Unit 3: Cloud Virtualization technology

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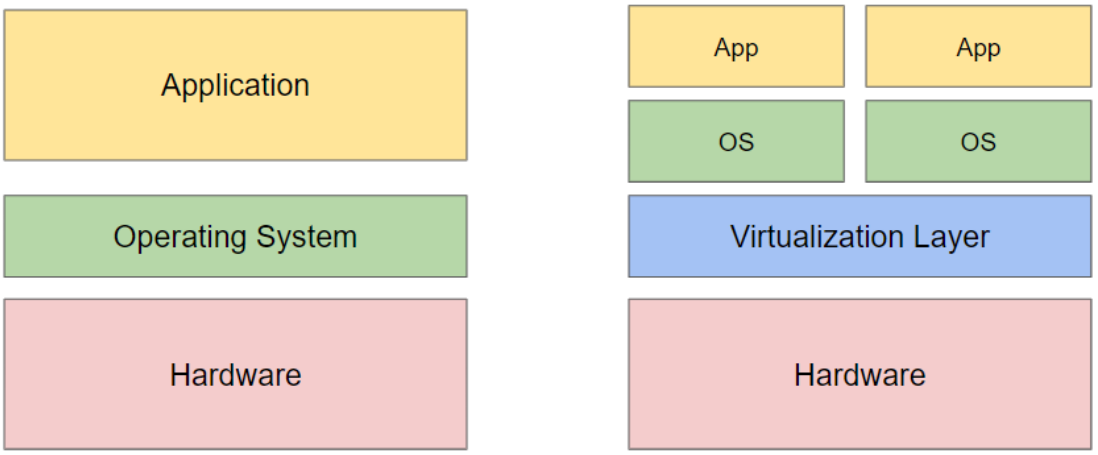
Virtualization

`Virtualization` can be defined as a process that enables the creation of a virtual version of a
desktop, operating system, network resources, or server. Virtualization plays a key and
dominant role in cloud computing.
This ensures that the physical delivery of the resource or an application is separated from
the actual resource itself. It helps reduce the space or cost involved with the resource. This
technique enables the end-user to run multiple desktop operating systems and applications
simultaneously on the same hardware and software.
The process also ensures virtual emulation of products or services in the same machine, and
it does not slow down or impact the system's efficiency.



Traditional Machine Architecture

Virtual Machine Architecture

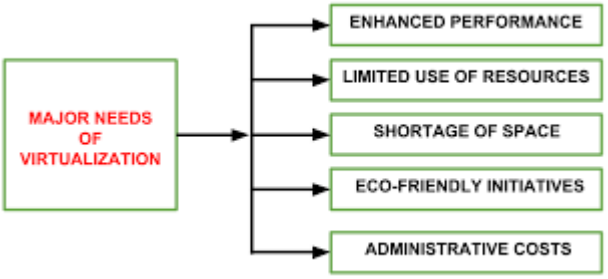
This virtual machine is managed by a software or firmware, which is known as `hypervisor`.

Characteristics of Virtualization Virtualization offers several features or characteristics as listed below:

- **Distribution of resources:** Virtualization and Cloud Computing technology ensure end-users develop a unique computing environment. It is achieved through the creation of one host machine. Through this host machine, the end-user can restrict the number of active users. By doing so, it facilitates easy of control. They can also be used to bring down power consumption.
- **Accessibility of server resources:** Virtualization delivers several unique features that ensure no need for physical servers. Such features ensure a boost to uptime, and there is less fault tolerance and availability of resources.
- **Resource Isolation:** Virtualization provides isolated virtual machines. Each virtual machine can have many guest users, and guest users could be either operating systems, devices, or applications.
- **Security and authenticity:** The virtualization systems ensure continuous uptime of systems, and it does automatic load balancing and ensures there is less disruption of services.
- **Aggregation:** Aggregation in Virtualization is achieved through cluster management software. This software ensures that the homogenous sets of computers or networks are connected and act as one unified resource.

Needs of Virtualization in Cloud Computing

Virtualization is the most needed in cloud computing. Virtualization helps in transferring data easily, protects from system failures, reduces the cost of operations, and provides security to data. Virtualization also helps in increasing the efficiency of the development and operations team by not creating the physical systems for their tasks. They can use virtual machines and servers for testing applications or software. There are five major needs of virtualization which are:



1. ENHANCED PERFORMANCE

Currently, the end user system i.e. PC is sufficiently powerful to fulfill all the basic computation requirements of the user, with various additional capabilities which are rarely used by the user. Most of their systems have sufficient resources which can host a virtual machine manager and can perform a virtual machine with acceptable performance so far.

2. LIMITED USE OF HARDWARE AND SOFTWARE RESOURCES

The limited use of the resources leads to under-utilization of hardware and software resources. As all the PCs of the user are sufficiently capable to fulfill their regular computational needs that's why many of their computers are used often which can be used 24/7 continuously without any interruption. The efficiency of IT infrastructure could be increase by using these resources after hours for other purposes. This environment is possible to attain with the help of Virtualization.

3. SHORTAGE OF SPACE

The regular requirement for additional capacity, whether memory storage or compute power, leads data centers raise rapidly. Companies like Google, Microsoft and Amazon develop their infrastructure by building data centers as per their needs. Mostly, enterprises unable to pay to build any other

data center to accommodate additional resource capacity. This heads to the diffusion of a technique which is known as server consolidation.

4. ECO-FRIENDLY INITIATIVES

At this time, corporations are actively seeking for various methods to minimize their expenditures on power which is consumed by their systems. Data centers are main power consumers and maintaining a data center operations needs a continuous power supply as well as a good amount of energy is needed to keep them cool for well-functioning. Therefore, server consolidation drops the power consumed and cooling impact by having a fall in number of servers. Virtualization can provide a sophisticated method of server consolidation.

5. ADMINISTRATIVE COSTS

Furthermore, the rise in demand for capacity surplus, that convert into more servers in a data center, accountable for a significant increase in administrative costs. Hardware monitoring, server setup and updates, defective hardware replacement, server resources monitoring, and backups are included in common system administration tasks. These are personnel-intensive operations. The administrative cost is increased as per the number of servers. Virtualization decreases number of required servers for a given workload, hence reduces the cost of administrative employees.

Hypervisor

A hypervisor is a software that you can use to run multiple virtual machines on a single physical machine. Every virtual machine has its own operating system and applications. The hypervisor allocates the underlying physical computing resources such as CPU and memory to individual virtual machines as required. Thus, it supports the optimal use of physical IT infrastructure.

