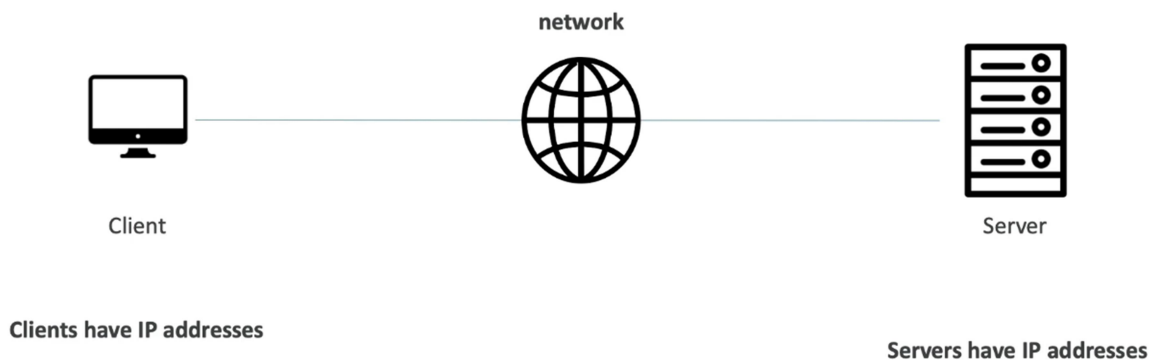


Introduction

How Websites work



Well we have a server hosted somewhere, and we, as a web browser, want to get access to that server to visualize a websites.

What we are going to do as a client is use a network. A network between ourselves and the server,

And the client will find the network and will use network to route the packets, the data into the server, then the server will reply to us, and we will get the response, and we can view a website.

Obviously that is very simplified, but that gives you an idea.

Now for the clients to find the server and the server to find the clients, you need to have IP addresses.

So a client has IP addresses and a server also have an IP address. And so the idea is that when you use an IP address, you can send a request to wherever you want to the server you want, and the server can know how to find you back.

This is very similar to when you are writing some letters to your friend.

For example, you would write a letter, and that would be your data, and you would be the client,

then when you send the letter you put it in your mailbox, and then the network will be the network of the post office, then the post office will use network and the address you put on the letter to route your letter to the destination, which is, in this case, the server, and then if your correspondent wants to reply you back, they can use the address you put on the back of the envelope to write you back, and again, use the same network to get the letter back to you.

So servers are just like the network of your mail.

What is Server Composed of?

Well a server is going to contain a CPU, and a CPU is a little piece that will be doing some computations, it will be very helpful to do some calculations and find results, and then, your server also needs RAM, or memory.

This is going to be very, very fast memory, which will allow us to store information and retrieve it very quickly.

When you are thinking, you are actually making computations, very complicated ones, but they are computations, but then you need to retain some information, and again, we have memories and these memories are in our brain, so if we think of the CPU and the RAM together, they sort of look like a brain.

Now we also need to have some more long-term storage of data. Obviously it's still in our brain as humans, but in computers, we have included some special storage to store data, for example, files, and then if we want to store the data in a more structured way, we're going to use a database, and a database is going to be data formatted in a way that we can easily search it and query it.

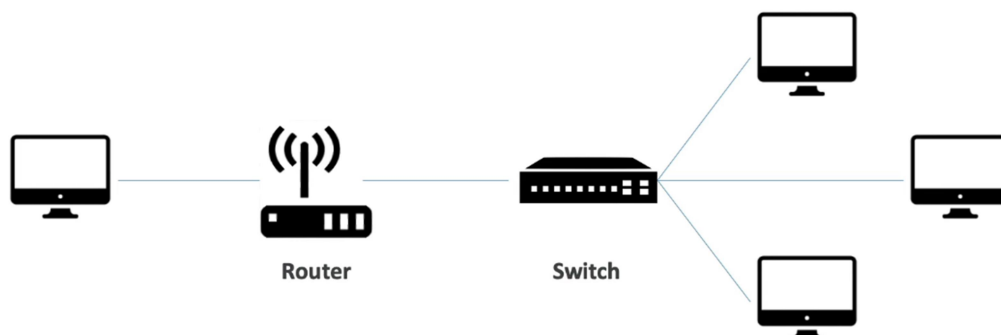
Finally in the server, we're also going to have some networking aspect. So there's going to be the routers, switch, DNS servers.

