22AIE305: CLOUD COMPUTING

PUBLIC CLOUD

A public cloud is an IT model where public cloud service providers make computing services—including compute and storage, develop-and-deploy environments, and applications—available on-demand to organizations and individuals over the public internet.

Rapid Elasticity:

- Elasticity is defined as the ability to scale resources both up and down as needed.
- To the consumer, the cloud appears to be infinite, and the consumer can purchase as much or as little computing power as they need. This is one of the essential characteristics of cloud computing

Advantages

- Measured Service: In a measured service, aspects of the cloud service are controlled and monitored by the cloud provider. This is crucial for billing, access control, resource optimization, capacity planning and other tasks.
- On-Demand Self-Service: The on-demand and self-service aspects of cloud computing mean that a consumer can use cloud services as needed without any human interaction with the cloud provider.

Advantages

- Ubiquitous Network Access: Ubiquitous network access means that the cloud provider's capabilities are available over the network and can be accessed through standard mechanisms by both thick and thin clients.
- Resource Pooling: Resource pooling allows a cloud provider to serve its consumers via a multi-tenant model. Physical and virtual resources are 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)

PUBLIC VS PRIVATE

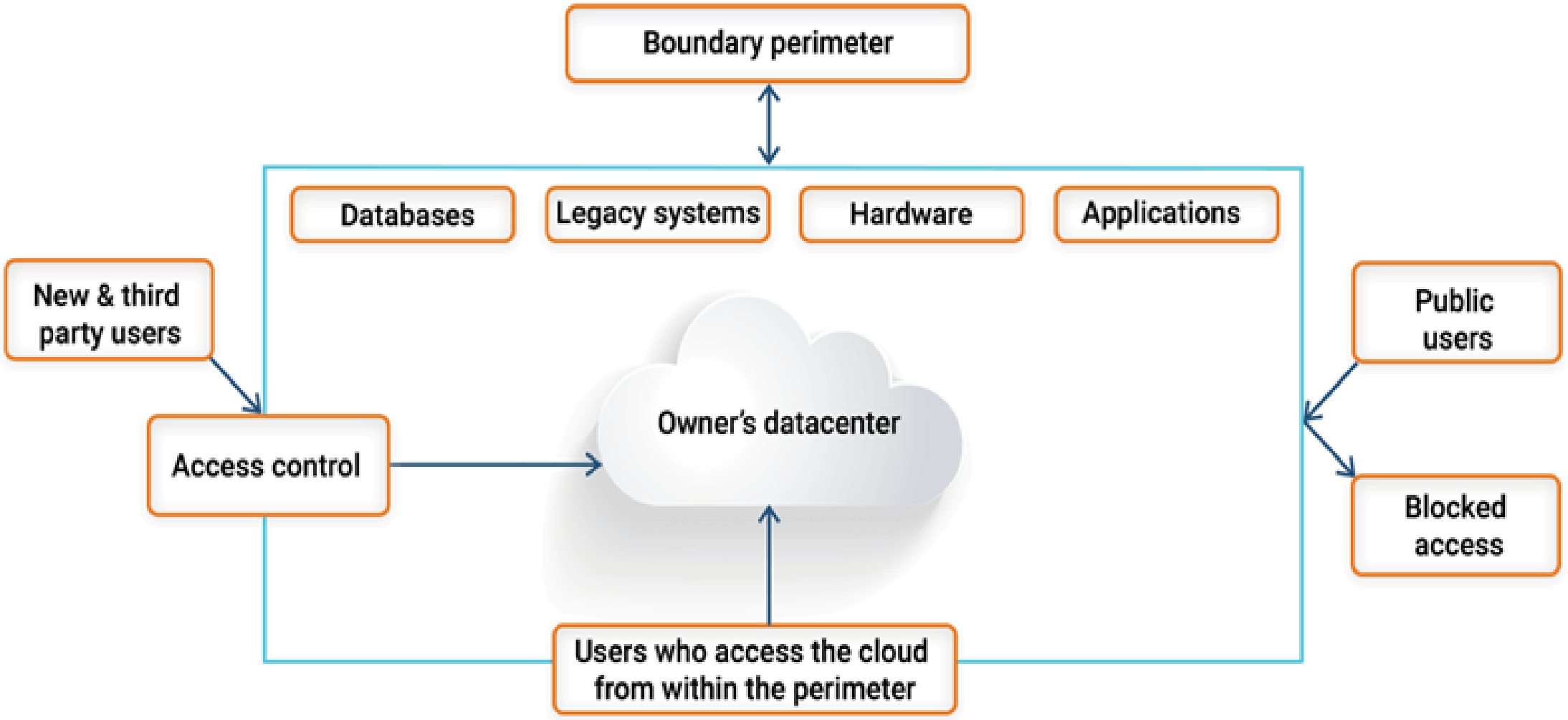
The main difference between public cloud and private cloud is where it is hosted and who is responsible for managing it.

PUBLIC VS PRIVATE ANALOGY

A common public cloud example is to think of it as similar to renting an apartment: You pay rent for a single apartment, the building manager handles the maintenance, you share the overall space with other tenants, with security around your own belongings.

