Operating systems

Adil ENAANAI
adil.enaanai@gmail.com
Computer Science Department
Faculty of Science -Tetouan-

Chapter 1

Introduction to operating systems

Preliminary

Processor

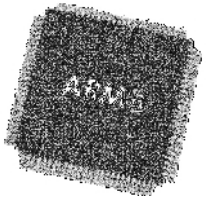
```
MOV AX, 7
ADD AX, 6
MOV BX, 3
DIV BX
```

Programmer

The programmer loads the program into main memory

The processor reads the program instructions and executes them one after the other

Is this program valid for any processor family?



Each CPU family has its own instructions

Preliminary

Processor

Process A

```
MOV AX, 7
ADD AX, 6
MOV BX, 3
DIV BX
```

Process B

```
MOV AX, 2
ADD AX, 5
MOV BX, 4
DIV BX
```

Programmer

What is the order of execution of its instructions?

So you need a scheduler that manages processes

How are instructions and data stored in memory?

So you need a mechanism to manage memory

Preliminary

User

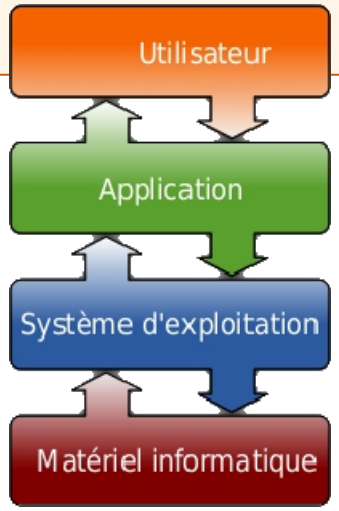
Intermediate interface (operating system)

Hardware

The operating system manages hardware, data and processes.

Definition

An operating system (OS) is the software in an electronic device that controls hardware devices and receives instructions from the user or other software (or applications). This software must be adapted to an operating system.



Definition

- 1 pilote

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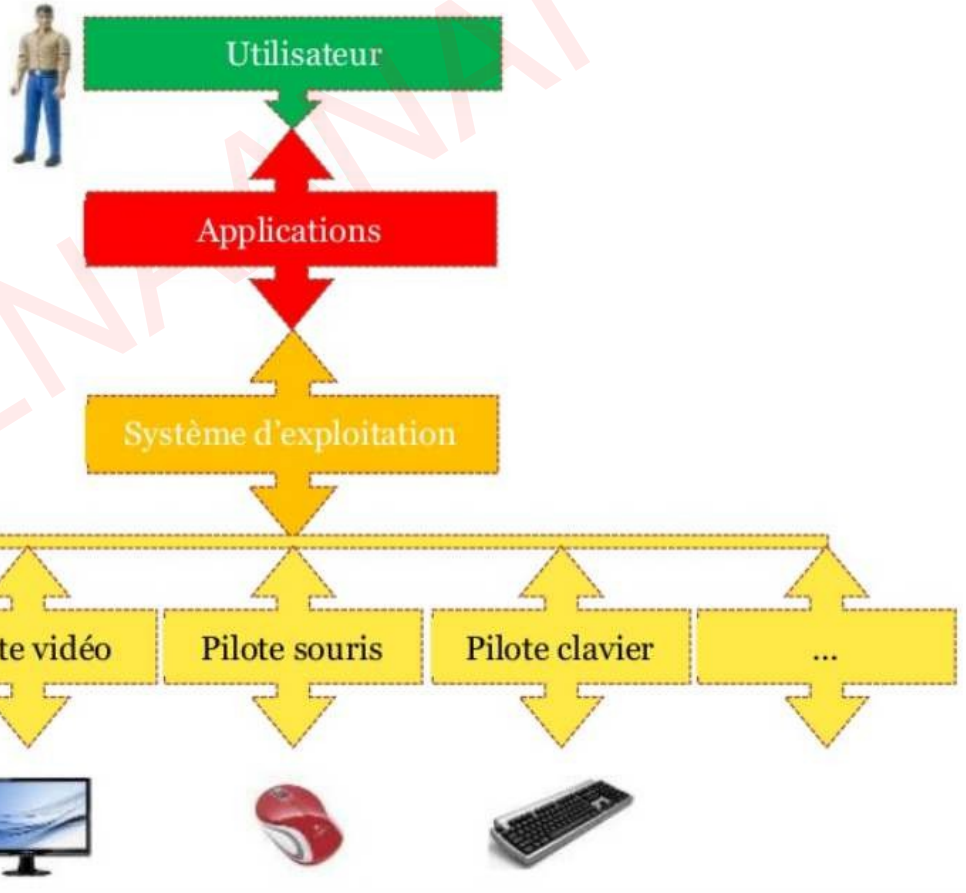
1 périphérique



Driver concept

A driver is a program that provides the link between an operating system and a peripheral device. As a result, computer **peripherals** and **components** (such as printers and sound cards) need their own drivers to operate.

