Both solutions can help maximize your current resources and technology dollars

Virtualization vs. Cloud Computing: What's the Difference?

22AIE305

Introduction to Cloud computing

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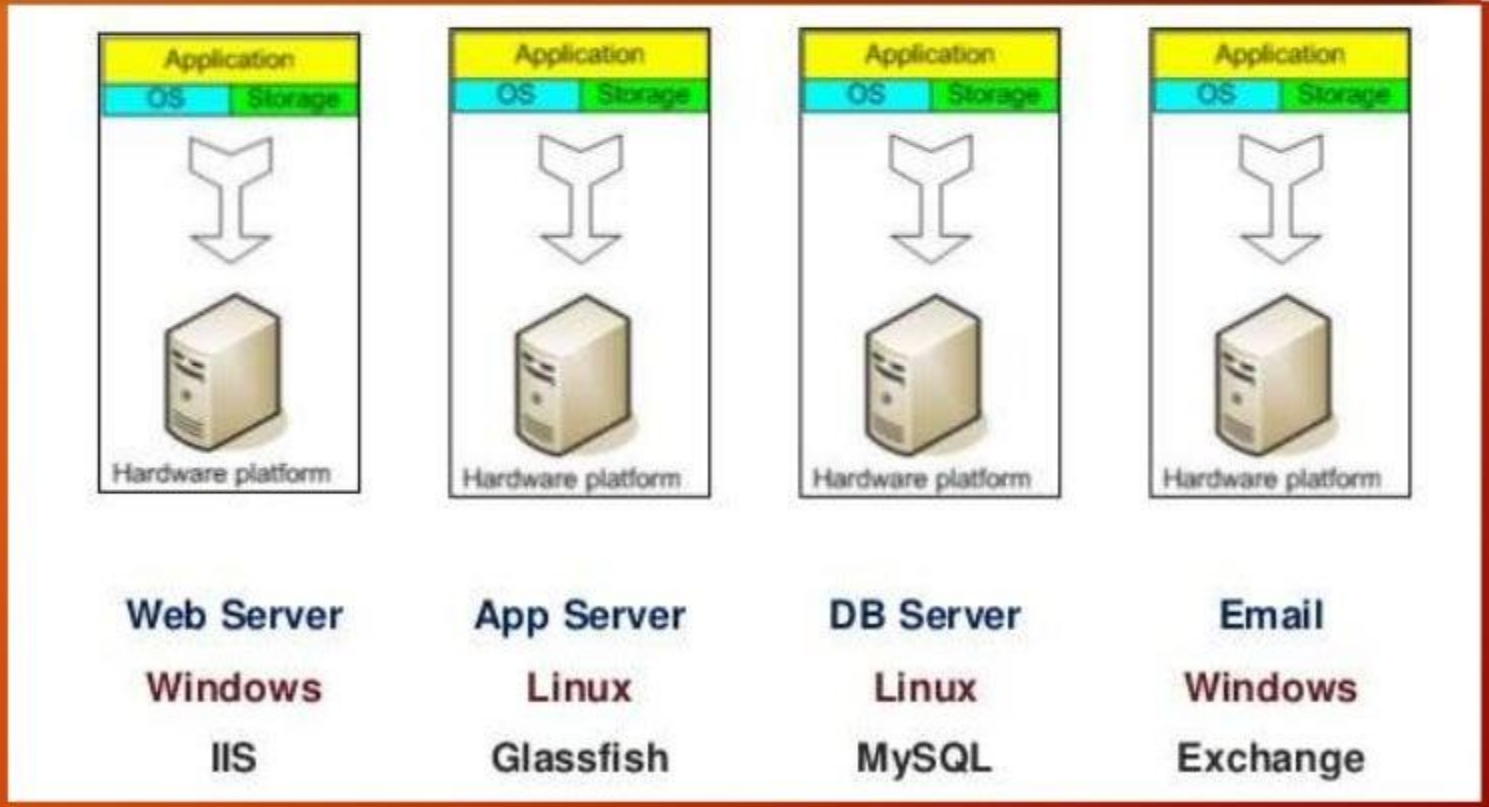
Motivation

