CLOUD COMPUTING
LAB 1 – Part 1

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IaaS- Digital Ocean

Overview of Digital Ocean:

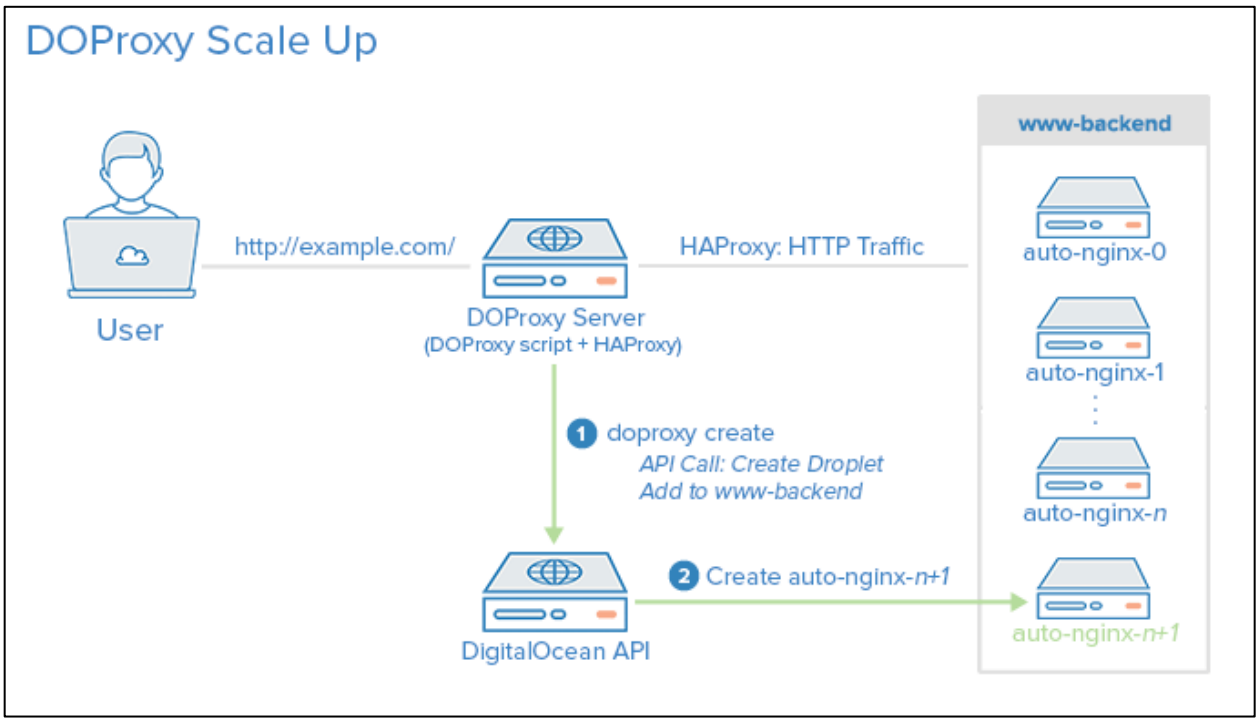
Digital Ocean (spelled as a single word; “Digital Ocean” was a 90’s-era producer of wireless communications gadgets) is a new cloud hosting supplier. Launched in 2011, Digital Ocean concentrates solely on developers’ needs. The organization currently has 9 data centers positioned in San Francisco, Singapore, Amsterdam, New York and London.

Digital Ocean concentrates on three key selling points to stand out: simplicity, pricing, and high-performance virtual servers. They zero in on giving developers an easy and quick way to set up affordable Linux instances which they call droplets. Digital Ocean supports most of the modern Linux distros; Ubuntu, Fedora, Debian, and CentOS. It is straightforward to set up several applications on their droplets e.g. Ruby on Rails, LAMP, Ghost, Docker or stack.

Digital Ocean is known for providing very high-performance servers. Their network speed is 1Gbps; all hard disks are SSD and an incredible start-up time of only 55 secs. Digital Ocean nodes are placed at the top by independent performance tests, way far above Amazon machines.

Finally, Digital Ocean prides itself with a simple, user-friendly setup. Targeting developers only, providing Linux virtual machines and DNS management. It lacks hosted databases, configuration management, analytics, load balancing among others. Digital Ocean proudly markets themselves as a bare-bones IaaS provider for Linux developers.

Architecture:



Features of Digital Ocean:

VERY FAST DEPLOYMENT

The time a server takes to become live after deployment has a great impact in pleasing a client and making them want to come back. We compared this time to other competing companies namely Linode, Amazon web services, and Rackspace.

SIMPLE API INTERFACE

Digital Ocean's tagline goes "Simple Cloud Hosting built for developers". True to this, the company offers a very simple API interface that developers can take advantage of to deploy and manage their servers/droplets effectively and efficiently.

FAST SSD STORAGE

The invention of SSD storage has truly revolutionized computing services. From simple personal computers to huge data centers, everyone is moving away from HDD storage.

PLENTY OF STORAGE SPACE

If you run out of space on your droplet, Digital Ocean allows you to attach more space to suit your demands. You can have as much as 16TB of SSD storage attached to each of your droplets.

PROS:

- **Affordable**: Comparing with other companies in the same space, Digital Ocean offers the best price for even better services. Besides that, you can also use a promo code to get some free credits when sign up, then you can used it to create free 3 months vps to try Digital Ocean services.
- **Very Fast Network**: A 40Gbps network means that you get the best speeds in the market. If you are hosting a website, you never have to worry about the traffic to your website.
- **Fast SSD Storage**: Very few companies have moved to SSD storage. The fact that Digital Ocean offers 100% SSD storage places it at the head of the pack as the go-to host provider.
- **Great UI**: Digital Ocean's control panel places all features within easy reach. You can deploy, backup, restore, and manage servers/droplets with relative ease.
- **8 datacenters in 3 continents**: For optimum user experience, you have the option to choose from 8 data centers located in the United States, Europe, and East Asia.
- **Easily Customizable Servers**: You can easily customize your servers to your preferred customization. You can therefore run any application you want on them.

CONS:

- They don't offer Windows servers
- They have no managed servers. You do all the deployment and maintenance work yourself
- The customer support is quite slow to respond to inquiries.

IaaS- Linode Cloud

Overview of Linode:

Linode is a cloud hosting provider that focuses on providing Linux powered virtual machines to support a wide range of applications. Given its roots, many experts do not see it as a beginner friendly.

Back in 2003, at the time of its launch, Linode was considered ahead of its time with virtualization hosting. It has grown into a multinational corporation serving 800,000 customers from 196 countries. Linode server location are optimized for serving a global audience in terms of reducing latency and improving UX.