Drivers are developed by the manufacturers of the hardware to which they correspond.

Driver concept

Question!!!

Does a hard disk need a driver to be recognized?

Answer!!!

Of course OUIIIIIIIIII

To load the operating system *you need* to *access the hard disk, but how can you access the hard disk if your operating* system is *not yet loaded?*

BIOS (Basic Input Output System)

It's the **BIOS** that, when the computer starts up, acts like an operating system, enabling vital components (video card, hard disk, optical drive, keyboard) to boot up using standard drivers.

Plug And Play

Plug and Play (the abbreviation PnP is also used), which stands for
The "connect and play" or "plug in and use" procedure enables new peripherals to be recognized quickly and automatically by the operating system as soon as the hardware is plugged in, without the need to restart the computer.

Roles

A computer consists of:

- Processor that runs multiple processes
- Memory that stores data and programs being executed (*processes*)
- Storage media (*e.g. hard disk*)
- Peripherals (*Optical drives; Printers;* ...)

So.., th system operating mu man all the components and provide a user-friendly envir nment in se where users can easily create and run programs.

Roles: Process management

Program: A set of instructions written using a programming language.

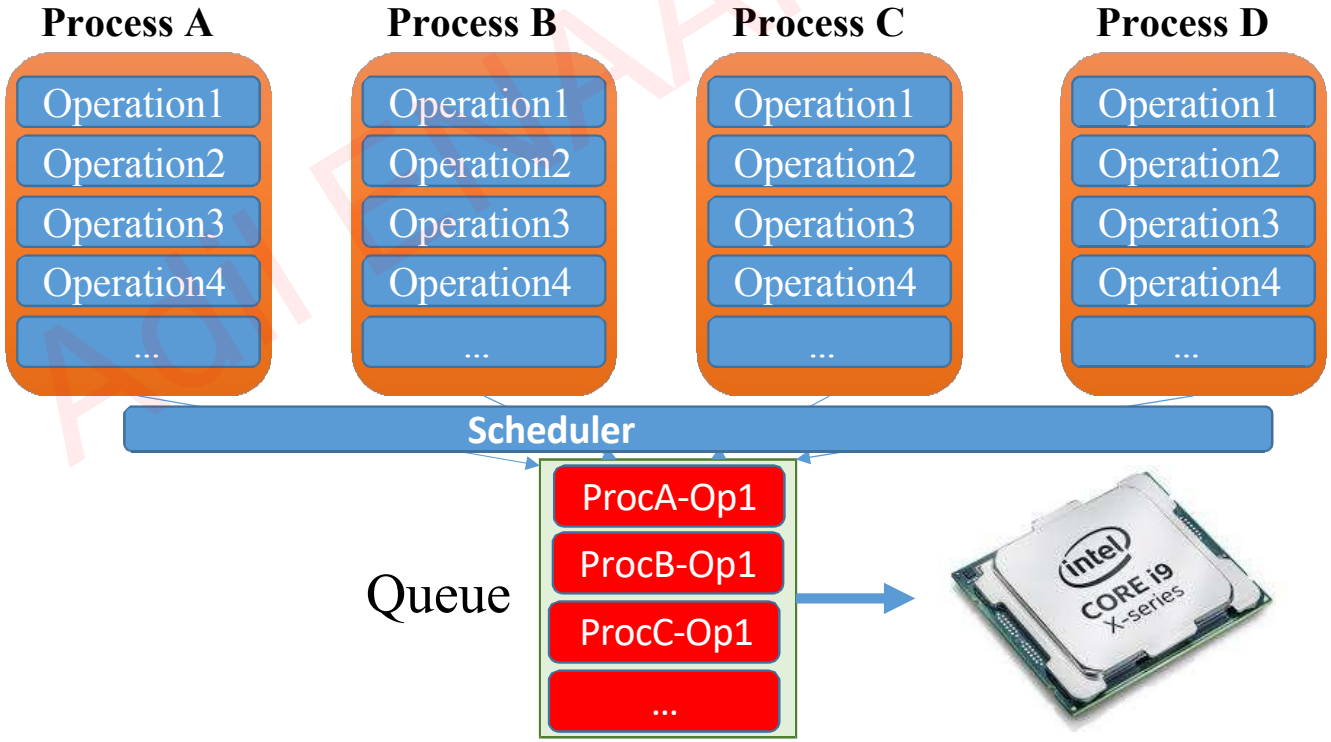
Process: Running program

For a process, we speak of an allocation of resources (memory and processor) required for its normal execution.

