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Computing Fundamentals

Planning

Session	Subject	Test – Hand-in
1	Network Models	
2	Internet Protocol Suite	
3	Network segmentation	
4	Network protocols	
5	Operating systems	
6	Command Line	
-- 30/10 – 5/11 --	Autumn break – HERFSTVAKANTIE	
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Computing Fundamentals

Operating systems (OS)

- ... is system software that manages the computer hardware and the resources available (resources) for the software and thus provides the common services to make computer programs work.
- ... is a program that connects hardware and software. It is the mediator for soft- and hardware and ensures efficient use of the hardware. It's goal is so that users can run programs.

- The OS itself is loaded by a boot program, which in turn is loaded by the BIOS.

Functions of the OS

Computer hardware =

- Electronic, mechanical, optical components, …
  - motherboard, CPU (Central Processing Unit), RAM (random access memory), storage (hard disk drive (HDD) or solid state disk (SSD)), NIC (network interface card), card reader (SD (Secure Digital), eID ...) and (optical or mechanical) input and output devices such as printers, Blu-ray drives and keyboards, mice, touch screens, joysticks, speakers, ...

The OS task is to let all of these work together and present these to the user in a simple and smooth way.

The OS abstracts = simplified representation

The OS provides an abstract and simplified representation of the underlying hardware, which is otherwise too complex to present to the user.

Different hardware from various manufacturers is presented in the same way by means of a common display (common interface).

If this abstraction layer was not there, we would have much less variety in terms of hardware and we would still have to program differently for each video and sound card as was the case in the 1990s.

The OS does arbitration = the referee

Multiple users should be given the impression that they do not share the available resources with other users.

Every user thinks that only they have access to the CPU, RAM, storage, Computing card, …

Context switching = arbitration

Context switching

- When an event occurs, the OS saves the status of the active process and restores the status of the new process that requires attention.

What is saved?

- Everything that is incompatible with the new process: CPU status, pointers to memory and files…

Changing context takes place when a process (a) wants to do input or output, (b) goes into a waiting state or (c) is in a sleep state.

Pre-emptive scheduling = arbitration

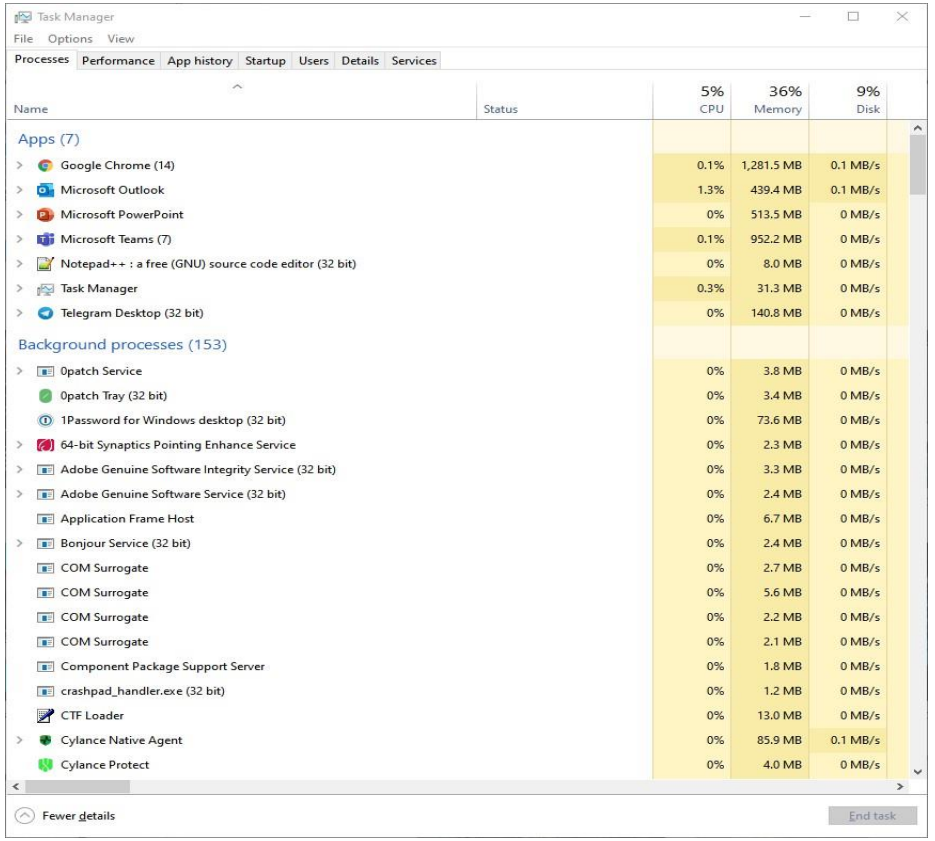
Does this mean that a process can run forever if it never allows to change context?
No, there is such a thing as “pre-emptive scheduling” Some operating systems force processes to pass on the CPU to another process (NT, Unix)

