Getting Started With
Multi-Cloud Architecture

Google Cloud Platform

aws

Azure

simplilearn

Introduction

Many people envision a "Cloud" as a single platform for applications spread across several locations. Actually, that would be a Multi-Cloud architecture.

You probably have already taken a look at AWS for your next application, AWS Lambda or AWS Inferential, in this case, where AWS is hosting the Application in Amazon's data centers. In addition to Amazon's resources, you may be using a combination of help from partners such as Google Cloud Platform and Microsoft Azure, or you may be going to a new vendor such as Google Cloud. All the while, the application is delivered to your end-user using a platform like a mobile device or a laptop.

The biggest and most significant challenge for your users is the speed of performance.

Perhaps, they have used solutions that can't meet the performance requirements your customer is looking for, especially in the application delivered to the end-user.

You might have spent a considerable amount of time and money developing your solution using a single solution that works for every user. In the end, you may have been able to cut costs, increase efficiency and address the requirements your customers have for their product, but it wouldn't have been as good of a solution for all users.

There's no one-size-fits-all solution. Your users require a solution that works for each of them. There's no application, no single platform that will meet all of their needs or requirements. There will be configuration needs, cross-application, and cross-platform compatibility issues that you have to deal with regularly.

These are challenges that your developers face every day, and they need to be addressed. It's an issue that I've experienced first hand, as one of the co-founders of a multi-cloud platform that was acquired by a Fortune 1000 corporation.

What it means to have a Cloud-Native strategy

As the growing community of developers and businesses on the OpenStack platform grows, so does the toolkit's diversity to create, develop, and deploy solutions. This diversity makes it more complicated for developers to determine which toolset they need to get the job done and then figure out how to manage all of the tools they need.

Once you develop a Cloud-Native strategy, you can quickly spin up your first OpenStack virtual machine, deploy it into your private cloud or a multi-tenant public cloud – all in seconds. You can also deploy containerized applications directly into your cloud, and you can spin up and down machines as needed.

As long as you're using containers, you're already going Cloud-Native.

The growing ecosystem of containers and cloud-native tools can help you create the solutions and services of tomorrow today.

The different types of cloud system

Public cloud providers may be far more extensive than the vendors that offer private clouds. Large businesses often have multi-year contracts, while smaller companies may choose to purchase on an as-needed basis, without locking themselves into a long-term commitment.
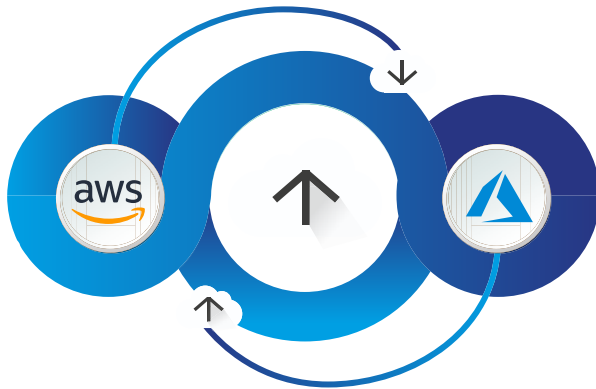
On the other hand, private cloud vendors may be much smaller and are sometimes seen as a more economical alternative, as they don't have to hire as many employees to run their business.

The cloud market can be full of contrasts, with benefits and risks that differ from vendor to vendor. With that said, here are a few key differences and considerations when planning your cloud strategy.

Security, compliance, and data sovereignty

Public cloud vendors generally meet their customers' security requirements, but they may not have similar security policies in place as private cloud providers. Public cloud providers can also offer data sovereignty over their customers' data, which can be easier to

manage. Private cloud vendors can't provide data sovereignty due to their data sitting behind firewalls, but they can ensure compliance and help you get around data silos.

