What is cloud computing

Cloud computing is on-demand computing resources delivered to you over the internet. Now think about that for a minute. You need access to some sort of computing. Maybe it's an application you need to run, maybe it's just a server that needs to be started for your company. No matter what it is, the cloud can provide those on-demand resources and they're delivered to you in most cases, I should caution in most cases, over the internet.

Now another way to answer the question, what is cloud computing? Cloud computing is a computing service that you traditionally did local or on-premises as it's called, meaning in your own office building let's say or on your own local computer and it's now performed remotely across the internet or across some network and it's performed off-premises meaning it's performed somewhere else, in some other office, in somebody else's data center, on somebody else's computer.

So those are the two basic definitions of cloud computing. Basically it's the computing that you need, but it's done by someone else and it's done somewhere else.

Cloud computing is an approach to computing that leverages the efficient cooling of an on-demand, self-managed virtual infrastructure. You can start and stop things yourself. You don't have to call an IT expert. And another point here is that it's a pool of resources. So you're not accessing just a single computer over the internet, although you could be, but in general, cloud computing is the accessing of a large pool of resources to gain access to the applications that you need and you can manage those applications and those resources yourself. So those are three different definitions of cloud computing.

Benefits

The first one here is fast access to resources or applications that you or your company needs. Let's say that you have a small business, perhaps you have 20 employees. They need access to email. You could go and purchase your own email server, you could install let's say Microsoft Exchange and purchase a license for that, configure the mail records, all those things or you could go to someone like Gmail or Office 365 and you could much more easily, much more inexpensively and with much less complexity have your own email system up and running within, for example an hour instead of what might be a couple weeks with the traditional physical server model, much less having to learn how to install, configure, and administer something like Microsoft Exchange. So just an example how cloud computing can provide you and your company fast access to the resources or applications that you need.

Another benefit is you only pay for what you use. So with the Microsoft Exchange model you might have to purchase a physical server that scales up to, for example, 200 users when you don't really need that capacity; you just have 20 users who need access to email. So with cloud computing you just pay on a per-user basis; you pay only for the licenses for the users that you need and if let's say a year later you have to cut staff down to just 10, well then you only pay for 10 licenses instead of 20 and compare that to having to pay for a physical server and software licenses that support up to 200 users.

Another benefit here is there's no capital expenditures to get started. So again, with the email server you don't have to purchase a physical server. You don't have to purchase a Windows server O/S license. You don't have to purchase Microsoft Exchange. None of that capital expense is needed. Simply pay on a per-user basis each month for the number of users who are using the mail system

and then there's the potential to eliminate the need for local IT staff to maintain infrastructure and applications.

Cloud computing also has the potential to lower your costs for the company when it comes to computing and applications and I don't say it always lowers those costs, but it has the potential to lower those costs. Additionally, you can deploy what you need yourself with self-service. So configuring for example, Office 365 to provide your company's employees email access requires a little bit of knowledge, but it's far less knowledge than what's needed to spec out a physical server, some storage, UPS battery backup, install an operating system, install Microsoft Exchange and configure it from there. So you don't need as much expertise and you can configure new user accounts with a few clicks of a mouse. Anyone can do that to add let's say a new email user mailbox for your company.

Risks of Cloud Computing

Cloud computing offers a ton of benefits, but just like anything that promises a ton of benefits, in many cases there's also at least one, if not a few risks that might be associated with those benefits and that's the case with cloud computing as well. So first off, with cloud computing one of the risks is that you're placing your trust in the cloud provider, meaning if you store all your data in Amazon Web Services or Microsoft Azure and one of those services goes down, you no longer have access to that data. Now those cloud computing providers invest millions or billions perhaps in ensuring that they do everything they can to protect from their services ever going down and maintain high availability, but not everything is within their control and sometimes cloud providers just like any provider do have some sort of downtime or performance slowdown, so you're placing complete trust in the cloud provider and if that provider goes down, then you're no longer going to have access to your data or applications and that's just one of the risks that you need to take.

You also need to be aware of the service-level agreement, which is the agreement between you and the provider that says that if the cloud provider does go down, what they will provide to you in return. So there could be some financial benefits back to you or refunded service fees if the provider goes down and you cannot access your data or applications. There's the potential for data loss, just like when you store your data anywhere. It could be on your local computer. There's always the potential for data loss, but with the cloud provider, if you put complete trust in them and you store all your data in that cloud provider and then that data is somehow lost, then you just have yourself to blame, right? So you always need to have backups even if you put everything in the cloud, you can back up from one cloud provider to another cloud provider or you can back up what's in the cloud locally down to your own data center or to your own computer. Yes, you can back up your Gmail or your Office 365 documents. You can back up all of that data that's in the cloud, so there's always the potential for data loss with any service, with any storage and that's just a risk that you need to keep in mind any time you store data really anywhere.