- Reduced physical redundancy
- Decreased downtime
- Automated management
- Pay-as-you-go model
- Self-service capability
- Resource pooling
- Network access
- Elasticity

Traditional server concept



Problems

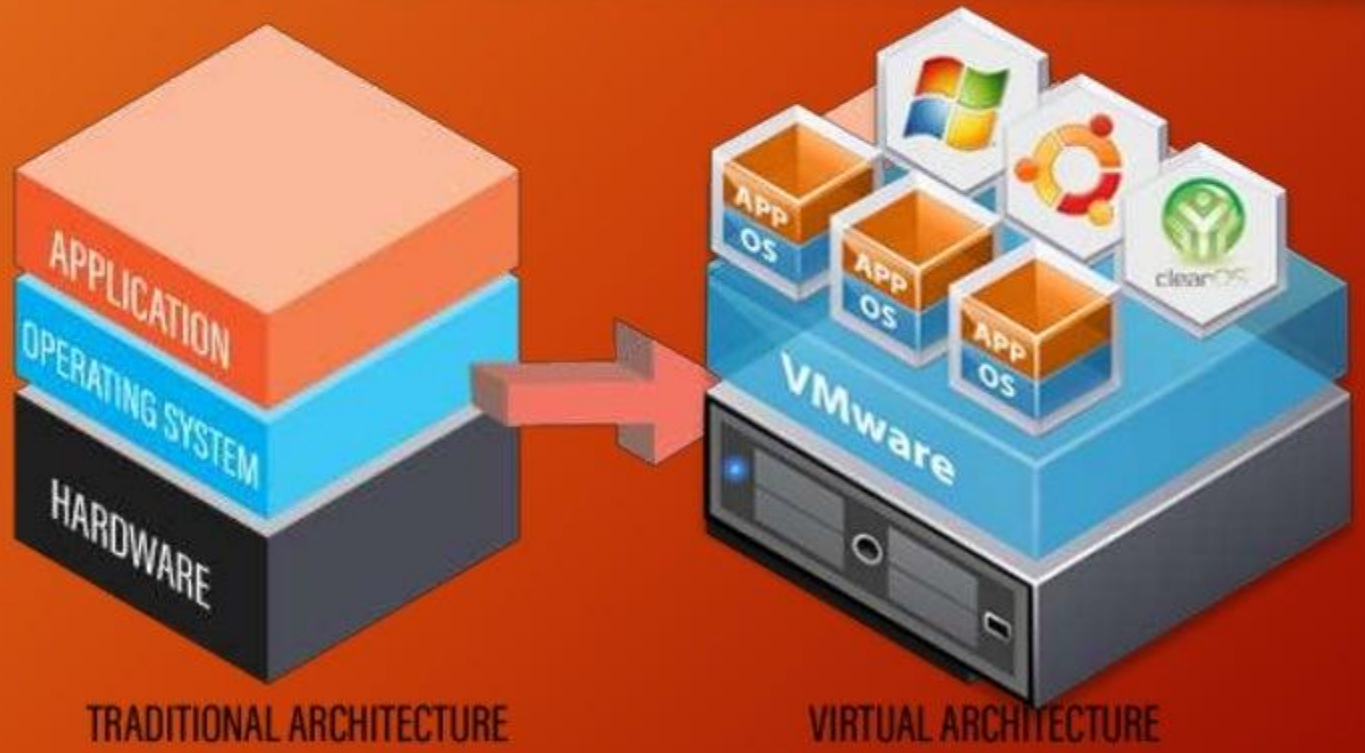
- Due to the limitations of x86 servers, many IT organizations must deploy multiple servers.
- Each Server normally operates at a fraction of their capacity.
- High storage and low processing demands

It results in a high inefficiencies and excessive operating costs

What is Virtualization?