So in the server, we have an aspect of compute, memory, storage, maybe your server sometimes is a database, and we have a networking aspect.

We get all these things on cloud as per our request and it is very easy.

So if we just want to define a little bit of IT terminology before we get started, the network is a bunch of cables, routers, and servers that are going to be connected with each other, and the router is a specific device that will forward the data packets between computers in the networks, and they will know where to send your packets on the internet, just like your post delivery service.

Now when we have a packet and it arrives at a destination, there's a switch, and the switch will send the packet to the correct clients on your network. So if we put all these things together, it looks like this.



Our client will send the data to a router, the router will find it's way all the way to a switch, and the switch will know to which computer in your network to send the data to. So why do we introduce all these things?

Well, let's go back to traditional IT.

When people used to start websites or companies before, they used to do it in their home or their garage, and so they would literally go to the store, buy a server, and they put the server in their home.

Now, as your website grows, you need to add more and more servers to serve that demand, and so your home starts to be filled with servers.

If your company is getting bigger, you're generating some money, you're going to move to your own office, and you decide to allocate a special room which is going to be called a data centre.

In a data centre, you're going to have, again, your servers, and you're going to be able to scale them by adding and purchasing more and more servers. Now this worked, and this worked for so many years, but there are a few problems with this approach.

- 1) When you have a data centre or your own home, you're going to have to pay your rent
- 2) You have to add power supply, cooling, and maintenance because it does require some electricity to run your servers, it does require some cooling because the servers do get hot
- 3) Sometimes they break down, so you need someone to do the maintenance.
- 4) If you want to add or replace servers, it will take a lot of time because you have to order them, and then you have to hook them up in your centre.
- 5) If tomorrow you're getting 10 times bigger, you're going to need 10 times more servers, but you may not have the time or the space to do so.
- 6) You also need to hire a team that is going to be there all the time, 24/7 to monitor the infrastructure in case something goes wrong.
- 7) What if there is a disaster, what if there is an earthquake, What if there's a power shutdown, or even a fire?

So can we externalize all this?

And the answer is yes, and that will be the cloud.

Cloud Computing

What is Cloud Computing

- 1) Cloud computing is the on demand delivery of computer power ,database storage, applications & IT resources
- 2) Through a cloud services platform with pay as you go pricing
- 3) You can provision exactly the right type & size of the computing resources that you need
- 4) You can access as many resources as you need almost instantly
- 5) Simple way to access servers storage, databases and a set of application services

What we use? Why?

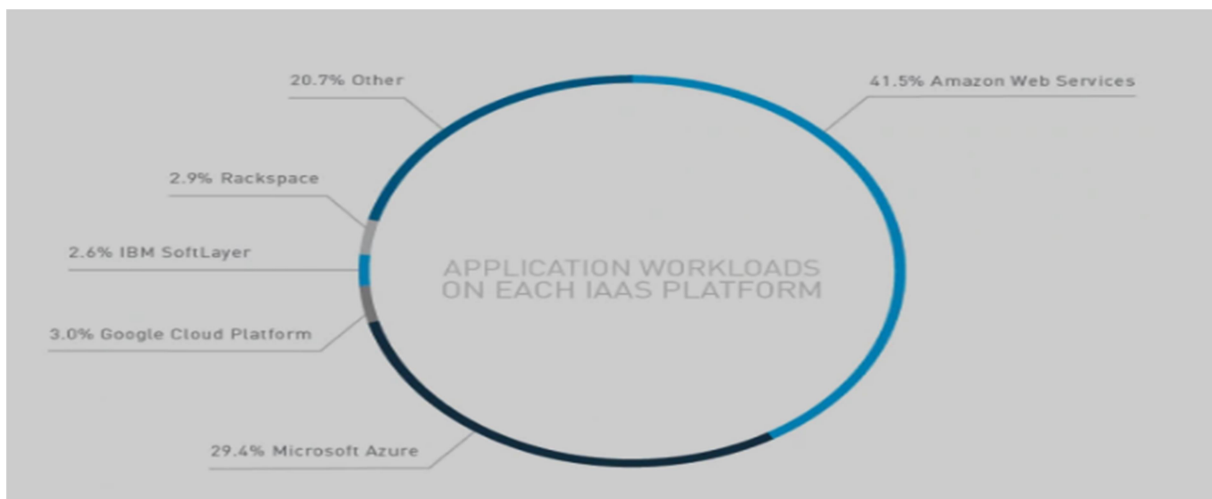
There are various platforms which provide us the cloud experience and helps us with various ways of deploying our projects.

