University of Batna 2
Faculty of Mathematics and Computer science

Cloud Computing
And Virtualization

Department of Computer science

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Problem:

! Increasing number of servers

! Poorly exploited resources

! Hight operating cost

Solution: Virtualization

Better exploitation of resources

Virtualization: A basis for the cloud computing

Software: Data and Applications

Hardware

Get rid of the hardware layer;

The hardware - being cyclically obsolete;

- often breaking down.

The idea behind all virtualization is to abstract a computer's hardware resources from the software that uses those resources. A hypervisor is a software tool installed on the host system to provide this layer of abstraction.

Server Virtualization

▪ Server virtualization is a virtualization technique that involves partitioning a physical server into a number of small, virtual servers with the help of virtualization software, so that the processor can be used more effectively and efficiently.

▪ Each virtual server becomes autonomous and runs its own operating system and applications.

▪ Virtualized and isolated servers are called Virtual Machine (VM).

1- Hypervisor (Virtual Machine Monitor (VMM))

abstracts operating systems and applications from their underlying hardware.

A control tool between the virtual operating system and the hardware:

- controls and supervises all the installed virtual servers while verifying and managing any I/O problems or hardware overload.

- can interrupt any critical error that could compromise the whole virtualized system.

- The physical hardware that a hypervisor runs on is typically referred to as a host machine, whereas the VMs that the hypervisor creates and supports are collectively called guest machines, guest VMs or simply VMs.

➤ Type-1 (bare-metal Hypervisor):

▪ runs directly on the host machine's physical hardware;

▪ no need to load an underlying OS (it implements most of the services provided by OS kernels)

▪ direct access to the underlying hardware;

Type 1 Hypervisor
Bare-Metal Architecture

Guest OS VM | Guest OS VM

Hypervisor

Hardware
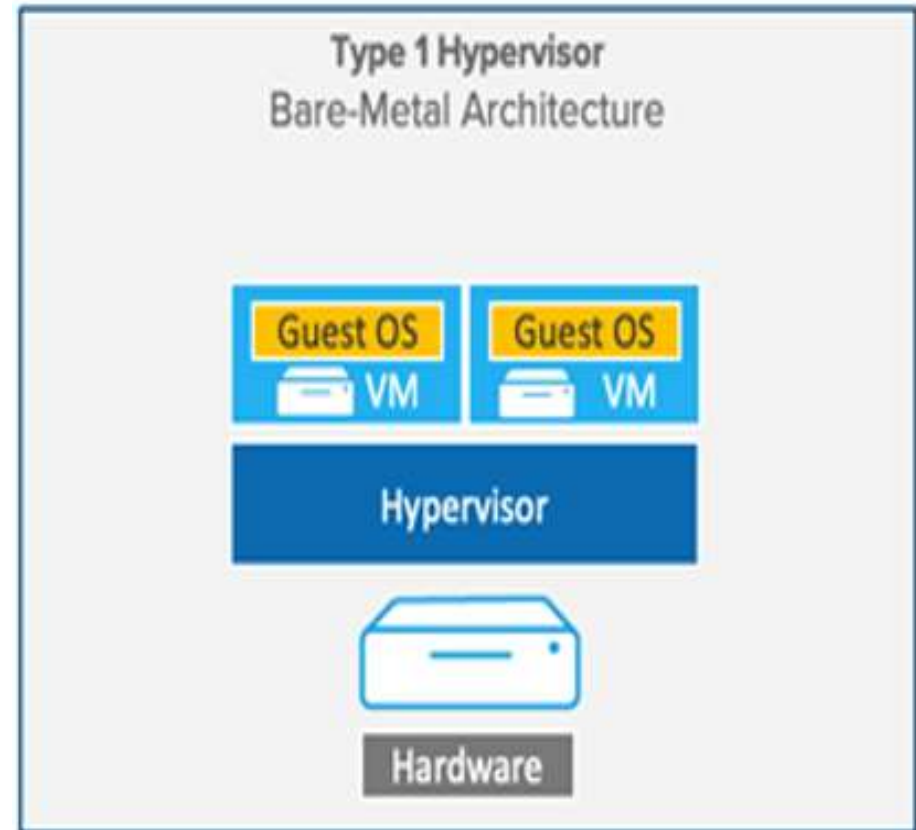
❖ The most efficient and best-performing hypervisors available for enterprise computing.