- **Virtualization** is the process of creating a software-based, or virtual, representation of something, such as virtual applications, servers, storage and networks.
- *It is a thin piece of software that decouples the OS from the physical bare-metal, and allows us to hedge physical hardware* – has been around since **IBM invented it in 1967;** and was commercialized by VMware in the form of "Elastic Sky X" or, ESX.
- It is the single most effective way to reduce IT expenses while boosting **efficiency** and **agility** for all size businesses.

Traditional vs. Virtual Architecture



Virtualization Architecture

Hypervisor

- It is a virtual machine manager/monitor
- It is a program which allows to share single hardwares
- Each virtual machine with guest OS acquires host's processor, memory and other resources
- A controller to isolate the virtual machines to operate with separate operating systems

Virtual Machines

- A virtual computer system is known as a “virtual machine” (VM)
- It has a tightly isolated software container with an operating system and application inside.
- Each self-contained VM is completely independent.
- Putting multiple VMs on a single computer enables several operating systems and applications to run on just one physical server, or “host.”

Key Properties of Virtual Machines

Partitioning

- Run multiple operating systems on one physical machine.
- Divide system resources between virtual machines.

Isolation

- Provide fault and security isolation at the hardware level.
- Preserve performance with advanced resource controls.

Encapsulation

- Save the entire state of a virtual machine to files.
- Move and copy virtual machines as easily as moving and copying files.

Hardware Independence

- Provision or migrate any virtual machine to any physical server.

Types of Virtualization

- **Server Virtualization**
  - Reduced operating costs
  - Faster workload deployment
  - Increased application performance
  - Higher server availability
- **Network Virtualization**
  - Allows applications to run on a virtual network as if they were running on a physical network.
  - Presents logical networking devices and services – logical ports, switches, routers, firewalls, load balancers, VPNs and more – to connected workloads.)
- **Desktop Virtualization**
  - Enables IT organizations to respond faster to changing workplace needs and emerging opportunities.
  - Virtualized desktops and applications can also be quickly and easily delivered

Benefits of Virtualization

- Reduced capital and operating costs.
- Minimized or eliminated downtime.
- Increased IT productivity, efficiency, agility and responsiveness.
- Faster provisioning of applications and resources.
- Greater business continuity and disaster recovery.
- Simplified data center management.
- Availability of a true Software-Defined Data Center..

It results in a high efficiency with a lower cost.

Virtualization Platforms

vmware

Xen

Microsoft Hyper-V

KVM

openstack CLOUD SOFTWARE

EUCALYPTUS

docker

PowerVM

Cloud Computing

The National Institute of Standards defines cloud computing as having the following:

On-Demand Self-Service – can I unilaterally provision computing capabilities?