Cost

Because a customer can provision resources in a public cloud or a private cloud of their own, public cloud vendors can charge on a per-consumable or per-year basis. That means if you use a cloud for 10 hours per month, you'll only pay for those ten hours a month, but if you're willing to share that resource with your team, it could cost a lot more.

Here are some common examples of public cloud pricing and some specific to each cloud vendor to help you understand how the pricing works. AWS, Microsoft Azure, and Google Cloud are the leading public cloud providers, and they typically offer slightly different terms. Here's how these prices break down:

- **Public cloud-only:** Amazon offers a 30-day free trial and monthly charges of $2 per month. Amazon offers a 30-day free trial and monthly costs of $2 per month.

- **Cloud-plus-AWS:** If you want a single license to use Amazon Web Services, you'll have to pay $5 per month for the first year. After that, you'll pay $15 per month. If you want a single license to use Amazon Web Services, you'll have to pay $5 per month for the first year. After that, you'll pay $15 per month.

- **Cloud-plus-Azure:** Azure prices start at $12 per month for the Standard plan. The total cost works out to be $80 per year.

- ✅ **Cloud-plus-Google:** Google charges $7 per month for its first year, after which you'll pay $20 per month.

  You might get a break on the price if you're using a single instance of your chosen cloud. Here are some costs for the same service across different options:

- ✅ **Private cloud:** Amazon charges $2.50 per hour for a single-node instance. Azure and Google charge $4 and $4.50 per hour, respectively.

- ✅ **Public cloud:** AWS charges $7.33 per hour for a single-node example. Azure charges $8.33 per hour for a single-node instance. Google charges $5.31 per hour for a single-node instance.

If you want to create your private cloud, there are plenty of options. Even though you might end up paying a bit more than if you were using a public cloud, it will be worth it for a more manageable private cloud project.

Data storage

Most public cloud providers provide a simple storage option: e-mail storage and collaboration. Amazon, Microsoft, and Google all offer in-cloud e-mail storage and collaboration services similar to one another and free. On the flip side, Dropbox charges you a small monthly fee per gigabyte for their cloud-based storage. On the public cloud side, Microsoft and Google offer multiple file storage options ranging from $0.005 per gigabyte to $0.10 per gigabyte, and Dropbox charges $0.01 per gigabyte.

Don't worry about data sovereignty for your company's data. The cloud storage capabilities of public cloud providers are most likely compatible with your data centers. Amazon and Google also have Cloud Platform

SDKs and APIs, allowing third-party companies to build their applications on top of the cloud providers' platforms. The important thing is to remember each cloud provider's limitations and make sure you take into account potential transfer and networking issues.

The cloud and networking

Data transfers are a large part of public cloud computing and, in some cases, can be expensive for businesses. As a general rule, the longer you are sending data, the more it will cost, while shorter transmission times will cost less.

For example, in the United States, companies can usually send one megabyte per second for free. One megabyte per second isn't much. For example, Amazon charges as little as $0.006 per megabyte for non-Prime customers.

For most businesses, though, sending 1 gigabyte per second is a deal-breaker. It's possible to send 100 megabytes per second to the United States with AWS and Azure, but it'll cost you $10 per month per 1000 megabytes. For all other locations, the cost is $0.005 per megabyte. And if you're sending over 40 terabytes a month, the price per month will be $1,260 with AWS and $2,330 with Azure.

Additionally, Amazon charges a flat annual fee for its Prime service, which comes in at $60 per year. Amazon's Prime Instant Video is another $59 per year for Prime members.

The amount of money you'll end up spending on your availability will depend on your business needs. Here are some pricing points for different bandwidth options:

Signing up for a VPN service

If you work in a highly regulated industry, you'll want to consider a private cloud. Private clouds have fewer regulatory concerns, and they're significantly less expensive.

When you set up a VPN for your company, you can control the VPN server's location and IP address, which helps protect your business's sensitive information. The great thing about a VPN is that you can buy a separate one for your private cloud.

