

Snapshot: image of hard disc frozen in time. Happens when we restart. Record state of memory and cpu location. Exactly where you were files opened etc.

- Allows you do revert mistakes such as deleting a home directory.
- Less space consumed by snapshot then a backup → doesn't affect system performance
- Issue may undo good work

Disadvantages of snapshot compared to backup:

- Generally snapshot at storage level so has issues with memory intensive applications. End in state in crash inconsistency – data might not be cleanly written so consistency data in database might not be valid
- Certain hardware level some cpu can't do it. But backups can do it on any cpu since
- Don't protect media failures.
- Also some software don't even support snapshot data saving. So unsupported data in programs may be corrupt

Backup: backups are more intensive so that backup software can communicate to with applications to make sure all data in memory is written correctly into disk → reduces crash inconsistency state.

Difference backup and backup:

Multiple virtual machine on hardware

Virtualisation: a machine within a machine that allows us to deploy multiple operating systems on a single computer. Virtualisation works in the following method

- The hypervisor layer allows the running of multiple **virtual machines** → Each virtual machine (needed to trick operating system in thinking it has full rights to resources) host operating system → each operating system runs applications

Reasons for virtualisation:

- **Server consolidations:** involves the use of virtualisation to replace multiple real underutilized machines → with machines with multiple machines running on single system. Saves space, power, cooling, and maintenance cost
- **Live migration for loading balancing and fault tolerance:** allows for live migrations where an entire virtual machine can be moved to one physical server to another without interrupting applications running. Used when hardware fails on a server but you don't want to turn server off.

- **Performance isolation and security:** allows isolation of multiple users and application on a computer but this way stops resource hogs, or a user installing a virus that effects other users. Thus increasing performance and security.
- **Software development and legacy system support:** they can use it to write and debug programs safely and less annoyingly. So if a program with a bug crashes entire os then without virtualisation would you need to reboot manually which is a long waiting time. Also allows developers to write programs in different os easily by using the operating system development tools only available to the operating system.

Virtual machine: It is an image of idealised computer that is needed for hosting operating system. It is needed for virtualisation as trick operating system in thinking it has exclusive access to hardware, peripherals. The following things are needed to trick the operating system/components of virtual machine

- CPU access
- Main memory access
- Mass storage access
- I/O typically network interface

Types of OS virtualisation:

- **Emulation:** places largest amount of software in between hardware and guest os. It is the slowest. Presents to each guest os, a software based model of entire computer including microprocessors. Even parts of os interface with input output/all of the instructions in instruction streams of both guest os and application os needs to pass through virtual machine before processor.
- **Classical virtualisation:** allows for the guest os and host processor to have the same ISA. This allows the skipping of binary translation so that the os and application instruction streams directly on processors. This allows the guest os to run application faster because no translation.
- **Paravirtualisation:** Modifying the guest os so instructions that are trapped don't pose a problem and clue the os in to thinking something odd is going on. Downside is os must be modified so you need to be able to do it.

Hypervisor:

- A **small program** that enables virtualisation and creates a layer which virtual machine can be created on.
- The operating systems that run on top of hypervisor are called guest operating system.
- Sits between hardware and operating system and it manages the hardware and deals with request coming from operating system that were running on top of it (guest/virtual machine).
- So it manages sharing resources of physical resources into virtual. Think a program like vmware
 - **Type 1 Hypervisor:** (bare metal) running operating system on **directly machine hypervisor os**, very basic os that just allows for installation of other os (machines hardware is normally server hardware not like normal computers). Creates virtualisation layer on top of which the virtual machine are created on. EG: Hyper-V so think install windows server os on server/computer, Xen. The fastest less layers. Like Murdoch lab where you reinstall os
 - **Type 2 Hypervisor:** (hosted/guest model hypervisor) software application installed on top of host operating system + **hypervisor os**. So have computer hardware and you already have a host os like windows but then you install type 2 hypervisor which creates virtualisation layer in which you can create virtual machine. Eg: parallel application (so on my macbook I installed windows), virtual box, vmware workstation, Microsoft virtual pc
 - **Disadvantages:** extra layer means not quite as fast could be if it was running bare metal. Lack of support for hardware on virtual machine.

Note: hypervisor type 1 is different from dual booting.

Nat network: (host internet ip address: 134.115.153.223 virtual machine: 134.115.153.223) it shares the same ip address to multiple devices to connect to internet. Think home all devices share same ip address. Issues is you can't connect outside in (can't access to individual device outside in only router there can make a web server but can't view it from outside) and you must enable IP forwarding before you can make internet connection

Bridging network: (host: 134.115.153.223 vs virtual machine: 134.115.153.73): is a computer **networking** device that creates a single aggregate **network** from multiple communication **networks** or **network** segment. so you can run your own web servers and people can view it. You can access from outside to an individual device.

Reasons for virtualisation:

- Allows experiments in a safe contained environment (such as installing applications that may have viruses)
- Portable: so you may config and test virtual server on laptop. So then you can copy it to server with no reconfigurations. Also you may be able to test different config without effecting faults
- Not locked into os installed on server: Choose os based on the best environment for job

Standard OS model:

- Software – applications + operating system
- Hardware- cpu i/o ram

Simplest way to map iso: the user maps them as a virtual cd drive