And then just like the potential for downtime, there's also the potential for slow access to your data. I mean, you're separating yourself from your data and let's say that massive amounts of data or perhaps that data grows massively over time. If one day you decide to download all that data or move it to another cloud provider or move it to your own data center, you have the potential for very slow access to that data and that's just something to keep in mind. After all, your connection to the cloud is only as fast as your network connection to the internet or perhaps you have a private connection to this cloud provider, but in most cases it's the internet.

Another risk to be aware of is potential questions related to legality or regulatory, for example financial or government entities. They can't just store their data in the cloud anywhere, for example, out of the country. They have to keep in mind government regulations and the law associated with the data that they're storing and the data that they have to protect. Now if we're talking about your own personal email, this isn't something you have to worry about, but if you have a company and you're storing medical data, health data, employee data, financial data or credit card data or any data that's regulated by the government, you're going to have to take into special consideration which cloud provider you use and where they're storing your data. Then there's the potential for loss of customization.

If you purchase let's say your own servers and storage and software applications and run everything locally, you know exactly what the costs are going to be. When it comes to cloud computing there may be scenarios where you consume much more than you anticipated that you would consume and you end up with a much larger bill than you anticipated you would receive. So again, that's something to keep in mind. When you spin up, let's say virtual machines in the cloud, you're paying by the minute or by the hour for those virtual machines. So if you forget about them and just leave them on out there all month long, you might get a much larger bill at the end of the month than you thought you would. So those are the risks that you need to be aware of with cloud computing.

Many Forms of Cloud Computing

software-as-a-service

Now I mentioned earlier that cloud computing comes in many forms. So what does that mean exactly? Well, one of the forms of cloud computing is called SaaS or software-as-a-service. So with SaaS you're accessing applications directly in the cloud. These applications are already running and you're just simply paying to use them. So this is the most likely form of cloud computing that you have already used. Examples could be Gmail, Office 365, SalesForce. com, even Dropbox is a software-as-a-service.

So again, SaaS is software, it's an application that you're using that's running in the cloud.

infrastructure-as-a-service

Another form of cloud computing is infrastructure-as-a-service or IaaS as it's commonly called. So within infrastructure-as-a-service you're accessing a virtual machine. So that virtual machine is an instance of a physical computer virtualized and running in the cloud. So it has an operating system, it has virtual hardware like virtual CPU, memory, virtual storage, virtual networking. On top of that operating system you can do whatever you want. You can install applications, you could install a web server, you could install a database server.

So this is typically how an enterprise that's wanting to move computing resources out of their data center and into the cloud would use the public cloud. They would use this infrastructure-as-a-service to replace or to augment their existing infrastructure that's running in their server room or in their data center.

platform-as-a-service

Another form of cloud computing is platform-as-a-service or PaaS as it's commonly called. With platform-as-a-service, developers who need access to a platform, a development platform, for example it could be a SQL server that's already running and they simply need access to deploy a database or it could be a web server that's already running and they need access just to put their

code on that web server and deploy a new web application. Platform-as-a-service or PaaS services provide those developers exactly what they need to get their application or their database up and running very, very quickly.

They don't have to worry about maintaining the underlying web server or the underlying operating system or the computing hardware. They simply deploy their web application and that web server from their perspective, seems to scale infinitely and they only pay in many cases per transaction, some sort of usage, utility-based consumption model.

What Is Virtualization?

Virtualization is the logical division of physical computing resources.

Well, let me pop over into what they call VMware Fusion on my local computer here and just give you a quick example of what virtualization looks like. So here we go. This is one example of virtualization. This is an application called VMware Fusion. With VMware Fusion on this Macintosh computer I can run all these different virtual machines. These are other computers that I can run. I can run Mac OS X. I can run Windows. I can run Linux-based operating systems. All these can be easily run on this one Macintosh computer using virtualization and it's one thing to do it on your desktop like I'm doing it here, but it's another thing to leverage it in the public cloud and that's how public cloud providers work. Not using VMware Fusion, but using a virtualization hypervisor, which is the piece of software that makes virtualization possible. They use a hypervisor in their datacenters across all of their hundreds of thousands of physical servers to run many virtual machines for many different customers in their public cloud datacenter.

What Is a Virtual Machine?