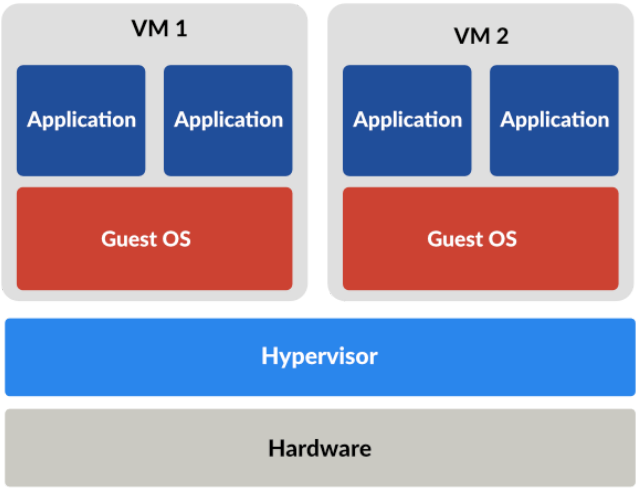
Why is a hypervisor important?

Hypervisors are the underlying technology behind virtualization or the decoupling of hardware from software. IT administrators can create multiple virtual machines on a single host machine. Each virtual machine has its own operating system and hardware resources such as a CPU, a graphics accelerator, and storage. You can install software applications on a virtual machine, just like you do on a physical computer.

The fundamentals of virtual machines and other virtualization technologies have enabled cloud computing services in enterprise applications. They allow you to scale computing services efficiently on limited hardware infrastructure. For example, different business departments can run different workloads separately by using multiple virtual machines on a single server.

Hypervisor Classifications:
Hypervisors are classified into two types:

1. Type I hypervisor or Bare metal/ Native Hypervisors
2. Type II hypervisor or Embedded/ Host Hypervisors

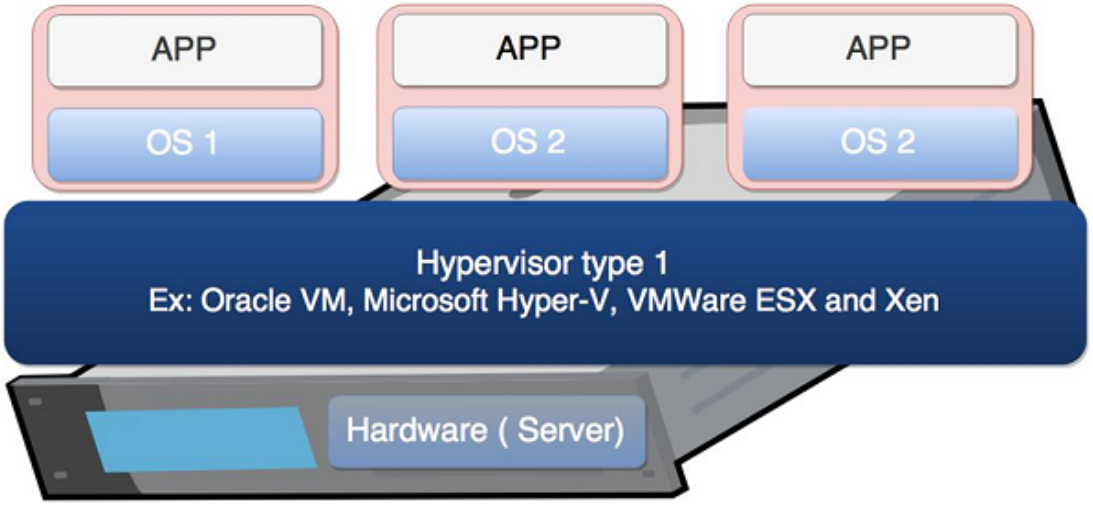


Type 1

1. Type I hypervisor or Bare Metal/Native Hypervisors:

Software systems that run directly on the host's software as a hardware control and guest operating system monitor. A guest operating system thus runs on another level above the hypervisor. This is the classic implementation of virtual machine architectures. A variation of this is embedding the hypervisor in the firmware of the platform, as is done in the case of Hitachi's Virtage hypervisor and VMware ESXi.

Examples of this virtual machine architecture are Oracle VM, Microsoft Hyper-V, VMWare ESX and Xen.



Advantages:

Such kinds of hypervisors are very efficient because they have direct access to the physical hardware resources (like CPU, Memory, Network, Physical storage). This causes the empowerment the security because there is nothing any kind of the third-party resources so that attacker couldn't compromise with anything.

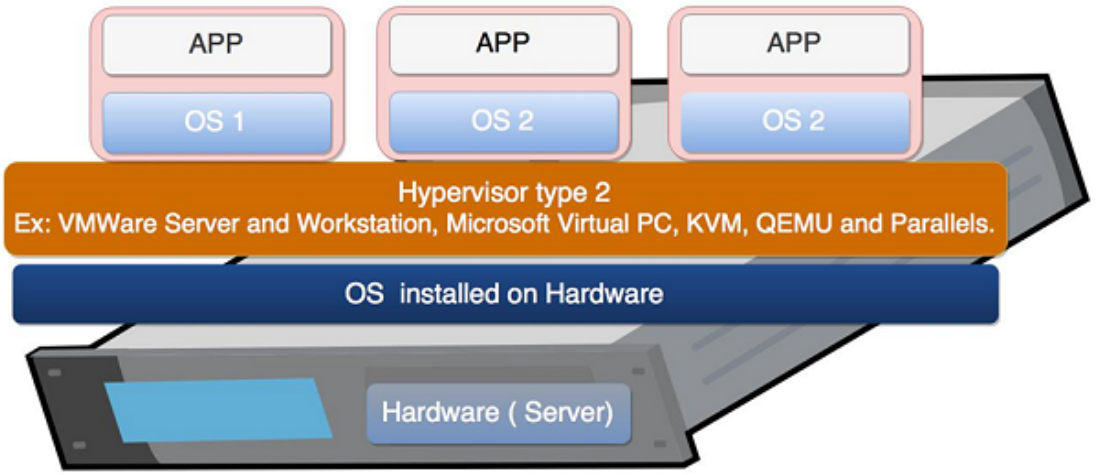
Disadvantages:

One problem with Type-1 hypervisor is that they usually need a dedicated separate machine to perform its operation and to instruct different VMs and control the host hardware resources.

2. Type II hypervisor or Embedded/Host Hypervisors:

Software applications that run within a conventional operating system environment. Considering the hypervisor layer being a distinct software layer, guest operating systems thus run at the third level above the hardware.

A well-known example of a hosted hypervisor is Oracle VM VirtualBox. Others include VMWare Server and Workstation, Microsoft Virtual PC, KVM, QEMU and Parallels.