To compete with the industry giants such as AWS, Google Compute Engine, and Azure, it has continued to introduce innovation such as transitioning from user-mode Linux (UML) to Xen virtualization in March 2008 and then to Kernel-based virtual machines (KVM) in mid-2015. Other milestones include its backup service (2009), Node Balancer, a load-balancing service (July 2011), and Linode Managed for businesses in 2013 for detecting and monitoring events. So far, you must have an idea of what is Linode. Its revenue is $100 million. Though Linode Revenue is less when compared with AWS, GCP, or Azure, but with constant innovation, they aim to become the top choice for developers.

Features of Linode:

In a world full of IaaS cloud providers, you must be wondering why developers would opt for it. For many developers, it all comes down to the value they think Linode delivers for their projects.

Affordable Cloud Computing:

The affordability factor lies in the corporate DNA of Linode, and as such, they were the first to introduce a flat pricing model for cloud computing. Their slogan

“no calculator required” set the idea for simple pricing. Today, they continue to deliver their promise by making pricing easy for all users.

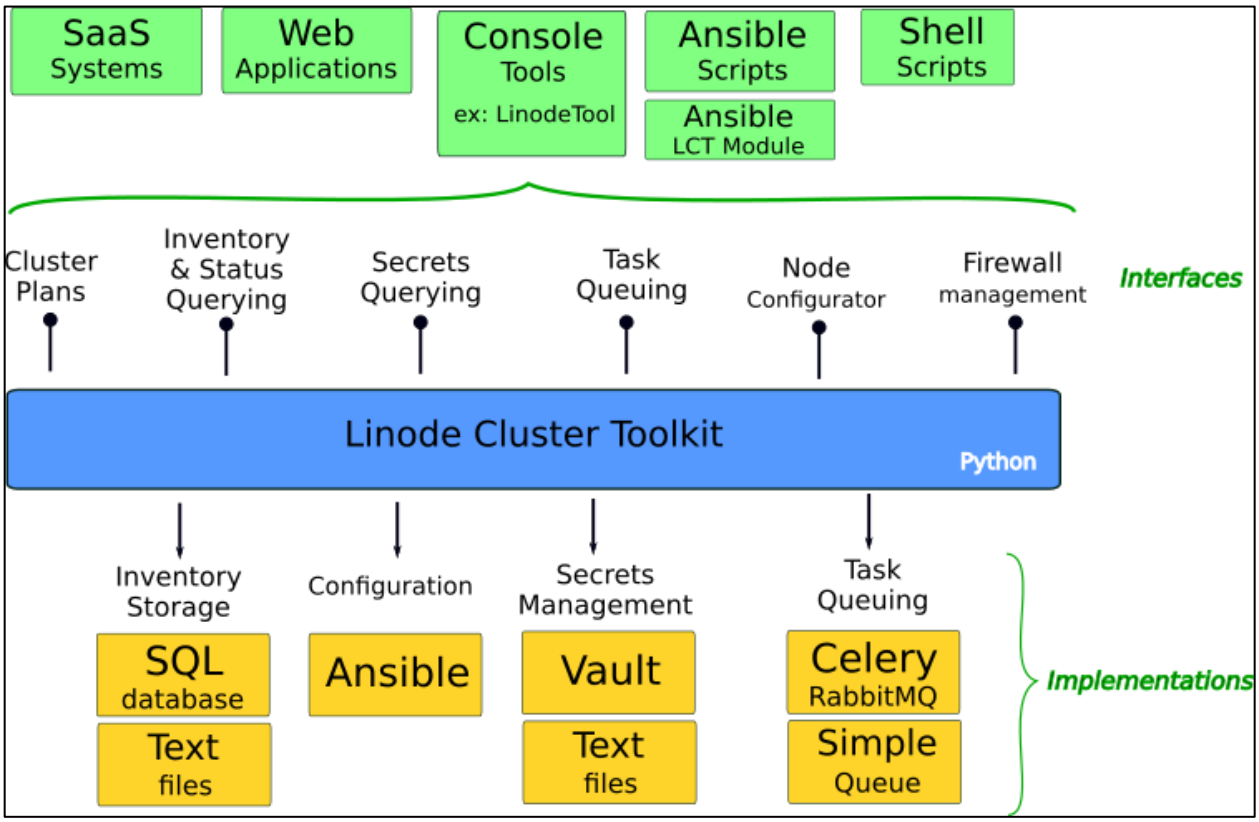
Award-Winning Customer Support:

Even though it offers cloud services at competitive prices, their support does not disappoint. Linode offers several tiers of support that users can go through to resolve their issues.

Powered by Linux:

Linode started as a brand for developers built by developers. In essence, it’s mission is similar to Ubuntu’s “for developers, by the developers.” According to an industry survey, 83.1% of developers prefer Linux as their development and deployment environment. As it’s an excellent choice for developers, who wish to work with an end-to-end Linux based application workflow.

Architecture:



Pros of Linode:

- Extremely reliable
- Great documentation
- Good value
- Easy to configure
- Simple UI
- Great Customer support
- Servers across the world

Cons of Linode:

- It doesn't have latest Kernels
- IP address fails over support
- Poor SSH root access

IaaS- Cisco

Overview of the Metacloud Service:

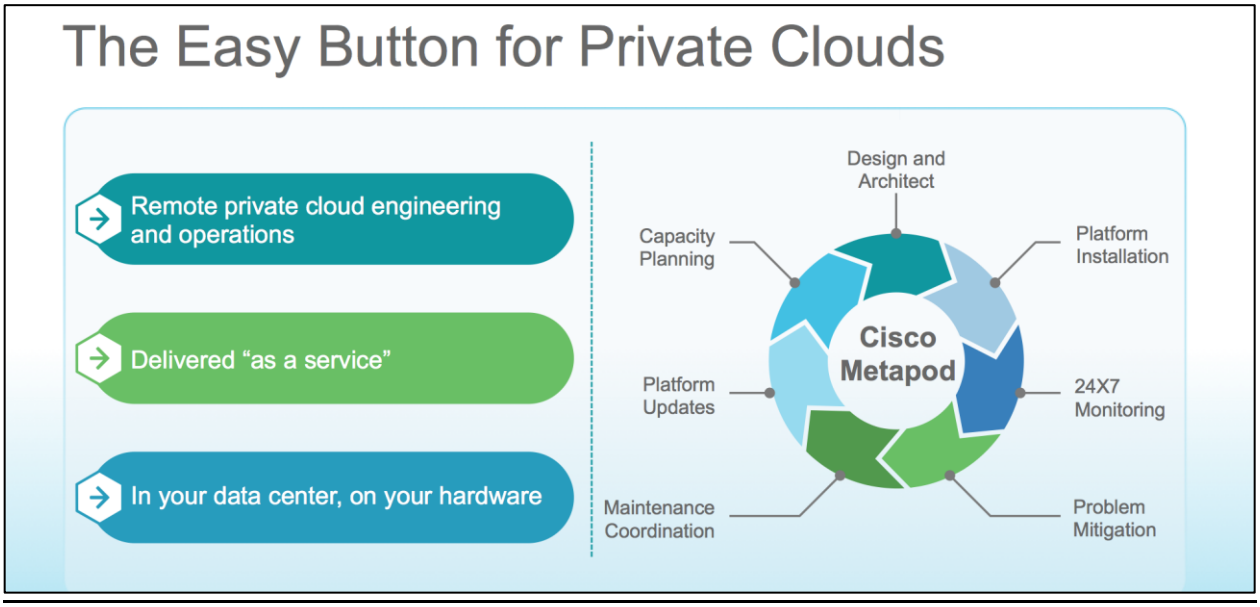
The Metacloud Service is an Infrastructure-as-a-Service (IaaS) solution, delivered in an End User's data center as a Software-as-a-Service offer by Cisco. The Metacloud Service is intended for End User private cloud infrastructure as a service use cases.