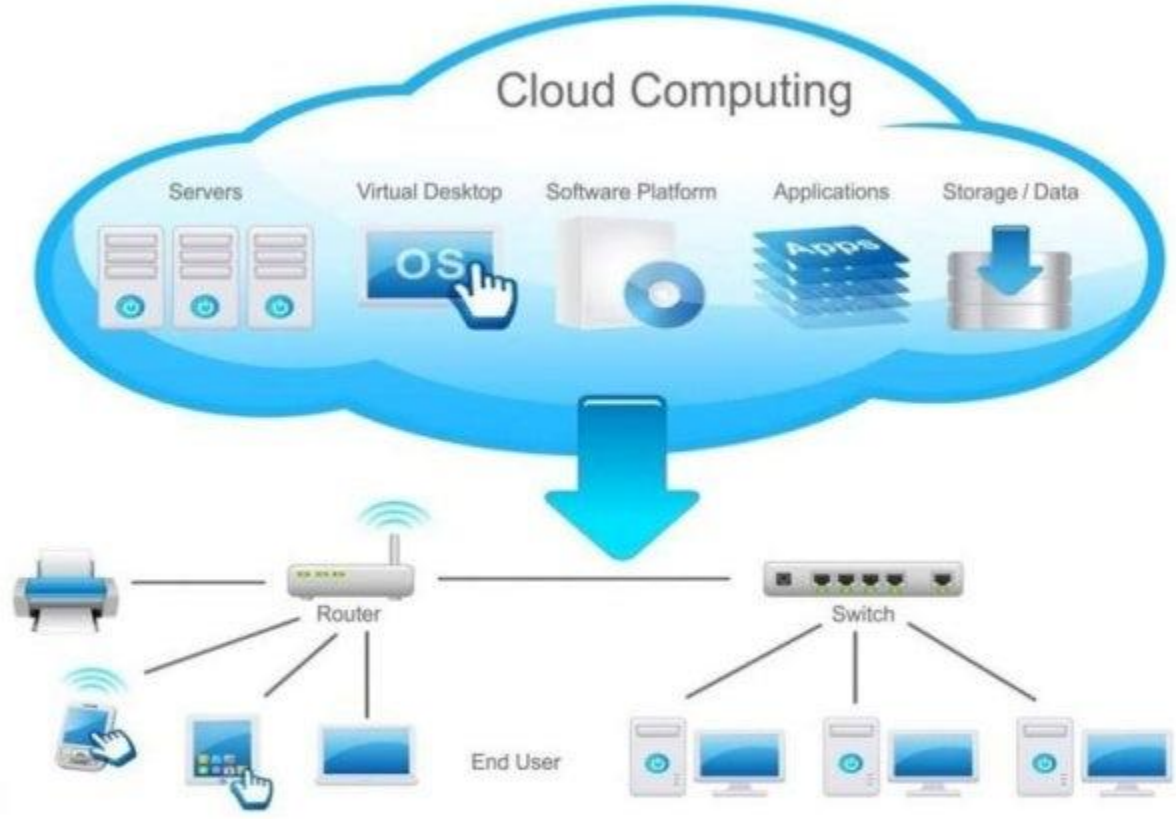
Broad Network Access – can I access through multiple clients and devices over network?

Resource Pooling – can I decouple resources from physical hardware?

Rapid Elasticity – can I add and reduce capacity through software?

Measured Service – who is using what and how much?

A lot more to cloud computing than simply creating a "resource pool."



Cloud Computing Layout Diagram

Example services using cloud computing

- Scalable Usage
  - Netflix
- Big data Analytics
  - Hadoop, Cassandra, HPCC etc.
- Chatbots
  - Siri, Alexa and Google Assistant
- Business Process
  - Salesforce, Hubspot, Marketo etc.
- Communication
  - Skype, WhatsApp, Microsoft Outlook, Yahoo! Mail, Google Mail etc
- Backup & Recovery
  - Amazon S3, Google Drive, Microsoft OneDrive, Apple iCloud, Dropbox etc.
- Social Networking
  - Facebook, LinkedIn, Twitter etc.
- Cloud Hardware
  - Google Chromebook Laptop (with google chrome as the interface of OS and online apps)