Advantages:

Such kind of hypervisors allows quick and easy access to a guest Operating System alongside the host machine running. These hypervisors usually come with additional useful features for guest machine. Such tools enhance the coordination between the host machine and guest machine.

Disadvantages:

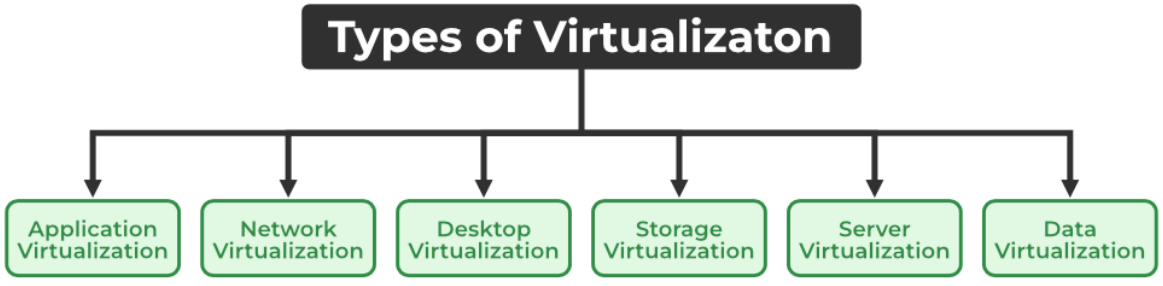
Here is no direct access to the physical hardware resources so the efficiency of these hypervisors lags in performance as compared to the Type-1 hypervisors, and potential security risks are also there an attacker can compromise the security weakness if there is access to the host operating system so he can access the guest operating system.

Important Terminologies of Virtualization:

There are a few essential technologies in Virtualization, which are defined as follows:

- Virtual machine: A virtual machine can be defined as the computer of a virtual type that operates beneath a hypervisor.
- Hypervisor: This can be defined as the operating system that runs on actual hardware. A virtual counterpart of the operating system is a subpart that executes or emulates the virtual process.
- Container: These can be defined as virtual machines of lightweight nature that are a subset of the same operating system instance or the hypervisor. They are a collection of processes that executes along with corresponding namespace or identifiers of process.
- Virtual network: This is defined as the network being separated logically and is present inside the servers. Such networks can be expanded across multiple servers.
- Virtualization software: This type of software helps deploy Virtualization on the computer device.

TYPES OF VIRTUALIZATION



There are many variants or types available under virtualization technology as listed below: -

- Application Virtualization

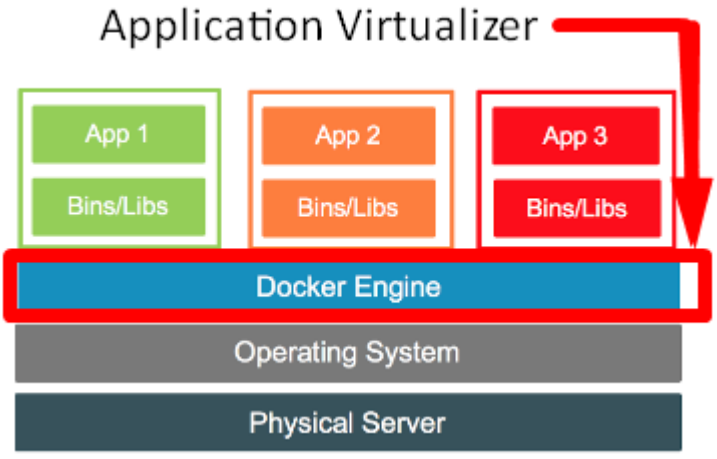
- Network Virtualization
- Desktop Virtualization
- Storage Virtualization
- Server Virtualization
- Data Virtualization

1. **Application Virtualization**

The process of installing an application on a central server (single computer system) that can virtually be operated on multiple systems is known as application virtualization. For end users, the virtualized application works exactly like a native application installed on a physical machine.

With application virtualization, it's easier for organizations to update, maintain, and fix applications centrally. Admins can control and modify access permissions to the application without logging in to the user's desktop. Another benefit of application virtualization is portability.

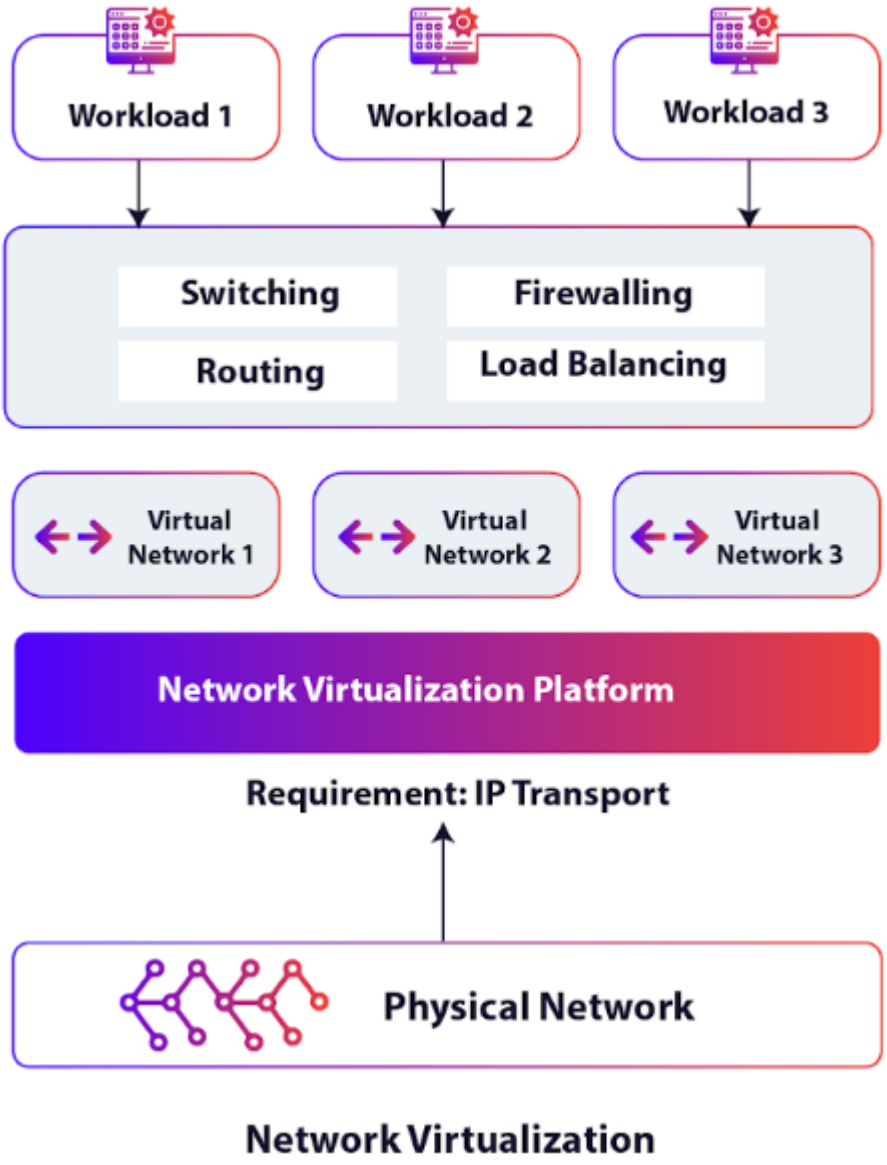
It allows users to access virtualized applications even on non-Windows devices, such as iOS or Android. This helps save user's time invested in application installations and load operations.