Below are few examples for the same

- Amazon **Web** Services
- Microsoft Azure
- Google Cloud Platform
- IBM Cloud
- Rackspace
- GoDaddy
- Verizon Cloud
- VMware

All of the providers have their own benefits and disadvantages alongwith them.

AWS is used widely, below is the coverage as per MacAfee survey



We will also be using the Amazons AWS for this semester for learning, understanding and testing purpose.

AWS owns & maintains the network connected hardware required for these application services, while you provision & use that you need via a web application

Essentials characteristics of Cloud Computing

Characteristics of Cloud Computing

- ***On-demand self-service.***

A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

- ***Broad network access.***

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

- ***Resource pooling.***

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

- ***Rapid elasticity.***

Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

- ***Measured service.***

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Advantages of Cloud Computing

Reduced IT costs

Moving to cloud computing may reduce the cost of managing and maintaining your IT systems. Rather than purchasing expensive systems and equipment for your business, you can reduce your

Cloud Computing

costs by using the resources of your cloud computing service provider. You may be able to reduce your operating costs because:

- the cost of system upgrades, new hardware and software may be included in your contract
- you no longer need to pay wages for expert staff
- your energy consumption costs may be reduced
- There are fewer time delays.

Scalability

Your business can scale up or scale down your operation and storage needs quickly to suit your situation, allowing flexibility as your needs change. Rather than purchasing and installing expensive upgrades yourself, your cloud computer service provider can handle this for you. Using the cloud frees up your time so you can get on with running your business.

Business continuity

Protecting your data and systems is an important part of business continuity planning. Whether you experience a natural disaster, power failure or other crisis, having your data stored in the cloud ensures it is backed up and protected in a secure and safe location. Being able to access your data again quickly allows you to conduct business as usual, minimising any downtime and loss of productivity.

Collaboration efficiency

Collaboration in a cloud environment gives your business the ability to communicate and share more easily outside of the traditional methods. If you are working on a project across different locations, you could use cloud computing to give employees, contractors and third parties access to the same files. You could also choose a cloud computing model that makes it easy for you to share your records with your advisers (e.g. a quick and secure way to share accounting records with your accountant or financial adviser).

Flexibility of work practices

Cloud computing allows employees to be more flexible in their work practices. For example, you have the ability to access data from home, on holiday, or via the commute to and from work (providing you have an internet connection). If you need access to your data while you are off-site, you can connect to your virtual office, quickly and easily.

Access to automatic updates

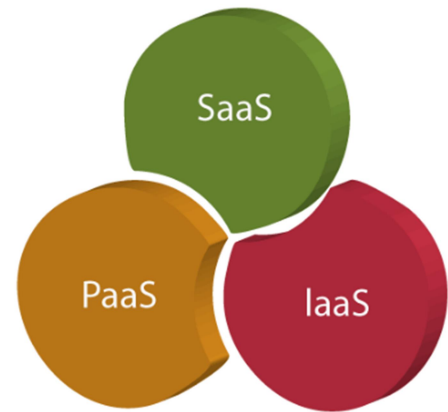
Access to automatic updates for your IT requirements may be included in your service fee. Depending on your cloud computing service provider, your system will regularly be updated with the latest technology. This could include up-to-date versions of software, as well as upgrades to servers and computer processing power.