The best VPNs provide a wealth of features, including NAT and IPSec tunnels, secure DNS, and faster uploads. Depending on the provider, a VPN's cost can range from $15 to $500 a month per customer.

Using a Hybrid Cloud

Hybrid cloud systems are popular because they offer features that public clouds cannot deliver. Because they use two types of cloud resources, private clouds can provide the same performance, reliability, and cost as public clouds while using fewer resources and being managed more efficiently by the IT department. Organizations may be tempted to migrate to public clouds because of the costs of running on-premises cloud services. But cloud services can also be costly when using resources that the organization doesn't own or that may not be available on-site. As an example, Amazon Web Services (AWS) costs $10 per hour for each server that the company uses. In addition to the servers' cost, you also pay for the bandwidth and

storage that your data needs. If the compute and storage requirements exceed the amount you're paying for, you'll have to pay AWS a charge for that excess use.

Private clouds and hybrid clouds work differently. In a hybrid, one cloud type is responsible for everything on-premises — like your own data center. The other type is responsible for the data entering from the internet and the servers that run that data. The organization's IT department still manages two kinds of clouds. You can move your workloads between the cloud types and do other things, but the services that are in the on-premises cloud are not entirely "cloud-enabled." This division requires more management.

Which cloud should I use? The best answer to that question depends on your individual needs. If you have many applications running in the cloud, public cloud resources might be ideal for you. Private cloud resources could be more appropriate if you have very few applications.

Another factor to consider is which of these cloud services meet your organization's security needs. Because hybrid cloud systems work more like private cloud systems, the organizations that do best with hybrid cloud are those with a strong IT infrastructure.

What is a hybrid cloud?

You may have heard the term hybrid cloud before, especially in the context of a private cloud, but what does that mean? It's not a natural outcome of a private cloud, nor is it the logical outcome of a public cloud (Amazon Web Services). Instead, it's an architecture choice that adds one or more types of resources to an existing IT infrastructure, changing the ownership, coordination, and purpose of individual applications between private and public cloud platforms.

So let's use a typical example to get a better understanding of this new architecture. Let's say your organization has five private data centers and five public cloud platforms to spread the workloads across all the different use cases and domains. In this scenario, you'd still have the five data centers as individual pieces of infrastructure. Nevertheless, you'd have all of the cloud platforms in one dedicated instance, in which each forum would be completely private. Here's how the different types of cloud platforms fit into this architecture.

Each cloud platform in this scenario is separate from the other but links to private data centers. For example, if you want to deploy the Google Cloud Platform, you use the Google Cloud Platform Private Cloud, or GPCP for short. GPCP is an extension of the public Google Cloud Platform (GCP), running in a dedicated instance in private data centers. You're then able to manage GPCP instances

using Google tools and APIs and work with GCP services from one set of tools and APIs. This hybrid configuration allows you to use the same management tools and APIs for all five platforms without managing each separately, which could be a significant time-saver.

Hybrid cloud capabilities are extending beyond the five public cloud platforms, too. We've seen the public cloud market evolve to the point where most IT professionals are already using a hybrid cloud model in the private cloud, so IT departments are more and more leveraging the same tools and processes for public and private clouds. However, this same concept doesn't extend to all of the top public cloud platforms, so here's what they might look like.

Now that Amazon is bringing IaaS to the public cloud, the company makes a hybrid cloud that uses the standard approach to deploying applications. Each of the public cloud platforms offers a hybrid-like approach by using virtual machines and containers. You can use the AWS Cloud Shell, a command-line-based console, to provision a new public cloud instance that's connected to one or more private data centers, essentially creating a private cloud. You can \use AWS Athena, a tool that's baked into the AWS Cloud, to publish virtual machine-native applications that are secure, scalable, resilient, and comply with the latest security and compliance standards. You can also use Amazon ECS, an integration container management tool, to orchestrate, manage,

and perform complex operations across different types of containers connected to a variety of AWS Cloud platforms.