2. **Network Virtualization**

Network virtualization helps manage and monitor the entire computer network as a single administrative entity. Admins can keep a track of various elements of network infrastructure such as routers and switches from a single software-based administrator's console.

Network virtualization helps network optimization for data transfer rates, flexibility, reliability, security, and scalability. It improves the overall network's productivity and efficiency. It becomes easier for administrators to allocate and distribute resources conveniently and ensure high and stable network performance.



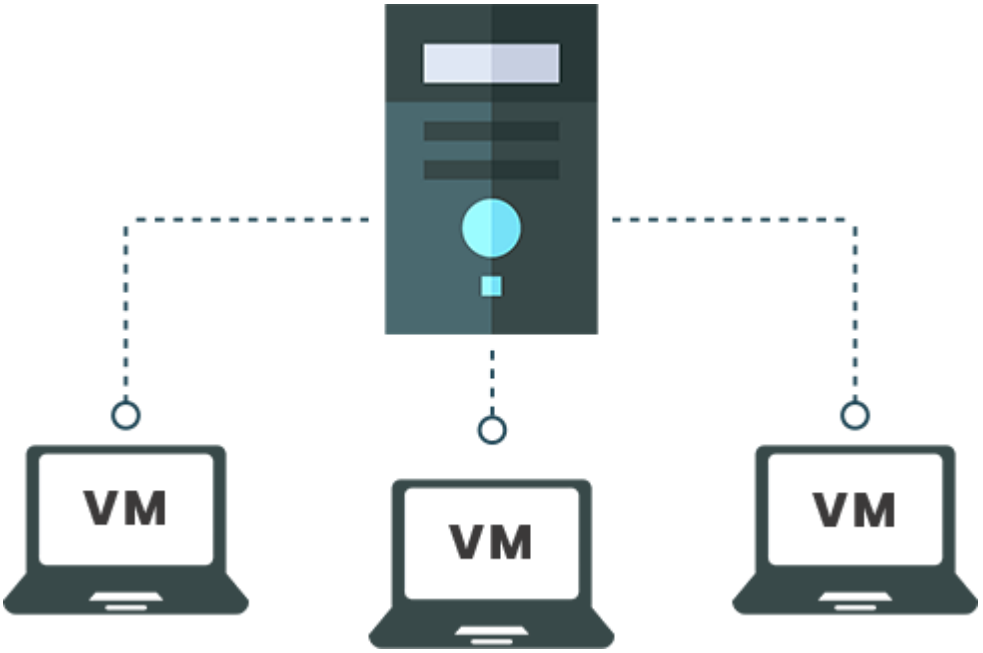
Network Virtualization

3. **Desktop Virtualization**

Desktop virtualization is when the host server can run virtual machines using a hypervisor (a software program). A hypervisor can directly be installed on the host machine or over the operating system (like Windows,

Mac, and Linux). Virtualized desktops don't use the host system's hard drive; instead, they run on a remote central server.

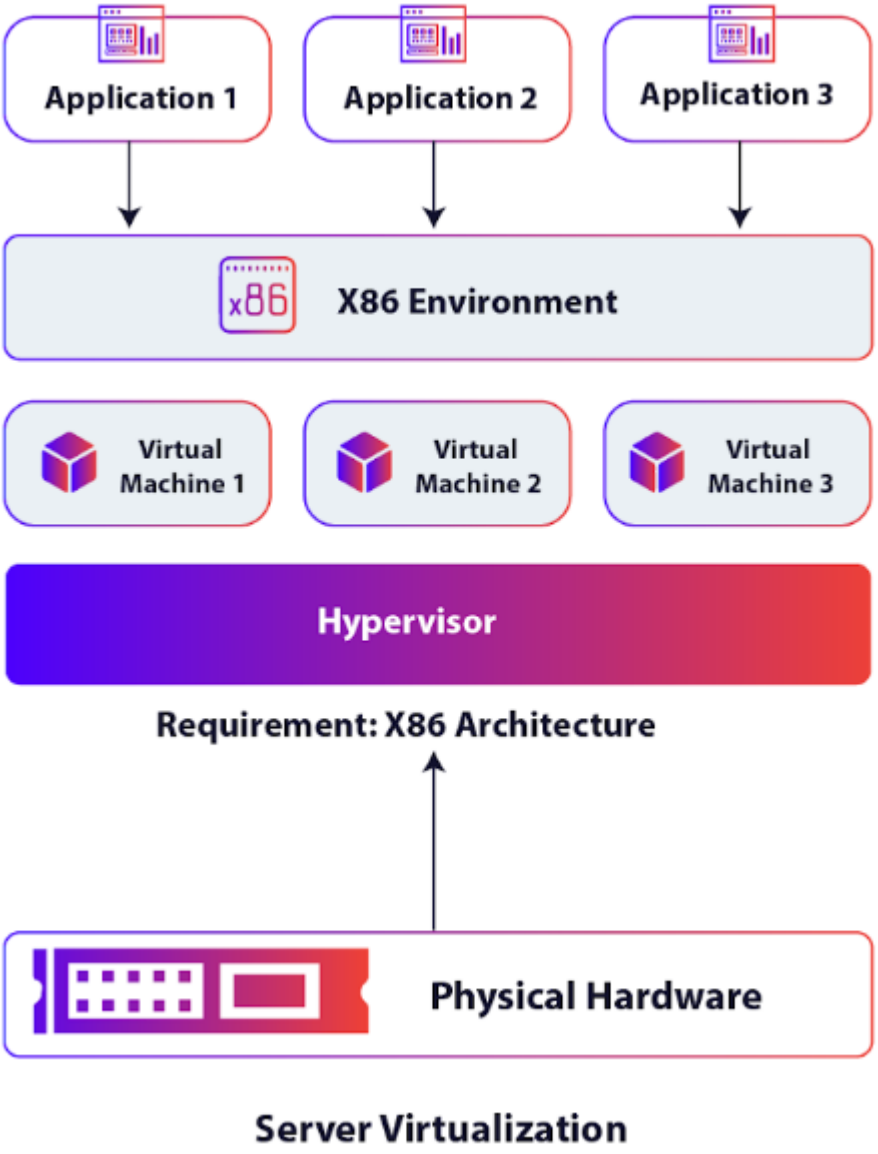
This type of virtualization is useful for development and testing teams who need to develop or test applications on different operating systems.



