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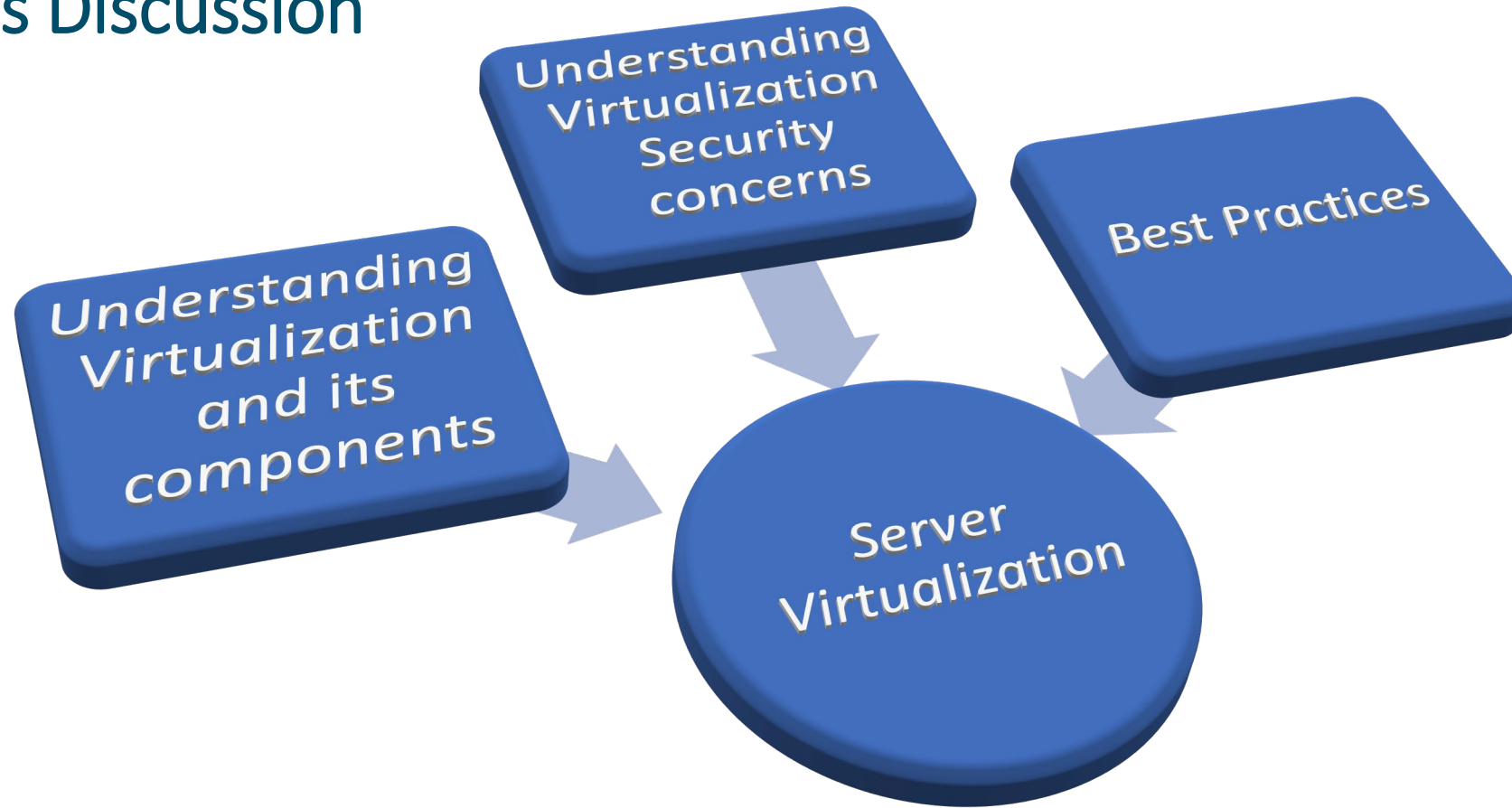
Trawsnewid Addysg, Trawsnewid Bywydau
Transforming Education, Transforming Lives

Virtualization

Network Operating Systems and Services ACCA5023

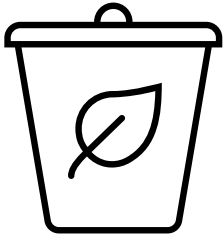
During this week, we shall focus on server virtualization! we will delve into the virtualization concepts, with a primary focus on understanding its components, exploring virtualization security concerns, and learning about best practices in this field.

