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Term Paper Assignment

Rushabh Jaiswal
Akhil Varupula

Comparative Analysis of Mobile and Desktop Operating Systems

Abstract

Both mobile and traditional operating systems that are designed for desktops and laptops are designed in different ways and for different purposes. In this report we are going to compare these two kinds of operating systems based on their design, usability, services, customizability and hardware. There are lot of details involved in computer OS design, but one prominent fact is that computer operating systems were not really designed for mobile use over wireless networks. Instead, they evolved and were understood as a part of wired system, most commonly, as parts of single physical machine. On the other hand, mobile OS are built on what the computer OS has been established. There are wide variety of mobile operating systems are available in the market such as Android, iOS, Symbian etc. that provides the combined features of computer operating systems like Windows, MacOS etc. In addition to that includes calls, messaging, health tracking etc. Also in this report we present the specification and performance efficiency comparison of both operating systems to better reflect the contrast nature of these operating systems

Introduction:

Operating System is a software program that manages hardware and software resources and provides the services that needs to run the basic computer programs. Operating System is considered as a bridge between human commands and hardware response. In this era, operating system is used in every mobile, desktop, tablets and laptops. A small development in operating system bring out a big change in its functionality. As the requirement of the users are changing day by day, developers needs to provide some new features after a certain period of time.
The main functions of the operating systems are:

- Making the user experience better and execute user programs in an efficient manner.
- Use the computer hardware resources efficiently.
- Make the whole computer convenient to use.

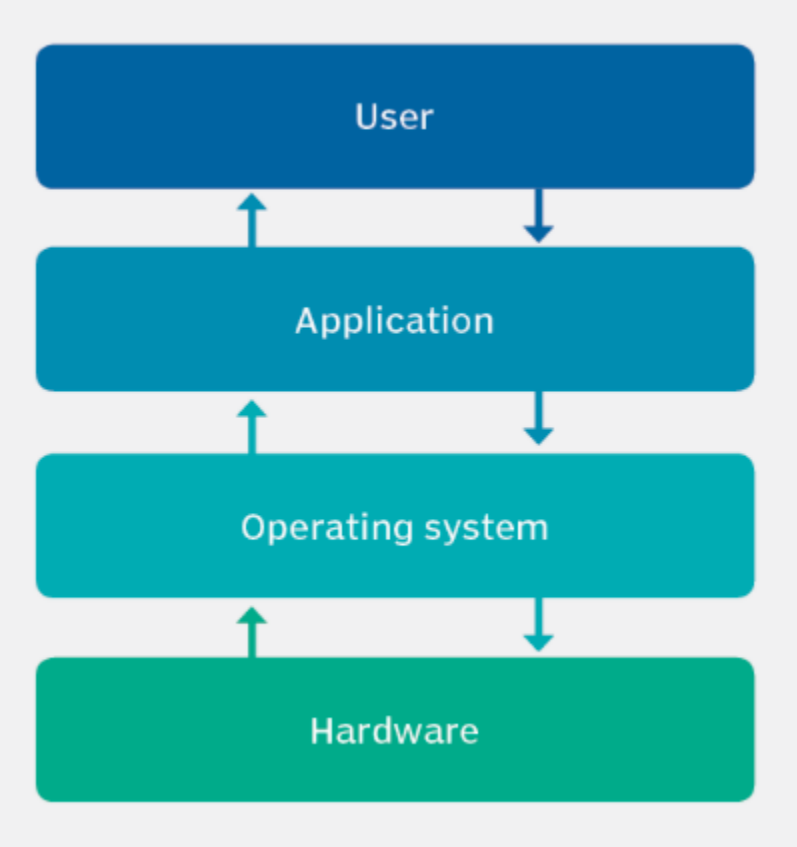

Fig 1. General System Structure

Mobile Operating System:

Mobile Operating System is a software program which is developed specially to run on mobile devices, tablets, etc. Mobile OS is flexible in terms of development and research where any developer can create an application that are run and managed by mobile OS. But Mobile OS is

built on the same platform on which the desktop OS are built. Mobile devices plays very crucial role in human day to day life. Various tasks ranging from making calls to getting health monitoring can be done by a single mobile devices.

