Outcomes:

7.4.1 Understand the role and characteristics of virtual environment components: virtual machines (clients, servers) and hypervisors (type 1, type 2).

7.4.2 Understand key features of virtual environments: increased security, managed execution, sharing, aggregation, emulation, isolation, portability.

7.4.3 Understand benefits of virtual environments: cost-effectiveness, easy management, resilience, lower carbon footprint, improved disaster recovery, better testing, education and training options.

7.4.4 Understand drawbacks of virtual environments: extra hardware load, slower execution, potential false performance representation.

7.4.1

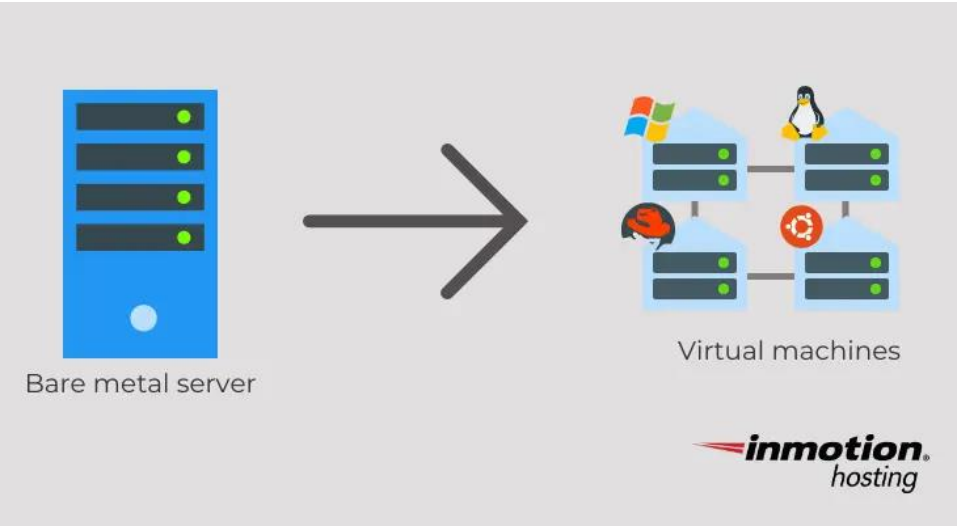
Understand the role and characteristics of virtual environment components:

- Virtual machines (Clients, Servers)
- Hypervisors (Type 1 and Type 2)

What is a virtual machine?

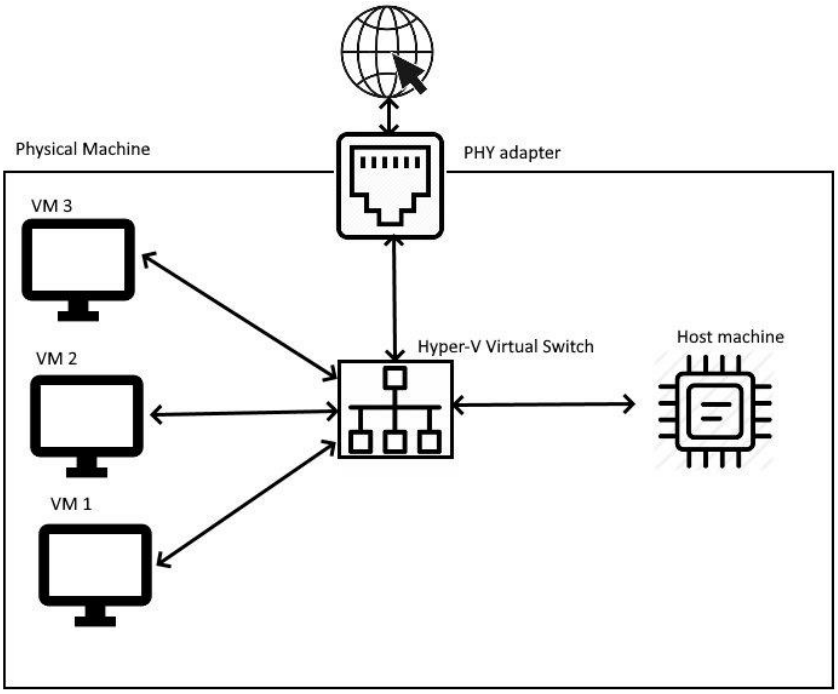
A virtual machine is a software-based emulation of a physical computer.

- Runs on operating systems and applications just like a physical computer.
- It's hosted on a physical machine and managed by a **hypervisor**.



In a physical network, switches enable devices to communicate to the network and to each other, and a router connects the network to the Internet.

On a server with multiple virtual machines, there will be virtual switches and routers to do the same job.