➤ Type-1 (bare-metal Hypervisor):

▪ More efficient, lower latency and better performance.
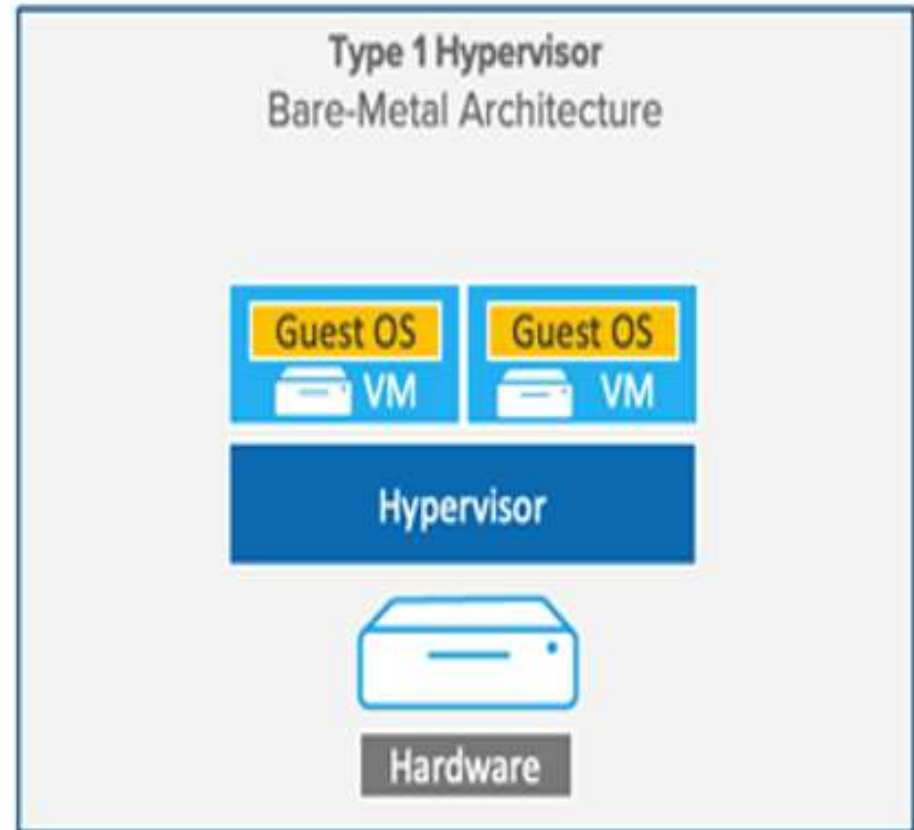▪ Used in enterprise environments and data centers.
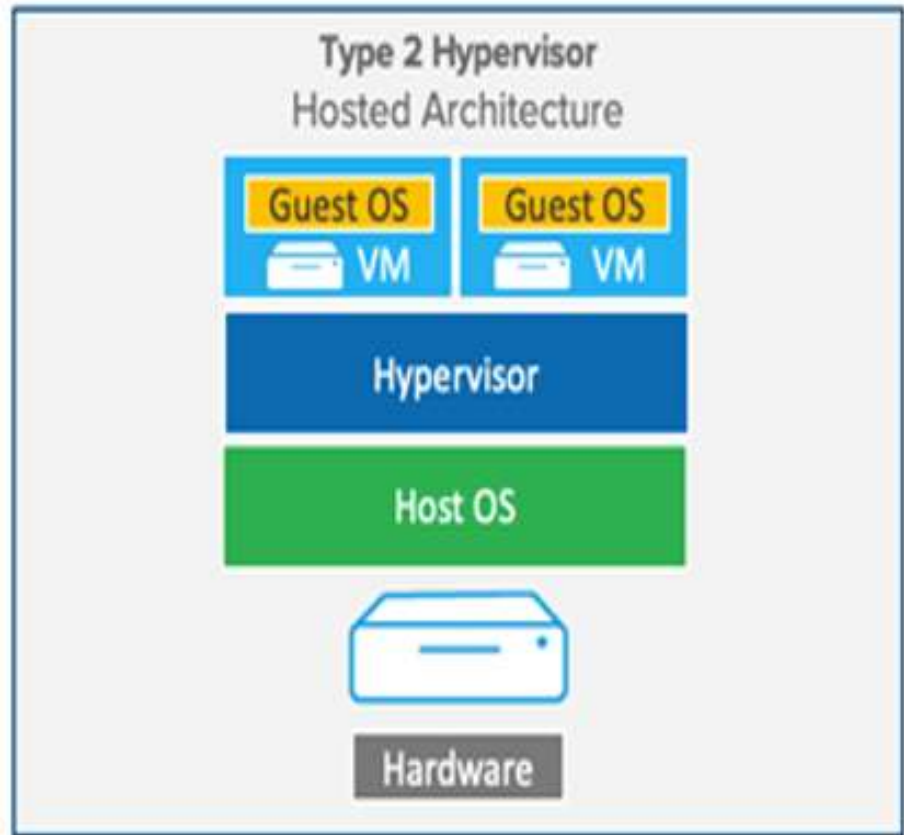
Examples:

XEN
VM ware ESX
Microsoft Hyper-V
KVM
.....

➢ Type-2 (hosted Hypervisor):

▪ Installed on top of an existing host OS running as a software layer.

▪ The guest OS will run at the 3rd level above the hardware.

Type 2 Hypervisor
Hosted Architecture

❖ The presence of an underlying OS introduces unavoidable latency.

➤ Type-2 (hosted Hypervisor):

- Easier to set up but has less performance.
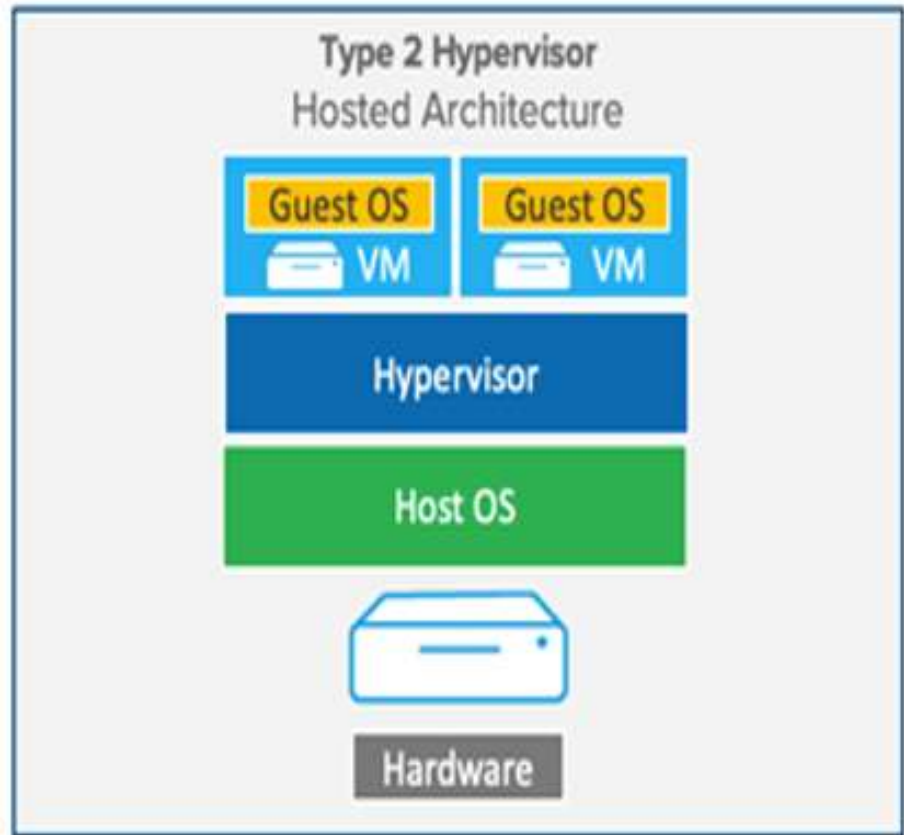- Used for development, testing and personal use.