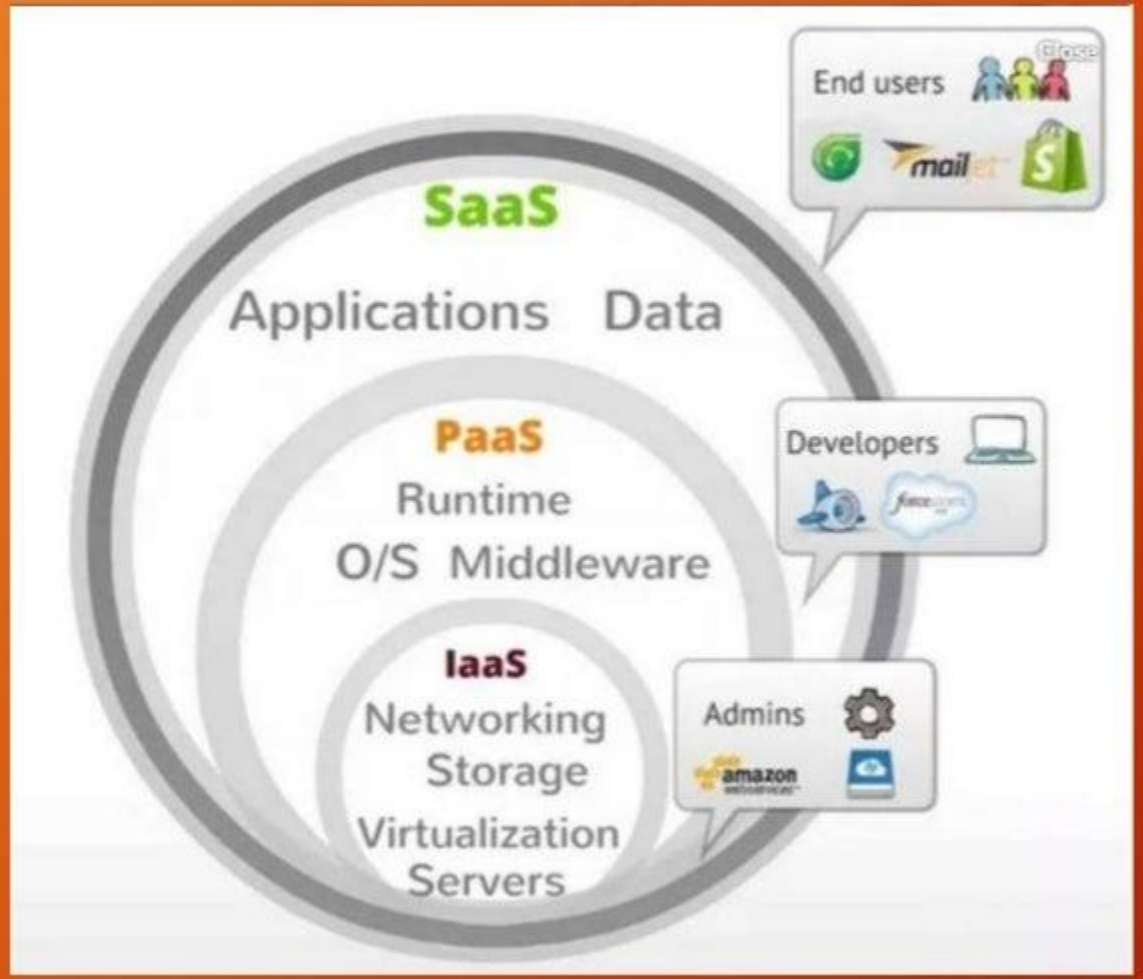
How are clouds deployed?

Public clouds
Created from resources not owned by the end users.

Private clouds
Created from resources owned—either physically or contractually—by the end users.

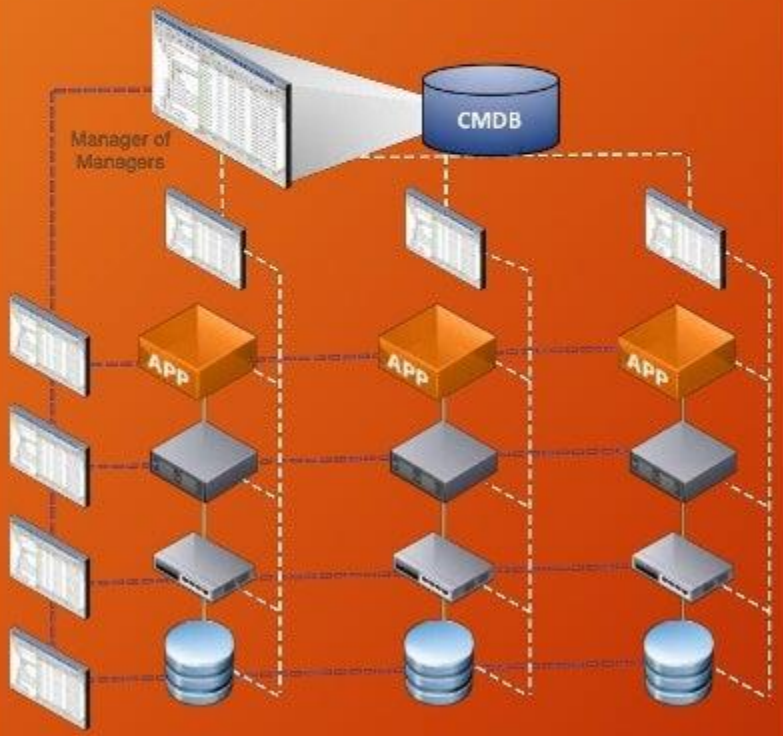
Hybrid clouds
Created from a variety of resources, both private and public.

