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Types of Cloud Computing

Lecture (3)

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Types of Cloud

- *Public clouds*. The cloud is open to the wider public.
- *Private clouds*. The cloud is implemented within the private premises of an institution and generally made accessible to the members of the institution or a subset of them.
- *Hybrid or heterogeneous clouds*. The cloud is a combination of the two previous solutions and most likely identifies a private cloud that has been augmented with resources or services hosted in a public cloud.
- *Community clouds*. The cloud is characterized by a multi-administrative domain involving different deployment models (public, private, and hybrid), and it is specifically designed to address the needs of a specific industry.

Public Cloud

Currently, public clouds are used both to completely replace the IT infrastructure of enterprises and to extend it when it is required.

A fundamental characteristic of public clouds is multitenancy. A public cloud is meant to serve a multitude of users, not a single customer. Any customer requires a virtual computing environment that is separated, and most likely isolated, from other users. This is a fundamental requirement to provide effective monitoring of user activities and guarantee the desired performance and the other QoS attributes negotiated with users. QoS management is a very important aspect of public clouds.

A public cloud can offer any kind of service: infrastructure, platform, or applications. For example, Amazon EC2 is a public cloud that provides infrastructure as a service; Google AppEngine is a public cloud that provides an application development platform as a service; and SalesForce.com is a public cloud that provides software as a service. What makes public clouds peculiar is the way they are consumed: They are available to everyone and are generally architected to support a large quantity of users. What characterizes them is their natural ability to scale on demand and sustain peak loads.

Public Cloud : Architectural View

From an architectural point of view there is no restriction concerning the type of distributed system implemented to support public clouds. Most likely, one or more datacenters constitute the physical infrastructure on top of which the services are implemented and delivered. Public clouds can be composed of geographically dispersed datacenters to share the load of users and better serve them according to their locations. For example, Amazon Web Services has datacenters installed in the United States, Europe, Singapore, and Australia; they allow their customers to choose between three different regions: *us-west-1*, *us-east-1*, or *eu-west-1*. Such regions are priced differently and are further divided into availability zones, which map to specific datacenters. According to the specific class of services delivered by the cloud, a different software stack is installed to manage the infrastructure: virtual machine managers, distributed middleware, or distributed applications.

What are the related issues with Public Cloud ?

Private Cloud

Private clouds are virtual distributed systems that rely on a private infrastructure and provide internal users with dynamic provisioning of computing resources. Instead of a pay-as-you-go model as in public clouds, there could be other schemes in place, taking into account the usage of the cloud and proportionally billing the different departments or sections of an enterprise. Private clouds have the advantage of keeping the core business operations in-house by relying on the existing IT infrastructure and reducing the burden of maintaining it once the cloud has been set up. In this scenario, security concerns are less critical, since sensitive information does not flow out of the private infrastructure. Moreover, existing IT resources can be better utilized because the private cloud can provide services to a different range of users. Another interesting opportunity that comes with private clouds is the possibility of testing applications and systems at a comparatively lower

Private Cloud - Benefits

- *Customer information protection*. Despite assurances by the public cloud leaders about security, few provide satisfactory disclosure or have long enough histories with their cloud offerings to provide warranties about the specific level of security put in place on their systems. In-house security is easier to maintain and rely on.
- *Infrastructure ensuring SLAs*. Quality of service implies specific operations such as appropriate clustering and failover, data replication, system monitoring and maintenance, and disaster recovery, and other uptime services can be commensurate to the application needs. Although public cloud vendors provide some of these features, not all of them are available as needed.
- *Compliance with standard procedures and operations*. If organizations are subject to third-party compliance standards, specific procedures have to be put in place when deploying and executing applications. This could be not possible in the case of the virtual public infrastructure.

