OPEN SOURCE CLOUD APPLICATION SOLUTION WITH PAAS, SAAS AND IAAS

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ABSTRACT

The article discusses providing an open source application with Infrastructure as Service (IaaS), Platform as Service (PaaS) and Software as Service (SaaS). Using Infrastructure as a Service, we provide Open Stack as a solution for virtual servers and other resources like RAM, disk storage, etc. Using Software as Service - Tonido, we aim to design an open source solution for cloud storage. Similarly, we aim to design a solution using PaaS that can be accessible through internet usage rather than developing and installing complex software and hardware equipment. Linux Virtual Machine (VM) will be designed as an open source solution for PaaS. The article contributes equally to SaaS, PaaS and IaaS based applications in order to make cloud technology user-friendly.

Keywords: Cloud Computing, Software as Service (SaaS), Infrastructure as Service (IaaS), Platform as Service (PaaS), Open Stack, Micro Stack, Tonido, Linux, Virtual Machine (VM).

I. INTRODUCTION

Cloud Operating System is an open-source web work area following the cloud registering idea. It goes about as a stage for web applications composed utilizing the cloud figuring ideas. It incorporates a Desktop climate with number of utilizations and system utilities. It is available by compact gadgets by means of its portable front end. The Cloud Operating System allows us to transfer files and work with them regardless of where we are. It contains applications like Word Processor, Address Book, PDF peruse, and a lot more created by the Cloud merchant. It can be very much grown primarily in PHP, XML, and JavaScript. The OS constructed is a basic Linux based Operating System that runs simply on a Web program, giving total admittance to an assortment of Web-based applications that permit the client to perform numerous basic assignments without booting a full-scale Operating System. In light of its effortlessness and straightforwardness, Cloud OS can boot in only a couple seconds. The Operating System is intended for the systems that are for the most part used to peruse the Internet. From Cloud the client can rapidly boot into the principle OS, since Cloud OS keeps booting the fundamental OS in the foundation which can be seen from the program [2].
A Web service is a product module that is intended to play out a specific arrangement of errands. Web services in distributed computing can be looked for over, the arrange and can likewise be summoned in like manner. At the point when conjured, the web service would have the option to give the usefulness to the client, which summons that web service. Web services use something known as SOAP (Simple Object Access Protocol) for sending the XML information between applications. The information is sent over typical HTTP. The information which is sent from the web service to the application is known as a SOAP message. Regularly than not, these heterogeneous applications need a type of communication to occur between them. Since they are fabricated utilizing distinctive improvement dialects, it turns out to be truly hard to guarantee exact communication between applications [3].

In the Cloud services many algorithms are proposed for a better service [11]. Using the Cloud services grid power system can be controlled [12]. Cloud is also useful when we are dealing with a high dimension data [13, 14, 15]. To enhance the security in the cloud biometrics are used and proved successful [16]. In 5G Network which is the future for in the Mobile technology the cloud can play a vital role [17, 26, 27]. Cloud services are used in the Automation process [18, 20, 21, 22, 23]. DES encryption method used for providing the security for the Cloud [19, 24, 25].

II. SOFTWARE AS A SERVICE (SaaS)

Software as a service (SaaS) is a software dissemination model in which a Cloud supplier has applications and makes them accessible to end clients over the Web. In this model, a free software shipper (ISV) may get a pariah Cloud supplier to have the application. Or then again, with bigger organizations, as Microsoft, the Cloud supplier may likewise be the Software vender. SaaS is one of three principle classifications of cloud computing, close by Infrastructure as a service (IaaS) and Platform as a service (PaaS). A scope of IT experts, business clients and individual clients use SaaS applications. Things range from individual diversion, as Netflix, to cutting edge IT contraptions. Not in the slightest degree like IaaS and PaaS, SaaS things are consistently promoted to both B2B and B2C clients.
SaaS works through the Cloud transport model. A Software supplier will either have the application and related information using its own Specialists, Databases, Frameworks organization and Computing assets, or it very well may be an ISV that agreements a cloud supplier to have the application in the supplier's information local area. The application will be open to any device with an association. SaaS applications are commonly gotten to through web browsers Therefore, organizations using SaaS applications are not tasked with the plan and upkeep of the software. Clients basically pay an enrolment cost to access the software, which is an instant course of action. SaaS is solidly identified with the application service supplier (ASP) and on-request computing software transport models where the supplier has the client's software and passes on it to affirmed end clients over the Web. In the Software-on-request SaaS model, the supplier gives clients network-based admittance to a lone copy of an application that the supplier made explicitly for SaaS dissemination. Dependent upon the Service-level Understanding (SLA), the Client's information for each model might be taken care of locally, in the Cloud or both locally and in the Cloud.