Today's Discussion



Before we dive into today's topics, let's briefly recap and touch base IP Addressing from last week - where we left and move forward.

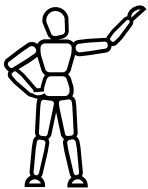
Resources



Resources required for your Coursework – Worksheets

- ✍ Download from Microsoft Evaluation Center
- ✍ Download from <https://www.debian.org/distrib/>

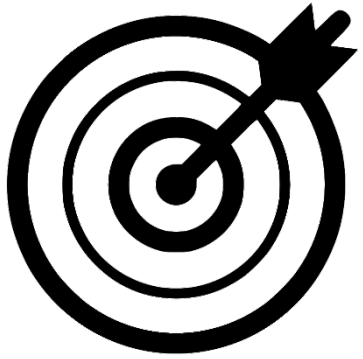
Action



As we conclude today's lecture on server virtualization, I hope you now have a clearer understanding of virtualization concepts and its various perspectives.

- ✍ This newfound clarity will empower you to embark on detailed research into different types of hypervisors used in virtualization.
- ✍ By exploring various hypervisor options, you'll be equipped to make informed decisions regarding the selection of a hypervisor that aligns with the requirements of your coursework.
- ✍ Remember, the choice of hypervisor can significantly impact the performance, scalability, and management of virtualized environments. So, use this knowledge wisely as you progress through your coursework and beyond. Good luck!

Objectives



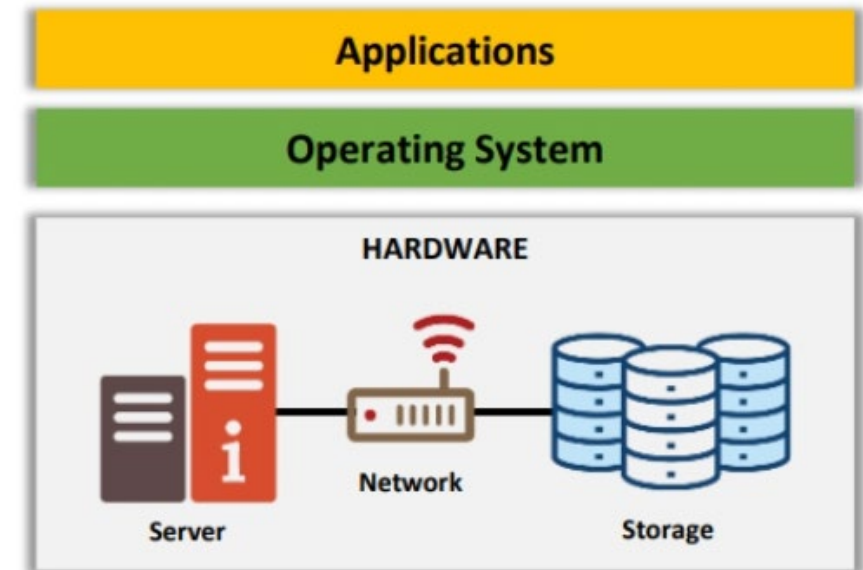
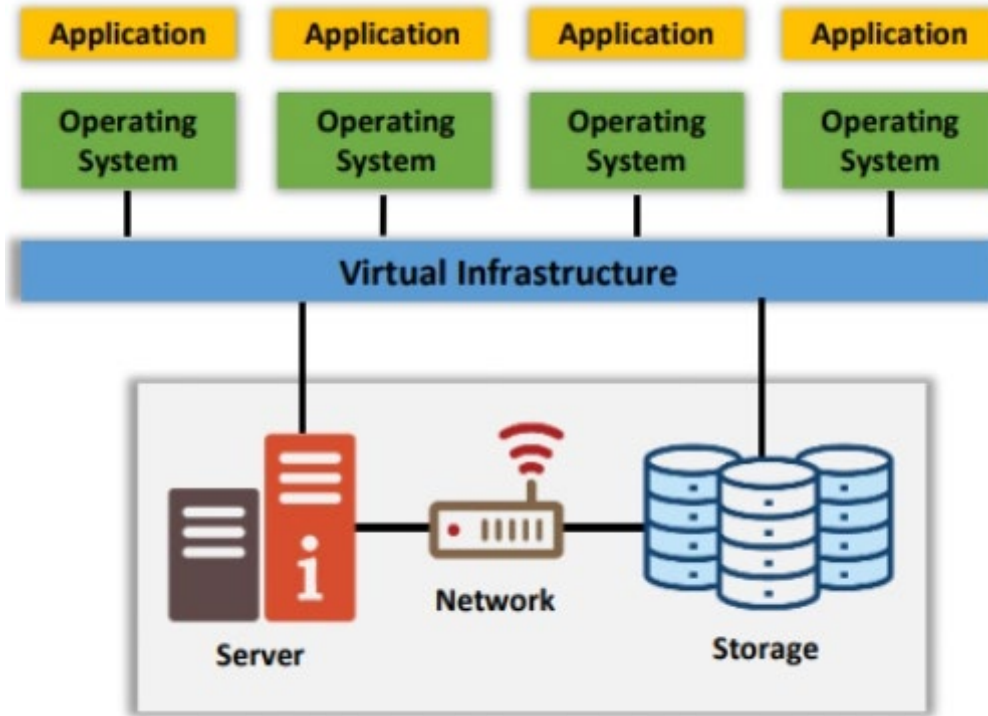
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- ✍ **Discuss with your group on your understanding about IP Addressing – Introduced and research done during previous lecture. Scan the QR and key in your Inputs**
- ✍ Understand Virtualization Concepts
- ✍ Research on Hypervisor
- ✍ Recommendation: Complete Task 1 (Hypervisor and IP Addressing) in Coursework 1