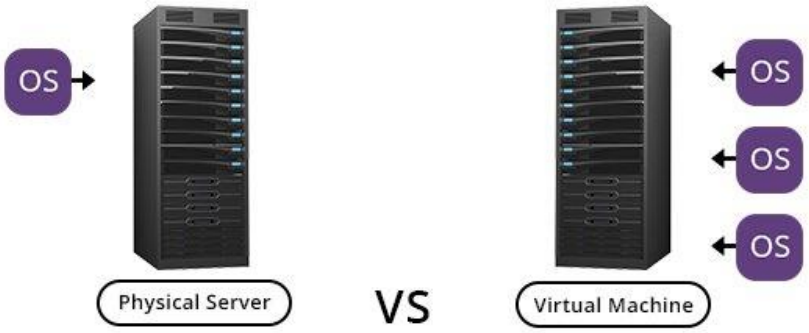
<u>Why would we ever use Virtual Machines?</u>

Running multiple virtual machines on a single physical server can save:

- Power
- Space
- Set-up
- Maintenance costs
- Individual devices can be cheaper (e.g. thin clients)

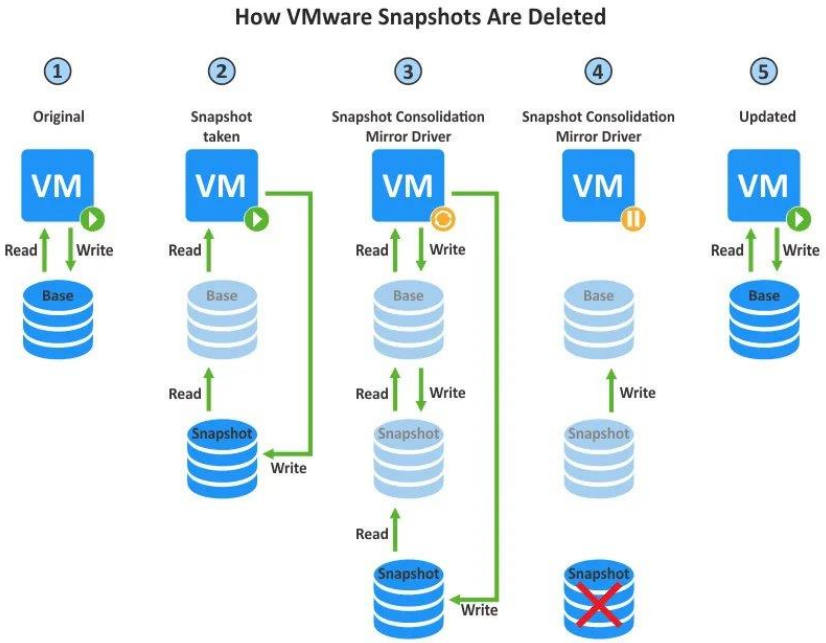
Other benefits include:

- A windows user might want to run programs restricted to MacOS (vice-versa)
- Developers can use VMs to test software in different operating systems and configurations
- To test the safety of software (won't damage the physical hardware)



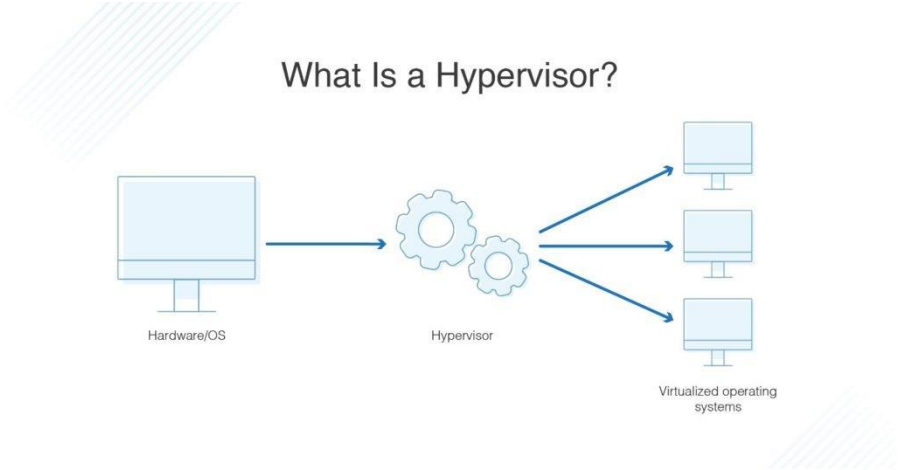
Characteristics of Virtual Machines

- Each VM operates individually, with its own operating system, files and settings.
- They emulate hardware resources and network interfaces.
- You can specify how much memory, CPU, etc., each VM uses.
- VMs can be moved or copied between host machines (quick setup and scaling)
- VMs can be saved in a snapshot and cloned for backups or scaling