Examples:
 Vmware Workstation
         QEMU
 Microsoft Virtual PC
  Oracle VirtualBox

         .....

Type 2 Hypervisor
Hosted Architecture

Guest OS | Guest OS
VM | VM
Hypervisor
Host OS
Hardware

❖ Any security vulnerabilities in the host OS could also potentially compromise all of the VMs running above it.
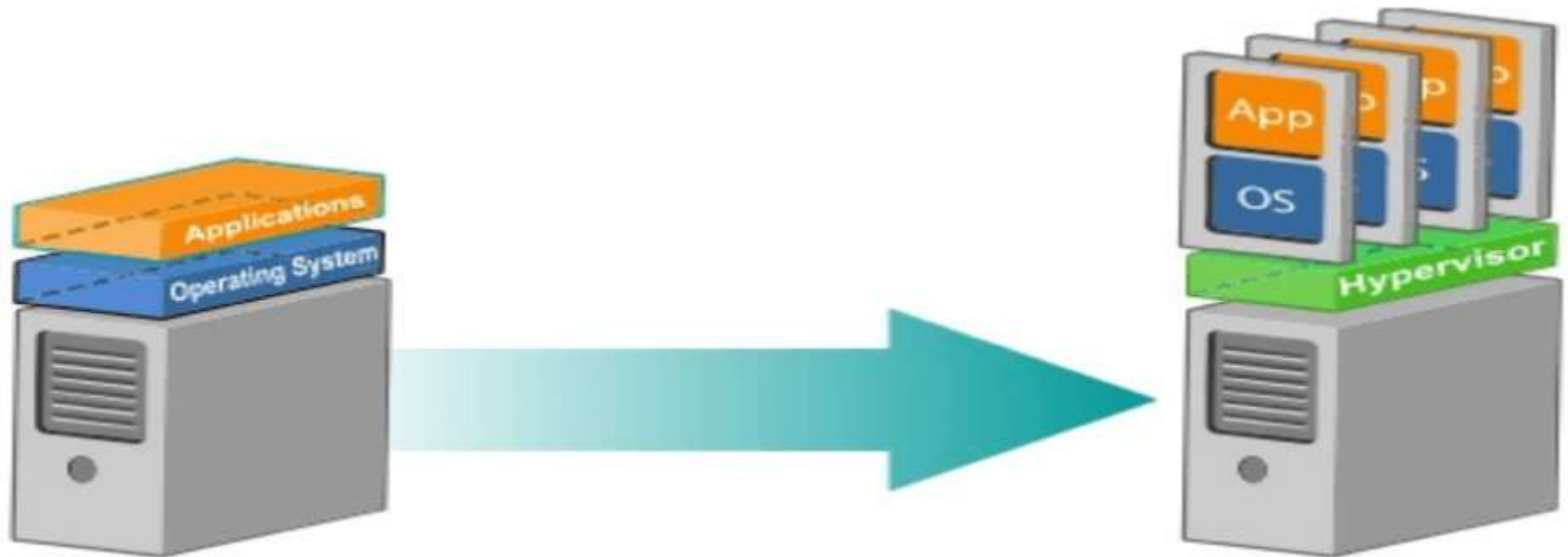
Virtualization and Cloud Computing