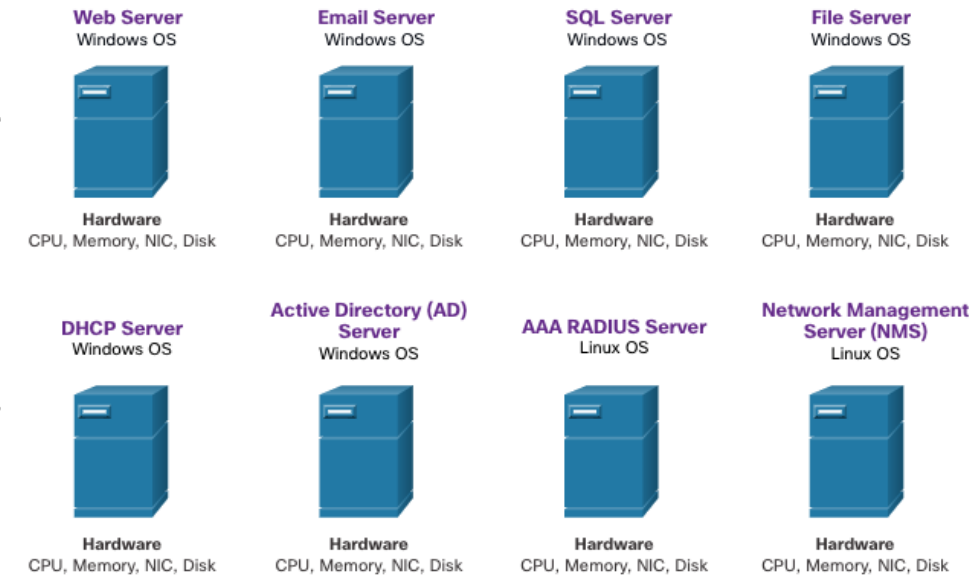
Virtualization

- Virtualization refers to a **software-based virtual representation of an IT infrastructure** that includes network, devices, applications, storage, etc.
- The virtualization framework **divides the physical resources which are traditionally bound to hardware**, into multiple individual simulated environments



Virtualization

- ✍ Sharing existing underutilized resources across a catalogue of IT Applications.
- ✍ The technique of virtualization has existed in Processing, storage, and networking.
- ✍ The past decade has focused on development of Virtual Machines.
- ✍ A virtual machine is a **tightly isolated software container** that runs its own operating system and applications as if it were a physical machine – (VMware website)
- ✍ Virtualization also **enables you to create storage devices and network resources**. So, instead of having ten physical machines/servers, you can have one physical server and nine VMs running on it.
- ✍ Windows Server 2019 comes equipped with a Hyper-V feature that enables virtualization.
- ✍ As a descendant of Windows Virtual PC, Microsoft's Hyper-V was introduced in **Windows Server 2008**.
- ✍ “Hyper-V provides the services that can be used to create and manage VMs, along with their resources”