4. **Server Virtualization**

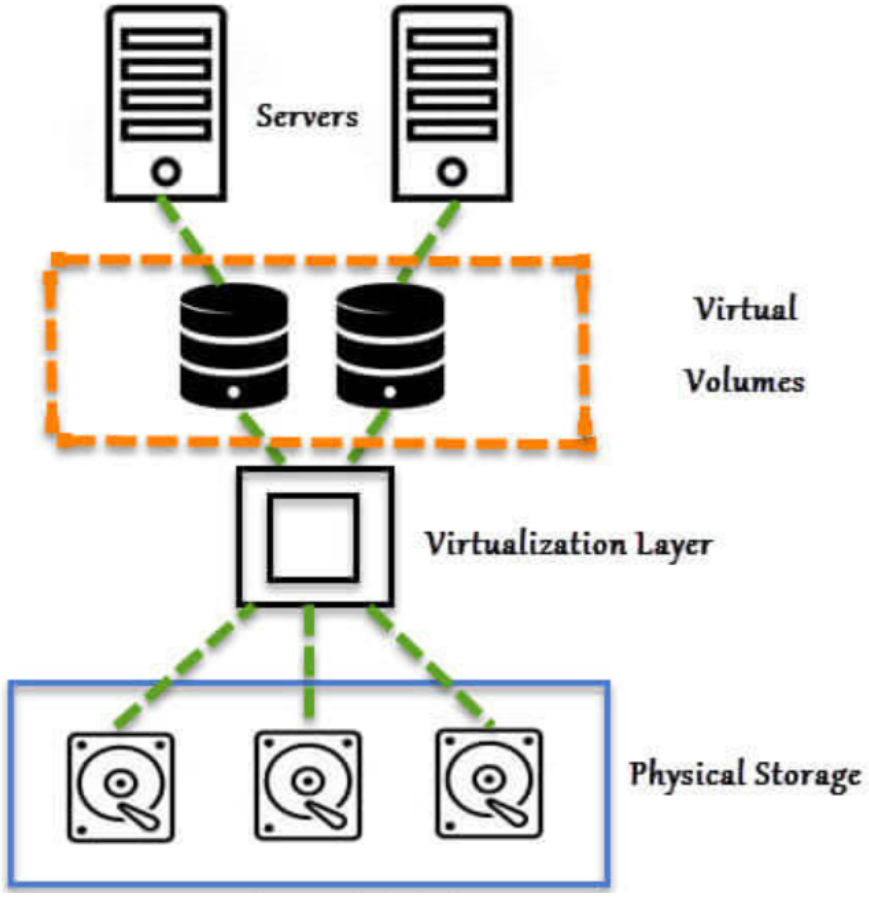
Server virtualization is a process of partitioning the resources of a single server into multiple virtual servers. These virtual servers can run as separate machines. Server virtualization allows businesses to run multiple independent OSs (guests or virtual) all with different configurations using a single (host) server.

The process also saves the hardware cost involved in keeping a host of physical servers, so businesses can make their server infrastructure more streamlined.



5. **Storage Virtualization**

Storage virtualization is the process of pooling physical storage of multiple network storage devices so it looks like a single storage device. Storage virtualization facilitates archiving, easy backup, and recovery tasks. It helps administrators allocate, move, change and set up resources efficiently across the organizational infrastructure.



6. Data Virtualization:

This is the kind of virtualization in which the data is collected from various sources and managed at a single place without knowing more about the technical information like how data is collected, stored & formatted then arranged that data logically so that its virtual view can be accessed by its interested people and stakeholders, and users through the various cloud services remotely. Many big giant companies are providing their services like Oracle, IBM, At scale, Cdata, etc.

Implementation Levels of Virtualization

Structures It is not simple to set up virtualization. Your computer runs on an operating system that gets configured on some particular hardware. It is not feasible or easy to run a different operating system using the same hardware.

To do this, you will need a hypervisor. Now, what is the role of the hypervisor? It is a bridge between the hardware and the virtual operating system, which allows smooth functioning.

Talking of the Implementation levels of virtualization in cloud computing, there are a total of five levels that are commonly used. Let us now look closely at each of these levels of virtualization implementation in cloud computing.