➢ Virtualization technology changes how physical infrastructure behaves, allowing multiple applications and operating systems to run on one system by creating simulated environments that operate in isolation:

▪ When a hypervisor is used in a physical computer or server. It facilitates the physical computer to separate its operating system and applications from its hardware.
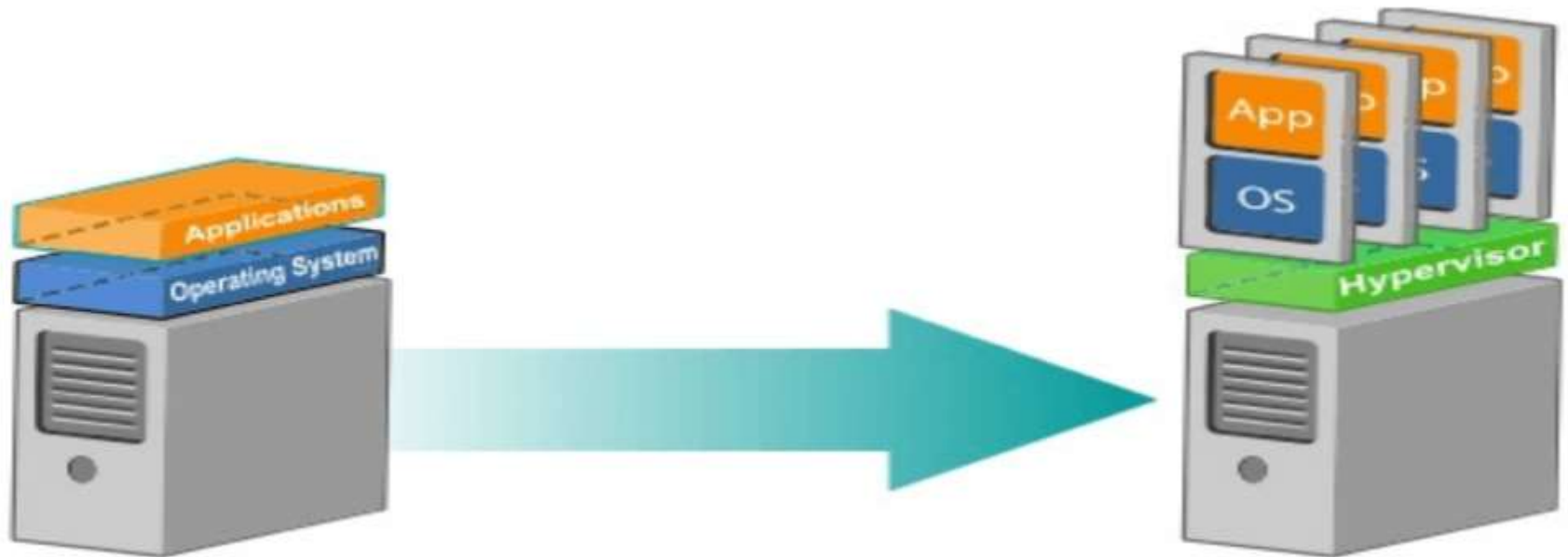
Virtualization and Cloud Computing

It creates several independent virtual machines.

- Each of these virtual machines can run its own operating systems and applications independently, while sharing the primary resources (memory, RAM, storage …) from the bare metal server.

- The hypervisor will act to direct and allocate bare metal resources to each of the various new virtual machines, thus ensuring they don't disrupt each other.

