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Cloud Foundations

Chapter 3: Types of Cloud

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Types of Cloud

The search for a Business Model

- As cloud computing emerged, companies were created. Questions arose: what is the best structure for companies engaged in the cloud industry, and how can a company generate revenue?

- Should a single company handle both physical facilities (air conditioning, power, and building security) and data center facilities, or should separate companies handle the two aspects?

- Should a single cloud company handle both the cloud hardware (e.g., servers and network equipment) and software (e.g., the software to create and control virtualized servers, the operating systems, and apps running on the servers), or should separate companies handle hardware and software?

What happened based on what you know of the current Cloud market?

Types of Cloud

The search for a Business Model

- A new industry always faces the question of overall structure.
- For cloud, it initially seemed some companies would develop the expertise needed to deploy and manage software and others would manage power and air conditioning.
- To maximize profits, however, companies that initially focused on physical infrastructure began to expand expertise and move into other segments.
- To categorize companies in the cloud industry, a classification arose that divides companies into several categories.

What categories can you think of based on the examples of Cloud applications we saw at the beginning of Chapter 1?

Types of Cloud

Cloud Service Types

- Cloud companies were divided into three broad categories.
- Although they are somewhat loosely-defined and overlap, the categories help clarify the major roles of companies.
- Each category uses the phrase as a Service:
  - **Infrastructure as a Service**
  - **Platform as a Service**
  - **Software as a Service**
- As Cloud companies expanded, some companies started to have several offers. This categorization now applies to the different offers/services provided by Cloud companies.

Could you give some examples of these different service types?

Types of Cloud

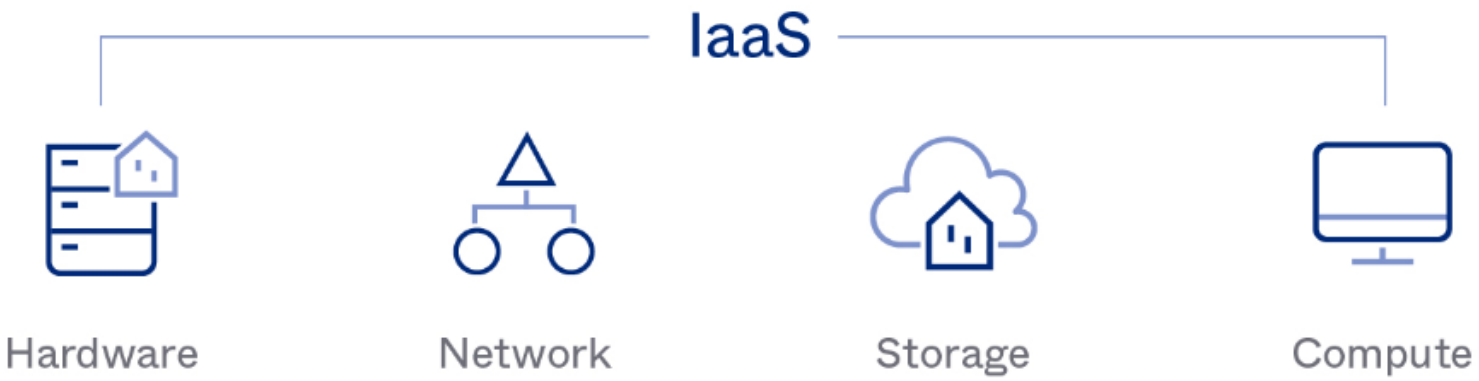
Infrastructure as a Service (IaaS)

- In the simplest case, an IaaS company offers physical resources, such as a building, power, and air conditioning.
- Typically, IaaS companies also provide servers, networking equipment, and basic data storage facilities (e.g., block storage on disk).
- An IaaS company may offer customers many additional services, such as load balancers, data backup, network security, a way to boot both physical and virtualized servers, and assignment of Internet addresses.
- A customer can choose which operating systems and applications run and may have the ability to control network access (e.g., to configure a firewall).
- The most advanced IaaS companies use operating systems that can scale the customer's services and the facilities allocated to a customer up or down as needs vary.

