Cloud Computing Architectural Model

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The Cloud Computing Architecture

- Utility-oriented data centers are the first outcome of cloud computing, and they serve as the infrastructure through which the services are implemented and delivered
- Any cloud service, whether virtual hardware, development platform, or application software, relies on a distributed infrastructure owned by the provider or rented from a third party
- The characterization of a cloud is quite general: It can be implemented using a datacenter, a collection of clusters, or a heterogeneous distributed system composed of desktop PCs, workstations, and servers
- Commonly, clouds are built by relying on one or more datacenters. In most cases hardware resources are virtualized to provide isolation of workloads and to best exploit the infrastructure

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- According to the specific service delivered to the end user, different layers can be stacked on top of the virtual infrastructure: a virtual machine manager, a development platform, or a specific application middleware
- As described in earlier lectures, the cloud computing paradigm emerged as a result of the convergence of various existing models, technologies, and concepts that changed the way we deliver and use IT services. A broad definition of the phenomenon could be as follows:

  "Cloud computing is a utility-oriented and Internet-centric way of delivering IT services on demand. These services cover the entire computing stack: from the hardware infrastructure pack- aged as a set of virtual machines to software services such as development platforms and distributed applications"

Contd.

- Cloud computing supports any IT service that can be consumed as a utility and delivered through a network, most likely the Internet
- Such characterization includes quite different aspects: infrastructure, development platforms, application and services
- It is possible to organize all the concrete realizations of cloud computing into a layered view covering the entire stack, from hardware appliances to software systems
- Cloud infrastructure can be heterogeneous in nature because a variety of resources, such as clusters and even networked PCs, can be used to build it
- Moreover, database systems and other storage services can also be part of the infrastructure
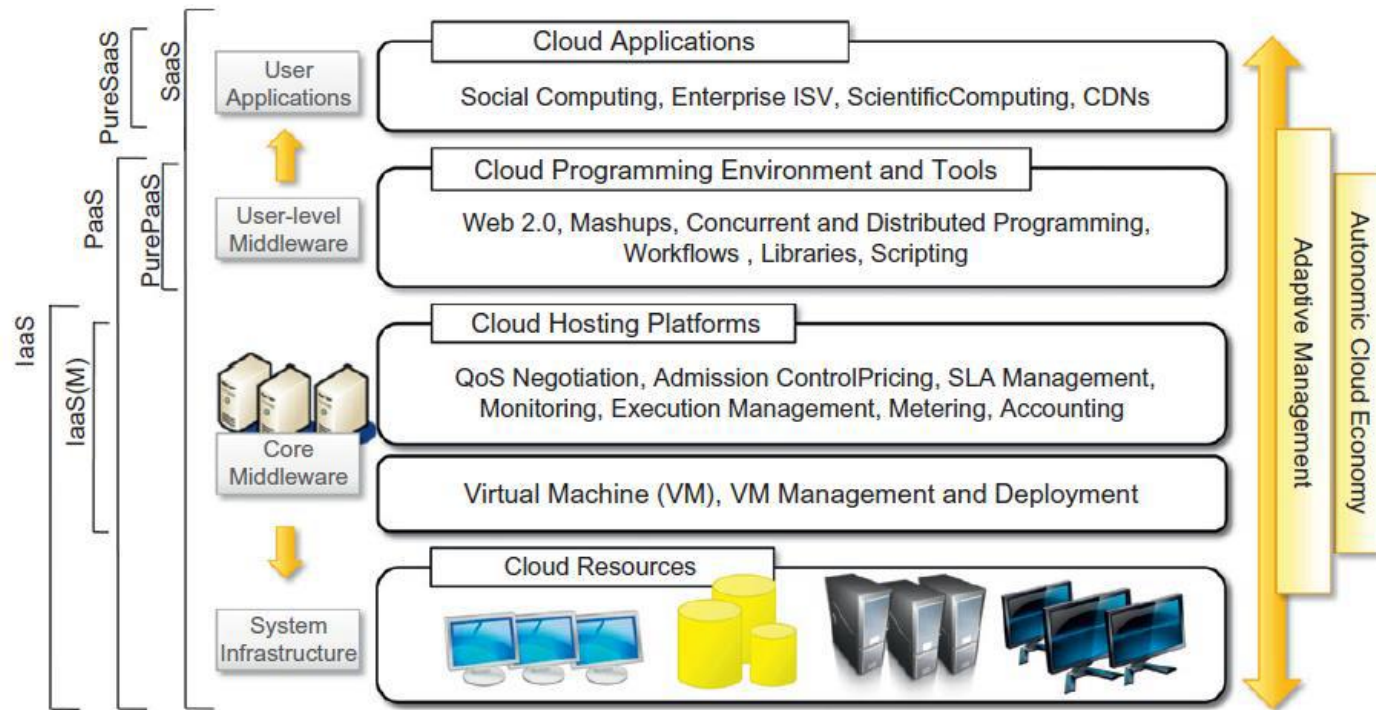
The Cloud Computing Architecture

FIGURE 4.1

The cloud computing architecture.