Roles: Process management

Process scheduling

Determines who takes the processor and for how long (or operations), and the order of priority

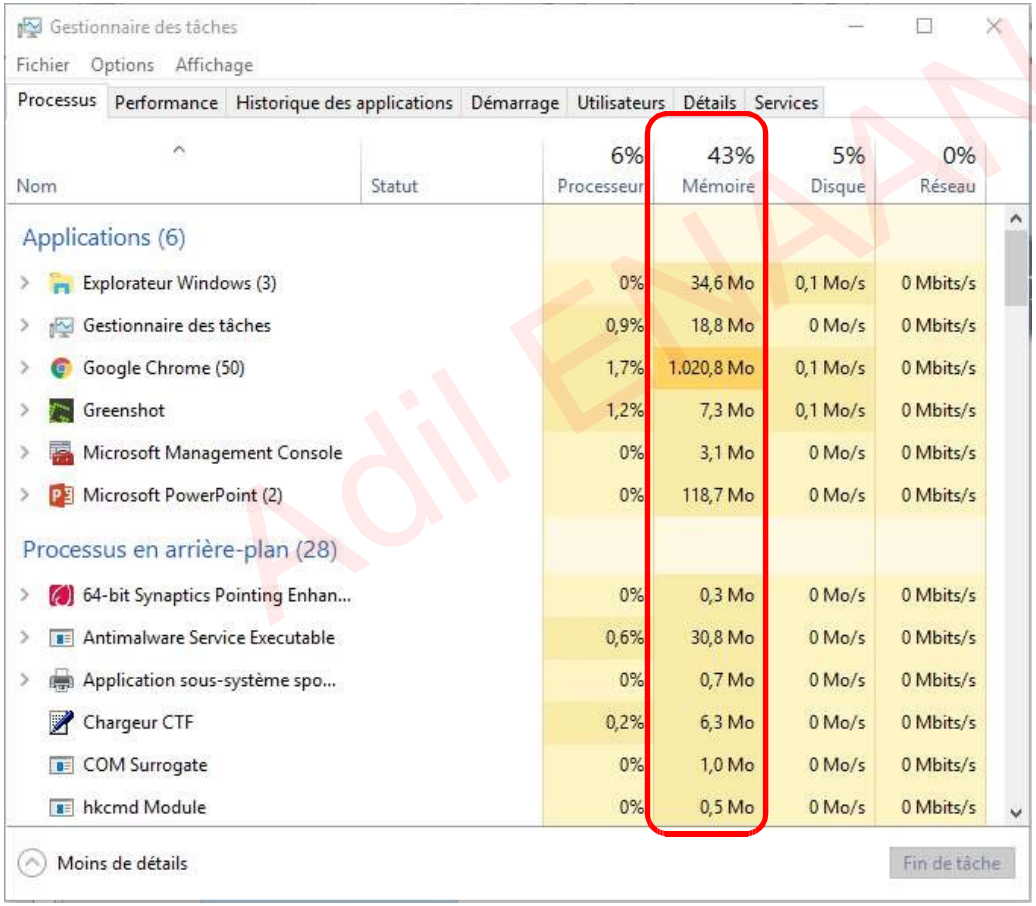


Roles: Process management

In operating systems, the **scheduler** refers to the component of the operating system kernel that selects the order in which processes are executed on a computer's processors. In English, the *scheduler is* called *scheduler*.

Roles: Memory management

Virtual memory



Assuming the memory is 100% full

What's going on?