**SaaS Design**

SaaS applications and services normally use a multi-inhabitant approach, which implies a single occurrence of the SaaS application will be running on the host laborer’s, and that singular example will serve each purchasing in client or cloud occupant. The application will run on an alone version and arrangement across all clients or occupants. In spite of the way that different purchasing in clients will run on a similar cloud example with an ordinary infrastructure and stage, the information from different clients will regardless be isolated. The average multi-inhabitant design of SaaS applications implies the cloud service supplier can oversee upkeep, updates faster, easier and even more successfully. As opposed to completing changes in different occurrences, draftsmen can roll out essential improvements for all clients by looking after one, shared occasion. Besides, multi-tenure permits a more prominent pool of assets to be accessible to a bigger social event of people, without bartering significant cloud limits like security, speed and protection.

**SaaS Benefits**

SaaS dispenses with the necessity for associations to introduce and run applications on their own PCs or in their own information places. This dispenses with the expense of equipment procurement, provisioning and support, as well as software approving, establishment and sponsorship.

- **Adaptable instalments:** As opposed to purchasing software to introduce, or extra equipment to help it, clients become tied up with a SaaS offering. Progressing costs to a typical working expense permits numerous associations to rehearse better and more unsurprising arranging. Clients can likewise end SaaS commitments at an ideal chance to stop those monotonous costs.

- **Automatic refreshes:** Instead of purchasing new software, clients can rely upon a SaaS supplier to naturally perform updates and fix the board. This further reduces the load on in-house IT staff.

- **Accessibility and unfaltering quality:** Since SaaS traders pass on applications over the web, clients can get to them from any web-empowered device and area.

- **Customization:** SaaS applications are consistently adjustable and can be incorporated with other business applications, particularly across applications from a commonplace software supplier.
III. INFRASTRUCTURE AS A SERVICE (IaaS)

**FIGURE 4. IaaS and its Services**

IaaS is usually called Hardware as a Service (HaaS). It is one of the layers of the cloud computing stage. It grants clients to reconsider their IT infrastructures like Labourer’s, organizing, taking care of, amassing, Virtual Machines, and various assets. Clients access these assets on the Internet using pay as per use model. In standard encouraging services, IT infrastructure was leased for a specific time span, with pre-chosen equipment design. The client paid for the arrangement and time, paying little notice to the certified use. With the assistance of the IaaS Cloud computing stage layer, Clients can continuously scale the setup to meet changing essentials and are charged particularly for the services truly used. IaaS cloud computing stage layer discards the prerequisite for every association to keep up the IT Infrastructure. IaaS is offered in three models: Public, Private, and Crossbreed Cloud. The Private Cloud deduces that the infrastructure stays at the Client premise. Because of the Public Cloud, it is arranged at the Cloud Computing stage shipper's worker ranch, and the combination Cloud is a mix of the two wherein the Client picks the most astonishing aspect either Public Cloud or Private Cloud.

IaaS supplier offers the accompanying types of assistance –

- **Figure**: Computing as a Service incorporates virtual focal preparing units and virtual principle memory for the VMs that is provisioned to the end-clients.
- **Capacity**: IaaS supplier gives back-end stockpiling to putting away records.
- **Network**: Network as a Service (NaaS) gives networking segments like switches, switches, and extensions for the VMs.
- **Load balancers**: It gives load adjusting ability at the infrastructure layer.

**IaaS Benefits**

There are the accompanying points of interest in the IaaS computing layer -

- **Shared infrastructure**: IaaS permits numerous clients to have a similar actual infrastructure.
- **Web admittance to the assets**: IaaS permits IT, clients, to get to assets over the Web.
- **Pay according to utilize the model**: IaaS suppliers offer types of assistance depending on the compensation according to utilize the premise. The clients are needed to pay for what they have utilized.
- **Zero in on the centre business**: IaaS suppliers centre around the association's centre business instead of on IT infrastructure.

On-request scalability: On-request scalability is perhaps the greatest bit of leeway of IaaS. Utilizing IaaS, clients don't stress over to update programming and investigate the issues identified with hardware segments [4].
IV. PLATFORM AS A SERVICE (PaaS)

Platform as a Service (PaaS) gives a runtime environment. It licenses engineers to successfully make, test, run, and pass on Web applications. You can purchase these applications from a cloud service supplier on a pay as indicated by use reason and access them using the Internet association. In PaaS, back end versatility is administered by the Cloud service supplier, so end-clients don't need to worry about managing the Infrastructure. PaaS joins Infrastructure (Labourers, Storing, and Systems administration) and Platform (Middleware, improvement mechanical assemblies, database organization structures, business knowledge, and that is just a hint of something larger) to help the Web application life cycle. Platform as a Service (PaaS) gives a runtime environment. It licenses engineers to helpfully make, test, run, and send web applications. These applications can be purchased from a Cloud service supplier on a pay as indicated by use reason and access them using the Internet association. In PaaS, back end adaptability is directed by the Cloud service supplier, so end-clients don't need to worry about managing the infrastructure. PaaS consolidates Infrastructure (labourers, accumulating, and systems administration) and Platform (middleware, progression devices, database organization structures, business information, and anything that is possible from that point) to help the Web application life cycle.