The Metacloud Service is not intended to enable an End User to provision or deliver a public cloud infrastructure as a service (compute or storage). Support of the Cisco Metacloud Service will be provided solely to the End User. End User agrees that its use of the Metacloud Service will comply with the intended use cases described above.

Metacloud, based on OpenStack, is a cloud platform that is capable of instantiating independent virtual machines and storage volumes via a website dashboard, command line interface and/or application programming interfaces. It accomplishes this by orchestrating an interconnected system of components

including, but not limited to, compute, storage, networking, and identity management. Each independent deployment of the platform comprises an Availability Zone.

Architecture of Metacloud:



Features of Metacloud:

The key features of the Metacloud Service are listed below.

● Interface with cloud environments using the named and versioned OpenStack APIs listed in Metacloud Service documentation, or the included web-based user and administrative dashboard, or via the appropriate API call;
● Create and manage virtual partitions known as Projects between workloads, applications and teams that allow for organization and access control into portions of the environment;
● A repository and catalog of Cisco- and customer-provided virtual machine images that utilize the environment's compute, memory and storage resources to

create general or workload specific virtual machines. Administrators can define through the web dashboard which images are available to which Projects and users;

● Users and Administrators have self-service access to configure security and network access to individual virtual machines through OpenStack security groups as well as through traditional operating-system level network filtering within a running virtual machine;

● Self-service access through the web dashboard and OpenStack APIs to manage, monitor and terminate existing virtual machines;

● Users have self-service access to OpenStack orchestration capabilities to create and manage programmable templates that can launch and configure resources from within the Capacity of their Availability Zone;

● Administrators have self-service web access to view real-time and historical data captured by Cisco on the performance, stability, and capacity of the Control Plane and Capacity of their Availability Zone;

● Administrators can configure block storage-based volumes and allocate those volumes to Projects for Project users to attach and detach to and from virtual machines;

● 24x7x365 support provided by web portal, email or phone;

● Proactive monitoring and problem resolution of the Metacloud Service; and,

● Metacloud Service upgrades and new features are included with a subscription.

PaaS- Platform as a service

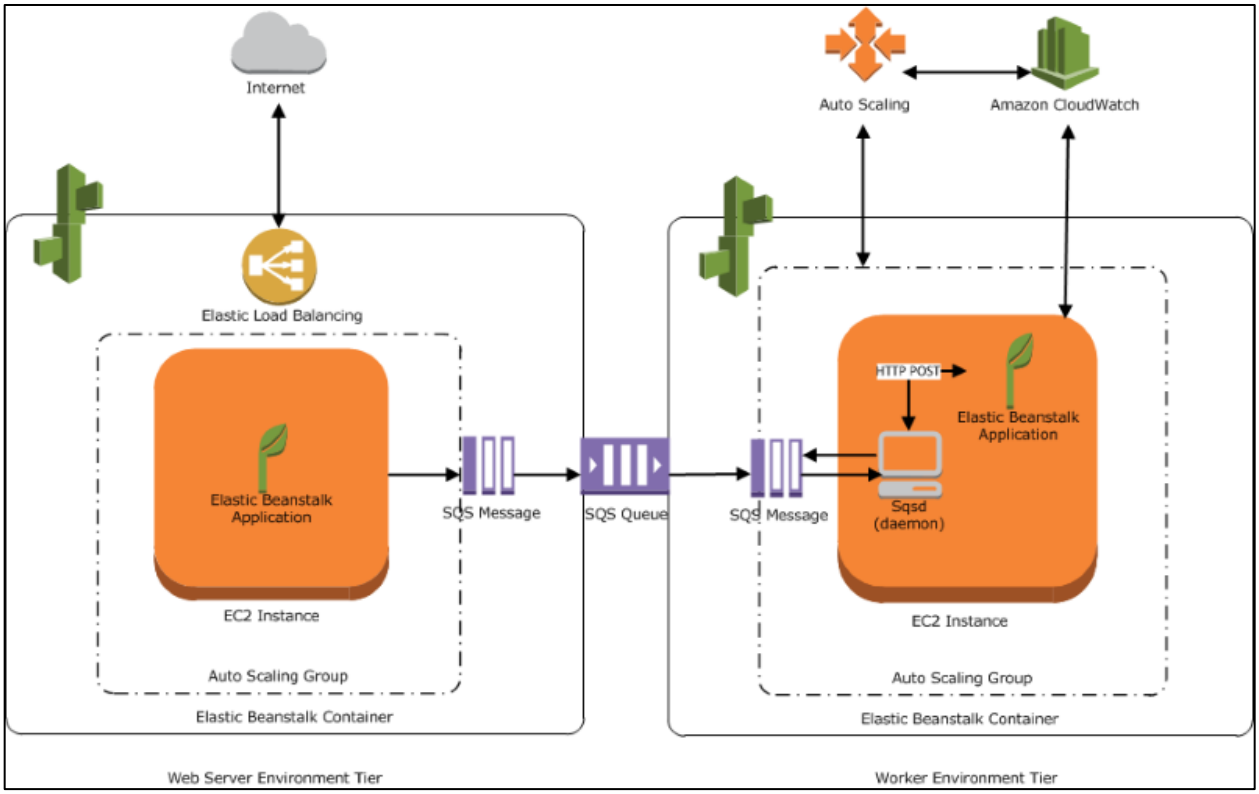
AWS Elastic Beanstalk

URL: https://aws.amazon.com/elasticbeanstalk/

AWS Elastic Beanstalk is an easy-to-use service for deploying and scaling web applications and services developed with Java, .NET, PHP, Node.js, Python, Ruby, Go, and Docker on familiar servers such as Apache, Nginx, Passenger, and IIS.