Types of Cloud

Infrastructure as a Service (IaaS)

- In a nutshell, IaaS covers the following resources:



Types of Cloud

Software as a Service (SaaS)

- SaaS is a subscription model in which a customer pays a monthly fee to use software rather than make a one-time purchase.
- Cloud computing has enabled the SaaS industry by providing a way for SaaS vendors to scale their offerings to handle arbitrarily many customers.
- When a user accesses a SaaS application, the application runs on a server in a cloud data center rather than on the user's computer. Files that the user creates are stored in the cloud data center rather than on the user's local device.
- One very famous example of SaaS is Microsoft 365 in which each customer pays a monthly fee to use programs in the Office suite.

Types of Cloud

Software as a Service (SaaS)

- SaaS has the following main advantages:
  - **Universal access:** SaaS software can be accessed at any time from any device, for example using a web browser, or a mobile app.
  - **Guaranteed synchronization:**
    - Synchronization refers to keeping data identical across multiple devices.
    - With conventional software, synchronization problems arise because a user must load a copy of a file onto a device before using the file.
    - The SaaS synchronization guarantee arises because only one copy of each file exists. All changes are applied to a single copy of the file, even if the changes are made using two devices.

Types of Cloud

Software as a Service (SaaS)

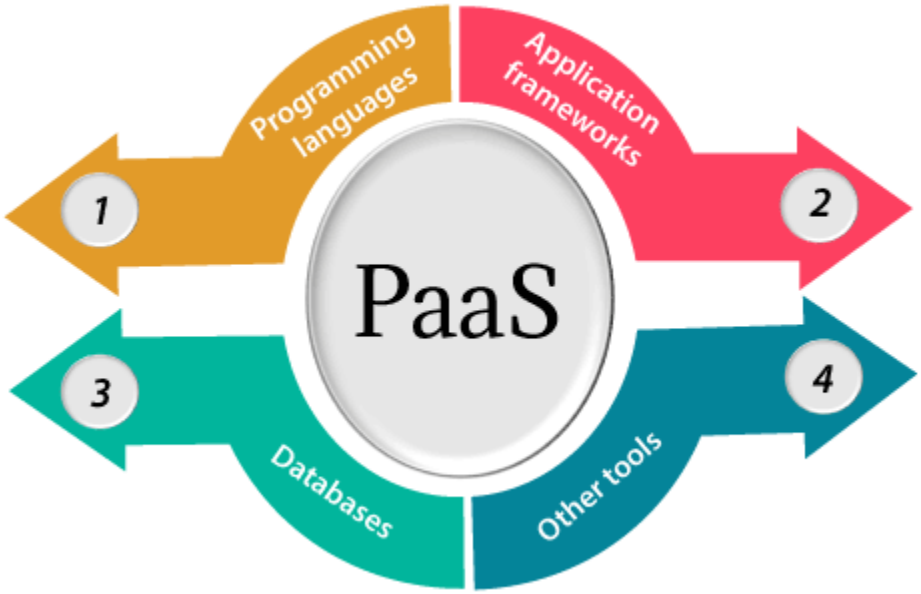
- SaaS has the following main advantages:
  - **High availability:**
    - Most data centers have uninterruptible power systems that use generators and/or battery backup systems. Thus, the data center can continue operating during a power outage.
    - In addition, the data storage facilities at a data center usually include a backup mechanism, and many store the backups at another physical location.
  - **Low resource access:**
    - Because processing and storage occur in a cloud data center, a device used to access a SaaS service does not need a powerful processor, large memory, or storage.

Types of Cloud

Platform as a Service (PaaS)

- The primary goal of PaaS is a facility that allows a customer to build and deploy software in a cloud without spending effort configuring or managing the underlying facility.

- You can think of PaaS as development and deployment tools for Cloud, as well as any tool you may use in the Cloud to build/run an application.