Private cloud is more like owning a house, where you have your own personal space that belongs to you, but you're also personally responsible for the overall care and upkeep.

PRIVATE CLOUD



Characteristics of Private Cloud

Here are some important characteristics of the Private Cloud:

- Employees can securely access data around the globe using a device of their choice.
- High availability and redundancy are inherently part of the architecture.
- Gives you better and more direct control over your data.
- Cloud computing is a transformational catalyst for business.
- Offers flexibility in serving up applications.
- Built-in resource usage and audit logging tools.

TYPES OF PRIVATE CLOUD

There are various ways in which private clouds can be hosted and managed. Each implementation offers its unique functionality and advantages. Here are three types of Private Clouds:

Virtual Private Cloud: A Virtual Private Cloud (**VPC**) is a cloud model that offers the benefits of a private cloud using public cloud resources. VPC uses isolated environments within public clouds. VPC allows organizations to run their workloads independently from other users. Virtual logic ensures that users' computing resources are private even though other organizations share the server.

Hosted Private Cloud: In this type, the Cloud Service Vendor offers servers used exclusively by a single organization. They manage the network and hardware/software updates for you. The vendors offer a support team, high-demand scalability options, and a user-friendly dashboard to assist in server management.

Managed: Managed private clouds are private clouds that do not share their infrastructure. It is called a dedicated or single-tenant cloud. Usually, the organization owns the data center and not the cloud provider. Mostly third-party vendor manages this kind of private Cloud. The vendor offers support, upgrades, maintenance, and remote management services in this private Cloud.

VMWARE PRIVATE CLOUD

VMware, a subsidiary of Broadcom, is a provider of virtualization and cloud computing software headquartered in Palo Alto. It offers a suite of private cloud solutions that seamlessly integrate with existing infrastructure. With a global presence in over 120 countries, VMware is the top private cloud provider.

#	Cloud Service Provider	Regions	Availability Zones
1	Amazon Web Services (AWS)	33	105
2	Microsoft Azure	64	126
3	Google Cloud Platform (GCP)	40	121
4	Alibaba Cloud	30	89
5	Oracle Cloud	48	58
6	IBM Cloud	10	30
7	Tencent Cloud	21	65
8	OVHcloud	17	37
9	DigitalOcean	9	15
10	Linode (Akamai)	20	20

Amazon Web Services (AWS), the cloud computing service of Amazon.com, is the largest cloud service provider globally. From its data centers, the business provides over 200 fully featured services including compute, storage, and database.

AWS offers a popular private cloud called Amazon Virtual Private Cloud or Amazon VPC. Using VPC, you can launch AWS resources in an isolated virtual network that you define – i.e., on-premises or through a remote managed provider. Essentially, VPC lets you create a private instance of public AWS resources, complete with its core capabilities.

Azure, the second largest cloud service provider globally.

Through Microsoft Azure, the company delivers a consistent hybrid cloud experience, developer productivity, artificial intelligence (AI) capabilities, and security & compliance.

Offers a range of private cloud solutions, including Azure Stack HCI, Azure Stack Hub, and Azure Stack Edge for on-premises deployments and Azure Dedicated Host for single-tenant private cloud hosting

Provides Azure Virtual Networks and ExpressRoute, which allow customers to create isolated and secure cloud environments and establish private connections to Azure.

Utilizes its own hypervisor, Hyper-V, for virtualization, which is built directly into Windows Server operating systems running on Azure's cloud infrastructure

Google Cloud Platform (**GCP**), part of Alphabet Inc, is the third largest cloud service provider globally, providing enterprise-ready cloud services. GCP enables developers to build, test, and deploy applications on its distributed and scalable infrastructure, while utilizing the service's capabilities in security, data management, analytics, and artificial intelligence (AI). It is a public Cloud.

GoogleCloud

- Google Cloud provides storage, development tools, access to machine learning and DBMS, and much more.
- The services provided by Google Cloud are various, including IaaS, SaaS and PaaS solutions.
- Shared VPC, where multiple projects can leverage the VPC network with individualized management and billing for each project

Public cloud platforms, such as Google Cloud, pool resources in distributed data centers around the world that multiple companies/users access over the internet. Rather than an in-house team, the public cloud providers are responsible for managing and maintaining the underlying infrastructure. As a result, leveraging public cloud services reduces IT operational costs and frees up time for teams to focus on valuable work that directly benefits the business.

Google has both public and private cloud offerings. Google Drive is a public cloud storage solution whereas Google Anthos can be used to create customized virtual private cloud (VPC) and hybrid clouds

Google private cloud solutions include Anthos for hybrid and multi-cloud management, VMware Engine for running VMware workloads natively on Google Cloud, and Distributed Cloud Edge for running workloads at the network edge.

Google Compute Engine (GCE) is built on top of the KVM hypervisor, and consists of custom-designed servers, storage systems, and networking equipment connected through a high-speed, software-defined network architecture

Google Multi-cloud delivers multi-cloud management and interoperability through its Anthos platform, allowing users to manage and deploy applications across multiple clouds, including AWS and Azure, as well as on-premises environments.