We can simply upload your code and Elastic Beanstalk automatically handles the deployment, from capacity provisioning, load balancing, auto-scaling to application health monitoring. At the same time, you retain full control over the AWS resources powering your application and can access the underlying resources at any time.

Architecture:



Using EC2 instance, we can create our environment which is easily scalable and deployed within seconds. Load balancer will take care of load optimization and we can get notification using SQS (Simple Queue Service) once we reach the maximum load. Amazon CloudWatch will trigger the billing alarm to the user about the utilization of resources in the environment. Elastic beanstalk is deployed using EC2 instance.

Benefits

Auto scalable: -
Elastic Beanstalk can automatically scale our application up and down based on the requirements. Using auto scaling technique, we can scale up our application when CPU utilization metrics goes high and scale down when CPU metrics goes down.

Complete resource control: -
We have the freedom to select the AWS resources, such as Amazon EC2 instance type, that are optimal for your application.

Complete Developer Productivity: -
Elastic Beanstalk provisions and operates the infrastructure and manages the application stack (platform) for you, so you don't have to spend the time or develop the expertise.

Customers using elastic beanstalk

BMW is using AWS for its new connected-car application that collects sensor data from BMW 7 Series cars to give drivers dynamically updated map information.

Zillow also began using AWS Elastic Beanstalk, a service for deploying and scaling web applications and services. Developers can upload code to Elastic Beanstalk, which then automatically handles the deployment, from capacity provisioning, load balancing, and auto-scaling to application health monitoring.

Limitations:

- Elastic Beanstalk archives the old application version in an S3 bucket. However, if there are 500 old version, further deploys fails. You can delete them through the Elastic Beanstalk UI, but this caught us off guard multiple times. All of these problems are an indication of Elastic Beanstalk's general lack of transparency.

- Its ecosystem and integration with third party software is not yet enriched, it is complex to manage if the AWS EB application is required to be integrated with another service in order to operate.

- It requires the intervention of an administrator for its management, even the routine maintenance of the platform is not very automated and requires the intervention of operating personnel.

PaaS- Google App engine

URL: https://cloud.google.com/appengine

Google App Engine is a development as well as a hosting platform that powers everything from big businesses web apps to mobile games, using the same infrastructure that powers Google's worldwide-scale web applications.
It is a platform-as-a-service (PaaS) Cloud computing platform that is fully managed and uses inbuilt services to run your apps.
You can start development almost instantly after downloading the software development kit (SDK).
You can go on to the google app developer's guide right away when you click on the language you wish to develop your app in.

Features of App Engine

- Access to the application log.
- Blob store serve large data objects.
- Google Cloud Storage.
- SSL Support.

- Page Speed Services.
- Google Cloud Endpoint, for mobile application.

Advantages of Google App engine

Infrastructure for security

Google's security and privacy policies are applicable to the apps developed using Google's infrastructure. It is rarely any type of unauthorized access to date as the application data and code are stored in highly secure servers.

Faster Time to Market

Stimulating the development and maintenance of an app is critical when it comes to deploying the product fast. With the help of Google cloud app Engine, a business can quickly develop-

- Feature-rich apps with a quick development process
- The backend application in a PaaS style environment

Easy to use

Google App Engine (GAE) incorporates the tools that you need to develop, test, launch, and update the applications

Platform Independent

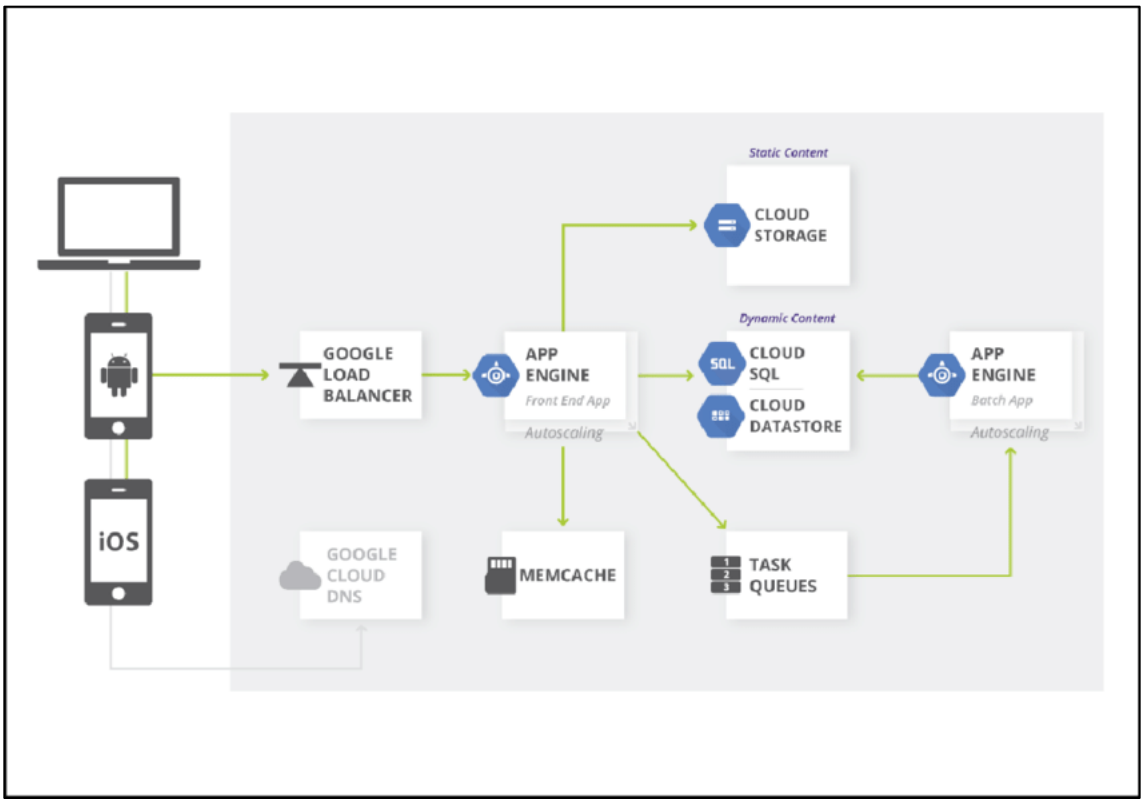
You can move all your data to another environment without any difficulty as there are not many dependencies on the app engine platform.

Disadvantages of google app engine

- It is not easy to process unit test. It cannot fix the root cause and does not support add SSL to web site. The GAE may be the development for future web application, but it is not equipped for building a modern web site now.