Virtualization Approaches

- ☐ Full Virtualization
- ☐ OS assisted Virtualization or Para Virtualization
- ☐ Hardware assisted Virtualization
- ☐ Hybrid Virtualization



Levels of Virtualization

- ☐ Storage Device Virtualization
- ☐ File System Virtualization
- ☐ Server Virtualization
- ☐ Fabric Virtualization



Types of Virtualization

- ☐ Operating System Virtualization
- ☐ Network Virtualization
- ☐ Server Virtualization
- ☐ Desktop Virtualization

Technologies

- ✧ Enable various forms of virtualization, including network virtualization, server virtualization, desktop virtualization, and OS virtualization.

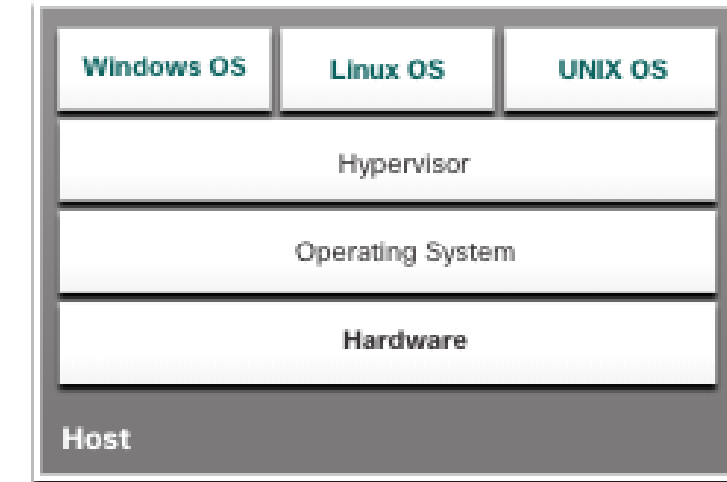
Type 1 Hypervisor:

- ✧ Bare-metal Hypervisor - runs directly on the physical hardware.
- ✧ It allows for the creation and management of multiple virtual machines (VMs) on a single physical server.
- ✧ Type 1 hypervisors are used to implement server virtualization, desktop virtualization, and other forms of virtualization.



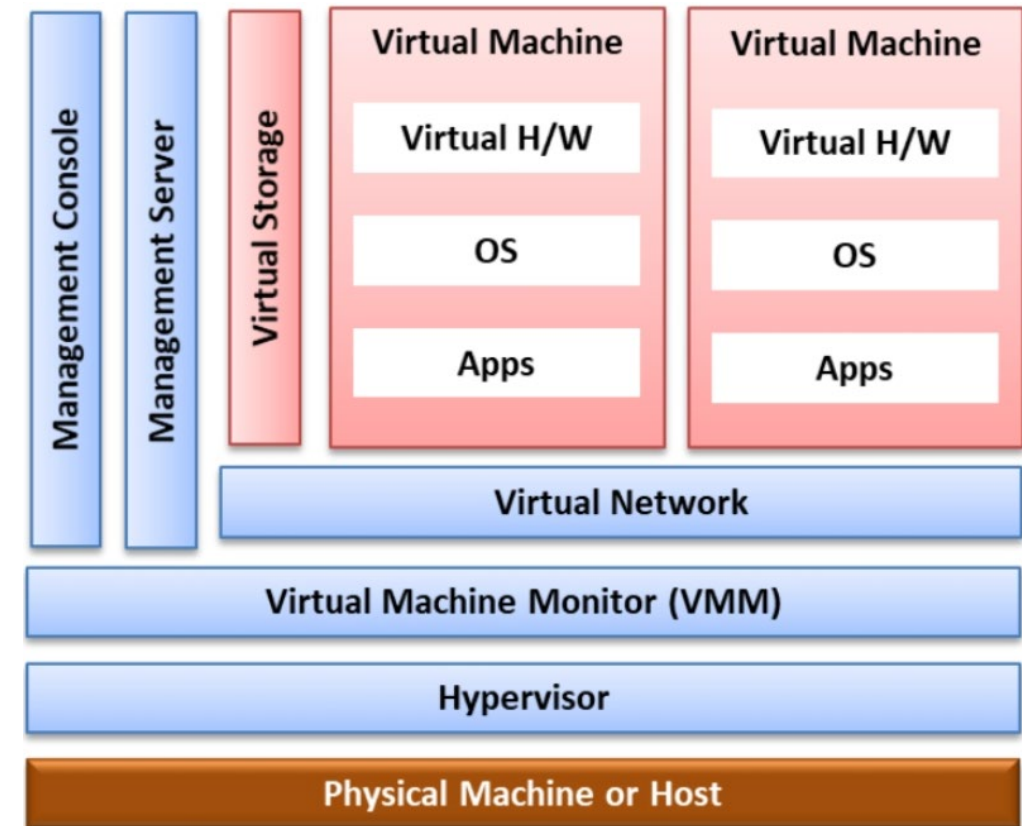
Type 2 Hypervisor:

- ✧ Hosted Hypervisor - runs on top of a host operating system.
- ✧ It enables users to create and manage VMs on their desktop or laptop computers.
- ✧ Type 2 hypervisors are primarily used for desktop virtualization and **development/testing purposes.**



Full Virtualization

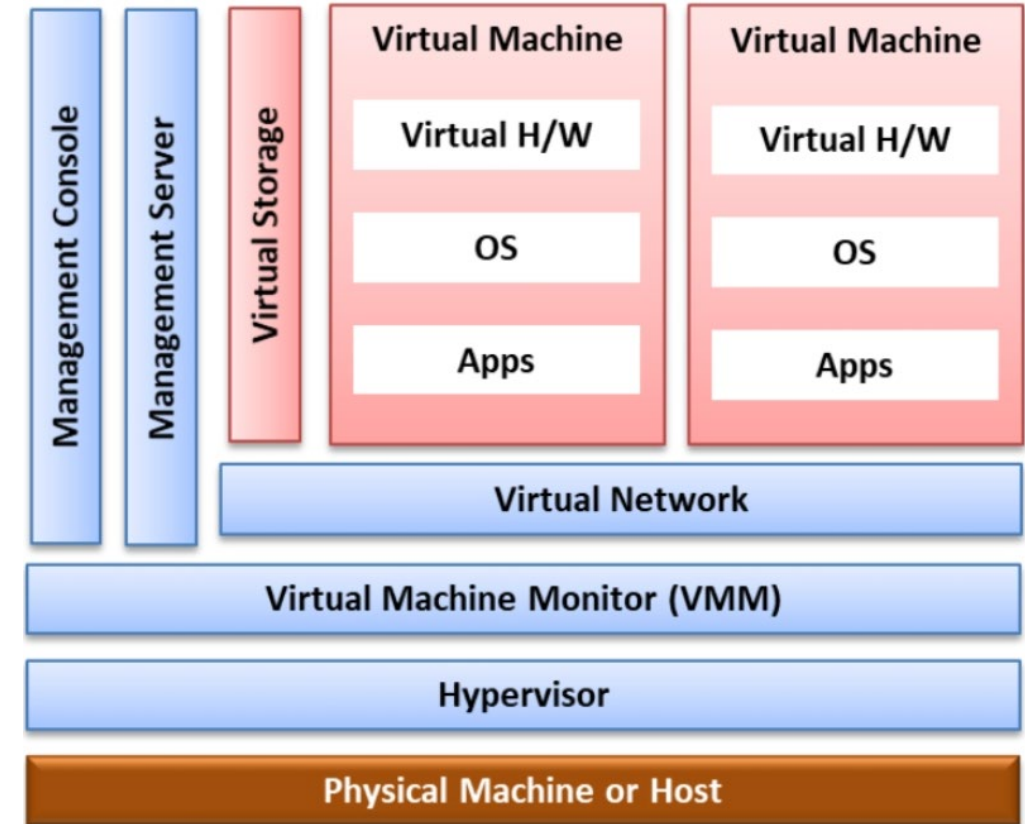
- ✍ Full virtualization involves a setup where the **guest operating system** (OS) remains oblivious to the fact that it's running in a virtualized environment
 - ✍ Instead of directly communicating with the underlying hardware, the guest OS sends commands to the VMM.
 - ✍ The VMM acts as an intermediary between the guest OS and the host hardware.
 - ✍ It receives commands from the guest OS and translates them into binary instructions that the underlying hardware (host hardware) can execute.
- ✍ VMM is responsible for managing and allocating resources to the guest OS.
- ✍ It ensures that the guest OS has access to the necessary resources, such as CPU, memory, and storage, while also maintaining isolation between multiple guest OS instances running on the same physical hardware.