Cloud Storage

Globally unified, scalable, and highly durable object storage for developers and enterprises.

Compute Engine

Computing infrastructure in predefined or custom machine sizes to accelerate your cloud transformation.

BigQuery

Serverless, highly scalable, and cost-effective cloud data warehouse designed for business agility.

Google Kubernetes Engine

Google Cloud's highly reliable and automated Kubernetes service that lets you get started easily.

Anthos

Modernize existing applications and build cloud-native apps anywhere to promote agility and cost savings.

SOLUTION

Serverless computing

Enable faster and more secure development, deployment, and operations.

Alibaba Group's cloud computing unit, known as Alibaba Cloud, is the fourth largest cloud service provider globally, the primary cloud vendor in Asia Pacific, and the largest cloud service provider in China. Through Alibaba Cloud, the business offers cloud services, including elastic computing, database, storage, network virtualization, large-scale computing, security, management & application services, big data analytics, and machine learning.

Oracle Cloud Services offers SaaS and Oracle Cloud Infrastructure (OCI). Through OCI, the company delivers Oracle Private Cloud Appliance and Oracle Private Cloud at Customer, including compute, storage, and networking services.

Kyndryl, now designs, builds, and manages private, public, and multi-cloud environments for its customers.

OVHcloud is a Europe-focused cloud service provider offering solutions including bare metal & hosted private cloud, public cloud, and web cloud services. Linode, owned by Akamai Technologies, is a cloud computing platform and an Infrastructure-as-a-Service (IaaS) provider

DigitalOcean

- The company started as a wireless technology maker and creator of the first smartphone in the world, Seahorse.
- Today, DigitalOcean is one of the world's first IaaS producers. They provide users with virtual machines, apps, databases, virtual private cloud, cloud firewalls, and other virtual infrastructure elements needed for uninterrupted business operations.

Adobe CreativeCloud

- Creative Cloud is a SaaS model where users can access any of the Adobe products on the cloud for a subscription.
- A user can use any of the Adobe products during a trial period. If the user is dissatisfied, they can stop the trial and pay nothing.
- Otherwise Adobe will start billing the user on a monthly basis

Hewlett Packard HPE

- Hewlett Packard Enterprise (HPE) offers a range of private cloud solutions, including Infrastructure as a Service (IaaS) through their HPE GreenLake platform, which provides a pay-per-use model for computing, storage, and networking resources.
- Supports multiple virtualization technologies, such as VMware vSphere, Microsoft Hyper-V, and OpenStack

IBM Cloud

- Offers a range of private cloud solutions, including Infrastructure as a Service (IaaS) with IBM Cloud Private and Platform as a Service (PaaS) solutions, such as IBM Cloud Paks, which run on Red Hat OpenShift.
- Uses virtualization platforms, including VMware, OpenStack, and IBM's own PowerVM, which run on top of IBM's hardware infrastructure consisting of IBM Power Systems and IBM Z mainframes

Dell

- Dell Digital matrix, EMC PowerOne autonomous infrastructure and Dell EMC VxRail hyperconverged infrastructure
- Uses Iaas with PowerEdge servers, PowerSwitch networking, and PowerMax storage systems
- Dell offers private cloud service through the Project Apex cloud console

Cisco

- Cisco Unified Computing System (UCS) for Infrastructure as a Service (IaaS)
- Cisco Container Platform for Platform as a Service (PaaS)
- Utilizes VMware vSphere as the primary virtualization platform, along with Cisco's Application Centric Infrastructure (ACI) for software-defined networking (SDN) and Cisco HyperFlex for hyperconverged infrastructure

Rackspace

- Offers managed private cloud solutions, including dedicated servers, virtualization, and hybrid cloud environments, supporting various platforms such as VMware, Microsoft, and OpenStack
- Delivers “programmatic” infrastructure by partnering with original equipment manufacturers (OEMs) like Dell, Cisco, Palo Alto Networks, and NetApp to provide standard offers at scale or solutions tailored to a customers’ specific needs

SAP

- SAP, better known for its enterprise resource planning (ERP) software, offers a sophisticated private cloud solution as well. The company's SAP S/4HANA Cloud (private edition) brings the full potential of SAP into a private cloud environment, complete with a pre-built line of business (LoB) and industry processes.
- supports 25 industries in 39 world languages

Distinguish between private and public cloud

- Private cloud computing involves **dedicated** resources and infrastructure hosted either on-premises or in a third-party data center, exclusively for a single organization. In contrast, public cloud computing provides **shared** resources and infrastructure, managed by a third-party provider, to multiple clients over the internet. Some organizations may opt for a **hybrid** approach, combining both private and public cloud solutions.

Cloud Computing Security Challenges

- Data Privacy/Confidentiality
- Unauthorized Access
- Hijacking of Accounts
- Legal & Regulatory Compliance
- Lack of Visibility in Security
- External Sharing of Data
- Misconfiguration
- Unsecure Third-party Resources