- Without native file system read/write access, it is hard to process some data transform with existing library, and it doesn't support some native file system base library as well.

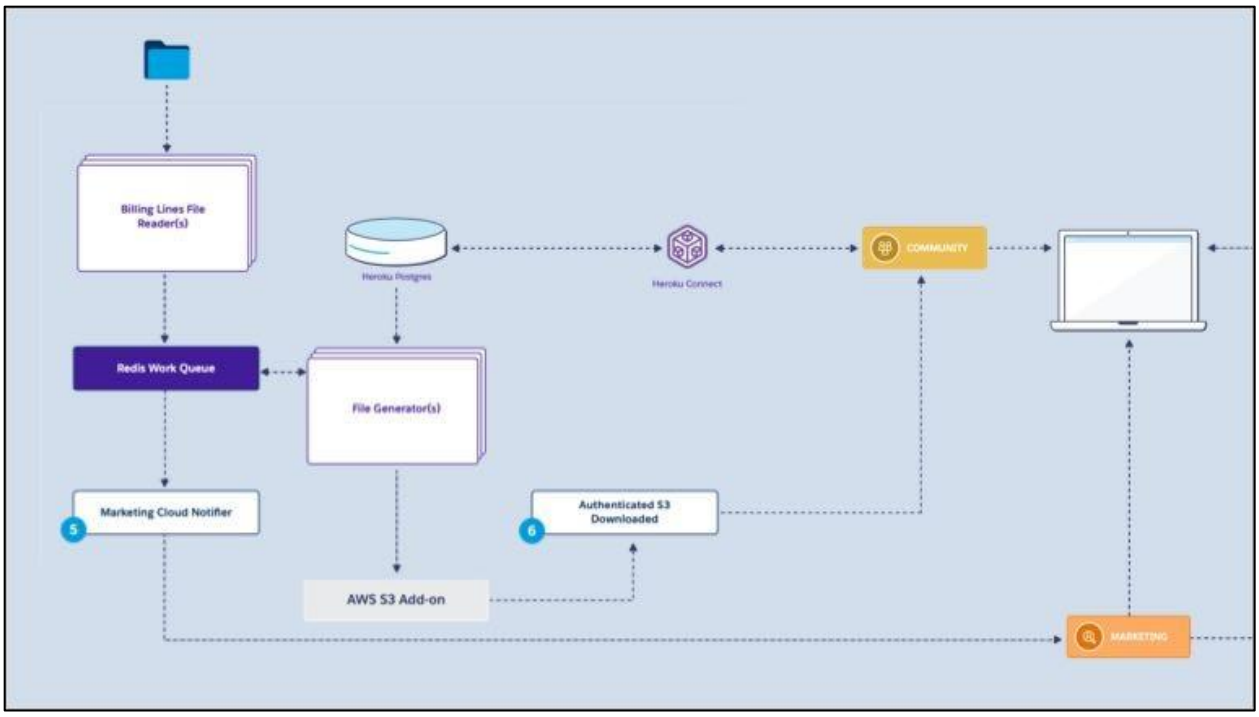
Architecture of google app engine



PaaS- Heroku

URL: https://www.heroku.com

Heroku is a Platform as a Service (PaaS), delivering tools that enable software development. Heroku, as a PaaS, allows business to quickly deploy, build, manage, and scale enterprise-level applications while bypassing infrastructure headaches normally required to host an enterprise quality application. It acts as the middleman between hosting/infrastructure and Salesforce.



Building modern web apps on heroku

Advantages of Heroku

- Extremely easy to start, you don't need to deal with the infrastructure. For startups that don't want to spend time and money on setting up their configurations it's fantastic - a true time saver

- No Ops (Almost) - Developers can focus on product development rather on managing infrastructure - this is especially relevant for small start-up's who need to roll their code quickly into production and focus on new features, not Ops.

- Scaling is straightforward - just specify the number of processing units (dynos) you need, and you're set.

Disadvantages of Heroku

- With Heroku you cannot control the exact configuration of your application, in terms of hardware, OS, firewall, versions etc.

- For high volume applications, they charge premium. Meaning you might end up paying for them more than you would have paid for comparable capacity in EC2.

- Dyno is a "Black Box" You cannot SSH to your Dyno and debug a memory/CPU/disk io/network bottleneck.

Software as a service - SaaS

Google Apps

URL: https://gsuite.google.com/

Google Apps are a suite of web-based messaging and collaboration applications that Google hosts on their own servers. Google provides these applications as a "service," rather than as software to download and install. To access these applications, you simply use a web browser on a computer that's connected to the Internet.

Cloud Provider: Google cloud is the cloud service provider of Google Apps

Key Benefits of Google Apps

- **Lots of storage --** You have a full 15GB of online storage for your email, so you can archive all of your email online. You do not need to worry about deleting messages or saving them in offline folders.
- **Enhanced message organization and retrieval** -- With Google Mail, you spend less time managing folders and searching for messages. For example, you can add one or more tags, or "labels," to your messages to organize and store them more efficiently. And with the Google-powered search feature, you can find any message quickly and easily, whether it's in your Inbox or stored in your message archive.

- **Easier calendar sharing** -- Google Calendar lets you and your team members quickly and easily share your calendars with each other and specify the details you want to show. Calendar sharing is a great way for you and your coworkers to keep each other informed about your schedules. Now it's easier than ever to find out if someone is in a meeting, on a business trip, or on vacation.
- **Integrated chat** -- With the Google Talk instant messaging application, you can communicate instantly with your coworkers right from the Email interface. In addition, all your chats are automatically saved in your Email application, so you can always retrieve important information.
- **Real-time collaboration --** Using Google Docs, you can create documents, spreadsheets, and presentations, and you and your team members can view and edit them at the same time. You can still use your Microsoft Office products as needed, but now you'll have more options for storing and collaborating on your documents.
- **Easy-to-build team web sites** -- With Google Sites, your team has the ability to quickly publish a robust internal web site on which to gather all sorts of shared information, such as documents, spreadsheets, presentations, files, and videos. You can even embed Google calendars and other gadgets on your site.

Limitations of Google Apps

- **No forms in emailing client:** If you need built-in forms and workflows for your business, you need to look for other third-party apps that offer that application.
- **Document conversion issues:** You may experience challenges converting Google sheets and Docs to Microsoft documents and PDF formats. You're forced to look for a third-party app to help in conversion.
- **Time-consuming:** It may take some time to import data and documents into the system from other external sources.