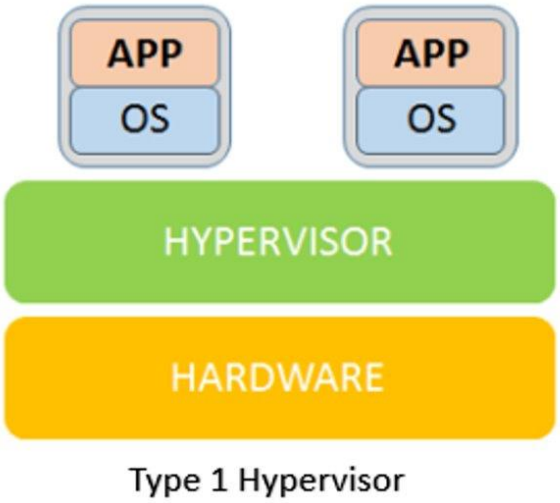
What is a Hypervisor?

Hypervisors manage and run the VM on the host. They manage the CPU, memory, storage and networking between the VMs, and monitoring and security tools.



Type 1 Hypervisor

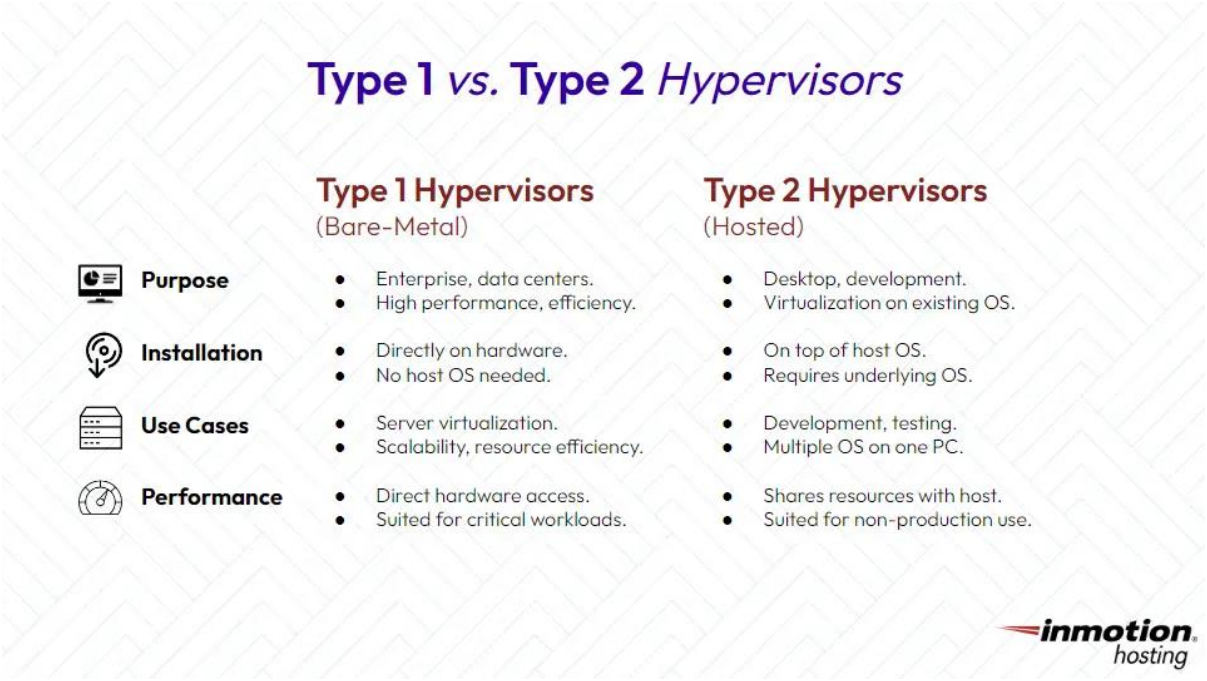
Known as ‘bare metal’, Type 1 runs directly on physical hardware of the server or machine. E.g. Vmware ESXI, HyperV



Type 2 Hypervisor

Type 2 runs on top of a host operating system, e.g. Oracle Virtual Box.

The key difference between type 1 and type 2, is that type 1 has a direct hardware access versus type 2’s reliance on the host’s OS for resource management.



Recap Questions

1. When would an organisation want to move from servers to virtual servers? [2]
2. What is the difference between a dedicated Server and a cloud server? [2]
3. Suggest why a start-up company might use a shared server. [2]
4. Suggest a consideration when running an emulated operating system on a client machine. [1]

1. An organisation would want to move from servers to virtual servers when they run out of physical space and need to scale up their server operations without investing a lot of finance into a new location.
2. A dedicated server is an inhouse server, physical or virtual (e.g. VMs) that resides within the organisations business, whereas a cloud server is a fully virtual server that that they 'rent', such as AWS.
3. **A shared server is a single physical server that hosts multiple clients (such as a website), which each client sharing resources such as CPU, RAM, and storage**. A start-up company may use this because, it is a cost-effective and affordable option.
4. **An emulated operating system runs inside software (an emulator) that mimics the hardware of another system.** Allowing an OS designed for one architecture (like Windows) to run on a different one (e.g. Mac). A consideration when running an emulated operating system would be performance, since issues with lag and lower frame rates occur.