Cloud Service Models

There are the following three types of cloud service models -

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)

Let us discuss each of them in details



Infrastructure as a Service (IaaS)

IaaS or Infrastructure as a Service is basically a virtual provision of computing resources over the cloud. An IaaS cloud provider can give you the entire range of computing infrastructures such as storage, servers, networking hardware alongside maintenance and support.

Businesses can opt for computing resources of their requirement without the need to install hardware on their premises. Amazon Web Services, Microsoft Azure, and Google Compute Engine are some of the leading IaaS cloud service providers.

Characteristics of IaaS

There are the following characteristics of IaaS -

- Resources are available as a service
- Services are highly scalable
- Dynamic and flexible
- GUI and API-based access
- Automated administrative tasks

Advantages of IaaS cloud computing layer

There are the following advantages of IaaS computing layer -

1. Shared infrastructure

IaaS allows multiple users to share the same physical infrastructure.

2. Web access to the resources

IaaS allows IT users to access resources over the internet.

3. Pay-as-per-use model

IaaS providers provide services based on the pay-as-per-use basis. The users are required to pay for what they have used.

4. Focus on the core business

IaaS providers focus on the organization's core business rather than on IT infrastructure.

5. On-demand scalability

On-demand scalability is one of the biggest advantages of IaaS. Using IaaS, users do not worry about to upgrade software and troubleshoot the issues related to hardware components.

IaaS provider provides the following services -

1. **Compute:** Computing as a Service includes virtual central processing units and virtual main memory for the VMs that is provisioned to the end-users.
2. **Storage:** IaaS provider provides back-end storage for storing files.
3. **Network:** Network as a Service (NaaS) provides networking components such as routers, switches, and bridges for the VMs.
4. **Load balancers:** It provides load balancing capability at the infrastructure layer.

Platform as a Service (PaaS)

PaaS cloud computing platform is created for the programmer to develop, test, run, and manage the applications.

Characteristics of PaaS

There are the following characteristics of PaaS -

- Accessible to various users via the same development application.
- Integrates with web services and databases.
- Builds on virtualization technology, so resources can easily be scaled up or down as per the organization's need.
- Support multiple languages and frameworks.
- Provides an ability to "**Auto-scale**".

Advantages of PaaS

There are the following advantages of PaaS -

1) Simplified Development

PaaS allows developers to focus on development and innovation without worrying about infrastructure management.

2) Lower risk

No need for up-front investment in hardware and software. Developers only need a PC and an internet connection to start building applications.

3) Prebuilt business functionality

Some PaaS vendors also provide already defined business functionality so that users can avoid building everything from very scratch and hence can directly start the projects only.

4) Instant community

PaaS vendors frequently provide online communities where the developer can get the ideas to share experiences and seek advice from others.

5) Scalability

Applications deployed can scale from one to thousands of users without any changes to the applications.

Software as a Service (SaaS)

SaaS is also known as "**on-demand software**". It is a software in which the applications are hosted by a cloud service provider. Users can access these applications with the help of internet connection and web browser.

Characteristics of SaaS

There are the following characteristics of SaaS -

- Managed from a central location
- Hosted on a remote server
- Accessible over the internet
- Users are not responsible for hardware and software updates. Updates are applied automatically.
- The services are purchased on the pay-as-per-use basis

Advantages of SaaS cloud computing layer

1) SaaS is easy to buy

SaaS pricing is based on a monthly fee or annual fee subscription, so it allows organizations to access business functionality at a low cost, which is less than licensed applications.

Unlike traditional software, which is sold as a licensed based with an up-front cost (and often an optional ongoing support fee), SaaS providers are generally pricing the applications using a subscription fee, most commonly a monthly or annually fee.

2. One to Many

SaaS services are offered as a one-to-many model means a single instance of the application is shared by multiple users.

3. Less hardware required for SaaS

The software is hosted remotely, so organizations do not need to invest in additional hardware.

4. Low maintenance required for SaaS

Software as a service removes the need for installation, set-up, and daily maintenance for the organizations. The initial set-up cost for SaaS is typically less than the enterprise software. SaaS vendors are pricing their applications based on some usage parameters, such as a number of users using the application. So SaaS does easy to monitor and automatic updates.