This type of setup makes the best use of private cloud instances and is also compatible with public cloud platforms, making it much more cost-effective than maintaining individual clouds. This hybrid cloud configuration allows you to do things like scale the container instances across different regions, host them on AWS's more than 60 data centers worldwide and use the AWS tools and APIs.

Google has always been an excellent public cloud option, offering the same control and freedom you would expect from a private cloud while also using standard tools and protocols to manage your workloads across all of your infrastructure. GCP offers a similar approach to public and hybrid cloud platforms by using virtual machines and containers. You can also deploy and scale applications on the Google Cloud Platform using a combination of the Google Cloud Platform Console, Google Cloud IoT Core, and Google Container Engine (GKE), among others. Once you've configured your applications, it's easy to continue working on them using GCP tools and APIs, including the Google Cloud Shell.

The Google Kubernetes Engine also enables you to use Google Kubernetes, an open-source, hybrid cloud-native application framework, for running containerized workloads. Once you've set up your containers, it's a snap to launch and manage them using the Google Cloud

Launcher, a convenient tool that will run containers, scale them, and deploy and manage applications. This hybrid cloud setup allows you to take advantage of the power of Google's public cloud platform while also utilizing your own data center or private cloud.

Microsoft Azure

One of the easiest ways to move existing workloads into the Azure cloud is to use the Azure Marketplace. Azure Marketplace offers tools and products that make it easy to move legacy applications, such as legacy workloads in Microsoft SQL, Azure Active Directory (Azure AD), and Exchange, into Azure. The Microsoft Azure Container Service (Azure CS) lets you deploy container-based applications on Azure. Simultaneously, the Microsoft Azure Monitoring Service (Azure MMS) enables you to create, view, and track container and cloud workload monitoring. Microsoft Azure Active Directory Service (Azure AD SDS) allows you to deploy, connect, and manage Microsoft Azure Active Directory on-premises and in the cloud. Microsoft Azure Stack gives you an option to combine the freedom and control of an on-premises private cloud with the power and ease of use of Azure's public cloud.

IBM **Cloud**

IBM Cloud offers a wide range of public and hybrid cloud solutions. The IBM Cloud Hybrid Service provides a service that combines VMware Cloud on AWS with cloud-native capabilities from IBM to enable companies to build and host their entire applications across VMware and AWS public clouds. You can use IBM Cloud Private

for AWS for your applications or use the IBM Cloud Platform for SAP HANA for applications.

IBM Cloud also offers a wide range of cloud-computing services for IoT, big data, blockchain, advanced analytics, and other unique computing workloads, such as IBM Analytics Cloud, IBM Analytics, and Cloud Platform HPC, all built on IBM Cloud. For the Oracle Cloud, IBM offers the IBM Cloud on SAP HANA for SAP customers. This offering lets you run and manage your SAP HANA database applications in the cloud or your private data center.

In addition to using these cloud service providers to host your workloads, you can also choose to run workloads and applications on your hardware using virtual machines and containers. You can choose a private cloud solution for greater flexibility or deploy a public cloud solution for efficiency. The choice is yours.

Virtualization

In addition to running your workloads and applications on-premises or in the cloud, you also have the option to run them in virtual machines and containers. As with traditional operating systems and applications, virtualization software can take advantage of the multiple processors and memory that have become standard in most servers. Virtualization can also make it easy to mix and match hardware so that you can swap out one processor chip or another for a performance boost or combine several processors to create the right multicore solution.

A key aspect of running in a virtualized environment is the hypervisor, the software that orchestrates the virtual machine you are running. Hypervisors also can help you create secure, private, and isolated virtual environments.

To set up a virtual machine or deploy a container image, you need to use the open-source Xen hypervisor and its associated tools. In general, you can use the Xen hypervisor on any architecture, including ARM, x86, Power, and IBM System Z.