Virtualization allows you to run these virtual machines. So the hypervisor is the core piece of a virtualization solution. On that hypervisor you're able to run a virtual machine. A virtual machine is a software-based instance of a physical server where a guest operating system has access to emulated virtual hardware. So what exactly does that mean? Well, a virtual machine like I said, runs on top of a hypervisor that's loaded on a physical server. Those virtual guest machines or virtual guests as they're known, run on top of that physical server with the hypervisor and that becomes the virtual host. It provides all of the physical resources to the virtual machines to actually run the operating systems and applications. The operating systems and applications loaded on the guest virtual machines don't know the difference. They don't know that they're running on virtual hardware and that there's other virtual machines. They think they have full access to the physical hardware, to the physical server. So they're provided virtual resources from the hypervisor.

Let's jump back into VMware Fusion and I'll show you what this looks like. So here in this virtualization solution, which there are many, this one just happens to be called VMware Fusion, it has a hypervisor. It allows me to run multiple virtual machines. Each of these virtual machines has its own virtualized hardware. So if we go in here to processors and memory, you can see two processors and 3GB of memory are assigned to this virtual machine and my Macintosh computer, my host has much more memory available. It has 29GB or 29, 000MB available to run more virtual machines. So we have plenty of resources and then if we look at the hard disk here, it has a virtual hard disk that has 100GB. That's another virtual resource shared from the host, and then there are virtual network adaptors and you can configure multiple types of virtual networks and then when you want to run one of these virtual machines, you just power it on. And there we go. We're running Windows 10 on

a Macintosh computer, all thanks to virtualization, all thanks to the hypervisor. If I log in, there we go. We're inside of Windows 10. Thank you, virtualization! But virtualization isn't cloud computing unless that is you're running this virtual desktop over in the cloud. Since I'm running it locally, we're just using virtualization at this point. We aren't actually using cloud computing to do this, but virtualization is what makes cloud computing possible.

What Is a Container?

Moving on from virtual machines, let's talk about something called a container. A software container is an operating system-level virtualization where the operating system kernel provides isolated user spaces to run specific applications. Again, you get all that? Easy, right? Well, to help you make a little bit more of it, because that's kind of the dictionary-level definition there, let's talk about what containers are. Now containers have been around for a long time. In fact, containers have been in use just about ever since Unix or Linux have been in use and with containers, the operating system is sliced up into isolated secure areas to run specific applications. So with containers there's still just one operating system. There are not multiple operating systems like with virtualization. Containers can actually be run inside a virtual machine on a virtualization hypervisor so you can use containers with virtualization. Containers have much less overhead than virtualization and virtual machines and they have much faster startup times than virtual machines because essentially you're just running a new application, just in a secure area of the operating system. Now they've been popularized with excitement around Docker, Docker containers. Everybody's talking about it along with the cloud and cloud computing utilizes containers. So cloud uses both virtualization and containers

For example, I'm going to create a new container called hello-world. I'm going to download container, a piece of software that has a web server inside and even a sample web page. So here's the web preview from the web server. If I click on that, you can see if I go to this URL here, this is what comes up. So instead of having to install a web server and create a web page, that's already been done. This web server is up and running. I didn't have to configure it, I didn't have to install it, it just works, and that's the idea with containers.

I didn't have to install this in my existing operating system. It runs in a secure area of my desktop. It's already installed and it's already configured. That's the ease of containers. That's how efficient containers make the life of an administrator and containers are a huge part of cloud computing.

What Is Platform as a Service?

Platform-as-a-service is for developers. That's one of the biggest differences between infrastructure-as-a- service and platform-as-a-service. Platform-as-a-service is for developers; infrastructure-as-a-service is for really any infrastructure people, but it could even be for developers who just want more control over the infrastructure. Let's talk a little bit more about platform-as-a-service. What is it?

Well, it's a cloud service for developers primarily who want to be able to develop, run, and manage applications in the public cloud. With platform-as-a-service no servers, storage, networking, operating system, middleware or databases are needed. You don't have to install any of those if you're a developer and you want to deploy an application into a platform-as-a-service solution. Examples of platform-as-a-service are Amazon's Elastic Beanstalk, which I'll show you in just a moment, Microsoft Azure App Service, Google App Engine, Cloud Foundry, and Heroku. These are all popular examples of platform-as-a-service solutions.

1. Lab 1: Infrastructure-as-a-service

SETUP OF VM (1 credit)

Click on the link, and log in with your AP or OAMK email address.

Install a linux of Windows virtual machine and learn how to access it.

* Debian linux VM:
https://google.qwiklabs.com/focuses/3563?parent=catalog

* Windows VM:
https://google.qwiklabs.com/focuses/560?parent=catalog

2. Lab 2: Platform-as-a-service

*Deploy a Node.js Express Application in App Engine

https://www.qwiklabs.com/focuses/3340?parent=catalog

3. Lab 3: IAM roles

*Collaborating in the Google Cloud

https://www.qwiklabs.com/focuses/551?locale=en&parent=catalog