Private Cloud hardware and Software

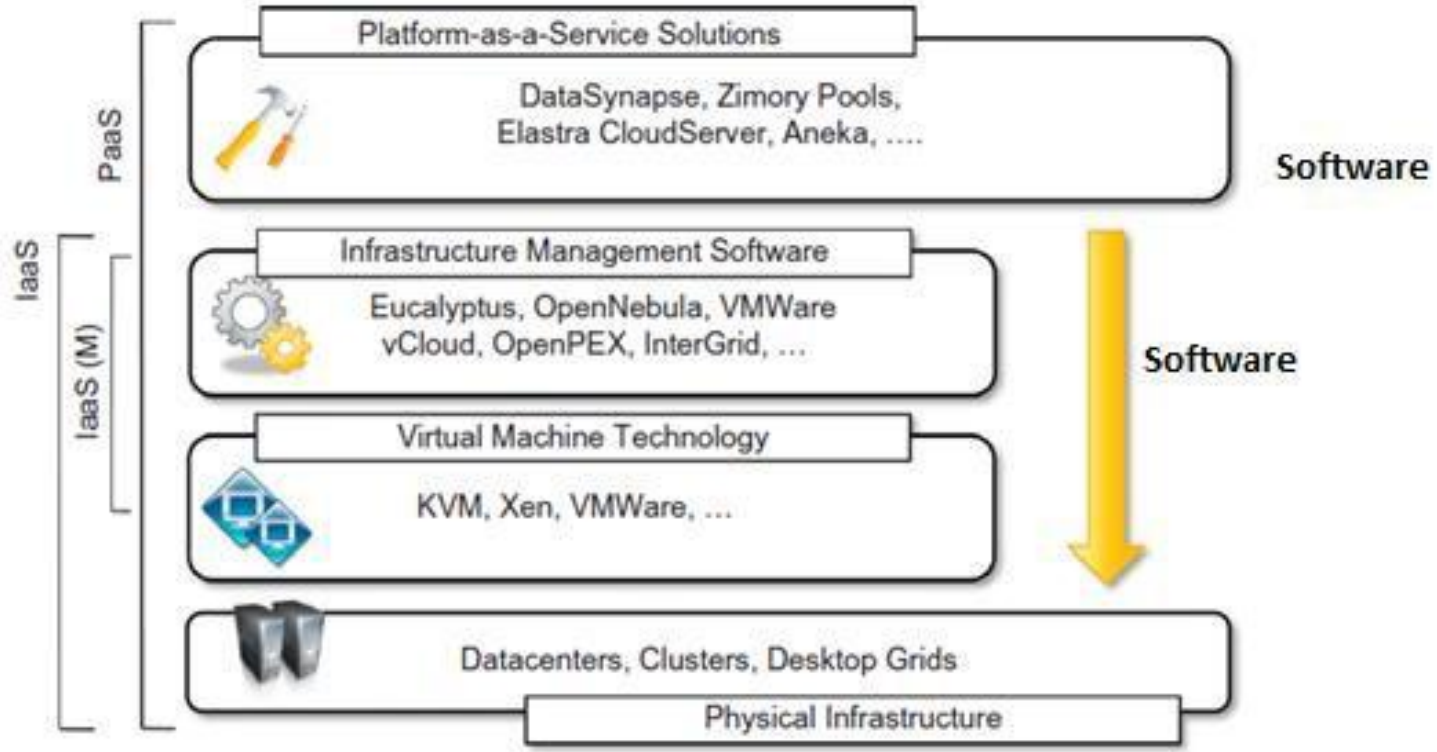


FIGURE 4.4

Private clouds hardware and software stack.