- **Limited Hangout features:** Google G suite has limited hangout features than slack.
- **Internet connection:** For the apps to function, you need internet connectivity 24/7. Slow connection or no internet limits your access to some apps.
- **Storage facilities:** The free package has limited storage space. Although paid packages have higher storage capacity, they do not offer more space like Office 365.
- **Integration of desktop email with the mobile client:** The mobile version of the app is clunky making users disappointed due to the lack of proper integration.
- **Limited recovery period:** If you delete Gmail, or Drive data, it can be recovered from the admin console within a limited period of time.
- **Single source:** The service relies heavily on the third party and should Google have any outage or server issues, it will affect the running of your business.
- **Web-based option:** G suite is purely a web-based platform and if you're used to using software's like Microsoft Office, you will find G suite features like Google Docs and Sheet not as effective as Office product.

SaaS- Microsoft Office 365

URL: https://www.office.com

Office 365 is a line of subscription services offered by Microsoft as part of the Microsoft Office product line. The brand encompasses plans that allow use of the Microsoft Office software suite over the life of the subscription, as well as cloud-based software as a service products for business environments, such as hosted Exchange Server, Skype for Business Server, and SharePoint, among others.1TB of storage in OneDrive, 60 minutes for calling phones from Skype, and more.

Cloud Provider: Microsoft Azure

Benefits of Microsoft Office 365

- **Cost effective —** Depending on how many users your office requires; Office 365 can be less expensive when it comes to paying for licenses. With the subscription model, you will receive upgrades automatically, so you don't have to pay for new software every time Microsoft issues a new release. Additionally, since you pay by the user, you are only paying for the resources you are using.
- **Storage Drive —** Each user also has access to One Drive, which depending on your service level offers up to 1 terabyte of storage, per user in a cloud environment. There are some permission-based features that allow you to share and sync files on a limited basis. You can also purchase additional storage if users need it.
- **Easy access to files —** For those who travel or work remotely, most Office 365 plans offer access to Word, Excel, PowerPoint and other programs through an online web version of the program, allowing you to open and edit your documents from any device and browser. There are also mobile apps you can download for the same purpose.
- **Email is accessible and affordable —** Since Office 365 Outlook is hosted in the cloud, you can access your email from anywhere, and at anytime. Most Office 365 email options do not require an administrator or hosted exchange server, making it way more affordable for smaller sized companies. Most plans are administered through a user-friendly interface that does not require an IT professional. However, if your business is larger and requires more robust controls, many of the enterprise versions have a PowerShell interface that administers permissions for email and other programs.
- **Scalability —** As with anything built in the cloud, Office 365 allows your business to scale from one user up to about 300 users. So as your business grows, Office 365 will scale to meet your requirements.
- **Additional tools —** Office 365 also features Skype, SharePoint and Lync Online for better communication and collaboration across your business.

- **Business continuity —** Built on the Microsoft Azure platform, Office 365 offers a reliable infrastructure, which is reliable and secure.

Limitations of Microsoft Office 365

- **Cost considerations —** While the Office 365 subscription is generally more cost effective for most businesses, it may not work for your business. There are often budget choices, i.e. Cap-Ex vs. Op-Ex, or your business could be seasonal, and the recurring fee may cause budget constraints.
- **Infrastructure configuration —** Not all businesses are one size fits all and there is less flexibility with customization when using Office 365 because it is built in the cloud. If you have a hybrid set-up, (combination cloud and on-prem) you may need to have third party involvement or add-ons when it comes to email or other collaboration tools.
- **Data Security —** As with any cloud-based solution, your information does not reside on-prem. In this case, it will sit on a Microsoft server. For many businesses, this is a secure option, but there are industries such as financial services and healthcare that must comply with regulatory constraints and require their data to be stored on-prem. Microsoft offers options for these businesses, but in general, they are more expensive and may not satisfy requirements.
- **Email Archiving and eDiscovery —** Office 365 also has limitations when it comes to archiving and eDiscovery tools. If your business is regulated, you will need to ensure that there are no restrictions in your plan when it comes to email retention and archiving. And while Office 365 boasts an eDiscovery tool, it may not be part of your plan or easy to administer. Before migrating to Office 365, you should examine both of these features. You may need to add a third-party email archiving service provider to ensure compliance.
- **Email quotas and limitations —** Unlike on-prem exchange servers, there are limits placed on how many emails you can send and receive in one day. These vary with subscription and Microsoft is working to improve size and quota limitations. This is something your business should investigate before moving ahead with Office 365.

- **Collaboration tool drawbacks —** If you use SharePoint, it is important to know that this program is also limited in Office 365. This is one of the tools that may require third party integration.

SaaS- Dropbox

URL: https://www.dropbox.com/?landing=dbv2

Dropbox is one of several popular cloud storage services that enable you to store and share your files online in the cloud.

Benefits of Dropbox

- **Easy interface:** Dropbox has a relatively easy interface that not only makes it easy for the user but also makes it smooth for any new user who might want to use it for the very first time.
- **16GB Free storage:** In addition to Dropbox giving you the capability of storing your files online, it also gives you an additional 16GB of free storage space to add onto what you already have.
- **File syncing:** Dropbox has made it easy for the user s to be able to sync their files across multiple platforms, which also allows them to be able to access the files from wherever they are.
- **File sharing:** In addition to that storing files, drobox also has the capability of sharing files between different users.
- **File versioning:** Besides sharing files, it is also easy to create multiple versions of the same file to allow the file to be viewed in different environments.
- **Selective syncing:** Dropbox also makes it possible for users to sync their files selectively. This means that users can easily choose what files they want to sync, and which ones do not require syncing.
- **Edits documents online:** Unlike other storage platforms, Dropbox also allows users to access their documents online from wherever they are

and then edit those files in any environment. This makes it easy for the user to edit documents on the Go.

- **Deleted file recovery:** Once a user deletes a file from the storage facility, they may be able to recover the file at a later date. This gives the user some level of flexibility that is not available in other storage platforms.
- **Downloads and uploads:** In addition to uploading files on the storage platform, it is also possible for anyone to download those files at any given time.
- **Web and mobile version:** Dropbox also offer various users serious flexibility in that it comes with a mobile version and a web version of the same. This allows different users to be able to access the storage platform from any device they may be using.