![Diagram of PaaS and its Services](image)

**FIGURE 5.** PaaS and its Services

PaaS suppliers give the Programming vernaculars, Application frameworks, Databases, and Other gadgets:

- **Programming vernaculars**: PaaS suppliers give diverse programming lingos to the architects to develop the applications. Some standard programming tongues given by PaaS suppliers are Java, PHP, Ruby, Perl, and Go.

- **Application frameworks**: PaaS suppliers give application frameworks to conveniently grasp application improvement. Some standard application structures given by PaaS suppliers are Node.js, Drupal, Joomla, WordPress, Spring, Play, Rack, and Zend.

- **Information bases**: PaaS suppliers give distinctive data bases like ClearDB, PostgreSQL, MongoDB, and Redis to talk with the applications.

- **Different Gadgets**: PaaS suppliers give various gadgets that are expected to make, test, and pass on the applications.

- **Simplified Development**: PaaS grants originators to focus in on the new development and progression without worrying about infrastructure the heads.

- **Lower danger**: No necessity for direct front interest in equipment and programming. Specialists simply need a PC and a web association to start building applications.

The principle contributions included by PaaS sellers are:

- Development instruments
- Middleware
- Operating frameworks

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PaaS is the accompanying layer up from IaaS in the Cloud Computing service model, and everything associated with IaaS is in like manner associated with PaaS. A PaaS supplier either supervises Labourers, amassing, and real worker cultivates, or gets them from an IaaS supplier [6].

V. PROPOSED METHODOLOGY

A. Software Requirements

- Ubuntu server 18.04
- Linux, a multi-core processor
- At least 8 GB of RAM.
- User account with sudo privileges
- Microsoft Azure account

B. Implementation/Flow

1. Implementing Open Stack as an application for SaaS

In this project, we are implementing Open Stack as Micro Stack Distribution.

- Step1: Installing Micro Stack
- Step 2: Initialise Micro Stack
- Step 3: Associate with Open Stack.
- Step4: Launch and access a VM

The microstack.openstack order gives a similar usefulness as the upstream Open Stack client. This implies you can utilize similar orders as on some other Open Stack establishment.

Micro Stack comes preconfigured with networking, a picture, flavors, opened security gatherings (TCP port 22 and ICMP), and a SSH keypair. Utilize the above client order to see these things as you ordinarily would. The dispatch order can even be supplanted by the client order (microstack.openstack worker make) [7].

2. Implementing Tonido as solution for SaaS

Step 1: Installing dependencies
• Tonido doesn't require too much in the way of dependencies

Step 2: Installing Tonido

• To install Tonido, download the installer.
• Once that file has downloaded, install it with the
• Next create a systemd file with the command:
• In that file, paste the following:
• [Unit]
  Description=Tonido Server
  After=local-fs.target network.target
• [Service]
  Type=forking
  User=root
  Group=root
  ExecStart=/usr/local/tonido/tonido.sh start
  ExecStop=/usr/local/tonido/tonido.sh stop
  Restart=on-failure
  RestartSec=5
• [Install]
  WantedBy=multi-user.target
• Save and close the file.
• Start and enable Tonido
• After the underlying arrangement, you'll stroll through the accompanying screens:
  • Your distant access worker URL
  • Remote access and sharing alternatives
  • Media record ordering choices
  • Information on versatile applications [8].

3. Implementing PaaS Services using Linux VM

Implementation of Linux as Virtual machine using Virtual Box

• Step 1: Create the virtual machine.
• Step 2: Create a virtual hard disk and storage devices for the VM [9].
• Step 3: Configure some settings for the VM.
• Step 4: Perform an unattended install of the OS.
• Step 5: Starting the Virtual Machine. [10].

VI. RESULTS

In this module, we discuss the open source solutions provided in this project for various SaaS, PaaS and IaaS Web services.

1. Open Stack as solution for SaaS

The screenshots below show the Open Stack developed in order to fulfill the Software as a Service purpose.

FIGURE 7. OpenStack Login Page on hitting it's URL : 10.20.20.1

FIGURE 8. Before creating any instance

FIGURE 9. Page to display the number of current instances running, Virtual CPU used, RAM Utilization and resource allocation
After logging in into the instance through ssh

2. **Tonido**

Implemented Tonido showing the file system on Web creating a personal Cloud.

3. **Linux as VM**

**VII. CONCLUSION**

In this prototype, an Open Source Web Solutions designed for Software as Service, Platform as Service and Infrastructure as Service. Open Stack and Micro Stack solutions are implemented for SaaS. Similarly, Tonido for
IaaS and Linux as a virtual machine for PaaS. The prototype collectively provides solutions for these kind of Web services and provides Cloud service optimization.

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