What services are provided by clouds?



Traditional vs Cloud Architecture

Traditional IT Management



Rigid. Complex. Fragile

Cloud Management

Agility. Scale. Simplicity

Core Benefits of Cloud Computing

- **Cost savings** - cloud computing save money.
- **Device and location independence** - cloud solutions allow to work wherever and whenever one like.
- **User-centric focus** - cloud solutions is designed with the user in mind.
- **Reliability and scalability** - cloud computing is more reliable, and more readily scaled, than on premise solutions.
- **Minimizes software management** - cloud solutions abstract maintenance away from the user.
- **Organizational focus** - cloud applications allow to focus on your core business and not be sidetracked by technology.
- **Data portability** - your data is your data, you will be able to move it as you see fit.
- **Best of breed security** - cloud security is better, by an order of magnitude, than on premise security.
- **Powerful analytics** - cloud solutions give an insight into data and how people work with it.

How do businesses know if they should use a true cloud solution?

- **Outsourced IT** —Free up internal IT resources for higher-value business support and allow you to put IT budget dollars toward efforts that advance your business.
- **Quick setup** — Cloud startup is relatively quick and easy. Plus, servers, appliances and software perpetual licenses go away when you use such a service.
- **Pay-as-you-go** —Software-as-a-Service (SaaS) applications allow the off-loading of basic IT requirements to cloud service providers. Pay for what you need and use. But you do not have to continue to invest in many of the products used to support the network and systems, such as spam/anti-virus, encryption, data archiving, email services and off-site storage.
- **Scalability** — Temporarily scale your IT capacity by off-loading high-demand compute requirements to an outside provider. Pay for only what you need and use, only at the time when you need it.

Virtualization vs Cloud Computing

- Virtualization can make 1 resource act like many, while cloud computing lets different departments (through private cloud) or companies (through a public cloud) access a single pool of automatically provisioned resources.
- But, Cloud computing is use of computing resources over a network, such as the Internet.
- In, cloud computing all the applications and software are loaded on to remote machines and servers, which are owned and managed by third parties.
- These applications could include anything from e-mail to word processing to complex data analysis programs.
- In order to use the applications and software, one can simply log onto the network and access the applications through a Web-based service that hosts all the programs.

Virtualization vs Cloud Computing

Virtualization	Cloud Computing
Virtualization is technology that allows you to create multiple simulated environments or dedicated resources from a single, physical hardware system. Software called a hypervisor connects directly to that hardware and allows you to split 1 system into separate, distinct, and secure environments known as virtual machines (VMs). These VMs rely on the hypervisor's ability to separate the machine's resources from the hardware and distribute them appropriately.	Cloud computing is a set of principles and approaches to deliver compute, network, and storage infrastructure resources, services, platforms, and applications to users on-demand across any network. These infrastructure resources, services, and applications are sourced from clouds, which are pools of virtual resources orchestrated by management and automation software. They can be accessed by users on-demand through self-service portals supported by automatic scaling and dynamic resource allocation.

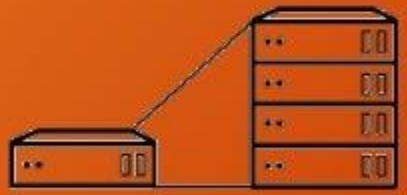
Virtualization vs Cloud Computing

	Virtualization	Cloud Computing
Definition	Technology	Methodology
Purpose	Create multiple simulated environments from 1 physical hardware system	Pool and automate virtual resources for on-demand use
Use	Deliver packaged resources to specific users for a specific purpose	Deliver variable resources to groups of users for a variety of purposes
Configuration	Image-based	Template-based
Lifespan	Years (long-term)	Hours to months (short-term)
Cost	High capital expenditures (CAPEX), low operating expenses (OPEX)	Private cloud: High CAPEX, low OPEX Public cloud: Low CAPEX, high OPEX
Scalability	Scale up	Scale out
Workload	Stateful	Stateless
Tenancy	Single tenant	Multiple tenants

What's the difference between scaling up and scaling out?