Cloud Provider- Amazon Web Service - AWS

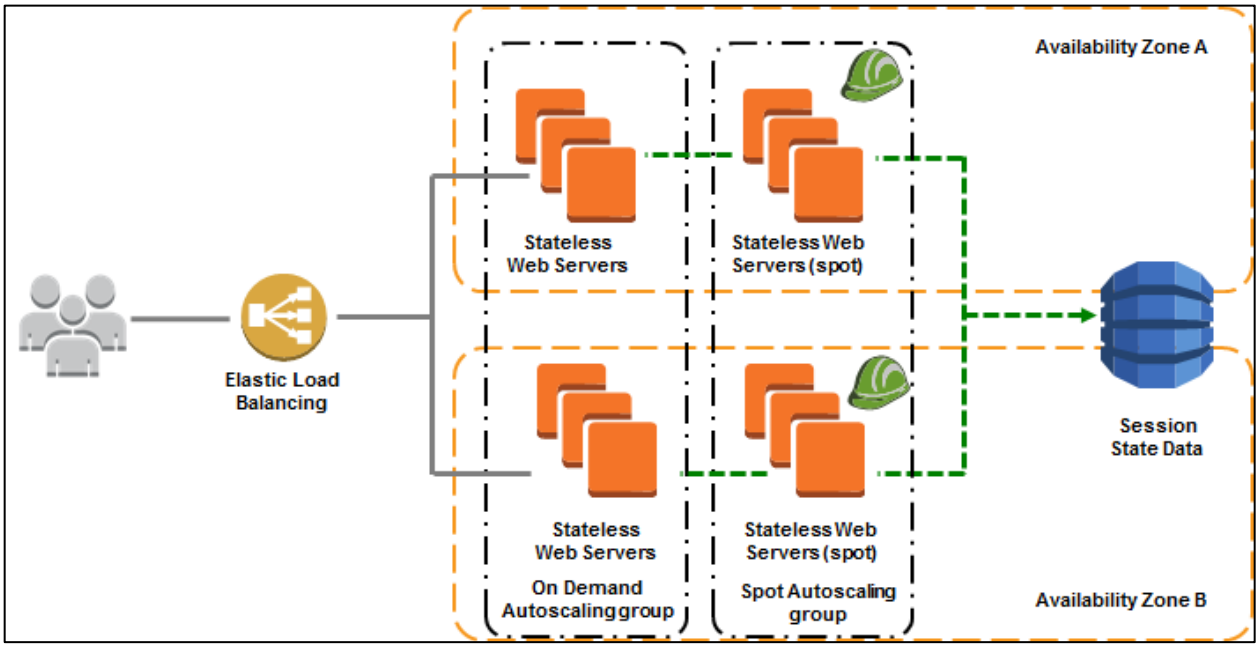
URL: https://aws.amazon.com/ec2/

Overview:

Elastic Cloud Computing provided by Amazon is one of the secure, reliable, resizable computing powers making it so prominent in the world of cloud services allowing the user to deploy their required virtual system with the pricing system as per their usage.

Why was it so famed?
They amaze with the building blocks, such as Faster innovation and increased security with AWS Nitro System, choice of process, High performance storage and enhanced networking.

Architecture:



The basic structure of **AWS EC2**, where **EC2** stands for Elastic Compute Cloud. EC2 allow users to use virtual machines of different configurations as per their requirement. It allows various configuration options, mapping of individual server, various pricing options, etc. We will discuss these in detail in AWS Products section. Following is the diagrammatic representation of the architecture.

Load Balancing:

Load balancing simply means to hardware or software load over web servers, that improver's the efficiency of the server as well as the application. Following is the diagrammatic representation of AWS architecture with load balancing.

Hardware load balancer is a very common network appliance used in traditional web application architectures.

AWS provides the Elastic Load Balancing service, it distributes the traffic to EC2 instances across multiple available sources, and dynamic addition and removal of Amazon EC2 hosts from the load-balancing rotation.

Elastic Load Balancing can dynamically grow and shrink the load-balancing capacity to adjust to traffic demands and also support sticky sessions to address more advanced routing needs.

Amazon Cloud-front:

It is responsible for content delivery, i.e. used to deliver website. It may contain dynamic, static, and streaming content using a global network of edge locations. Requests for content at the user's end are automatically routed to the nearest edge location, which improves the performance.

Amazon Cloud-front is optimized to work with other Amazon Web Services, like Amazon S3 and Amazon EC2. It also works fine with any non-AWS origin server and stores the original files in a similar manner.

In Amazon Web Services, there are no contracts or monthly commitments. We pay only for as much or as little content as we deliver through the service.

Elastic Load Balancer:

It is used to spread the traffic to web servers, which improves performance. AWS provides the Elastic Load Balancing service, in which traffic is distributed to EC2

instances over multiple available zones, and dynamic addition and removal of Amazon EC2 hosts from the load-balancing rotation.

Elastic Load Balancing can dynamically grow and shrink the load-balancing capacity as per the traffic conditions.

Security Management:

Amazon's Elastic Compute Cloud (EC2) provides a feature called security groups, which is similar to an inbound network firewall, in which we have to specify the protocols, ports, and source IP ranges that are allowed to reach your EC2 instances.

Each EC2 instance can be assigned one or more security groups, each of which routes the appropriate traffic to each instance. Security groups can be configured using specific subnets or IP addresses which limits access to EC2 instances.

Storage & Backups:

AWS cloud provides various options for storing, accessing, and backing up web application data and assets. The Amazon S3 (Simple Storage Service) provides a simple web-services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web.

Amazon S3 stores data as objects within resources called **buckets**. The user can store as many objects as per requirement within the bucket, and can read, write and delete objects from the bucket.

Amazon EBS is effective for data that needs to be accessed as block storage and requires persistence beyond the life of the running instance, such as database partitions and application logs.

Amazon EBS volumes can be maximized up to 1 TB, and these volumes can be striped for larger volumes and increased performance. Provisioned IOPS volumes are designed to meet the needs of database workloads that are sensitive to storage performance and consistency.

Amazon EBS currently supports up to 1,000 IOPS per volume. We can stripe multiple volumes together to deliver thousands of IOPS per instance to an application.

Features of Amazon EC2:

Amazon EC2 provides the following features:

- Virtual computing environments, known as *instances*
- Preconfigured templates for your instances, known as *Amazon Machine Images (AMIs)*, that package the bits you need for your server (including the operating system and additional software)
- Various configurations of CPU, memory, storage, and networking capacity for your instances, known as *instance types*
- Secure login information for your instances using *key pairs* (AWS stores the public key, and you store the private key in a secure place)
- Storage volumes for temporary data that's deleted when you stop or terminate your instance, known as *instance store volumes*
- Persistent storage volumes for your data using Amazon Elastic Block Store (Amazon EBS), known as *Amazon EBS volumes*
- Multiple physical locations for your resources, such as instances and Amazon EBS volumes, known as *Regions* and *Availability Zones*
- A firewall that enables you to specify the protocols, ports, and source IP ranges that can reach your instances using *security groups*
- Static IPv4 addresses for dynamic cloud computing, known as *Elastic IP addresses*
- Metadata, known as *tags*, that you can create and assign to your Amazon EC2 resources

- Virtual networks you can create that are logically isolated from the rest of the AWS cloud, and that you can optionally connect to your own network, known as *virtual private clouds* (VPCs)

Advantage of AWS:

- Easy to use:

  AWS's platform is clearly expressed and even a neophyte can use it. There won't be any problem for a new applicant as well as for an existing applicant. This is possible due to the AWS management console or well-documented web services.

