This paper proposes the strategy, architecture, solution and implementation details of private cloud for academic institutes of an educational organization. Paper focuses on two service models: platform as a service and storage as a service.

Cloud Computing

Cloud computing is known for its higher efficiency, better usability, higher utilization, lower cost and better management. Cloud computing can be defined as providing resources and capabilities of Information Technology (e.g., applications, storage's, communication, infrastructure, and collaboration) via services offered by cloud computing providers. Definition given by National Institute of Standards and Technology (NIST), "Cloud Computing" is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Abdulsalam Ya'u Gital *et al* 2011). There are several researcher gave different definition of cloud computing after they analyzed them, (1) Cloud Computing provide on-demand access to a pool of computing resources, (2) dynamically-scalable services, (3) device and media independency, and (4) simpler and easier maintenance of applications (Joel S. Mtebe, 2013).

Types of Cloud

Cloud computing provide efficient accessing of computing resources that are delivered over network. On the basis of user, services and access rights, three types of cloud exist (1) Private cloud: delivers computing resources as a service within an organization between restricted consumer. (2) Public cloud: delivers computing resources as a service between unrestricted consumer (3) Hybrid cloud: composition of clouds (Private or Public) that remain single entity but are bound together by protocol and technology. It delivers computing resources as a service over the network and is shared between several organizations and supporting a specific community that has shared concerns (Atul B Naik, *et al* 2013).

Why Private Cloud for University

Private cloud is used within organization hence it provides more privacy, security and control on usage of computing resources with less cost. It is popular in different sized organization like small, medium and large. It can run a few tens to more than hundreds of IT services. Presently many Academic Institutes are facing problem related to Platform as a service. A single workstation run numbers of platform on the basis of student requirement sometimes it degrade the performance of workstation, wastage of memory and also problem in running different platform at single time. Sharing of information between different workstation with different platform is a big issue. Various solutions are present in the market but they are also facing some problem like privacy, security and cost. Private cloud is simple, inexpensive and efficient solution for Academic Institute like University (Swati Vitkar 2012, Sidharth Sachdev *et al* 2013).

*Corresponding author: **Shraddha Masih**

Cloud Architecture

University can have several institutes or schools under its umbrella. The proposed architecture suggests private cloud implementation at two levels. i. At institutional level and ii. at University level. A web interface act as an intermediate between user and private cloud. Services are uploaded at server level. The step by step process to access cloud is as under

Institute Cloud

1. User Enter in Web interface for services.
2. Request for services.
3. If valid request then forward to server.
4. Response to user.
5. Response will forward to web interface.

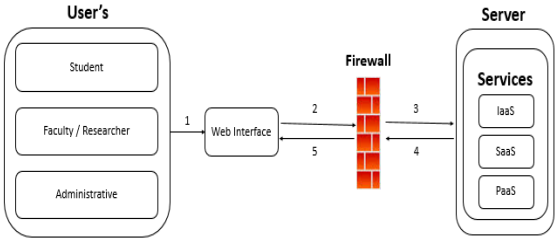

Figure 1 SCSIT cloud architecture

Framework for University cloud

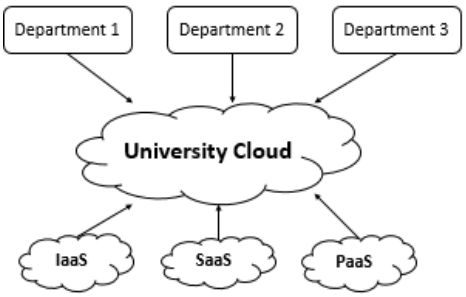

Figure 2 University cloud architecture

Every department in the university has computer and IT resources. All departments can access University's private cloud infrastructure to optimally utilize their resources.

Delivery Model for IAAS and SAAS

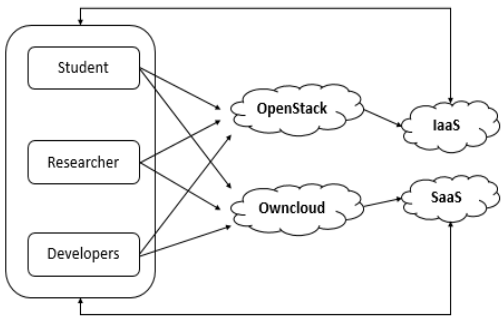

Figure 3 Delivery model service's

Implementation details

Open Stack

Cloud computing is an advanced computing arena that delivers computing resources that are provided as services over the Internet in a remotely accessible manner. Several software's are available to implement Cloud computing platform, Open Stack is one of them. It is an open source software which provide control and flexibility, proven software, compatibility and industry standard. There are mainly five services provided by Open Stack Nova (compute service), Swift (storage service), Glance (imaging service), Keystone (identity service) and Horizon (UI service) (Atul Jha, *et al* 2012). Installation guide of OpenStack given below,