We use the RAM extension on the hard disk

This extension is called

Virtual memory

Roles: Memory management

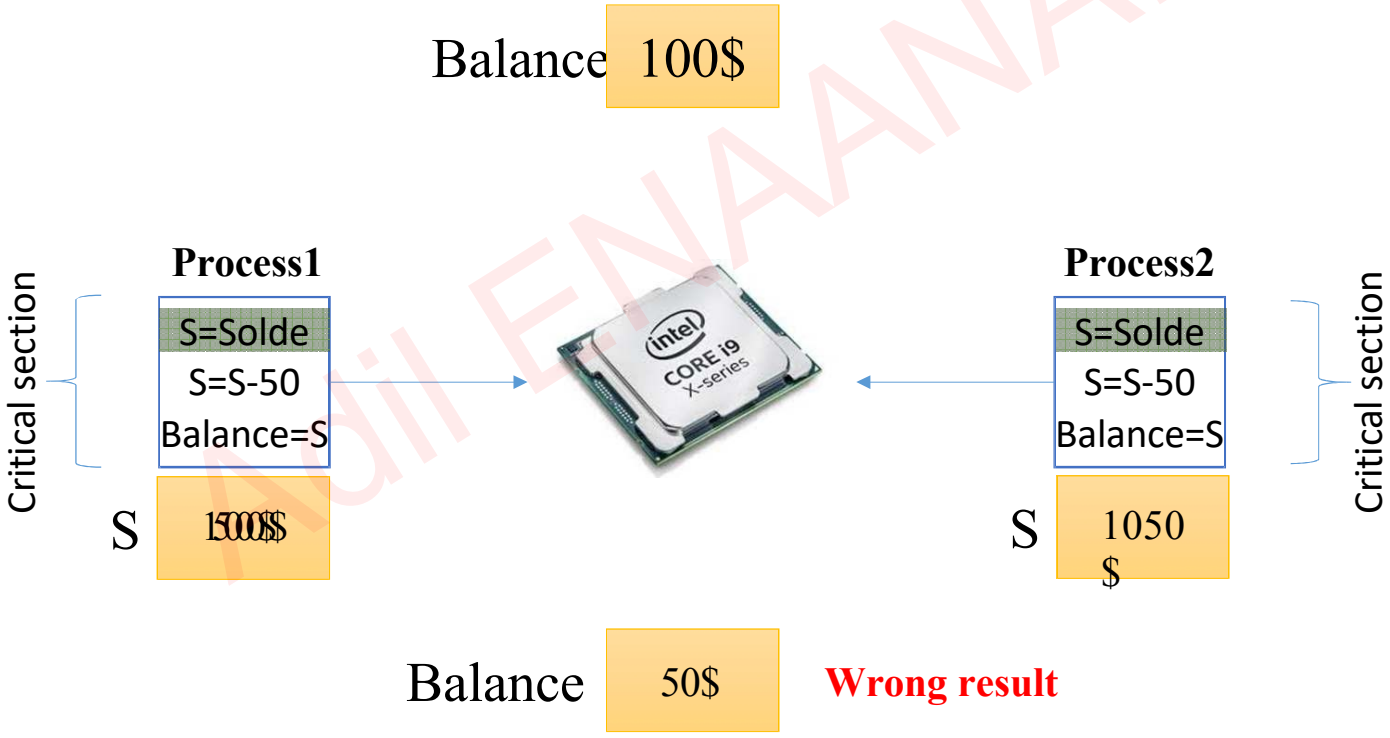
Virtual memory

When a process can't find enough RAM memory to store its data, the operating system selects (according to an algorithm) some data and stores it in virtual memory (on the hard disk) to free up RAM.

Data always flows back and forth between RAM and virtual memory. This is called *SWAPPING.*