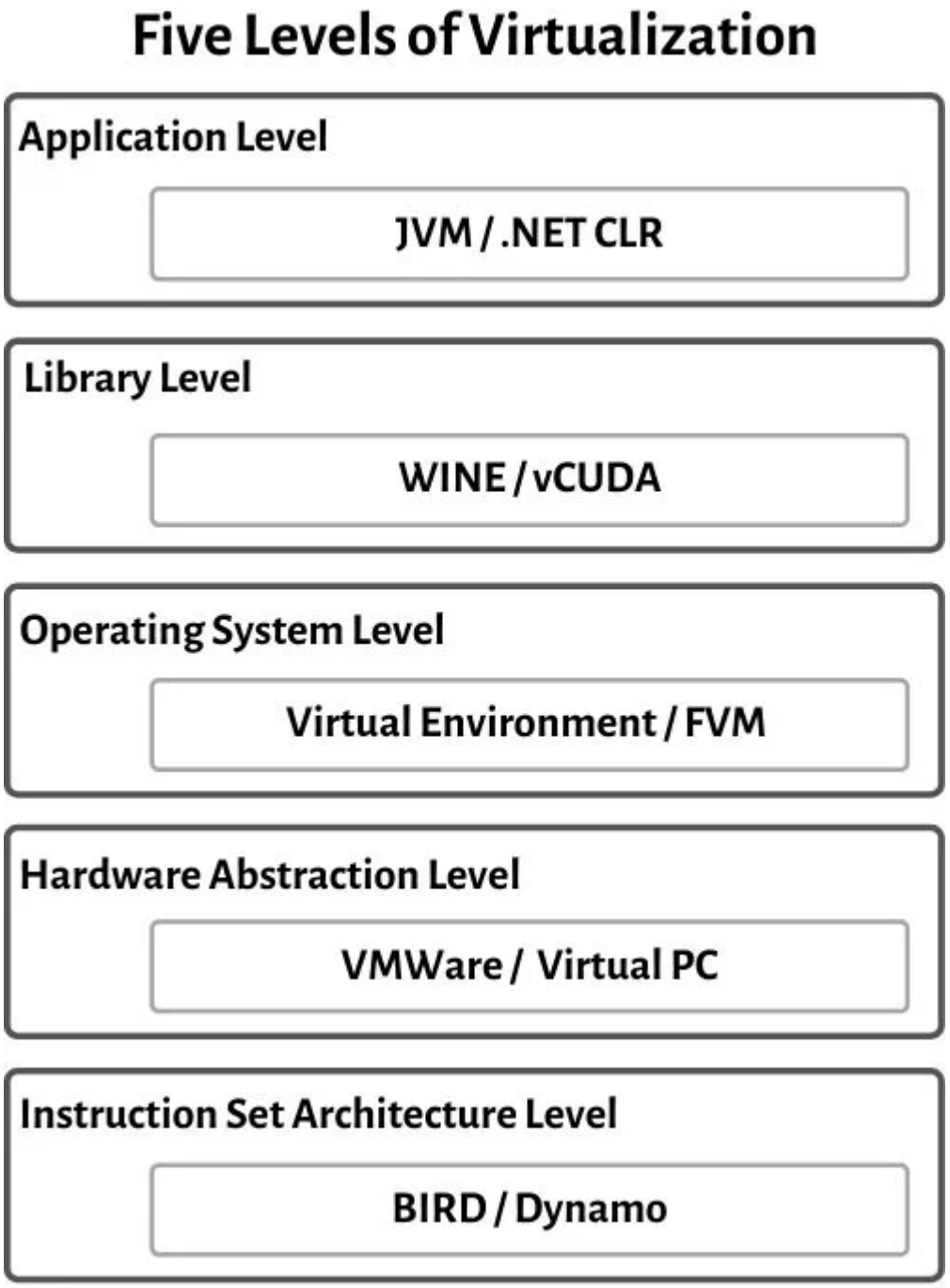


Fig: Virtualization ranging from hardware to applications in five abstraction levels

Virtualization can be implemented at various operational levels, as given below:

1. Instruction set architecture (ISA) level

2. Hardware level

3. Operating system level

4. Library support level

5. Application level

1. **Instruction Set Architecture Level (ISA)**

ISA virtualization can work through ISA emulation. This is used to run many legacy codes that were written for a different configuration of hardware. These codes run on any virtual machine using the ISA. With this, a binary code that originally needed some additional layers to run is now capable of running on the x86 machines. It can also be tweaked to run on the x64 machine. With ISA, it is possible to make the virtual machine hardware agnostic. For the basic emulation, an interpreter is needed, which interprets the source code and then converts it into a hardware format that can be read. This then allows processing. This is one of the five implementation levels of virtualization in cloud computing.

2. Hardware Abstraction Level (HAL)

True to its name HAL lets the virtualization perform at the level of the hardware. This makes use of a hypervisor which is used for functioning. At this level, the virtual machine is formed, and this manages the hardware using the process of virtualization. It allows the virtualization of each of the hardware components, which could be the input-output device, the memory, the processor, etc. Multiple users will not be able to use the same hardware and also use multiple virtualization instances at the very same time. This is mostly used in the cloud-based infrastructure.

3. Operating System Level

At the level of the operating system, the virtualization model is capable of creating a layer that is abstract between the operating system and the application. This is an isolated container that is on the operating system and the physical server, which makes use of the software and hardware. Each of these then functions in the form of a server. When there are several users, and no one wants to share the hardware, then this is where the virtualization level is used. Every user will get his virtual environment using a virtual hardware resource that is dedicated. In this way, there is no question of any conflict.

4. **Library Level**

The operating system is cumbersome, and this is when the applications make use of the API that is from the libraries at a user level. These APIs are documented well, and this is why the library virtualization level is preferred in these scenarios. API hooks make it possible as it controls the link of communication from the application to the system.

5. **Application Level**

The application-level virtualization is used when there is a desire to virtualize only one application and is the last of the implementation levels of virtualization in cloud computing. One does not need to virtualize the entire environment of the platform.

This is generally used when you run virtual machines that use high-level languages. The application will sit above the virtualization layer, which in turn sits on the application program.

It lets the high-level language programs compiled to be used in the application level of the virtual machine run seamlessly.

BENEFITS OF VIRTUALIZATION

From increasing the agility, flexibility and scalability of your business's IT to increasing the performance of your workforce to allow for the optimization of resources, virtualization has numerous benefits for your organization.

Here are some additional Pros/Benefits of Virtualization:

- Virtualization offers several benefits, such as it helps in cost reduction and boosting productivity towards the development process.
- It does away with the need to have a highly complex IT infrastructure.
- It facilitates remote access to resources and ensures that it promotes faster scalability.
- It is highly flexible, and it allows the users to execute multiple desktops operating systems on one standard machine.
- It removes the risks involved in terms of system failures, and it also boosts flexible data transfer between different virtual servers.
- The working process in Virtualization is highly streamlined and agile, which ensures that the users work and operate most economically.

Disadvantages of Virtualization

The disadvantages of Virtualization are very much limited in nature.

Here are the cons/disadvantages of Virtualization:

- The transition of the existing hardware setup to a virtualized setup requires an extensive time investment, and hence this can be regarded as a time-intensive process.
- There is a lack of availability of skilled resources that helps in terms of transition of existing or actual setup to virtual setup.
- Since there is a limitation in terms of having less skilled resources, the implementation of Virtualization calls for high-cost implementations.
- If the transition process is not handled meticulously, it also poses a security risk to sensitive data.

What are the benefits of Virtualization in cloud computing?

The benefits of virtualization in cloud computing are listed below:

- Data will be more secure by creating a backup of data on the server
- Flexibility will be increased by the use of network virtualization
- Reduces the risk of system failure because of using multiple devices to do the same task
- Cost reduction since the no need for physical systems and maintenance cost also reduced.
- The data can be retrieved and transferred with less cost.

Pros of Virtualization in Cloud Computing :

- **Utilization of Hardware Efficiently:** With the help of Virtualization Hardware is efficiently used by user as well as Cloud Service Provider. In this the need of Physical Hardware System for the User is decreases and this results in less costly. In Service Provider point of View, they will vitalize the Hardware using Hardware Virtualization which decrease the Hardware requirement from Vendor side which are provided to User is decreased. Before Virtualization, Companies and organizations have to set up their own Server which require extra space for placing them, engineer's to check its performance and require extra hardware cost but with the help of Virtualization the all these limitations are removed by Cloud

vendor's who provide Physical Services without setting up any Physical Hardware system.