Based on priorities that are linked to processes and through which the OS can arrive at the equitable (fair) distribution of available resources.

So, what is a process exactly?

… is a program that is in progress and has a number of components

- the running program itself,
- the data with which this program is working,
- the resources that this program needs, such as memory and files
- and the state of the program.



Abstraction or arbitration?

Supporting both Intel and AMD processors?

→ **abstraction**

Switch between applications (Windows: alt+tab)

→ **arbitration**

Assign isolated memory per application

→ **arbitration and abstraction**

Make Skype capable of using different types of cameras

→ **abstraction**

The ability to work with a variety of hard disk manufacturers

→ **abstraction**

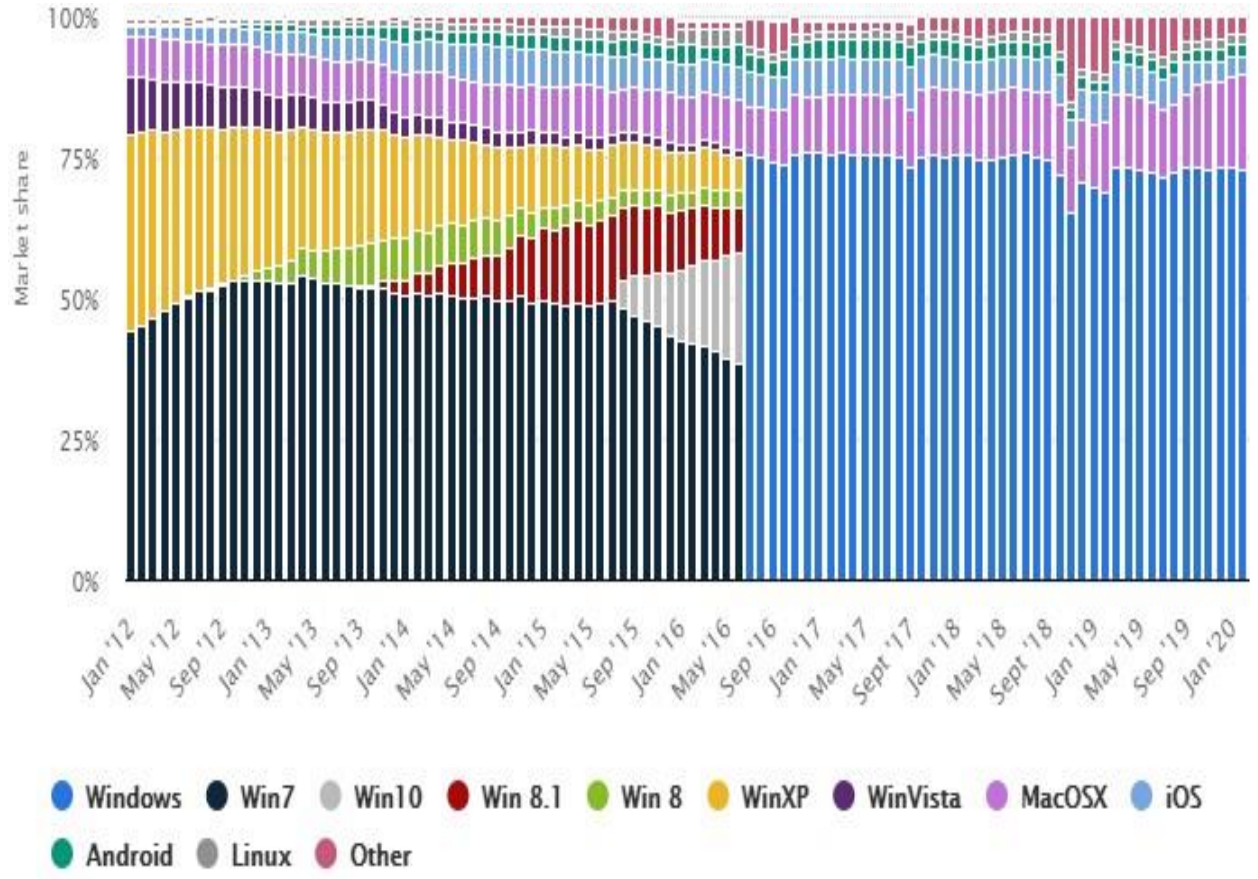
Send and receive messages over the network

