Cloud Computing Architectural Model

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Hybrid Clouds

- Public clouds are large software and hardware infrastructures that have a capability that is huge enough to serve the needs of multiple users, but they suffer from security threats and administrative pitfalls

- Although the option of completely relying on a public virtual infrastructure is appealing for companies that did not incur IT capital costs and have just started considering their IT needs (i.e., start-ups), in most cases the private cloud option prevails because of the existing IT infrastructure

- Private clouds are the perfect solution when it is necessary to keep the processing of information within an enterprise's premises or it is necessary to use the existing hardware and software infrastructure

Hybrid Clouds

- One of the major drawbacks of private deployments is the inability to scale on demand and to efficiently address peak loads
- In this case, it is important to leverage capabilities of public clouds as needed
- Hence, a hybrid solution could be an interesting opportunity for taking advantage of the best of the private and public worlds. This led to the development and diffusion of hybrid clouds
- 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

Hybrid/Heterogeneous Cloud Overview
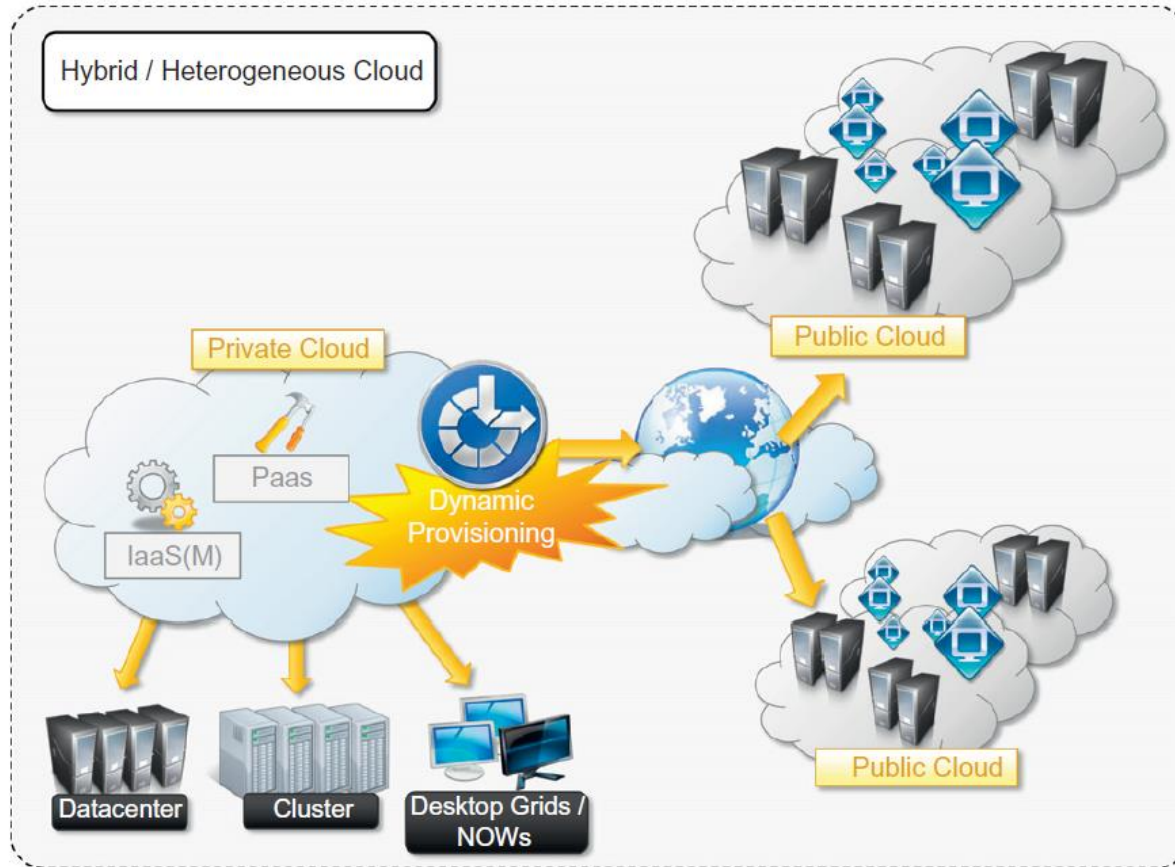
Hybrid Clouds

- Hybrid cloud 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
- Hybrid clouds address scalability issues by leveraging external resources for exceeding capacity demand
- These resources or services are temporarily leased for the time required and then released. This practice is also known as cloudbursting

Hybrid Clouds

- Whereas the concept of hybrid cloud is general, it mostly applies to IT infrastructure rather than software services
- Service-oriented computing already introduces the concept of integration of paid software services with existing application deployed in the private premises
- In an IaaS scenario dynamic provisioning refers to the ability to acquire on demand virtual machines in order to increase the capability of the resulting distributed system and then release them
- Infrastructure management software and PaaS solutions are the building blocks for deploying and managing hybrid clouds
- In particular, with respect to private clouds, dynamic provisioning introduces a more complex scheduling algorithm and policies, the goal of which is also to optimize the budget spent to rent public resources

Hybrid Clouds

- Infrastructure management software such as OpenNebula already exposes the capability of integrating resources from public clouds such as Amazon EC2
- In this case the virtual machine obtained from the public infrastructure is managed as all the other virtual machine instances maintained locally
- What is missing is then an advanced scheduling engine that's able to differentiate these resources and provide smart allocations by taking into account the budget available to extend the existing infrastructure
- In the case of OpenNebula, advanced schedulers such as Haizea can be integrated to provide cost-based scheduling

Hybrid Clouds

- A different approach is taken by InterGrid. This is essentially a distributed scheduling engine that manages the allocation of virtual machines in a collection of peer networks
- Such networks can be represented by a local cluster, a gateway to a public cloud, or a combination of the two
- Once a request is submitted to one of the InterGrid gateways, it is served by possibly allocating virtual instances in all the peered networks, and the allocation of requests is performed by taking into account the user budget and the peering arrangements between networks

Hybrid Clouds

- 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.