Types of Cloud

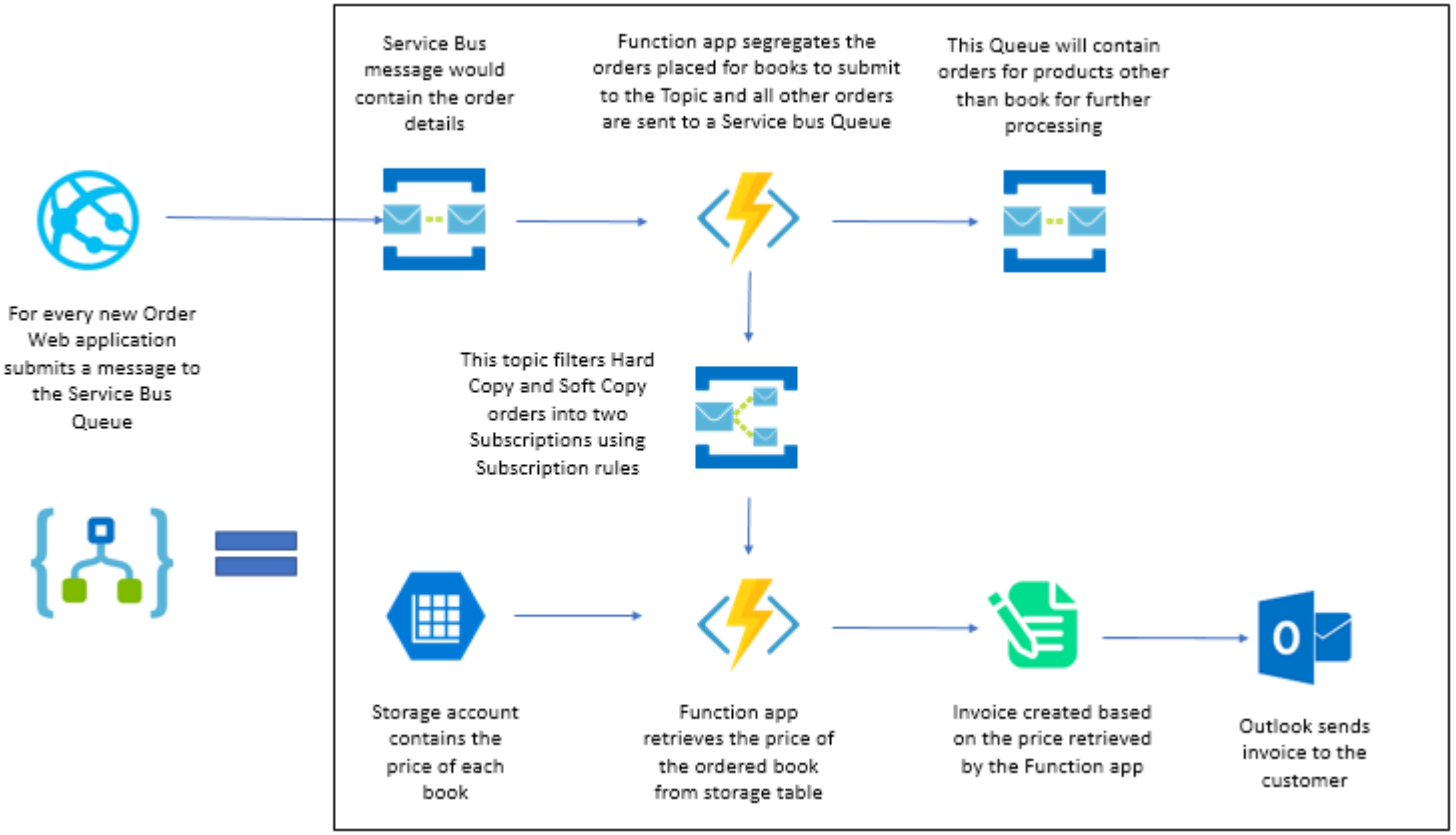
Platform as a Service (PaaS)

- A company offering PaaS may provide both basic infrastructure and facilities for software development and deployment.
- Basic infrastructure includes many of the IaaS facilities, such as servers, storage facilities, operating systems, databases, and network connections.
- Facilities for software development and deployment include compilers, middleware, program libraries, runtime systems (e.g., Java runtime and .NET runtime), and services that host a customer's applications.