- No capacity Limits:

  Organizations launch different projects and the guess what capacity they will need. AWS helps them by providing this capacity at a minimum cost. Through this benefit, their workload is decreased, and they can focus and built different ideas. The customers predict the capacity and they pay higher prices than that, but AWS provide them capacity at low-cost. The moment you feel like you should increase your capacity you can do it freely. Moreover, if you realize that you are not in need of so much storage you can get back to the previous storage and all you have to pay for what you use.

- Provides Speed and Agility:

  In the old world if we talk to an engineer, Enterpriser or a company about how long it will take to hire a server, the answer we will get is 1 week. But AWS provides us within minutes. All you have to do is select your requirement and you can proceed without talking to anyone as it is easy and flexible. With this, you can quickly deploy your application. AWS provides us with tools which helps us to reduce the time we spend on a task such Auto scaling, AWS Tool elastic load balance you can select them the basis of your demand. These applications can be accessed any time you need them.

- **Secure and Reliable**

  Amazon allows you to innovate and scale while keeping a secure environment and all you have to pay only for the services you use. AWS provides an end-to-end approach which secures and hardens your infrastructure. Amazon Web Service provide you with the security you need at a lower cost than in an on-premises environment.

  AWS provides security and also helps to protect the privacy as it is stored in AWS data centers. AWS infrastructure is designed to keep your data safe no matter what size of your data is. It just scales with your AWS cloud usage. AWS manages the highest standard of security and this is the reason users rely on AWS.

Disadvantages of AWS:

- **Limitations OF Amazon EC2:**

  AWS sets default limits on resources which vary from region to region. These resources consist of images, volumes, and snapshots. You can launch the limited number of instances per area. It also provides limited information for the resources managed by Amazon EC2 Amazon VPC console. However, you can request to increase the limit.

- **Security Limitations:**

  As security is one of the main features so AWS limits some of its features which cannot be changed at all are-

  - **EC-2 classic-** Maximum of 500 per instance and each Security Group can have a maximum of 100 permissions.
  - **EC2-VPC-** Up to 100 security groups per VPC.

- **Technical Support Fee:**

  AWS charges you for immediate support and you can opt for any packages among 3 which are-

- Developer
- Business
- Enterprise

- **General cloud Computing Issues:**

  AWS does have general cloud computing issues when you move to a cloud such as a downtime, limited control, and backup protection. However, these flaws can be overcome after some time. This makes them the temporary issue.

- Common Cloud Computing Problems:

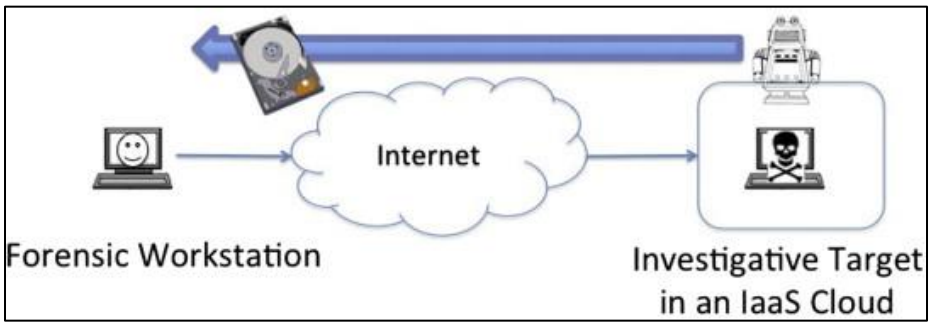
  Some of the concerns that come with migrating to cloud computing including backup protection risk of data leakage, privacy issues, security, downtime, and limited control.

  While it's normal to be concerned about these possible problems (and yes, they can happen), the cloud computing system already has most, if not all these covered.

  These problems are not just unique to AWS, they're common among cloud computing companies generally. But, since Amazon understands the importance of securing these, your business won't have to deal with any of that.

Interesting facts and research:

Acquiring forensic evidence from infrastructure-as-a-service cloud computing: Exploring and evaluating tools, trust, and techniques.



The forensic examination of the cloud will explore the cloud-based crime.

The forensic process varies greatly from computer devices to mobile devices due to the nature of the storage medium. Most mobile devices in current deployment use volatile memory to store user data. Computers generally use nonvolatile memory in the form of hard drives for their storage medium (although this is changing in some cases with many newer model devices integrating large format nonvolatile memory to enable the storage of music and video files).

When a device that uses nonvolatile memory is turned off, little generally happens to the storage medium. Devices that use volatile memory sources (such as most mobile devices currently in use) lose data when powered off. Even modern flash storage devices that are capable of storing data without power lose information as the device is divided, in order to use this memory in a manner that simulates both volatile and nonvolatile storage at the same time. The memory in these systems is generally backed up through the use of an internal battery, which, if depleted can result in lost data. Forensically, evidence trails on mobile devices can be destroyed though power loss. As such, it is essential to ensure that even a device that is turned off needs to have a power supply attached. This is essential if the investigator is to ensure that the data on the device is maintained in a forensically sound manner.

Forensic Process of IaaS:

Live Forensics

While forensics investigators traditionally removed power from a system, the typical approach now is to gather volatile data. Acquiring volatile data is called live forensics, as opposed to the postmortem forensics associated with acquiring a binary disk image from a powered down system. One attack tool stands out as having brought the need for live forensics into full relief.

Metasploit is an extremely popular free and open source exploitation framework. A strong core group of developers led by HD Moore have consistently kept it on the cutting edge of attack techniques. One of the most significant achievements of the Metasploit framework is the modularization of the underlying components of an attack. This modularization allows for exploit developers to focus on their core competency without having to expend energy on distribution or even developing a delivery, targeting, and payload mechanism for their exploit; Metasploit provides reusable components to limit extra work.

A payload is what Metasploit does after successfully exploiting a target; Meterpreter is one of the most powerful Metasploit payloads. As an example of some of the capabilities provided by Meterpreter, Figure 8.1 shows the password hashes of a compromised computer being dumped to the attacker's machine. These password hashes can then be fed into a password cracker that would eventually figure out the associated password. Or the password hashes might be capable of being used directly in Metasploit's PS Exec exploit module, which is an implementation of functionality provided by SysInternal's (now owned by Microsoft) PS Exec but bolstered to support Pass the Hash functionality. Information on Microsoft's PS Exec can be found at http://technet.microsoft.com/en-us/sysinternals/bb897553.aspx. Further details on Pass the Hash techniques can be found at http://www.coresecurity.com/corelabs-research/open-source-tools/pass-hash-toolkit.