Components of Virtualization

Para Virtualization

- ✧ The guest OS is aware of the virtual environment it's running in.
- ✧ The guest OS communicates directly with the host machine to request resources.
- ✧ Commands from the guest OS are translated into binary code for the hardware.
- ✧ The Virtual Machine Monitor (VMM) is not involved in the request and response operations.
- ✧ Para virtualization is commonly used in environments where **performance is critical**, such as high-performance computing (HPC) or real-time systems.
- ✧ It provides a **balance between performance and flexibility**, making it a suitable choice for specific use cases where performance optimization is a priority.



Components of Virtualization

Hardware Assisted Virtualization

“Modern microprocessor architectures feature special instructions designed to assist with hardware virtualization”

- ✧ These instructions allow the **guest operating system (OS) to execute privileged instructions** directly on the processor.
- ✧ The operating system treats system calls as user-level programs, **enhancing the efficiency and performance of virtualization.**

Hybrid Virtualization

- ✧ In this type of virtualization, the guest OS adopts the functionality of para virtualization and uses the VMM for binary translation to different types of hardware resources.

Virtualization Levels

Storage Device Virtualization

- ✍ This is the virtualization of storage devices using techniques such as data striping and data mirroring.
- ✍ **RAID** is an example of storage virtualization, in which multiple storage devices are combined into a single logical unit.

File System Virtualization

- ✍ This refers to the virtualization of data at the level of the file system.
- ✍ It facilitates convenience of sharing and protection of data within the software.
- ✍ Virtualized data pools manipulate files and data based on user demand.

Server Virtualization

- ✍ Server level virtualization enables the partition (or virtualization) of the server's OS environment.
- ✍ This involves the logical partitioning of the server's hard drive.

Fabric Virtualization

- ✍ This level of virtualization makes the virtual devices independent of the physical computer hardware.
- ✍ It creates a massive pool of storage areas for different virtual machines running on the hardware.
- ✍ Storage area network (SAN) technology is used to achieve fabric level virtualization.

Operating System Virtualization

- ✍ Enables hardware to execute multiple operating systems simultaneously.
- ✍ Reduces hardware costs and software update time by running applications requiring different OSs on a single system.

Discussion Point: What are some interesting projects or applications you could imagine using virtualized OS instances for?

Network Virtualization

- ✍ Abstracts physical network resources to create virtual networks.
- ✍ Combines multiple physical networks into a single virtual network or divides a physical network into multiple independent virtual networks.

Discussion Point: Can you think of any games, simulations, or collaborative activities that could benefit from virtual network technology?

Types

Server Virtualization

- ✧ Virtualizes server resources such as physical servers, processors, and operating systems.
- ✧ Enables creation of multiple virtual machines on a single server, each running its own OS.

Desktop Virtualization

- ✧ Hosts desktop operating system instances on a central server in the cloud.
- ✧ Allows users to access and control their desktops from any device.
- ✧ Data and files are stored centrally in the cloud, reducing dependency on local devices.

Overall, these forms of virtualization offer significant benefits such as resource optimization, cost reduction, and improved flexibility, making them essential components of modern IT infrastructures.

Virtualization Enablers

- ✧ Includes Network Virtualization (NV), Software-Defined Networking (SDN), and Network Function Virtualization (NFV).
- ✧ These technologies facilitate the creation of virtual environments by decoupling logical and virtual networks from underlying network hardware.
- ✧ Virtual networks created with these technologies can be integrated with virtual environments and run independently over physical networks within a hypervisor.
- ✧ SDN and NFV technologies are responsible for decoupling control and forwarding planes, combining hardware and software to create a completely software-defined network.
- ✧ These technologies enable simpler provisioning and management of network resources, playing a key role in virtualization.

Vendors

- ✍ Vmware ESXi
- ✍ Citrix Hypervisor
- ✍ Virtuallron
- ✍ Microsoft Hyper-V
- ✍ Virtual Box
- ✍ Proxmox VE

Any Questions?