5. No special software or hardware versions required

All users will have the same version of the software and typically access it through the web browser. SaaS reduces IT support costs by outsourcing hardware and software maintenance and support to the IaaS provider.

6. Multidevice support

SaaS services can be accessed from any device such as desktops, laptops, tablets, phones, and thin clients.

7. API Integration

SaaS services easily integrate with other software or services through standard APIs.

8. No client-side installation

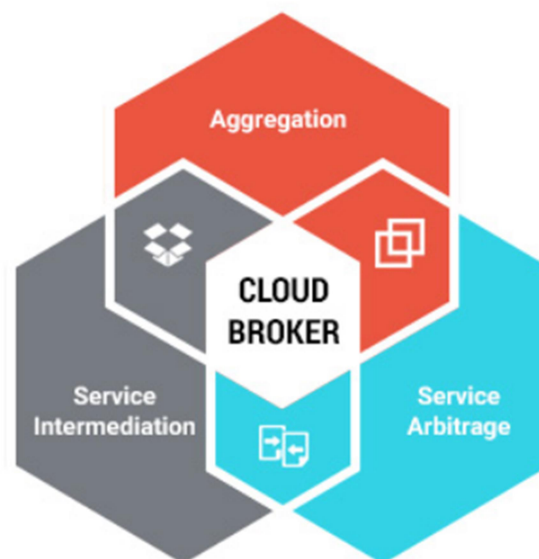
SaaS services are accessed directly from the service provider using the internet connection, so do not need to require any software installation.

Cloud Service Brokerage

Cloud technology has become exponentially accepted for companies all over the world, providing a Cloud Service Brokerage platform for them to run their sensitive and critical operations, therefore cloud services are now more than ever a very integral part of the ICT infrastructures exploited by companies from many different industries.

According to research, Cloud Service Brokerage (CSB) is an ICT role and business model in which a company or other entity adds value to one or more (public or private) cloud services on behalf of one or more consumers of that service via three primary roles including;

- **Aggregation:** this involves combining and integrating multiple services, examples are; data integration, safeguarding process integrity and ensuring data portability between the cloud customer and the various cloud services providers.
- **Service Intermediation:** this is the provision of value-added services or basically improving a capability without actually providing any of the cloud services itself. These services may include identity and access management, security management and reporting, or supervision on pricing and billing.
- **Service Arbitrage:** Some cloud broker services providers are not directly involved in cloud customer contact, but rather enable other cloud broker services providers to provide their brokerage services. Examples of these cloud brokerage enablers are providers of cloud aggregation platforms or other (software) technology that enable aggregation providers to combine various cloud services into one or more aggregated cloud services to the cloud customer.



Benefits of Cloud Service Brokerage

Cloud Service Brokerage has significantly reduced processing costs, increase flexibility and reduced downtime as global offices, suppliers and other partners in the production chain can share information at real time with each other. Additional benefits attached with using a cloud services broker include:

- **Integrated service management:** Integrated service management provides key services, such as backup and recovery, resiliency, and security. These services ensure that your system is running all year round.
- **Access to IT resources anytime, anywhere:** Cloud services remove your data from their physical silos and makes them readily available for use whenever and wherever you need them.
- **Flexible scaling of resources:** with advancing years and changes in business, so also there is a change in your data needs. There are plans in place to help scale your data solution investments with your current needs for maximum resource optimization.
- **Low total cost of ownership (TCO):** Expedite delivery of your complex data projects helps reduce capital expenditures.
- **Automated self-service delivery:** automation simplifies and speeds up the integration and deployment of services. Cloud service brokerage provides options to automate your services and the possibility of designing the automation as your needs require.

Essentials for a Cloud Service Broker Platform

- **Services Catalogue Management:** A platform for enterprises and service providers to showcase the services offered.
- **Cloud Orchestration and Delivery:** For multi-cloud infrastructure service, you need a provisioning and orchestration framework that can support multiple clouds and transform your IT department into a self-service organization.
- **Billing and Payment Engine:** It should be able to monetize your process, integrate with critical applications, and account and charge for cloud services used, it can also interface with various payment gateways in real time.
- **User Provisioning and Administration:** A Cloud Service Broker platform should enable self-service provisioning of users and apps (services), manage users' identities and provide them with timely access to applications and data.
- **Roles-Based Access Controls:** A Cloud Service Broker platform should provide an efficient way to restrict access to various functions of the cloud management platform.