Types of Cloud

Platform as a Service (PaaS)

- This is an example of an e-commerce application deployed in Azure using several PaaS services:



Types of Cloud

Platform as a Service (PaaS)

- Although it is often associated with cloud infrastructure, PaaS can also appear in other forms.

- For example, some PaaS companies sell software development tools that allow a customer to build and deploy apps on the customer's internal network (e.g., Github)

- Other PaaS companies sell a software development tool intended for a cloud environment, but require the customer to obtain servers, storage, network connections and other cloud facilities separately (e.g., Docker)

Types of Cloud

Cloud Service Type Quizz

- In which category can you classify these Cloud services:
  - Virtual Machine:
    - IaaS
  - Blob Storage:
    - PaaS
  - Microsoft Teams:
    - SaaS
  - SQL database:
    - PaaS
  - Google Translate:
    - SaaS
  - Azure cognitive services translation:
    - PaaS

Types of Cloud

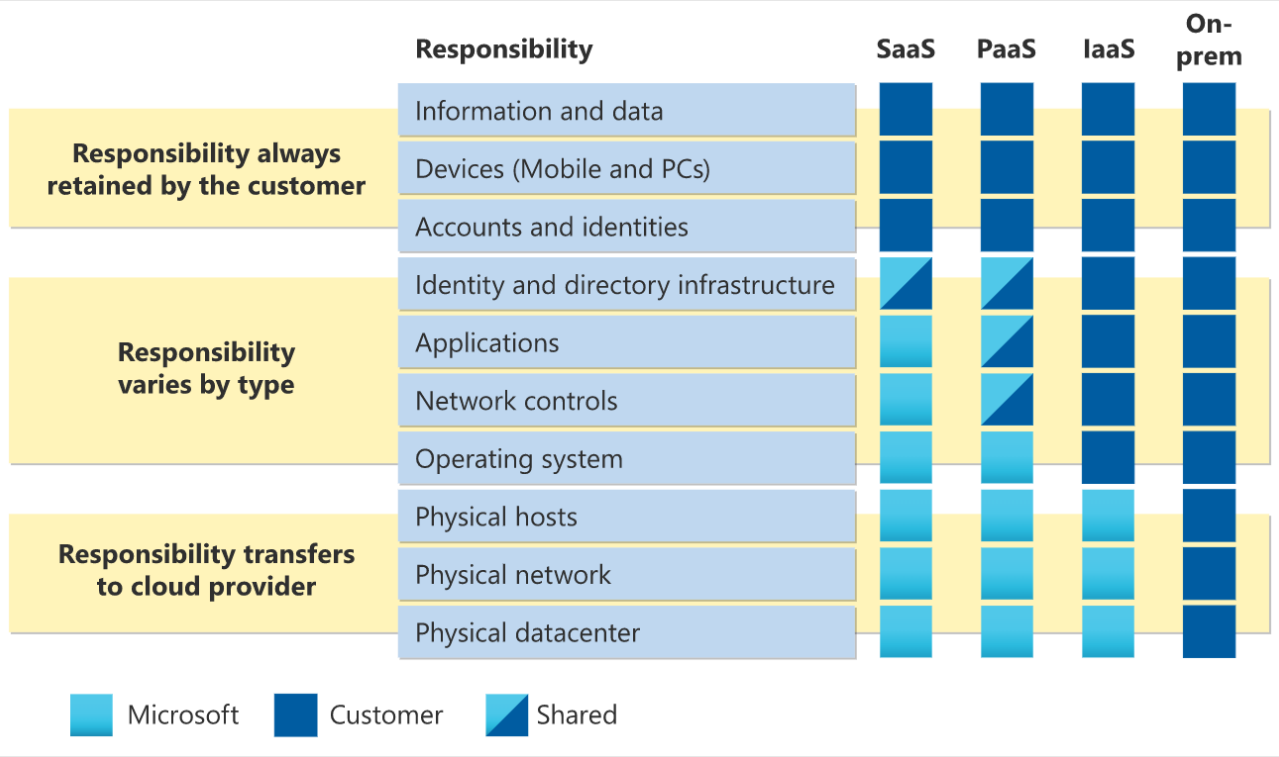
Many more types

- As Cloud offers evolved, many groups started to use the phrase as a Service to describe their particular niche offer:
  - **Network as a Service**
  - **Security as a Service**
  - **Desktop as a Service**
  - **AI as a Service**
  - **Function as a Service**
  - **…**
- However, all these offers can be seen as subcategories of the three main categories.

Types of Cloud

The shared responsibility model

- In a traditional corporate datacenter, the company is responsible for managing everything.
- With Cloud, the responsibility is shared with the Cloud Provider as follows:

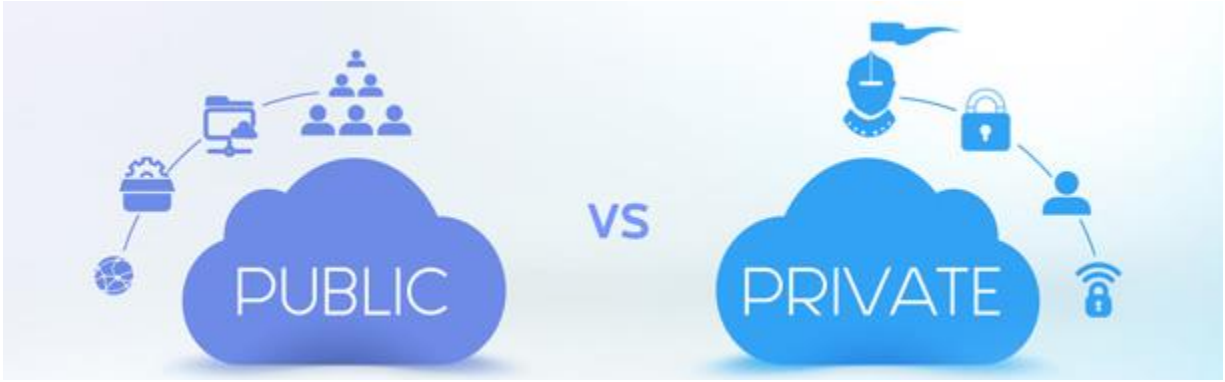


Types of Cloud

Cloud Deployment Models

- In addition to the categorization by service types, cloud computing can also be divided into two basic deployment models:
  - **Public Cloud**
  - **Private Cloud**

- Deployment models refer to the way cloud technologies are used by a company



Have you ever heard about these two types? What do you think is the difference between them?

Types of Cloud

Public Cloud

- A company that offers cloud computing to its customers is said to operate a public cloud.
- When using a public cloud, an organization leases services, including virtualized servers, and then uses the leased facilities to perform computation.
- When using a public cloud, an organization must choose a type of service:
  - A medium or large size enterprise customer is likely to choose an IaaS service that offers a set of virtualized servers, an amount of block storage, and Internet connectivity.
  - Customers who intend to create and deploy their own apps, may subscribe to a PaaS service.
  - A smaller public cloud customer may choose to subscribe to specific SaaS services.

Types of Cloud

Private Cloud

- Private cloud is a bit counterintuitive as it describes a cloud data center that is owned and operated by an organization and restricted to the organization's computing.
- What is the difference in your opinion between a traditional corporate data center, and a private cloud?
- We saw in the first chapter that an organization can reduce costs by consolidating all of its servers by placing them in racks in a data center.
- The organization can further reduce costs by employing cloud technologies, especially virtualization. This is what we call a private cloud.
- A private cloud allows the organization to benefit from flexibility and elasticity in the use of IT resources: computing from multiple departments can be easily spread over multiple physical servers.