→ **arbitration and abstraction**

There are all sorts of operating systems out there

Windows in one form or another
Unix, Linux, macOS
Embedded

- Android/Linux, iOS, Blackberry (?), Symbian (?),WearOS



https://www.distrowatch.com/

Different purposes, different sizes

- Mainframes
- Desktops
- Multiprocessor systems
- Distributed systems
- Clustered systems
- Real-time systems
- Handheld devices
- Network operating systems
- Cloud Operating System (Cloud OS)

IBM 704 mainframe (1964) *(human for scale)*

Network operating systems (NOS)

A network operating system (NOS) is **specialized software** that allows different devices on the same network to communicate with each other. Its primary function is to share applications, files, databases, and any other resources, equipping users with access to these across **any** of the **connected devices**.

Network operating systems (NOS)

Typically, operating systems are used on an **individual** level for each device connected to the network. For instance, a computer and a tablet would both run their own OS but connect to the **main network NOS**. This allows the user to easily access **shared** files or information in the wider system.

Network operating systems (NOS) vs. operating systems (OS)

A network operating system is designed to manage and share resources held on the network across multiple devices at any time, providing a centralized system for management and optimization. Think of this as a “one-to-many” distribution system from the server to any device connected to the network.

A traditional operating system (OS), like Windows or macOS, operates in a similar way but for a single device, like a desktop or laptop, rather than the entire network. These systems manage files and hardware, along with running applications, on that individual device only.

Where an **OS** is “**one-to-one**”, a **NOS** is “**one-to-many**”.

Types of network operating systems

Every network server is configured to meet the unique needs of the business, but here are the two main types that every NOS falls into.

Peer-to-peer

All devices connected to a peer-to-peer network OS have the same level of access and equal functionality. Each device has its own local memory but can use the network OS to communicate and share resources with other devices on the network.

For smaller teams with fewer devices on the network, this setup is ideal as it makes resources more accessible. Each device has the ability to manage other users on the network and other security systems for the OS.

While this makes sharing resources faster and easier, it's also a less secure setup since there's no centralized management option when all devices are treated equally. If the server fails, the entire system is disrupted, which can cause significant delays in work productivity and even data loss.

Types of network operating systems

Client/server

On a client/server network OS, a single server connects to multiple devices. Unlike peer-to-peer, these systems use the server to act as a centralized point from which all devices can then access individually based on their access level.

Both the server and the client or user share the responsibility for accessing network resources, but the server keeps all the information, like files and databases. Users can send requests to access these resources on their own devices.

For larger organizations or companies handling sensitive data, client/server NOS is more suitable. It offers better security and higher performance, and the server acts as a backup for any potentially lost data.

Although the system is more expensive to set up and requires a trained administrator to manage it, the benefits outweigh the costs.

Key features and functions of a NOS

The specialized software that most NOS run has similar features that make sharing resources across the network easier for businesses and teams. While each NOS can be configured to suit the company setup and requirements, most, particularly those running on a client/server model, offer the same functionality.

User access management

One of the most important features of a NOS is controlling who has access to different resources on the network. These settings are configured from a centralized administrative hub to maintain network security.

For any business, the goal should be to allow authorized users access only to the files and applications needed to complete their work rather than giving every user the same level of access to every resource on the network.