There are various mobile operating systems available in the market such as Android, iOS, Windows, Tizen, Sailfish OS etc. Each of these operating systems have their own memory management structure, security protocols, file system management and different user interfaces as well to differentiate them from each other.[1]

Android Operating System:

Fig. 2 Android Architecture

The android architecture has several steps involves as shown in the above figure.

Kernel: Linux acts as a support source for the system services such as memory management, security, process management and network. The kernel also acts as an abstraction layer between the hardware and the rest of the software stack.

Runtime: Runtime includes core libraries as well as Dalvik VM. The core libraries provides the libraries in java programming that provides almost all the functionalities needed. The Dalvik

virtual machine executes the files in the .dex format which is already optimized for the minimal memory usage. This virtual machine relies on the Linux kernel for underlying functionality such as low memory management and threading.

Language: Each android application always runs in its own process. It runs in its own instance of the Dalvik virtual machine.

Libraries: Android contains its own C/C++ libraries that is used by the android system and it is always available to the developers.

Application Framework: Almost all the application of android are made up of java programming language. This system comes with the predefined applications such as calendars, maps, notes, camera etc. Android has been made very flexible because it is open to everyone for the access as well as modification. Any developer can use the predefined framework API's that are used by the applications. This mechanism also enable the users to replace and modify the application components.[6]

iOS Operating System:

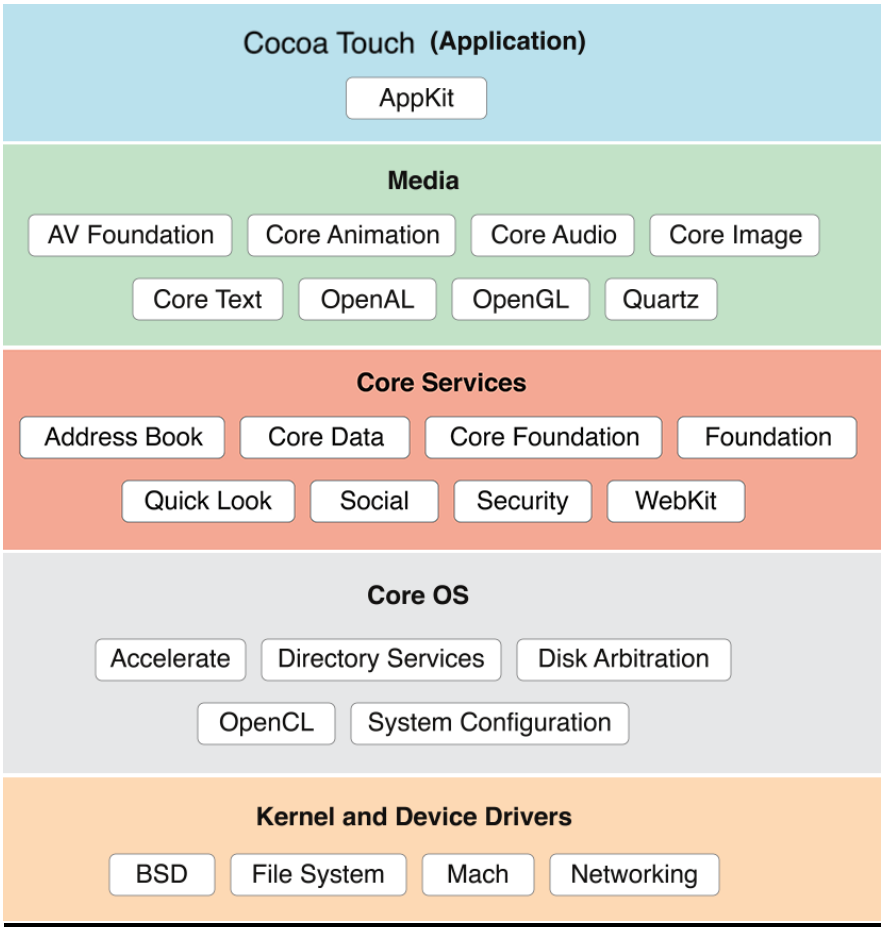

Fig.3 iOS Architecture

The iOS include four major components:

Core OS: This layer is also called as the foundation layer because all the other layers are dependent on this layer. This layer is responsible for managing the OS tasks, memory and processing and also responsible for interacting with the hardware.

