

Project 01

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Introduction

Our team has assigned a task to evaluate four different operating systems – Windows, Linux, MacOS and Solaris on the basis of some criteria. The criterion list has been attached in the end as an appendix ([Appendix A](#)). Our team has hands-on experience with Windows, MacOS and Linux but will unbiasedly work to provide fair review for Solaris as well.

Windows

- a. *Introduction:* Windows OS, by Microsoft is currently at its 11th version, namely Windows 11, with its latest update being 22H2 pushed out on Sept 21, 2022.
- b. *Desktop capabilities:* Windows OS has a GUI based desktop system meaning the user can use their pointing device (e.g., mouse) to hover/point and click at icons.
- c. For *file-server capabilities*, Windows have a different line of OS called Windows Server, latest being Windows Server 2022. Windows Server can act as a File Server with the help of FSRM (or File System Resource Manager) which is equipped with features like Quota Management, File Screening, Storage Reports, Access-Denied assistance (learn.microsoft.com, n.d.).
- d. *Web Hosting:* Windows Server has a Web Platform application which lets the server administrator modify the server into a Web Hosting machine. It comes with a framework, web server, database and the necessary tools required to create and host websites on a Windows Server. The Web Platform typically uses IIS (or Internet Information Server) to host a website by using either File Copy method or the Web Publish method.
- e. *Hardware compatibility:* The thing about Windows computers is there is not just one manufacturer. There are multiple brands which manufacture PCs for personal use, professional use and even for large-scale businesses on a custom basis.
- f. *Process management:* A Process in the Windows system include threads(s), virtual address space, code segment(s), data segment(s), environment strings & variables, process heap and other resources. Windows uses CreateProcess (similar to CreateFile) to create a process. This method requires a path to the executable file and ten more

parameters and return with two handles – one for process and other for the thread. Every process when created is given an ID to identify it and every thread it creates is also given an ID. Each process creates one or more threads to execute the parts of its code. Windows employs a priority-driven scheduling system based on the priority numbers and their status.

- g. *Memory management*: Memory management, in an operating system, keeps track of all the memory locations whether a process is using them or not. Not only this, but it also decides how much memory is to be assigned to every process and if a process releases some memory and changes its status. A thread from a particular process can access only its own virtual space, but not the other processes'. This helps to prevent corruption of processes. Windows have different function to allocate memory to a process, e.g., *GlobalAlloc*, *LocalAlloc*, *HeapAlloc*, etc.
- h. *Ease-of-Use*: Windows is one of the easy-to-use platforms with more than 75% of worldwide users. Anyone can start using Windows and it has gotten way user-friendly and appealing with recent updates.
- i. *Device support*: Windows PCs can support almost any I/O device. Its use ranges from Raspberry Pi devices to mega servers in big tech companies. From mouse and keyboard to external SSDs and GPUs, it supports numerous devices given the computer has the power and compatibility for that.
- j. *Application Support*: Windows has an extensive library of applications available for it mainly because of its wide user base (>76%). Windows has a big library of third-party applications, and a user can find an application for almost everything. With Windows 11, the system now also supports Android applications.
- k. *Environment*: Windows Server is a powerful tool and a system to run and manage a big network of computers in a company. An example can be UFV, where every student can login to any of the computers on the campus with their student ID and password which points to a centralized Windows Server which handles their login and also their files from one system to other.

Linux

- a. *Introduction*: Linux is a unix-like operating system released in 1991. Originally made for personal computers, it has now evolved into something great. Linux has a lot of different distributions, both free (Ubuntu, Debian) and paid (Red Hat). The best Linux

distribution for corporate use is Red Hat Enterprise Linux OS. Ubuntu has its own edition of server system as well, called Ubuntu Server.