- Install fresh setup of Ubuntu server we also use other server like CentOS and Debian server
- apt-get update || yum update –y
- adduser stack
- sudo "stack ALL=(ALL) NOPASSWD: ALL" >> /etc/sudoerc
- apt-get install -qqy git || yum install -y git
- git clone https://github.com/openstack-dev/devstack.git
- login as a stack user and then
- cp /devstack/sample/localrc /devstack/
- cd devstack
- nanolocalrc
- edit "localrc" file for
    - ADMIN_PASSWORD=STACK;
    - RABBIT_PASSWORD=STACK;
    - MYSQL_PASSWORD=STACK;
    - SERVICE_PASSWORD=STACK;
    - FLAT_INTERFACE=eth0;
    - FLOATING_RANGE=192.168.1.224/27
    - FIXED_RANGE=10.11.12.1/24
    - FIXED_NETWORK_SIZE=256

- run "./stack.sh"
- To access dashboard of openstack click on Server IP from other computer with in Network. To login in dashboard use your service password and username admin.

Experimental Results Openstack

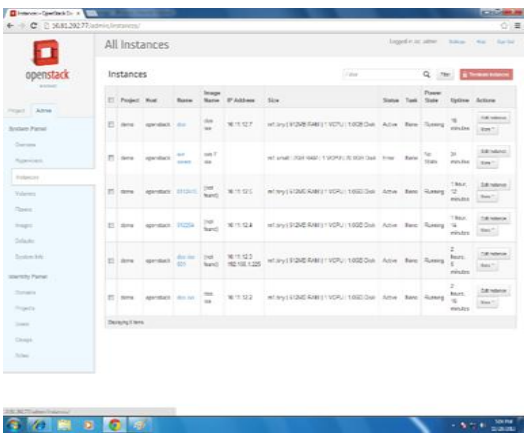

Fig.4 IAAS using Openstack

	Personal Computer	OpenStack
No. of CPU	2	24
RAM in GB	2	16
HARD DISK in GB	40	20
No. of Virtual Machine	1	10
No. of Machine Remote Access	1	10

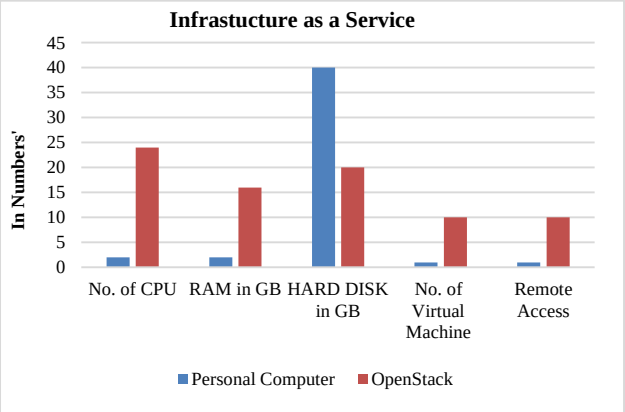

Fig.5 Storage Utilization Chart: PC vs Cloud

OwnCloud

It is a software system which provides Storage as a Service. It is accessible from everywhere and every device (desktop, notebook, tablet and smart phone). It provides online or offline access, automatic backup, easy sharing, easy extends storage, customization and several feature other features. It can share contacts, bookmarks, calendars, music and several types of files and apps over the network (Ben Martini *et al* 2013).

OwnCloud Implementation

- apt-get install lamp-server^
- mysql_secure_installation
- sudo apt-get install php5-gd
- sudosh -c "echo 'deb http://download.opensuse.org/repositories/isv:/ownCloud:/community/xUbuntu_12.04/ /' >> /etc/apt/ sources.list.d/owncloud.list"
- sudo apt-get update
- sudo apt-get install owncloud
- To access owncloud click to server IP in other computer within Network.

Experimental Results Owncloud

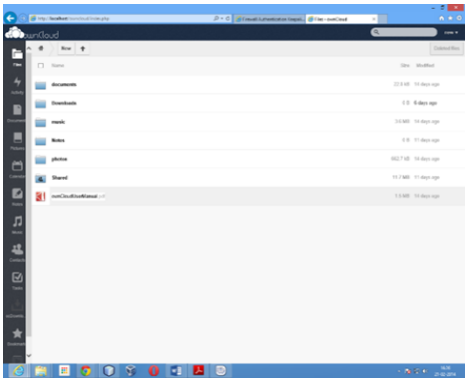

Fig.6 SAAS using Owncloud

	Personal Computer	OwnCloud
Personal Storage	100%	10%
Security	10%	75.00%
Beckup	10%	100%
Reliability	50%	90%
Remote Access	20%	100%