Key features and functions of a NOS

Resource sharing

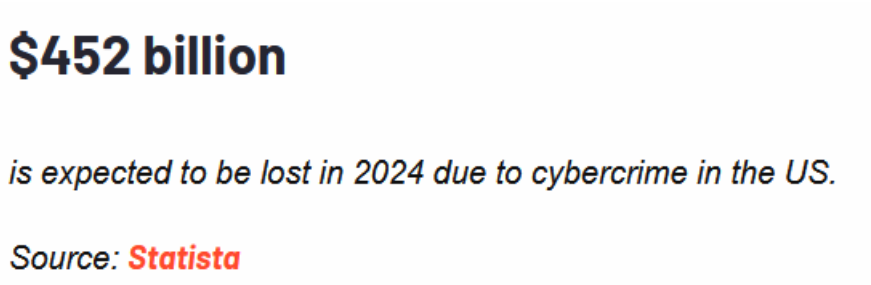
When multiple devices and users connect to the same network, they can easily share any resources hosted on the NOS like files, and applications, and even access other connected devices like printers or scanners.

Sharing data and hardware across the network is essential for team collaboration and improving productivity company-wide while ensuring that any network resources are managed securely. Since NOSs can connect to devices remotely, information can be shared no matter where the devices are located - whether it’s in the same room or across the globe.

Key features and functions of a NOS

Network security

With the growing risks of cyber threats, keeping networks secure should be a top priority for any business. Even with multiple devices connected to the operating system, these specialized tools come with a number of security features like user authentication, data encryption, and access control that administrators have responsibility for. These measures are the best ways to keep both data and users safe from unauthorized access.



Key features and functions of a NOS

Network operating system examples

There are many NOS options available, each with similar functions. Finding the right one for your business will often come down to budget and specific features that you might be looking for. Some of the most popular examples of NOS's are:

- Microsoft Windows Server: This is generally considered to be the most widely used NOS in the world, thanks to Windows' stability and focus on security. Enterprise-level businesses would benefit the most from this network operating system thanks to the extensive data storage options and application hosting this software provides.
- UNIX: The first UNIX OS was developed in the 1960s, with many different types now available such as Oracle Solaris and IBM Advanced Interactive eXecutive. For businesses looking to connect desktops and laptops to web servers, UNIX is a good choice for an NOS.
- Cisco/HP/… Internetwork OS: Cisco and HP are both a service provider and an NOS manufacturer, offering a range of network operating system technologies for businesses of all sizes. Enterprise companies needing more complex telecommunications software and routing tools may be better suited to a NOS as they integrate seamlessly across their product suite.

Cloud Operating System (Cloud OS)

In the age of cloud computing, it's increasingly common to hear about "cloud operating systems," but what exactly is a cloud OS?

A cloud operating system, or cloud OS, is a type of operating system specifically designed for running software applications and storing data in the cloud rather than on local devices. It can be thought of as a virtualized operating system that runs in the cloud and is accessible remotely from any device with an internet connection.

A cloud OS typically provides all the features and functionality of a traditional operating system, such as file management, system configuration, and security. However, instead of being installed on a local device, it is accessed via a web browser or a dedicated application.

The benefits of a cloud OS are numerous. First and foremost, it eliminates the need for expensive hardware upgrades, as most processing and storage occurs in the cloud. This means that users can access powerful software applications and store vast amounts of data without the need for high-end devices.

Cloud Operating System (Cloud OS)

Additionally, a cloud OS provides **seamless collaboration** and **remote work capabilities**. Team members can easily **access shared files** and **data** from **any location**, which can boost productivity and foster a more collaborative work environment.

Another significant advantage of a cloud OS is **enhanced security**. Because data is stored in the cloud, it can be **backed up** and **secured** using the latest, most advanced security measures. In contrast, local devices are often more vulnerable to cyber-attacks, which can lead to data breaches and other security issues.

Despite its numerous benefits, there are also some drawbacks to using a cloud OS. For example, **reliability** and **connectivity** can be a concern, as users need a stable internet connection to access the cloud. Additionally, some users may prefer the **familiarity** and **flexibility** of a traditional operating system over a cloud OS.

In conclusion, a cloud operating system is a virtualized operating system that runs in the cloud and provides a range of benefits, including cost savings, enhanced collaboration and security, and accessibility from any device. While it may not be suitable for everyone, a cloud OS is a powerful tool that can help drive innovation and efficiency in today's rapidly changing business landscape.