- b. *Desktop capabilities:* It depends in this case. Linux, originally, does not have desktop capabilities and is only a command-line based operating system. But its distributions can decide if they want to have a desktop and can build that into it (e.g., Ubuntu). The distributions made for servers may completely omit the desktop.
- c. For *file-server capabilities*, Linux has a good number of packages available which can fulfil the same need – setting up a file server. Samba is a widely used linux package which allows cross-platform file sharing. Samba can also work together with Windows Server and integrates printer sharing services.
- d. *Web Hosting:* To host a website on Linux, we would use Apache. Apache tied up with MySQL and PHP became so popular that companies have now working on a software stack called LAMP (Linux, Apache, MySQL, PHP/Python). Apache is a package in the vast library of Linux packages which lets the user set up and host a website on the system.
- e. *Hardware compatibility:* Linux for a general user does not require any extensive and powerful hardware but when being used a server in a giant pool of servers, it would just need faster RAM, secondary storage, and CPU, or even GPU in some cases. Linux distributions without the desktop utilizes the extra resources efficiently which in other cases would be devoted to the displaying the graphics.
- f. *Process management:* The OS has a PCB (or Process Control Block) which manages such things. Each process has a unique identifier, which is often called PID (or Process Identifier). In Linux, the PID is a number. A typical process in Linux has a structure – stack, heap, data & code. A process is created by one of the two functions – *system()* and *fork()* & *exec()*, the latter is better and secure. The processes can be in the following states during their execution – *new, ready, waiting, running, terminated*.
- g. *Memory management:* The memory management subsystem is responsible for managing the memory in the system, which includes distribution of memory between operating system and user processes, mapping files to processes, etc. It utilizes virtual memory because of security risks and insufficient space in the memory, etc.
- h. *Ease-of-Use:* Linux is not as user-friendly as Windows since it lacks desktop capabilities (except some distributions). Even the desktop versions are a little bit tough for a typical Windows user. For non-desktop versions, it would be a struggle for an

average Windows user since it does not support pointing devices (i.e., mouse) and only work with keyboards.

- i. *Device support:* Since Linux is basically a desktop-free operating system, there are not many devices that it can support apart from acting as a part of a big server system.
- j. *Application Support:* Basic Linux has a variety of packages available for almost everything. The desktop versions have third-party applications and packages available for the users. Ubuntu has a support of 10-yrs from the vendor if used a LTS version. Paid versions of Linux distribution (Red Hat) have lifetime support from the vendor.
- k. *Environment:* Typically suited for intermediate to advanced computer users. Linux is a good operating system for those who have been using them for quite some time and are good with command prompts. As for the corporates, Linux is a powerful server and is currently used in a great amount of web applications hosting.

MacOS

- a. *Introduction:* MacOS is a Unix-based operating system (much like Linux) but with desktop capabilities and made by Apple. As for the server, Apple has discontinued their MacOS Server series. However, the famous features of the server are now shipped with commercial MacOS systems built-in with the latest updates. The latest update being MacOS 13 Ventura. MacOS resembles Ubuntu in a similar but not-so-similar way.
- b. *Desktop capabilities:* MacOS, although Unix-based, comes with desktop capabilities much like Windows.
- c. *For file-server capabilities,* earlier it was only possible with MacOS Server editions but now, after its discontinuation, the file-server capabilities are shipped with the latest MacOS editions. The file-server feature gives us the typical settings – permissions, choosing folders, Time Machine, etc.
- d. *Web Hosting:* MacOS ships with Apache. However, with it being MacOS, there might be some steps that would be different. As there is LAMP stack, with Mac, it becomes MAMP.
- e. *Hardware compatibility:* Much like Windows, MacOS systems are compatible with a lot of peripheral devices, given there is access to such ports. Since it's a desktop, a mouse/trackpad is needed to use it.
- f. *Process management:* MacOS has a built-in Process Manager, which controls access to shared resources, manages execution and scheduling of applications. It is also responsible for allowing multiple applications to share the system's resource and CPU

time. MacOS provides a lot of applications to keep track of different processes, making it easy for developers.