Types of Cloud

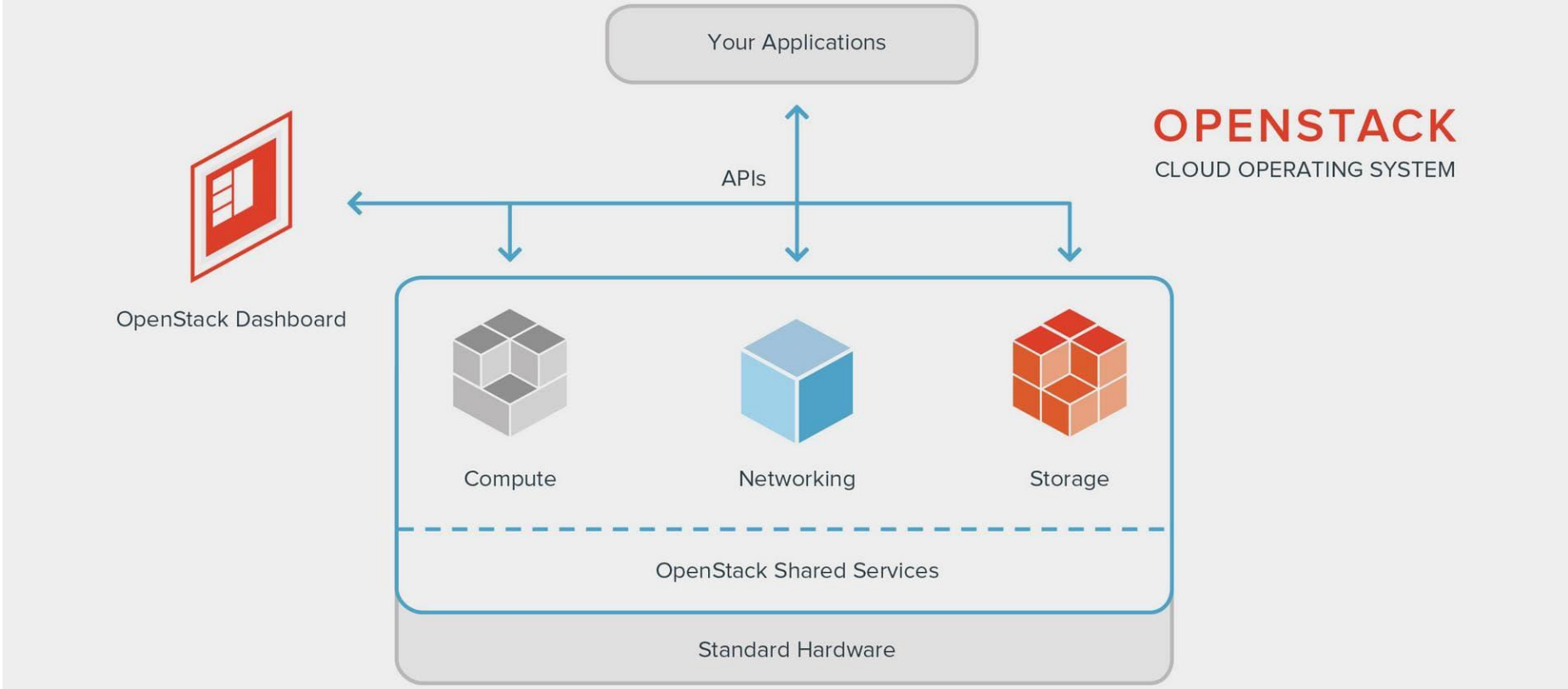
Private Cloud

- Private Cloud can either be managed by the IT staff of the company owning it, or by a third party.
- Some companies also specialize in providing solutions specific to the implementation and management of private clouds, we can cite:
  - VMWare
  - IBM
  - OpenStack
  - …

Types of Cloud

Private Cloud

- OpenStack is a suite of open-source software that allows you to create a full IaaS solution directly on physical servers:



Types of Cloud

Advantages of Public Cloud

- What are in your opinion the advantages of Public Cloud compared to Private Cloud?

- Public Cloud providers advertise three main advantages:

  - Economic:
    - Public cloud cost less than private clouds due to the economy of scale.