Cloud Computing

- ✓ Grid computing

- ✓ Virtualization Technology

- ✓ Web-based Platform
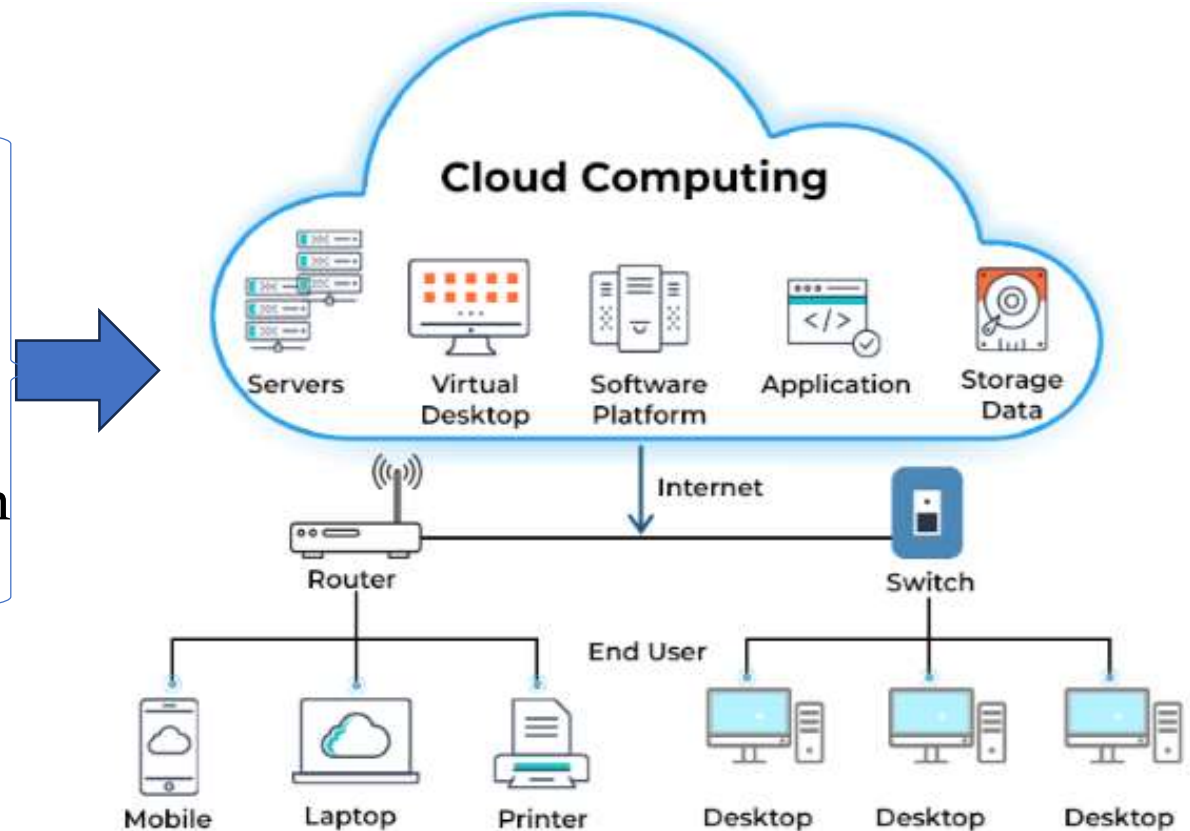
The delivery of computing services (servers, storage, databases, networking, software, analytics, and intelligence) over the internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale.

Economic View Point

➢ Business agility:

organizations can deploy their applications faster and leverage cloud computing services on-demand, such as the ability to scale up or down as required.

➢ Global acess to IT Infrastructure:

That means enterprises worldwide can easily access cloud services over a reliable internet connection, and with a fast VPN.

➢ Cost efficiency:

- Taking advantage of the increased efficiency that comes from multiple tenants sharing computing resources.
- Renting, rather than owning, hardwrae and other IT assets.

Economic View Point

➤ Innovation and Competition

Small and Medium-sized Business (SMBs) are coming in a big way to disrupt new ideas and compete with the leaders (no need to have all resources).

➤ Growth and Employment

The cloud computing industry is growing rapidly, creating massive employment opportunities in different directions.