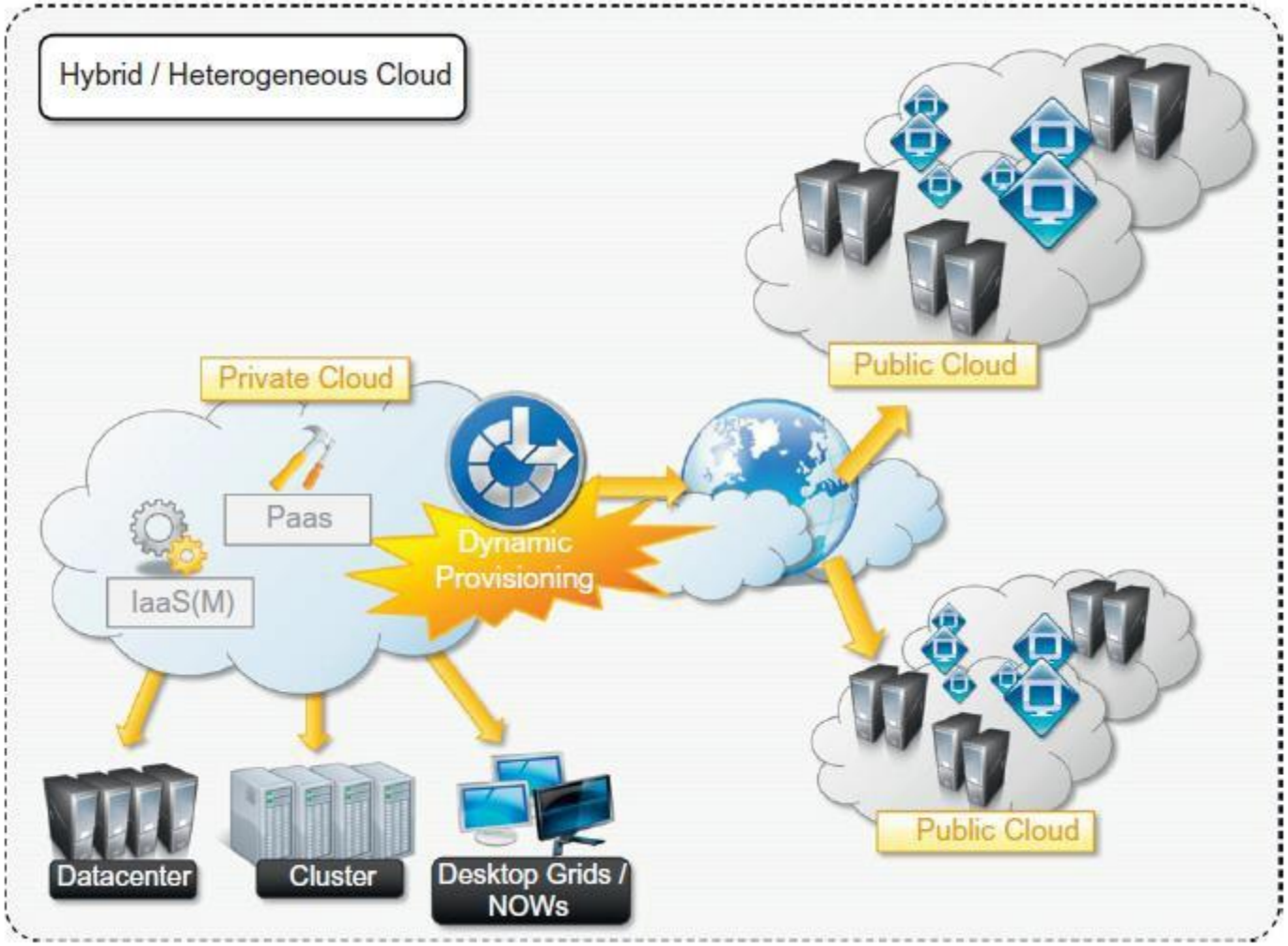
Private Cloud

What are problems of Private Cloud?

Hybrid Cloud

Hybrid clouds allow enterprises to exploit existing IT infrastructures, maintain sensitive information within the premises, and naturally grow and shrink by provisioning external resources and releasing them when they're no longer needed. Security concerns are then only limited to the public portion of the cloud that can be used to perform operations with less stringent constraints but that are still part of the system workload. Figure 4.5 provides a general overview of a hybrid cloud: It is a heterogeneous distributed system resulting from a private cloud that integrates additional services or resources from one or more public clouds. For this reason they are also called *heterogeneous clouds*. As depicted in the diagram, dynamic provisioning is a fundamental component in this scenario.