Core Services Layer: This layer is responsible for consisting the technologies that provides the services such as iCloud storage. Some of the core services are HomeKit, HealthKit, CloudKit, Core data, Address Book framework, Core location, Core motion, Core Foundation and StoreKit framework etc.

Media Layer: Media layer in iOS architecture enables the Graphics, Audio, Video technologies. Graphic Technologies like UI-Kit Graphics, Core Graphics framework, Core Animation, Core Images, OpenGl ES which handles 2D vector and animating views and 2D and 3D figures, GLKit and Metal. Audio Framework supports rich Audio experience and includes- Media Player Framework, AV Foundation, OpenAL. Video Framework includes AV Kit, AV Foundation, Core Media, Also the iOS support for the playback of movie files with the .mov, .mp4, .m4v and .3gp filename extensions.

Cocoa Touch Layer: This layer sits at the top of the iOS and it contains the framework which is used by the most of the developers. Cocoa touch is written in objective C and it is completely based on Mac OS X cocoa API.[6]

Similarities between Mobile OS and Traditional OS

Both mobile operating system and computer operating system have some things in common. Basically mobile operating system is built on the platform on which the traditional operating systems are built. Both operating systems require a display to allow the users to interact with the hardware through them. Both of these operating systems have some components in common and they provide the same services such as memory management, process management, I/O device management, security protocols, user interface to interact with the hardware, network management, network services etc.

Multitasking is the most important feature provided by both of these operating systems. Multitasking allows a user to perform multiple tasks at the same time without closing the other tasks running currently on the mobile phones or computer systems. Both of these operating systems have their memory management criteria where each of them assigns the memory to each of the applications present in the mobile or computer and as soon as the application finishes its work or stops in background, it makes the memory free used by that applications and makes use of it for another applications. In this way memory management is done by these operating systems.

For reading any input, a device must have the drivers to accept and run any peripheral device to any computer or mobile phone. Each of these operating systems provides the support for connecting and using any device.

Comparison of Operating Systems based on several criteria:

1. Booting Process

For Mobile: The booting process for mobile includes five stages such as bootstrap, Kernel, File System, System Startup and GUI.