Data center

An infrastructure consisting of computers, servers, security features networking equipment like routers or switches, software/applications as well as storage options.

Data Center = Compute Networking Storage
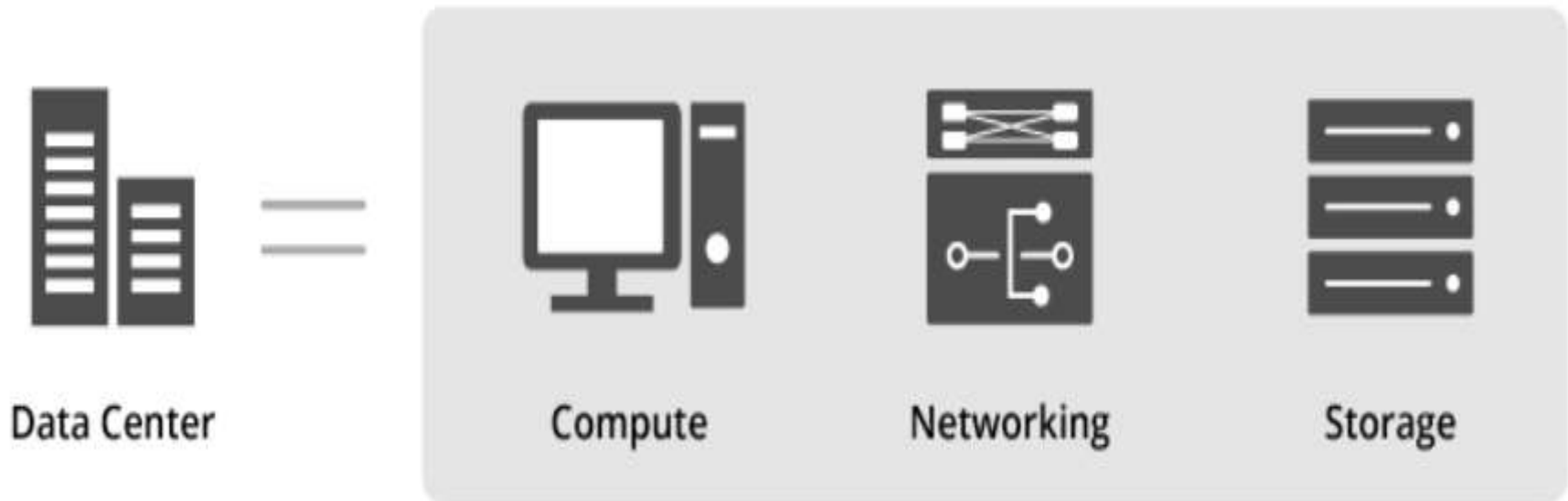
- The compute element : the processing power and memory needed to run apps;
- Storage : the media used to house enterprise data;
- Networking : interconnections between data center components and routers, controllers, switches, etc.

Data center

➤ On premisses

Companies store and manage their data, and this means the company has installed its software and operated locally on its computer servers. (A complete control)

Data center

➢ Cloud Computing Data center

Cloud Computing uses virtualization technology to deliver services that allow end-users to access virtualized servers, apps, … etc without purchasing that equipment themselves.

Data center

This model involves a Third-Party service provider hosting a company's computing resources.

Cloud service providers like: [Amazon AWS](#), [Microsoft Azure](#), and [Google Cloud Platform](#)(GCP) are responsible for managing and maintaining their cloud data centers, compared to managed services centers.

Role of Data centers in Cloud Computing

- Data centers serve as the foundation of cloud computing, enabling the delivery of a vast array of services to users worldwide.

- They host the infrastructure that powers popular applications and platforms, including social media networks, e-commerce websites, and enterprise software solutions.

Cloud is a set of physical hardware (as a foundation) and virtualized resources enabling the cloud's key benefits, such as on-demand access, scalability, and cost efficiency.