Roles: Memory management

Access control

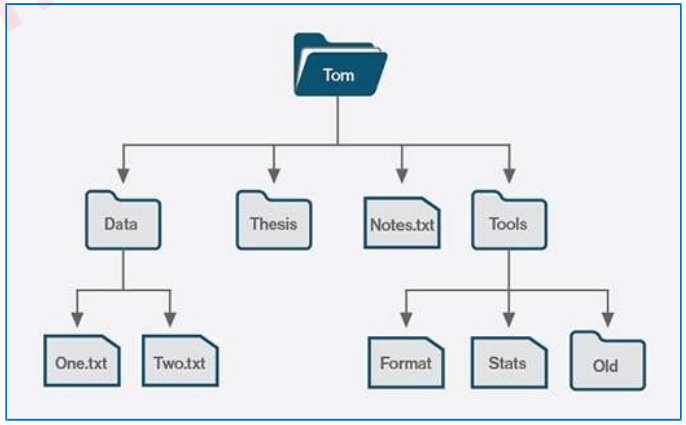


So we need to protect critical sections

Roles: Disk management

The file system

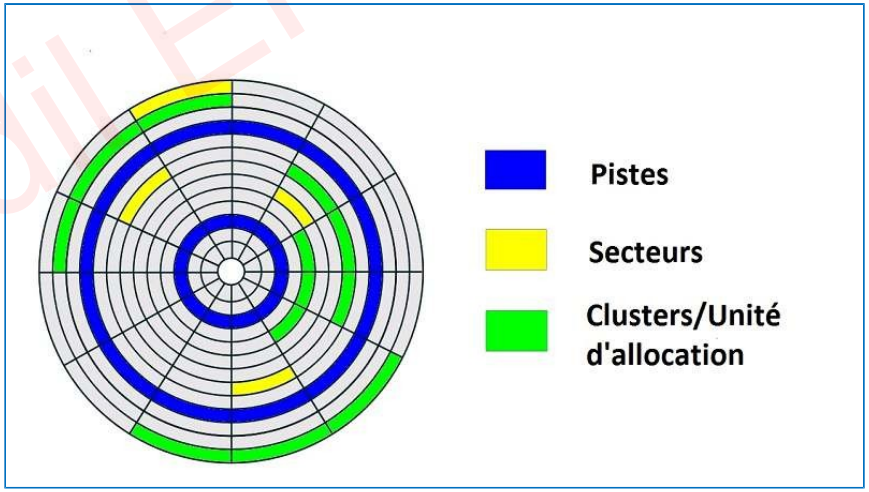
It's a set of rules that organizes the way files are stored and retrieved on a hard disk or any other storage medium. The layout of data on a medium is highly structured. For example, we start from a root which contains directories which, in turn, can contain several levels of sub-directories.



Roles: Disk management

The file system

The file system also defines how data is physically written to the medium. Each disk is made up of sectors that form storage blocks of a specific size. Each stored file will therefore occupy a block or overlap several blocks, depending on its size.



Roles: Disk management

The notion of allocation unit

the smallest physical part of a storage medium is called a sector (512 bytes for most hard disks).

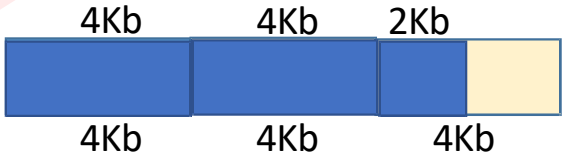
Several sectors can be grouped together by a file system to form a cluster.

A cluster is therefore the smallest allocation unit imposed by a file system, and is larger than a sector because it groups together several sectors.

Roles: Disk management

The notion of allocation unit

For an allocation unit with a size of 4096 bytes (4 kB), it will take 3 units (12 kB in total) to store a file with a size of 10 kB. The remaining 2 kB on the last block will be lost, as it cannot be occupied by another file. More precisely, our 10 kB file will weigh in at
final 12 ko.



The choice of allocation unit size is therefore important because the larger it is, the greater the loss of space when a file doesn't fill the entire last occupied block.

Roles: Disk management

File system types For Windows

FAT 32

Compatibility

Works with all versions of Windows, Mac, Linux, game consoles, car radios, DVD / Blu-Ray players, ... in short, virtually anything with a USB port.

Limitations

Maximum file size of 4 GB. In practice, this partition can be no larger than 2 TB.

Ideal use

Use on USB sticks, external hard drives or memory cards for maximum compatibility with most devices, as long as you don't need to use files larger than 4 GB.

Roles: Disk management

File system types For Windows

NTFS

Compatibility

Works with all Windows versions since Windows XP. Macs can only read NTFS partitions. Some Linux distributions can read and write NTFS drives, others can only read them.

Limitations

There are no technical limits that can be reached in practice.

Ideal use

To be used for the main Windows system and for all your internal hard drives working with Windows.

Roles: Disk management

File system types For Windows

ExFat

Compatibility

Works with all versions of Windows since Windows XP and Mac OS. Works with Linux after installing exFAT packages. **Limitations**

There are no technical limits that can be reached in practice.

Ideal use

Use for USB sticks, memory cards and external hard drives, especially if you want to be able to handle files larger than 4 GB. If your hardware supports exFAT, use it instead of FAT32.