SCALING UP (Virtualization)

Scaling up adds resources to a system that's managed by a single operating system or controller.



SCALING OUT (Cloud Computing)

Scaling out coordinates many small systems — each with their own controller or operating system—so work can be dispersed among them.

When an application demands more from a virtual machine (VM), you can either give that VM more resources so it can handle demand by itself (scale up), or you can spin up more VMs and disperse demand among them (scale out).
If that app is in a cloud environment, you either scale up by collecting more physical resources, virtualizing them, routing them into the existing resource pools, and managing them through the existing cloud's controls (this is typical of private cloud deployments); or you can scale out by requesting more cloud environments (this is typical of public cloud deployments).

Which one should I use? - Virtualization?

- Virtualization helps enterprises work more efficiently when compared to traditional workflows or applications installed directly on the server.
- Organizations can maintain a secure environment using in-house hardware and software that's managed by the organization's IT staff.
- Traditional workloads are well supported by enterprise virtualization products, because they are able to run on virtual instances of the outdated software the workloads are tied to.
- Virtualization allows enterprises to create more environments and resources from underused hardware.
- It lets you split processing power, storage, and memory among environments—essentially ignoring the physical installations and commoditizing the hardware.
- Virtual environments are also protected from themselves: Developers' individual sandboxes may live on the same physical server but are still separated from rogue or runaway code.

Which one should I use? - Private cloud?

- Private clouds allow enterprises to make their resources available on-demand while still adhering to security policies or regulations that require limited access, complex encryption, and a general accountability for where resources are sourced.

- Stateless, loosely coupled workloads—like those typically found in development, research, and telecommunications—are better supported by private clouds.

OpenStack for Private Cloud

- Once an enterprise has virtualized its resources, open source tools like OpenStack make it relatively easy to deploy private clouds.
- OpenStack uses a consistent set of application programming interfaces (APIs) to abstract virtual resources into discrete pools that power standard cloud computing tools.
- The core OpenStack projects handle compute, networking, storage, identity, and images—the infrastructure that establishes a cloud computing environment.

Which one should I use? - Public cloud?

- Public clouds reduce an enterprise's need to invest in their own hardware and management teams because everything is owned and managed by a third-party provider.
- Enterprises don’t own the gigabytes of storage their data is backed up to; don’t manage operations at the server farm where the hardware lives; and don’t determine how their cloud-based platforms, applications, or services are secured or maintained.
- Public clouds allow a client needing more resources, platforms, or services to simply pay a vendor by the hour or byte to have access to what’s needed, when it’s needed.
- Public clouds aren’t usually deployed as a standalone infrastructure solution, is a part of a heterogeneous mix of environments that leads to higher security and performance; lower cost; and a wider availability of infrastructure, services, and applications.

Open source tools for building and managing clouds

- **OpenStack** - https://www.openstack.org/
- **CloudStack** - https://cloudstack.apache.org/
- Eucalyptus - http://open.eucalyptus.com/
- **Synnefo** - https://www.synnefo.org/
- **FOSS-Cloud** - http://www.foss-cloud.org/
- **openQRM** - http://www.openqrm.com/
- **Deltacloud** - http://deltacloud.org/
- **Cloud.com** - http://open.cloud.com/
- **OpenNebula** - https://opennebula.org/

Open source tools for virtualization

- KVM - http://www.linux-kvm.org/page/Main_Page
- Ganeti - http://www.ganeti.org/
- oVirt - http://www.ovirt.org/Home
- Packer - http://www.packer.io/
- Vagrant - http://www.vagrantup.com/
- VirtualBox - https://www.virtualbox.org/
- Xen - http://www.xenproject.org/

Q/A

Thank you for your attention

Virtualization is one of the fundamental technologies that makes cloud computing work. However, virtualization is not cloud computing.