7.4.2

Understand key features of virtual environments: increased security, managed execution, sharing, aggregation, emulation, isolation, portability.

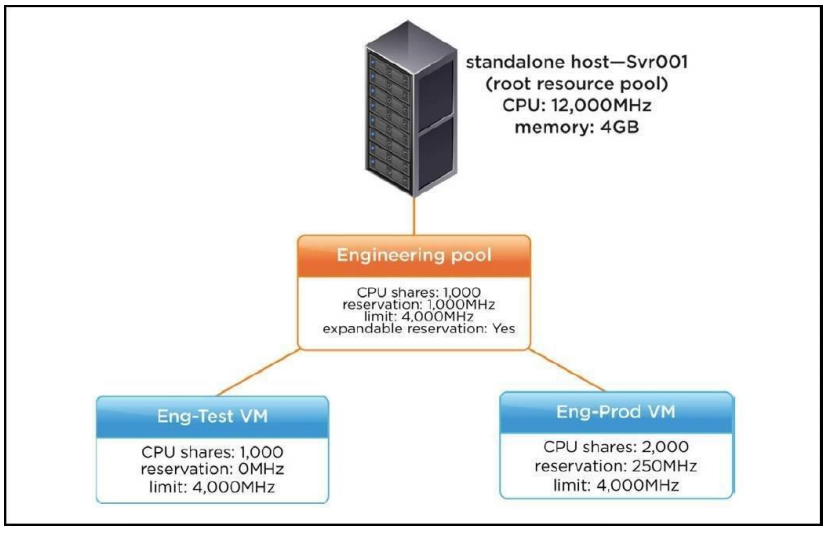
Increased Security

- Virtual servers provide a level of isolation between different environments.
- If one VM is compromised, other VMs and the host remain unaffected.
- Virtual servers can monitor and report traffic between VMs.
- Can detect if one virtual machine is launching a cyberattack or sharing a virus with another.
- Access control can be configured globally and at the lowest level. Rather than relying on individual physical machines.
- Snapshotting supported, make whole machine backups periodically and restore in case of security breach/failure.

Managed Execution

- A VM manager controls and filters the activity of the separate VMs.
- Manages the sharing, aggregations, emulation and isolation of VMs.
- Automation and orchestration tools can automate the set-up of new VMs based on needs.

Sharing Resources



- Sharing CPU/RAM between servers can be very efficient, especially if the demand of each virtual server fluctuates.

Suppose that 10 servers each generally, need 1 GB of RAM, but up to 8 GB of RAM during peak times, so they pay for 8 GB of dedicated RAM, so a total of 80 GB of RAM is needed.

It is much cheaper if they all share, for example, the RAM, on the basis that they don't all have peak times at the same time. On this basis they can spend a quarter of the amount to share 20 GB of RAM, and only if three of them peak at 8 GB at the same time will they start having problems.

Aggregation

The opposite of sharing resources; multiple physical servers; including their memory and CPU, are combined to create a larger, more powerful single virtual server.

Emulation

- An emulator is a virtual environment on a computer / server that emulates the operating system of a different computer / server. This is sometimes called a virtual box.

Isolation

- The principal that if a virtual instance of a server crashes, it does not affect any other VMs.
- Each VMs operating system will run its own set of RAM to ensure this, and in addition data isn't shared between virtual containers.

Portability

- A virtual server isn't tied to the machine it is running on.
- A hosting company can back up virtual servers, upgrade the hardware and then recover onto the new hardware (which is much easier than setting up a new server.)

Research task

1. An organisation has been advised to move to cloud computing but is reluctant to spend time investigating new technology possibilities as it is felt that an update to its current systems will meet its needs.

   LeadingEdge is one of many companies offering IT services. Read their article at **zzed.uk/11310-cloud** and use the information to create a one-minute presentation to convince the organisation to move to cloud computing now. Use an online presentation tool such as Prezi. [10]

Go to **zzed.uk/11310**

1. https://prezi.com/p/edit/dgevp7poeoy-/

Activity

You have been asked to put together an information guide for an organisation that is considering implementing a virtual environment. They do not know anything about virtual environments, just that they can be good. In the information guide, you are required to explain what a virtual environment is, the different types of virtualisation and the key features. The organisation would also like to know what the benefits and drawbacks are of having a virtual environment.

Revision: Flash Cards (7.4.1 + 7.4.2)