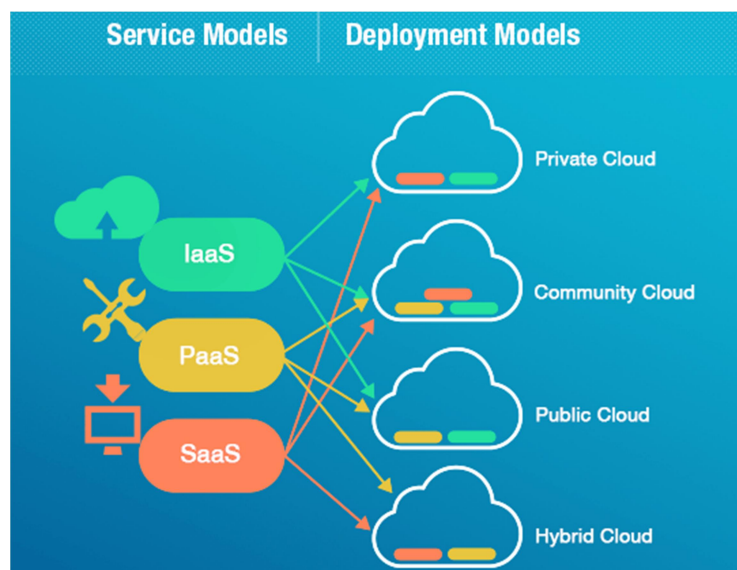
Cloud Computing

- **Identity and Policy Management:** Provision of automated solutions to enforce access policy proactively and detect existing violations in a users' environment.
- **Budgeting and Spend Management:** It should provide governance and budget management for cloud services by letting IT track every expense from beginning to end.
- **Monitoring and Dashboard:** IT needs to monitor cloud infrastructure performance continuously and identify and resolve issues that arise promptly and also provide visibility into the organization's cloud usage.
- **Extensible Reporting Framework:** It should empower customers the ability to securely build, generate, save own reports as per their personal needs and also a centralized database for reporting data from varying live feeds of users should be available.

Cloud deployment models

Different Types Of Cloud Computing Deployment Models

Most cloud hubs have tens of thousands of servers and storage devices to enable fast loading. It is often possible to choose a geographic area to put the data “closer” to users. Thus, deployment models of cloud computing are categorized based on their location. To know which deployment model would best fit the requirements of your organization, let us first learn about the types of cloud deployment models.



Cloud Computing

Private Cloud

It is a cloud-based infrastructure used by stand-alone organizations. It offers greater control over security. The data is backed up by a firewall and internally, and can be hosted internally or externally. Private clouds are perfect for organizations that have high-security requirements, high management demands, and availability requirements.

Public Cloud

This type of cloud services is provided on a network for public use. Customers have no control over the location of the infrastructure. It is based on a shared cost model for all the users, or in the form of a licensing policy such as pay per user. Public deployment models in the cloud are perfect for organizations with growing and fluctuating demands. It is also popular among businesses of all sizes for their web applications, webmail, and storage of non-sensitive data.

Community Cloud

It is a mutually shared model between organizations that belong to a particular community such as banks, government organizations, or commercial enterprises. Community members generally share similar issues of privacy, performance, and security. This type of deployment model of cloud computing is managed and hosted internally or by a third-party vendor.

Hybrid Cloud

This model incorporates the best of both private and public clouds, but each can remain as separate entities. Further, as part of this deployment of cloud computing model, the internal, or external providers can provide resources. A hybrid cloud is ideal for scalability, flexibility, and security. A perfect example of this scenario would be that of an organization who uses the private cloud to secure their data and interacts with its customers using the public cloud.

That's all for the basics knowledge of Cloud computing.

Let's start to dig deeper