Roles: Disk management

File system types For Linux

Ext2

It is the first system of file system by default file system on Linux distributions such as RedHat and Debian.

The maximum size of an individual file can be from 16 GB to 2 TB.

The overall size of a partition file system can be from 2 TB to 32 TB.

Roles: Disk management

File system types For Linux

Ext3

This type of partition supports logging.

The maximum size of an individual file can be from 16 GB to 2 TB.

A directory can contain a maximum of 32,000 sub-directories.

The overall size of a partition file system can be from 2 TB to 32 TB.

Roles: Disk management

File system types For Linux

Ext4

The maximum size of an individual file can be from 16 GB to 16 TB.

The global size of a partition file system can be 1024 Po (1,048,576 TB).

A directory can contain a maximum of 64,000 sub-directories.

New features: Sub Directory Scalability, Multiblock Allocation, Delayed Allocation, Fast FSCK,...

Roles: Disk management

File system types For MAC OS

APFS

file clones: on APFS, copying a file onto the same volume does not duplicate the data, but merely updates the metadata to indicate the existence of the clone file.

Snapshots: APFS has the ability to take a snapshot of the file system, i.e. a frozen read-only copy of the file system.

Roles: Disk management

File system types For MAC OS

APFS

space sharing: the container (which may consist of several aggregated physical disks) is divided into volumes, comparable to partitions. The main feature of these volumes is their dynamic size, which increases or decreases as files are added or removed.

encryption

sparse files

metadata integrity

fast directory sizing

crash protection

Roles: Disk management

Defragmentation

- The actual size of a file is smaller than its storage size
- In some blocks (storage units), there is free space that cannot be used.
- In addition, the blocks in a file are not necessarily located next to each other.

F1	F1	F2	F1	F1	F1	F3	F3	F2	F1

Deleting file 2 leads to the following situation:

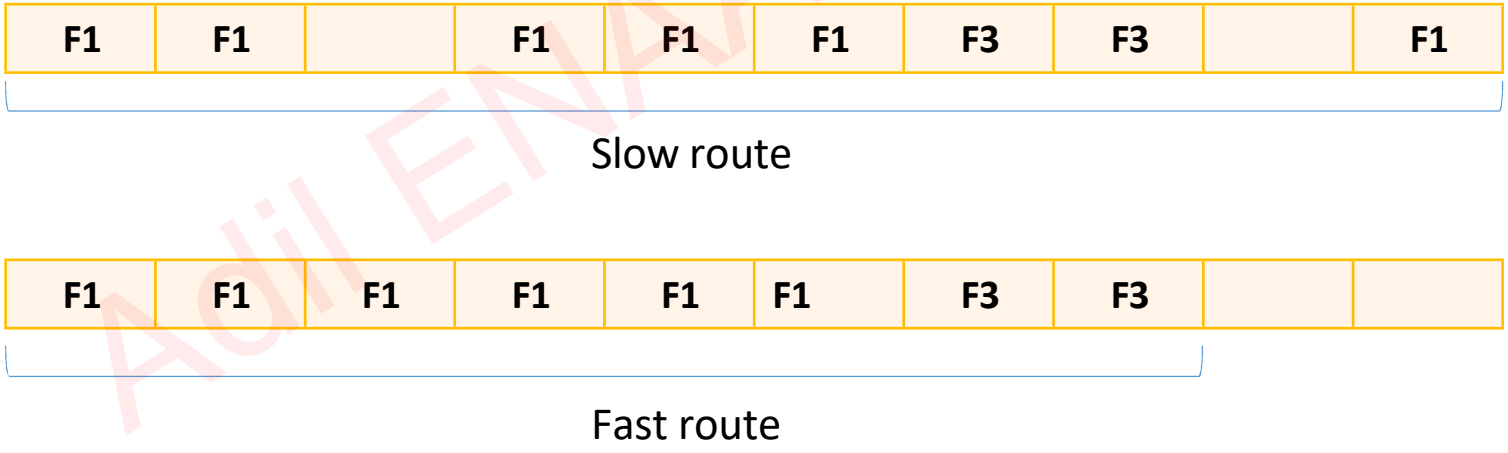
F1	F1		F1	F1	F1	F3	F3		F1

Running through empty blocks wastes time i n sequential searches

Roles: Disk management

Defragmentation

Defragmentation consists in grouping blocks of the same file together and putting unallocated blocks at the end.