- **Availability increases with Virtualization:** One of the main benefits of Virtualization is that it provides advance features which allow virtual instances to be available all the times. It also has capability to move virtual instance from one virtual Server another Server which is very tedious and risky task in Server Based System. During migration of Data from one server to another it ensures its safety. Also, we can access information from any location and any time from any device.
- **Disaster Recovery is efficient and easy** With the help of virtualization Data Recovery, Backup, Duplication becomes very easy. In traditional method, if somehow due to some disaster if Server system damaged then the surety of Data Recovery is very less. But with the tools of Virtualization real time data backup recovery and mirroring become easy task and provide surety of zero percent data loss.
- **Virtualization saves Energy:** Virtualization will help to save Energy because while moving from physical Servers to Virtual Server's, the number of Server's decreases due to this monthly power and cooling cost decreases which will Save Money as well. As cooling cost reduces it means carbon production by devices also decreases which results in Fresh and pollution free environment.
- **Quick and Easy Set up:** In traditional methods Setting up physical system and servers are very time-consuming. Firstly Purchase them in bulk after that wait for shipment. When Shipment is done then wait for setting up and after that again spend time in installing required software etc. which will consume very time. But with the help of virtualization the entire process is done in very less time which results in productive setup.
- Cloud Migration becomes easy – Most of the companies those who already have spent a lot in the server have a doubt of Shifting to Cloud. But it is more cost-effective to shift to cloud services because all the data that is present in their servers can be easily migrated into the cloud server and save something from maintenance charge, power consumption, cooling cost, cost to Server Maintenance Engineer etc.

Cons of Virtualization in Cloud Computimg :

- **Data can be at Risk:** Working on virtual instances on shared resources means that our data is hosted on third party resource which put's our

data in vulnerable condition. Any hacker can attack on our data or try to perform unauthorized access. Without Security solution our data is in threaten situation.

- **Learning New Infrastructure:** As Organization shifted from Servers to Cloud, they required skilled staff who can work with cloud easily. Either they hire new IT staff with relevant skill or provide training on that skill which increases the cost of company.
- **High Initial Investment:** It is true that Virtualization will reduce the cost of companies but also it is truth that Cloud has high initial investment. It provides numerous services which are not required and when unskilled organization will try to set up in cloud they purchase unnecessary services which are not even required to them.

Server Virtualization

Server virtualization is the process of dividing a physical server into multiple unique and isolated virtual servers by means of a software application. Each virtual server can run its own operating systems independently. Server virtualization is used to mask server resources from server users. This can include the number and identity of operating systems, processors, and individual physical servers.

Why Server Virtualization

Server virtualization is a cost-effective way to provide web hosting services and effectively utilize existing resources in IT infrastructure. Without server virtualization, servers only use a small part of their processing power. This results in servers sitting idle because the workload is distributed to only a portion of the network's servers. Data centers become overcrowded with underutilized servers, causing a waste of resources and power.

By having each physical server divided into multiple virtual servers, server virtualization allows each virtual server to act as a unique physical device. Each virtual server can run its own applications and operating system. This process increases the utilization of resources by making each virtual server act as a physical server and increases the capacity of each physical machine.

Key Benefits of Server Virtualization:

- Higher server ability
- Cheaper operating costs
- Eliminate server complexity
- Increased application performance
- Deploy workload quicker

Kinds of Server Virtualization: (Full virtualization, Paravirtualization, OS level virtualization, Hardware Assisted Virtualization, and Kernel-level virtualization)

1. **Full virtualization:**

- Guest operating systems are unaware of each other
- Provide support for unmodified guest operating system.
- Hypervisor directly interact with the hardware such as CPU,disks.
- Hypervisor allow to run multiple OS simultaneously on host computer.
- Each guest server run on its own operating system

Few implementations: Oracle's VirtualBox , VMware server, Microsoft Virtual PC

Advantages:

- No modification to the Guest operating system is required.

Limitations:

- Complex
- Slower due to emulation
- Installation of the new device driver is difficult.

2. Para virtualization:

- Unlike full virtualization, guest servers are aware of one another.
- Hypervisor does not need large amounts of processing power to manage guest OS.
- The entire system work as a cohesive unit.

Advantages:

- Easier
- Enhanced Performance
- No emulation overhead

Limitations:

- Requires modification to a guest operating system

The difference between full and pare virtualization is that, in para virtualization hypervisor
does not need too much processing power to manage the OS.

The difference between Full Virtualization and Paravirtualization are as follows:

Full Virtualization	Paravirtualization
In Full virtualization, virtual machines permit the execution of the instructions with the running of unmodified OS in an entirely isolated way.	In paravirtualization, a virtual machine does not implement full isolation of OS but rather provides a different API which is utilized when OS is subjected to alteration
Full Virtualization is less secure	While the Paravirtualization is more secure than the Full Virtualization.
Full Virtualization uses binary translation and a direct approach as a technique for operations.	While Paravirtualization uses hypercalls at compile time for operations.
Full Virtualization is slow than paravirtualization in operation.	Paravirtualization is faster in operation as compared to full virtualization.
Full Virtualization is more portable and compatible.	Paravirtualization is less portable and compatible.
Examples of full virtualization are Microsoft and Parallels systems.	Examples of paravirtualization are Microsoft Hyper-V, Citrix Xen, etc.
It supports all guest operating systems without modification.	The guest operating system has to be modified and only a few operating systems support it.
The guest operating system will issue hardware calls.	Using the drivers, the guest operating system will directly communicate with the **hypervisor.**

Full Virtualization	Paravirtualization
It is less streamlined compared to para-virtualization.	It is more streamlined.
It provides the best isolation.	It provides less isolation compared to full virtualization.

3. Operating System Level Virtualization

Operating system virtualization is also called as system-level virtualization. It is a server virtualization technology that divides one operating system into multiple isolated user-space called virtual environments. The biggest advantage of using server visualization is that it reduces the use of physical space, so it will save money. Linux OS Virtualization and Windows OS Virtualization are the types of Operating System virtualization. `FreeVPS`, `OpenVZ`, and `Linux Vserver` are some examples of System-Level Virtualization.

Advantages:

- Significantly lightweight than complete machines(including a kernel)
- Can host many more virtual servers
- Enhanced Security and isolation
- Virtualizing an operating system usually has little to no overhead.
- Live migration is possible with OS Virtualization.
- It can also leverage dynamic container load balancing between nodes and clusters.
- On OS virtualization, the file-level copy-on-write (CoW) method is possible, making it easier to back up data, more space-efficient, and easier to cache than block-level copy-on-write schemes.