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- The physical infrastructure is managed by the core middleware, the objectives of which are to provide an appropriate runtime environment for applications and to best utilize resources
- At the bottom of the stack, virtualization technologies are used to guarantee runtime environment customization, application isolation, sandboxing, and quality of service
- Hardware virtualization is most commonly used at this level
- Hypervisors manage the pool of resources and expose the distributed infrastructure as a collection of virtual machines
- By using virtual machine technology it is possible to finely partition the hardware resources such as CPU and memory and to virtualize specific devices, thus meeting the requirements of users and applications

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- This solution is generally paired with storage and network virtualization strategies, which allow the infrastructure to be completely virtualized and controlled
- According to the specific service offered to end users, other virtualization techniques can be used
- For example, programming-level virtualization helps in creating a portable runtime environment where applications can be run and controlled
- This scenario generally implies that applications hosted in the cloud be developed with a specific technology or a programming language, such as Java, .NET, or Python.
- In this case, the user does not have to build its system from bare metal
- Infrastructure management is the key function of core middleware, which supports capabilities such as negotiation of the quality of service, admission control, execution management and monitoring, accounting, and billing
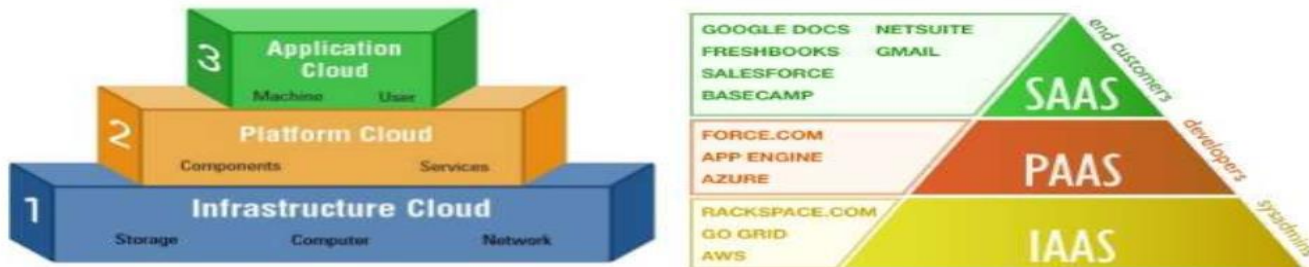
Types of Services

Types of Services

- Infrastructure or hardware-as-a-service
- Platform as a service
- Software as a service

Layers and types of cloud computing

Cloud computing can be viewed as a collection of services, which can be presented as a layered cloud computing architecture

Cloud Computing Services

- The combination of cloud hosting platforms and resources is generally classified as a Infrastructure-as-a-Service(IaaS) solution
- We can organize the different examples of IaaS into two categories: Some of them provide both the management layer and the physical infrastructure; others provide only the management layer (IaaS (M))
- In this second case, the management layer is often integrated with other IaaS solutions that provide physical infrastructure and adds value to them
- IaaS solutions are suitable for designing the system infrastructure but provide limited services to build applications
- Such service is provided by cloud programming environments and tools, which form a new layer for offering users a development platform for applications

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- The range of tools include Web-based interfaces, command-line tools, and frameworks for concurrent and distributed programming
- In this scenario, users develop their applications specifically for the cloud by using the API exposed at the user-level middleware. For this reason, this approach is also known as Platform-as-a-Service (PaaS) because the service offered to the user is a development platform rather than an infrastructure
- PaaS solutions generally include the infrastructure as well, which is bundled as part of the service provided to users
- In the case of Pure PaaS, only the user-level middleware is offered, and it has to be complemented with a virtual or physical infrastructure

Contd.

- The top layer of the reference model contains services delivered at the application level
- These are mostly referred to as Software-as-a-Service (SaaS)
- In most cases these are Web-based applications that rely on the cloud to provide service to end users
- The horsepower of the cloud provided by IaaS and PaaS solutions allows independent software vendors to deliver their application services over the Internet. Other applications belonging to this layer are those that strongly leverage the Internet for their core functionalities that rely on the cloud to sustain a larger number of users; this is the case of gaming portals and, in general, social networking websites