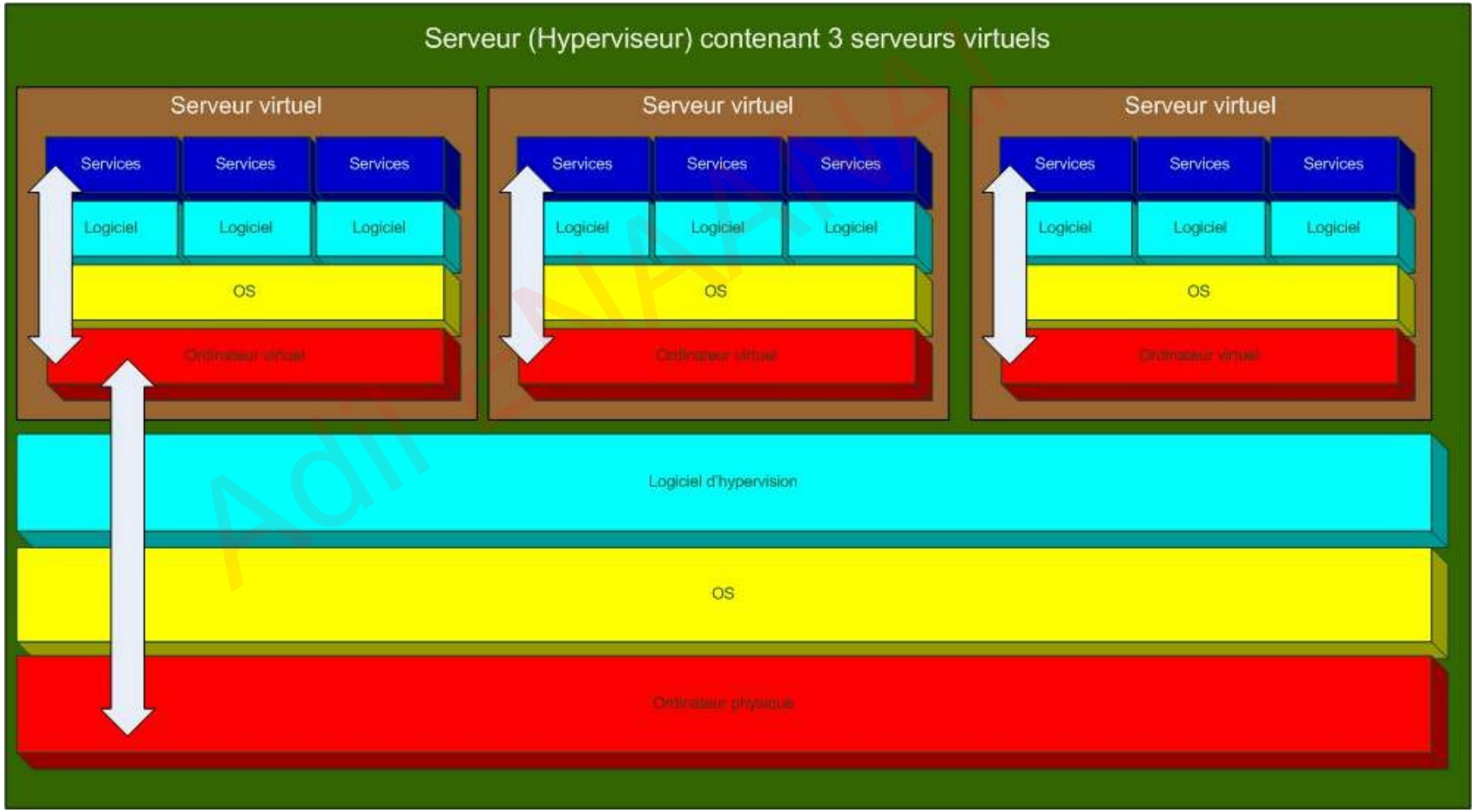
Operating system virtualization

What is virtualization?

Operating system virtualization involves using software to enable a hardware device to run multiple images of the system simultaneously.

Thanks to various virtualization technologies, it's possible to run several operating systems at the same time on the same computer. This means you can switch from one O.S. to another relatively quickly, as required, with a simple keyboard shortcut.

Operating system virtualization



Operating system virtualization

The benefits of virtualization?

- Virtualization consumes less energy
- The virtual machine is portable to any machine
- Restoring a virtual machine
- Test environment
- Licensing
- High availability
- Simplified monitoring
- From physical to virtual