    - Because they are larger, they can also use equipment that is less expensive but more difficult to manage like Software-Defined Networking (SDN) switches.

Types of Cloud

Advantages of Public Cloud

- What are in your opinion the advantages of Public Cloud compared to Private Cloud?

- Public Cloud providers advertise three main advantages:

  - Expertise:
    - Because it is much larger than the IT department in a single company, a public cloud provider can afford to maintain a staff with specialized expertise.

    - Thus, customers have access to expertise on a much wider range of topics than a local IT staff can provide.

Types of Cloud

Advantages of Public Cloud

- What are in your opinion the advantages of Public Cloud compared to Private Cloud?

- Public Cloud providers advertise three main advantages:

  - Advanced Services:
    - Public Clouds can offer advanced services that could be either too complex to manage or too costly to implement in a small scale.

    - We can cite here advanced security mitigation techniques, large scale high availability, as well as complex AI tools.

    - Cloud providers also offer platforms that allow a customer to build and deploy new apps without understanding the details of the underlying system. A software engineer can focus on building an app without learning how to create and replicate virtualized servers, establish network connectivity, or handle remote storage.

Types of Cloud

Advantages of Private Cloud

- It may seem that the advantages of public cloud will drive all companies to use public cloud services. Why would some companies prefer to have a private cloud?

- Private Cloud offers some advantages:

  - Retention of control and visibility :

    - For organizations in a regulated industry, regulations may require the organization to control the placement and transmission of data as well as the hardware and software used. A private cloud makes it possible for such an organization to comply with the rules.

Types of Cloud

Advantages of Private Cloud

- It may seem that the advantages of public cloud will drive all companies to use public cloud services. Why would some companies prefer to have a private cloud?

- Private Cloud offers some advantages:

  - Reduced latency with on-premises facilities :

    - Because they are located within a company, private cloud facilities are said to be on-premises.

    - The delay between employees and a private cloud data center can be significantly lower than the delay to a public cloud, especially if an organization is geographically distant from a public cloud site.

Types of Cloud

Hybrid Cloud

- Instead of choosing between public and private clouds, some organizations opt for a compromise that offers some of the advantages of each.
- Known as Hybrid Cloud, the compromise means an organization uses a public cloud provider for some computing and runs a private cloud for the rest.
- The balance between the two depends on the organization's needs as well as cost.
- Examples of why an organization might adopt a hybrid cloud approach include:
  - Control when needed: the hybrid approach allows companies subject to regulations to store these data on a private cloud, and reduce the costs by using public clouds for less sensitive computation.

Types of Cloud

Hybrid Cloud

- Examples of why an organization might adopt a hybrid cloud approach include:
  - Computational overflow:
    - During the organization's peak business season, the private cloud may have insufficient resources to handle the load.
    - Rather than add additional servers, which will remain underutilized most of the time, the organization can send some of the computation to a public cloud during the peak period.
    - To make overflow processing convenient, public cloud providers offer software that helps automate the process.

Types of Cloud

Multi-Cloud

- Because provider lock-in represents a potential long-term liability, large organizations try to avoid dependence on a single public cloud provider. To take advantage of public cloud services while avoiding lock-in, large organizations adopt an approach that has become known as multi-cloud.

- Multi-cloud means an organization becomes a customer of more than one public cloud provider.

- Although it avoids lock-in, using multiple cloud providers introduces challenges. It may not be easy, for example, to switch computation or data from one cloud provider to another. Services available from one provider may not match the services available from another.

Types of Cloud

Summary

- *Companies in the cloud industry can be divided into three broad categories, depending on what services they offer:*
  - *Infrastructure as a Service (IaaS)*
  - *Platform as a Service (PaaS)*
  - *Software as a Service (SaaS)*
- *Cloud computing can also be divided into two basic deployment models:*
  - *Public Clouds*
  - *Private Clouds*
- *Because both public and private clouds have advantages and disadvantages, some organizations choose a hybrid approach in which some computing is performed in the organization's private cloud, and other computation is performed in a public cloud.*