Virtualization also can be used to run applications on your hardware. You can use virtualization to run virtualized applications on bare metal or virtualized servers running on Intel chips, Power chips, or other systems with virtualization capabilities built-in. In this case, you have to specify whether you want to use a physical or a virtualized server for the hypervisor. With a virtualized solution, you can configure and manage virtual machines that use a hypervisor or an alternative.

In addition to Xen and KVM, other hypervisors used for virtualization include Microsoft Hyper-V, Parallels XenServer, and VirtualBox. You also can choose to run a Microsoft Windows-based hypervisor, such as VMware ESX or KVM, on bare metal systems. If you want to run a Windows-based hypervisor, such as Hyper-V, on x86 systems, you can use the Intel Compute Platform, which runs KVM.

When you run virtual machines or containers, you typically do not have access to the underlying hardware, so you need virtualization software and drivers. The virtualization software also enables you to access the hardware that your virtual machine or container is running on. It can make hardware-intensive tasks, such as memory allocation and virtual disk creation and deletion, easier.

To create a virtual machine, you create a virtual disk image with an appropriate storage capacity, memory, and CPU. You then mount this image on your virtual machine or container host machine and use the hypervisor to interact with the underlying hardware.

When you deploy a container, you create a virtual machine with the appropriate container image. You then use the hypervisor to create a virtual machine, and when you use the hypervisor to interact with the underlying hardware. This approach, called hyper-converged infrastructure, helps simplify managing containers and virtual machines, which should be considered an essential part of the IT landscape.

Mobile systems

Traditional on-premises infrastructure can be extended with mobile solutions, such as smartphones or tablets, to create an application-rich mobile computing environment. Using mobile devices to manage and operate business IT and access, interact with, and view data and data-intensive information and applications is a beneficial and economical solution.

In addition to supplying mobile devices, on-premises systems vendors offer virtualized enterprise applications that can provide an underlying cloud-like system for mobile devices. If you need mobile capabilities to manage and interact with business applications, then mobile virtualization may be the solution for you. These solutions, which rely on virtualization software for management, data management, and communication, can be deployed on various mobile devices, such as Apple iOS and Google Android.

Private clouds

Private clouds can be useful for enterprises that require a more tightly controlled environment for handling business applications that don't use sensitive information and data. The vendors that offer private cloud solutions include Cisco, Microsoft, Citrix, VMware, Oracle, and IBM. You can think of private cloud deployments as a hybrid computing solution where your on-premises data center connects to a private cloud solution.

This approach offers many advantages compared with on-premises systems. With a private cloud, you can enforce policies, such as network access and other security measures, that you wouldn't be able to impose on your on-premises infrastructure. You can connect directly to a remote site and have that site handle your IT needs, such as storage, server management, and networking.

For many enterprises, a private cloud approach may be the best way to run their private networks because they can use the security features of personal cloud technology to protect sensitive information. Private clouds allow businesses to move more workloads to the cloud and use public cloud technology for other applications.

Developing a strategy for a multi-cloud

How do you move from a public cloud strategy (where data is in the public cloud) to a hybrid cloud (where information is both in the public cloud and on-premises)?

My recommendation is to look at the elements of a hybrid cloud. Most strategies will have some hybrid in there somewhere.

- The critical aspects of a hybrid cloud are:

- Your strategy mustn't be based on a single element.

- A strategy should be adaptive and can be changed over time.

- If your strategy is based around security and performance, then you'll need to review that strategy in three to five years.

- If your strategy is based on application support, you might want to revisit that strategy in a decade.

- Ensure that you have some flexibility in what data you keep in each part of the hybrid cloud.

Public, private, and hybrid clouds are all options to help ensure that your business has access to the computing and communications resources it needs to grow and thrive. You should base your choice on your business's specific requirements and budget and the availability of different technologies to deploy your applications. These choices can help you deliver IT that meets your business's needs.

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