- g. *Memory management*: When booted up, it divides the memory into two partitions – system partition and application partition. The system allocated itself some memory first and the remaining one can be used up by the applications. The structure of the application partition for a typical process is – A5 World, Stack, *unused memory*, and Heap.
- h. *Ease-of-Use*: MacOS systems' ease-of-use would lie between Windows and Linux since it's a desktop, but it is based on Unix. It picks up things from both Windows and majorly from Ubuntu.
- i. *Device support*: Since the MacOS devices are only shipped by Apple, they last for a long-time but have decent support from vendor. Apple typically releases new devices every year which increases the chances of a device getting outdated soon.
- j. *Application Support*: The third-party applications are majorly supplied through the App Store which reduces the encounter of viruses significantly. Since Apple has the second largest user-base in the computer world, it's application support is great and would not be a problem in future.
- k. *Environment*: Typically suited for those who have already used Apple devices or are planning to switch to them. They are powerful development systems but would not be recommended to be put in the place of/act as servers.

Solaris

- a. *Introduction*: Solaris is also a Unix-based operating system by Oracle. It was originally made by Sun but after Oracle's takeover, it was renamed as Oracle Solaris. Many companies of the size 50-200 uses Solaris in their systems.
- b. *Desktop capabilities*: Since it is based on Unix, the underlying desktop capabilities and look is similar as that of MacOS and Ubuntu but with Oracle's touch in it.
- c. For *file-server capabilities*, Oracle utilizes the SMB protocol to turn the system into a file server. It can be achieved by first disabling Samba, configuring the SMB server, managing SMB Shares & Groups, configuring the Solaris as a client, and done.
- d. *Web Hosting*: Solaris comes with SRM (or Solaris Resource Manager) which has the capability of hosting thousands of web servers on a single machine. Like other unix distributions, Apache is used in Solaris to turn this system into a web server. This can be installed by using the terminal. Apache package comes bundled with PHP and

MySQL. Not just Apache, but Java, Python, Ruby, etc. all are available for web development.

- e. *Hardware compatibility:* Similar to other Unix/Linux distributions with desktop capabilities, Solaris can utilize mouse/trackpad. Other peripheral devices can be easily connected, given the access to ports and compatibility.
- f. *Process management:* The process initiated or executed by a system here is called Daemon, which are without a terminal. The kernel maintains a process structure called *proc_t*, which contains and references all the process state data. Even here, a process' identifier is called PID. The kernel loads a process image in its memory so that it can be executed.
- g. *Memory management:* Solaris kernel breaks the processes into segments which in turn are broken down into pages. These pages are then mapped to the physical memory by the hardware memory management unit using translation tables. Solaris has two ways of memory management – swapping and demand paging, where the latter is preferred.
- h. *Ease-of-Use:* Much like Ubuntu/MacOS, Solaris follows a similar underlying framework and would be easily used by an intermediate computer user.
- i. *Device support:* Solaris is shipped only by Oracle and as per their website, they have the support available till 2035 as per now.
- j. *Application Support:* Like Ubuntu, Oracle has its own store to get third-party applications, and the terminal is also available to download packages command-line style.
- k. *Environment:* The market share of Solaris is relatively low and only used by a handful of companies (whose revenues fall between 1 – 10M). Solaris can be used in a small server group and can act as a good Windows replacement or Linux distro.

Conclusion

In our conclusion, we would say Windows and Linux are better options when considering setting them up as a server for large corporations. Their capabilities are high, and so is their performance.

Appendix A – Criteria List

Our team ruled out the following list of criteria for choosing one of the said OSs –

- a. Desktop capabilities: GUI based, or no desktop.
- b. File server capabilities
- c. Web hosting + requirements
- d. Hardware compatibilities
- e. Process management
- f. Memory management
- g. Ease of use
- h. Device support
- i. Application support.
- j. Type of environment suited for

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