Limitations:

- Kernel or driver problems can take down all virtual servers.

4. Hardware Assisted Virtualization

Hardware Assisted Virtualization was presented by AMD and Intel. It is also known as Hardware virtualization, AMD virtualization, and Intel virtualization. It is designed to increase the performance of the processor.

Advantages:

- No modification to a guest operating system is required.
- Very less hypervisor overhead

Limitations:

- Hardware support Required

5. Kernel-Level Virtualization

Kernel-level virtualization is one of the most important types of server virtualization. It is an open-source virtualization which uses the Linux kernel as a hypervisor. The advantage of using kernel virtualization is that it does not require any special administrative software and has very less overhead. User Mode Linux (UML) and Kernel-based virtual machine are some examples of kernel virtualization.

Advantages:

- No special administrative software is required.
- Very less overhead

Limitations:

- Hardware Support Required

Advantages of Server Virtualization

There are the following advantages of Server Virtualization:

1. Independent Restart: In Server Virtualization, each server can be restart independently and does not affect the working of other virtual servers.

2. Low Cost: Server Virtualization can divide a single server into multiple virtual private servers, so it reduces the cost of hardware components.

3. Disaster Recovery: Disaster Recovery is one of the best advantages of Server Virtualization. In Server Virtualization, data can easily and quickly move from one server to another and these data can be stored and retrieved from anywhere.

4. Faster deployment of resources: Server virtualization allows us to deploy our resources in a simpler and faster way.

5. Security: It allows uses to store their sensitive data inside the data centers.

Disadvantages of Server Virtualization:

There are the following disadvantages of Server Virtualization:

1. The biggest disadvantage of server virtualization is that when the server goes offline, all the websites that are hosted by the server will also go down.

2. There is no way to measure the performance of virtualized environments.

3. It requires a huge amount of RAM consumption.

4. It is difficult to set up and maintain.

5. Some core applications and databases are not supported virtualization.

6. It requires extra hardware resources.

Uses of Server Virtualization:

A list of uses of server virtualization is given below -

- Server Virtualization is used in the testing and development environment.
- It improves the availability of servers.
- It allows organizations to make efficient use of resources.
- It reduces redundancy without purchasing additional hardware components.

Hypervisor Management Software

Virtualization management software is a type of software that is used for administering a virtualization host. It is used with the actual virtualization controller or hypervisor. This type of software connects directly to the hypervisor to provide additional management and monitoring tools with intuitive user interfaces that visualize the status of the system to enable administrators to make informed decisions when tweaking or managing the virtualized environment, which can be done on the same interface.

Virtualization management software allows for easy management of virtual environments through monitoring, reporting and control. An operator is able to determine the health and status of all virtual resources and virtual machines through reports that are visualized as graphs and pie charts to illustrate proportion and relativity. This allows the operator to make informed judgments on which courses of action to take based on set business protocols.

This type of management software also has built-in automation algorithms that allow for predefined actions to be taken based on certain situations, such as auto-provisioning of resources or additional instances whenever an increased traffic is deemed to require it.

Virtualization management software is used for the following:

- Managing the provisioning of virtual machines and infrastructure
- Managing storage performance even between different storage providers or vendors as well as mapping of each virtual machine to its assigned storage hardware
- Mobile administration
- Server and application monitor integration
- VM sprawl control
- Discovery/monitoring and maintenance
- Provision and configuration

A hypervisor, also known as a virtual machine manager/monitor (VMM), is computer hardware platform virtualization software that allows several operating systems to share a single hardware host.

Each operating system appears to have the host's processor, memory, and resources to it. Instead, the hypervisor is controlling the host processor and resources, distributing what is needed to each operating system in turn and ensuring that the guest operating systems/virtual machines are unable to disrupt each other.

The term 'hypervisor call' refers to the para virtualization interface, by which a guest operating system accesses services directly from the higher-level control program.

This is the same concept as making a supervisor call to the same level operating system.

Virtual infrastructure

Virtual infrastructure is a collection of software-defined components that make up an enterprise IT environment. A virtual infrastructure provides the same IT capabilities as physical resources, but with software, so that IT teams can allocate these virtual resources quickly and across multiple systems, based on the varying needs of the enterprise.

By decoupling physical hardware from an operating system, a virtual infrastructure can help organizations achieve greater IT resource utilization, flexibility, scalability and cost savings. These benefits are

especially helpful to small businesses that require reliable infrastructure but can't afford to invest in costly physical hardware.

Virtual Infrastructure Requirements

From design to disaster recovery, there are certain virtual infrastructure requirements organizations must meet to reap long-term value from their investment.

- **Appropriate Plan:** IT teams should understand how business development, market volatility, and technological advances will influence their hardware requirements and dependence on computing power, networking, and storage resources during developing a virtual infrastructure.
- Cost Analysis: If IT teams don't take the time to constantly review a virtual infrastructure and its deliverables, IT infrastructure costs can become unusable. Cost reduction strategies can vary from replacing old servers and renegotiating vendor contracts to automating server management activities that take time.
- Prepare for failure: Even the most robust virtual infrastructure can experience down, despite its hardware failure and high availability.

By taking advantage of monitoring software, buying extra hardware, and depending on clusters to help handle host resources, IT teams can plan for worst-case scenarios.

Benefits of virtual infrastructure

The benefits of virtualization touch every aspect of an IT infrastructure, from storage and server systems to networking tools. Here are some key benefits of a virtual infrastructure:

- **Flexible:** Compared to physical infrastructure, it allows for multiple server and networking configurations that take more resources and effort to modify.
- **Cost savings:** Virtualization eliminates capital and maintenance costs associated with factors such as electrical resources, physical security, and hosting and server growth by consolidating servers.
- **Backup and recovery:** Promotes simplified backups because if a few hosts are down, it can be saved elsewhere, allowing for fast recovery on other

hosts. For physical servers, which have to be revived before services can restart, this is almost impossible.

- **Simplified server management:** Organizations need to adapt rapidly, from seasonal fluctuations in market demand to abrupt economic downturns. Simplified server management ensures that IT teams, as appropriate, can spin up or down virtual machines and re-provision resources based on real-time requirements.
- **Load balancing:** It helps software-based servers to efficiently share and properly distribute workloads such that no one logical server is taxed more than the others.
- **Increased productivity:** Faster application and resource provisioning enable IT teams to adapt more rapidly to employee requests for new resources and technologies. The result increased IT team productivity, performance, and agility, and increased employee experience, and increased retention rates of talent without delays in hardware procurement.
- **Scalability:** Virtual infrastructure enables organizations to adapt rapidly growing systems to evolving consumer needs and market trends.