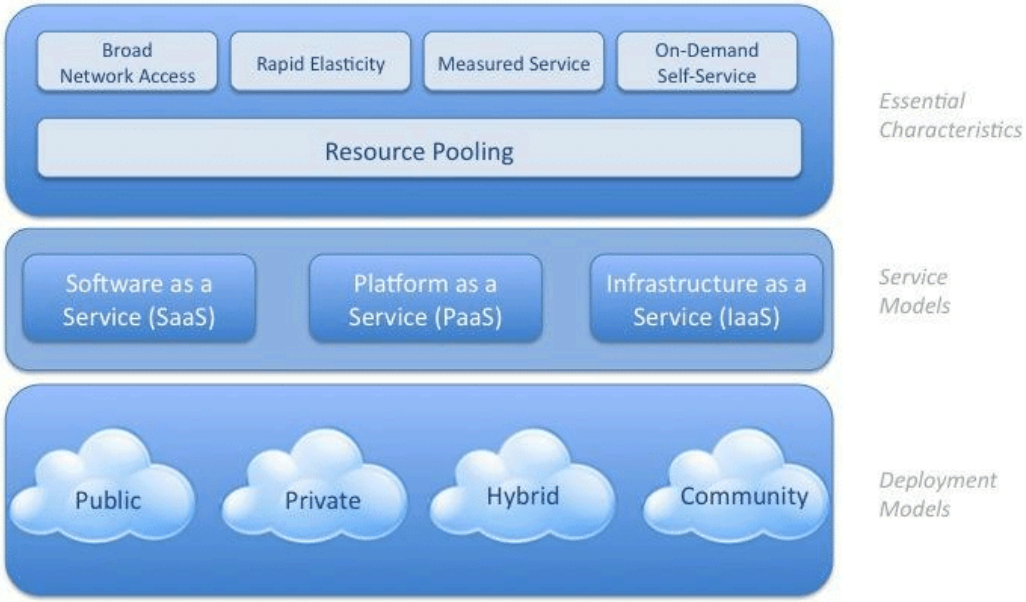
Cloud Concepts

4.1. Cloud Computing (NIST Model), Properties, Characteristics, Benefits 4.2. Cloud types; private, public and hybrid cloud. 4.3. Service models IaaS, PaaS, SaaS. 4.4. Role of virtualization in enabling the cloud. 4.5. Application availability, performance, security and disaster

Cloud Computing (NIST Model)

The National Institute of Standards and Technology (NIST) is responsible for developing standards and guidelines, including minimum requirements, for providing adequate information security for all agency operations and assets.

According to recent research, 92 percent of large organizations use more than one cloud. The report also predicts that by the end of 2021, 55 percent of enterprise workloads will rely on a public cloud. Clearly cloud adoption is expanding, and will continue to do so into the future.



Despite its prevalence, **cloud computing can be a confusing concept. To ease that confusion, the National Institute of Standards and Technology (NIST) proposed a definition of cloud computing in its NIST Special Publication 800-145 as:**

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

This cloud model is composed of five essential characteristics, three service models, and four deployment models.

Essential Characteristics:

On-demand self-service. A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

Broad network access. Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically 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). Examples of resources include storage, processing, memory, and network bandwidth.

Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Service Models:

Software as a Service (SaaS). The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure2 . The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user specific application configuration settings.

Platform as a Service (PaaS). The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider.3 The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

Infrastructure as a Service (IaaS). The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).

Deployment Models:

Private cloud. The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

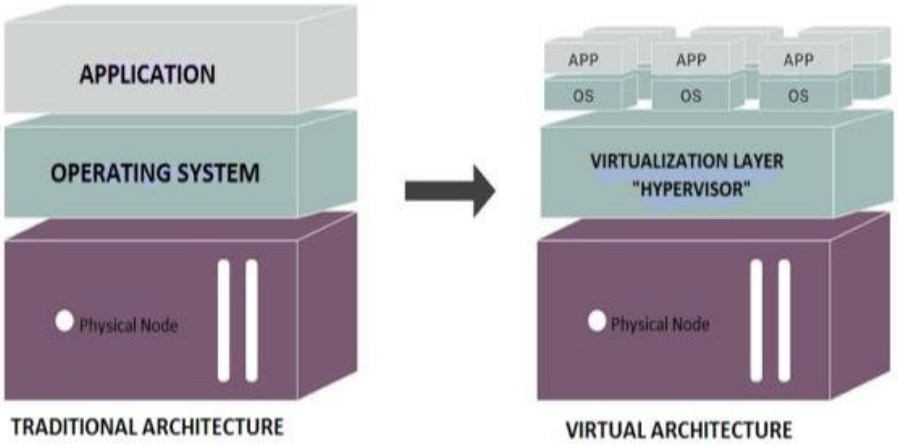
Community cloud. The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

Public cloud. The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

Hybrid cloud. The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

Role of virtualization in enabling the cloud.

Virtualization is the fundamental technology powering cloud computing. It separates computing environments from the physical infrastructure, thereby enabling multiple operating systems and applications to run simultaneously on a single machine.



A program designed to manage the physical resources of a computing machine and distribute those resources among several different operating systems, allowing them to run simultaneously is called a hypervisor. It creates multiple copies of a single physical computer's hardware resources, each visible to the user as a separate device. A guest user operating system can be installed on each virtual machine, not tied to the host hardware.

The hypervisor isolates the running operating systems from each other so that each of them utilizes the resources allocated to it alone. However, if necessary, the hypervisor also allows virtual machine OS to interact with each other.

Virtualization technology helps companies apply a cloud-based service delivery model to their on-premises infrastructure for improved internal workflows, security, and performance. Companies can also virtualize their infrastructure, software, or platforms to deliver a range of services to end-users.