Private Cloud Overview



Private Cloud Provision

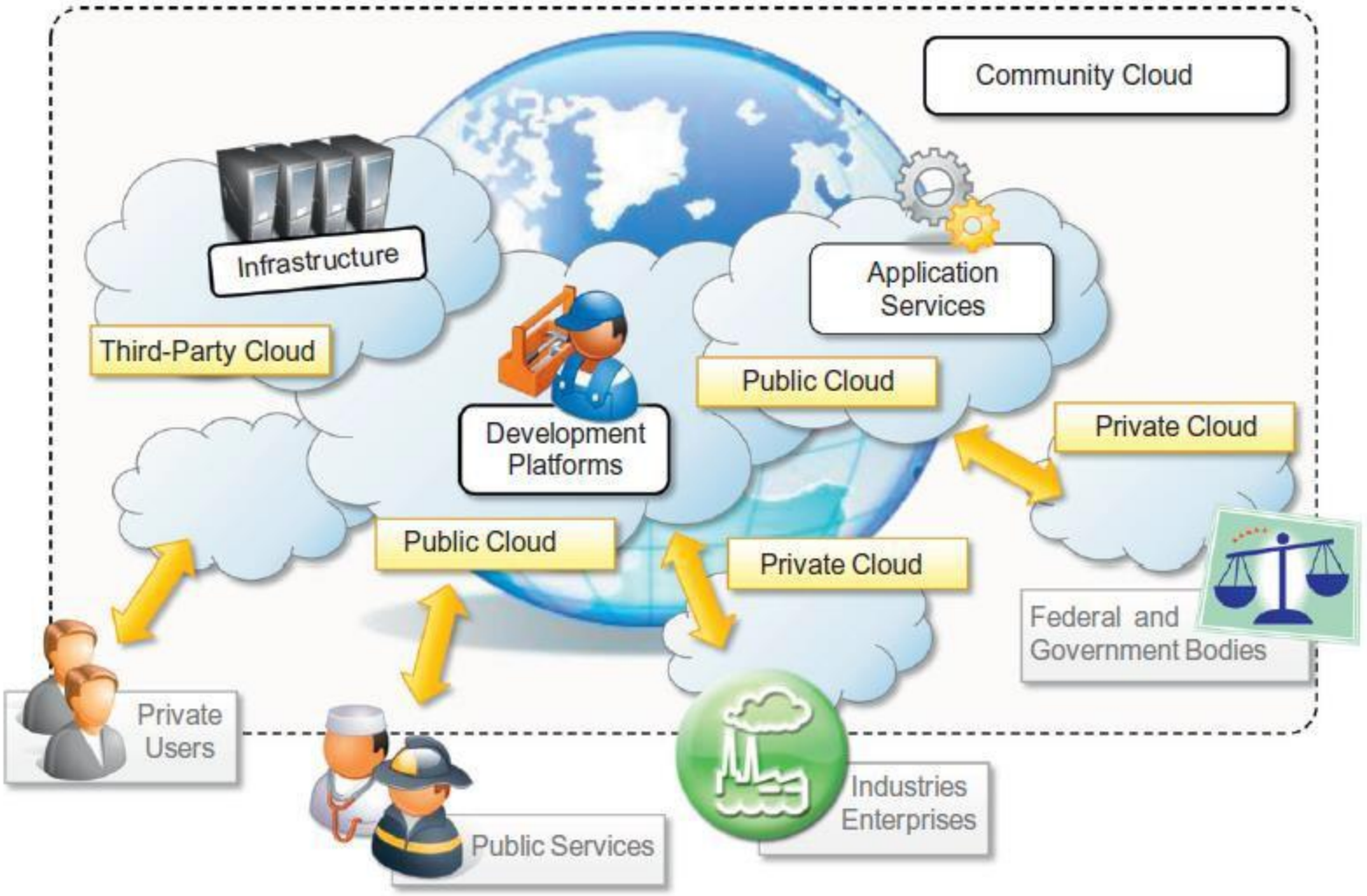
Dynamic provisioning is most commonly implemented in PaaS solutions that support hybrid clouds. As previously discussed, one of the fundamental components of PaaS middleware is the mapping of distributed applications onto the cloud infrastructure. In this scenario, the role of dynamic provisioning becomes fundamental to ensuring the execution of applications under the QoS agreed on with the user. For example, Aneka provides a provisioning service that leverages different IaaS providers for scaling the existing cloud infrastructure . The provisioning service cooperates with the scheduler, which is in charge of guaranteeing a specific QoS for applications. In particular, each user application has a budget attached, and the scheduler uses that budget to optimize the execution of the application by renting virtual nodes if needed. Other PaaS implementations support the deployment of hybrid clouds and provide dynamic provisioning capabilities. Among those discussed for the implementation and management of private clouds we can cite Elastra CloudServer and Zimory Pools.

Community Cloud

Community clouds are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community, or a business sector. The National Institute of Standards and Technologies (NIST) characterizes community clouds as follows:

> *The infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.*

Community Cloud



Community Cloud Applications and benefits

Applications

- Media industry
- Health care
- Energy and other core
- Scientific research

Benefits

Openness.

Community

Graceful failures.

Convenience and control.

Environmental sustainability.

Open Challenges

- Cloud definition
- Cloud interoperability and standards
- Scalability and fault tolerance
- Security, trust, and privacy

THANK YOU