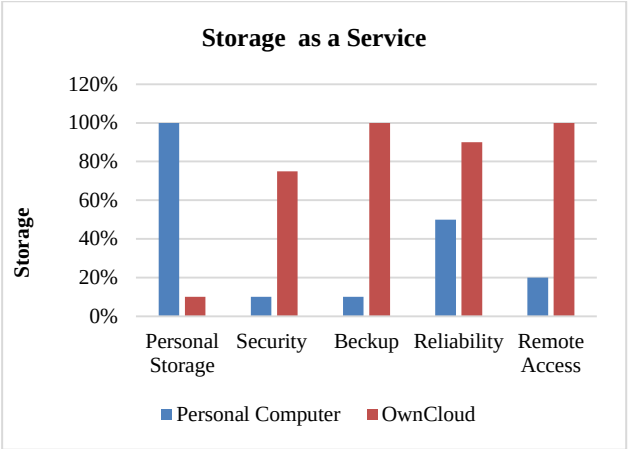

Fig.7 Infrastructure Utilization: PC vs Cloud

Cost Benefit Analysis

By using private cloud we reduce the storage resources by storing our data or information in the cloud rather than system. In terms of computing resources a benefit is that user does not have to own all the resources, he can make use of them on the existing cloud. In terms of economy, if we share a software system on cloud, a single license can be shared by multiple users. In Terms of reliability, even if the system on which the user is working, crashes, chances of data loss is negligible because data is parallely being stored in the cloud.

In this paper we introduce university on private cloud with cloud service. Like SAAS, PAAS, IAAS and EAAS services. It is more flexible and can deliver a lower total cost of ownership. Otherwise we can offer several options. With this implementation of private cloud, University can manage their application by their own available resources Otherwise University will have to spend thousands of rupee per year if it want to acquire these service from somewhere else.

Costing Tables for Storage and Cpucosts

Table 1: Cost Analysis of IAAS

COSTING CPU			
	Amazon EC2 Pricing	HCL DESKTOP	University Infrastructure
1 CPU	$0.176 per Hour	RS. 23500	Virtual CPU ONE TIME INVESTMENT (Utilization of existing CPUs)
2 CPU	$0.351 per Hour	RS. 32500	
4 CPU	$0.702 per Hour	RS. 36500	
8 CPU	$1.404 per Hour	$559.00 (RS 33925.71)	
16 CPU	$1.864 per Hour	$2339 (RS 141953.91)	

Table 2: Cost Analysis of SAAS

Costing Storage			
	Standard Storage Amazon	Storage Cost	University Infrastructure
First 1 TB / month	$0.085 / GB	RS 4190 (Seagate)	One Time Investment (Utilization of existing resources)
Next 49 TB / month	$0.075 / GB	RS 49*4190 (Seagate)	
Next 450 TB / month	$0.060 / GB	RS 450*4190 (Seagate)	
Next 500 TB / month	$0.055 / GB	RS 500*4190 (Seagate)	
Next 4000 TB / month	$0.051 / GB	RS 4000*4190 (Seagate)	
Over 5000 TB / month	$0.043 / GB	RS 5000*4190 (Seagate)	

Table 3: Rental Cost of cloud server purchase

Windows Hyper-V	**VW ware**	**|| Parallels**	**Xen**
E3-1270V3 Starting at $383/month **Server Configuration**:[Intel® Xeon® E3-1270V3 4 cores HT 3.5GHz 32GB RAM DDR3 1 TB SATA3 • 240 GB SSD]	E5-2620V2 Starting at $649/month **Server Configuration**: Intel® Xeon® 2x E5-2620V2 6 cores HT 2.10GHz 64GB RAM DDR3 • 2x 1 TB SATA3 RAID1-HW • 2x 240 GB SSD RAID1-HW + BBU	E5-2650V2 Starting at $749/month **Server Configuration**: Intel® Xeon® 2x E5-2650V2 8 cores HT 2.60GHz 128GB RAM DDR3 • 2x 1 TB SATA3 RAID1-HW • 2x 240 GB SSD RAID1-HW + BBU	E5-2690V2 Starting at $949/month **Server Configuration**: Intel® Xeon® 2x E5-2690V2 10 cores HT 3.00GHz 256GB RAM DDR3 • 2x 1 TB SATA3 RAID1-HW • 2x 240 GB SSD RAID1-HW + BBU

Private Cloud provides many services but for getting these we have to pay different peoples like internet provider, whose resources we are using ultimately. The services can also be rented from many service providers. The service cost of main vendors ranges from about 400$ to 1000$ per month. Similar configurations can be achieved through the private cloud framework. The cost of the services varies from service provider to service provider but a general cost is shown below.

Conclusion: This paper focuses on the work done in design and implementation of an academic cloud service. A private cloud solution can be implemented in an institute which bridges the gap between needs and current requirements of an institute. This paper also enlightens the way how to improve data and resource sharing with secure way in network, in online and offline mode. It reduces workload of user data on his PC and also reduces risk of data loss from his/her PC. Big organizations like Microsoft, Google and Amazon are using Cloud services for providing services of their users; same can be implemented for small organizations with private cloud. The proposed solution is cost effective in terms of resource utilization and power consumption.

Future work: Private cloud service can be used for web hosting. Private cloud service can be used for printer and scanner sharing which leads to save lots of money. This infrastructure can also be extended for software as a service.

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