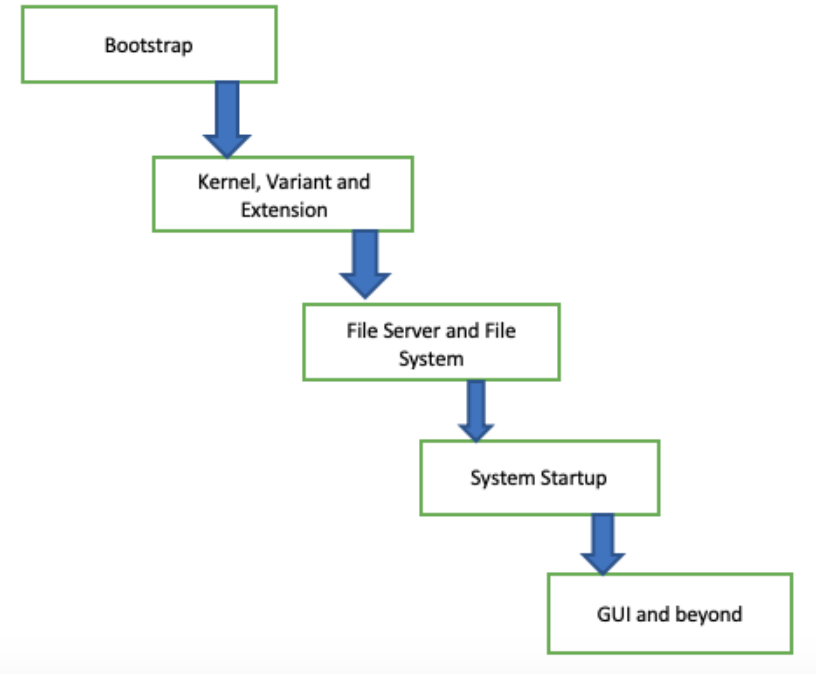

Fig 4. Booting Process in Mobile

- **Bootstrap:**As the power button is pressed, it resets the CPU. The code that executes at the initial stage is fixed at a location. The preliminary task is to check if all the component of chip are working properly. Then the bootloader locate and load the kernel.
- **Kernel:** The primary stage here is BSP(Board Support Packages) which is a code specific to a hardware or chip. The BSP contains a small program called a boot loader or boot manager that places the OS and device drivers into memory.
- **File System:** This stage is the middle of kernel stage and is loaded by the bootloader. Generally File system is use to store, organize and update the data at the initialization.
- **System Startup:**All the libraries and frameworks are initialized in this phase. Graphic Manager, Sound Manager etc are loaded in this phase.
- **GUI:** This is the last stage of booting process which is seen by everyone. GUI is the only way where user can interact with the whole system.[3]

For Desktop: The booting process for desktop operating system includes four stages such as BIOS,POST,MBR,NTLDR

OS → Features ↓	Mac OS	Windows	Linux
BIOS	NO	YES	YES
Kernel	XNU	Hybrid Kernel	Linux Kernel
Boot Loader	BootX or boot.efi	NTLDR	GRUB or LiLo

Fig 5. Comparative Table of Booting Features of Different Desktop Operating System.

- **BIOS:** The first stage occurs when a user turns on the computer in basic input/output system.
- **POST:** This is called as Power On Self Test which is inventory step and very critical step where the hardware configuration has been performed.
- **MBR:** This is a Master Boot Record where a basic input/output system looks for the booting priority which is stored in this booting process. After that, the operating system loads the KERNEL into the main memory.
- **NT Loader:** It is used to load the partitions into the computer system and identifies the other partitions.with this step the other support files like win.sys,NTOSKERNEL.exe get installed for which the application oriented environment get established.[3]

2.Hardware Requirements

Hardware requirements in Desktop operating system:

- Processor: the basic job of processor is to process the output based on the given input.
- Memory(RAM): while the OS boots up, processes load into the RAM
- Ethernet connection or a wireless adapter
- Some require a camera and a microphone

Hardware requirements in Mobile operating system:

- Processor
- Memory
- Touch Screen display
- Camera and Microphone

In general basic hardware requirements like processor, memory are similar for all types of operating systems. Desktop operating system needs more efficient hardware than a mobile operating system for its functioning as mobile operating system functionalities are limited when compared to desktop OS. Desktop operating system is more reliable and can perform better than a mobile operating system because of its better hardware availability. In case of portable devices like mobile, the space available for hardware requirements is quite limited compared to desktop, which forces its hardware to adjust with limited functionality. When we compare the operating systems based on the performance, the hardware plays a major role because more efficient operating systems need better requirements.

3. Memory Management

Memory management plays a prominent role in the functioning of operating system which handles or manages primary memory and moves the processes back and forth between disk and main memory during execution whether it is mobile OS or traditional desktop OS. Unlike desktops mobiles have a limited memory, when this memory is more occupied, the mobile phone is likely to hang or restart, to avoid these situations memory management should be properly done in the operating system level. These days all the mobile operating systems store the data in the memory and when the application is launched again, instead of reloading the application from starting, it starts from the point where it was previously left, this saves workload on RAM and thus helps in memory management.

While both the Android OS and Windows OS (desktop OS) manage RAM effectively, there are some significant differences. Android has a default security mechanism that sets a hard limit on the heap size in order to prevent apps from using all available memory. Android can also kill a process; any application component, including any background threads can all be consequently destroyed at any moment to release resources as needed. Each individual activity program executes the exact same number of instructions. The difference in the execution time of the activity programs are due to the memory management issue because the Android system tries to maintain an application process for as long as possible (this saves battery life), but eventually needs to remove old processes to reclaim memory for new apps or more important apps. Windows supports virtual memory and can run more programs than there is RAM to hold. The different operating systems respond differently to a sudden demand for main memory. Both the operating systems results in slowing of the applications as the memory load increases. Windows shows a smaller impact up to a point compared to Android. Once the main memory is saturated, the virtual memory system starts to thrash and performance is greatly degraded. The programs will run, but very slowly. The Android system does not allow the machine to be overcommitted and will terminate idle apps to free memory. The systems react differently, but have different goals. Nobody is running high performance computations on their phone. Android was developed for short life, interactive apps. Windows supports this along with a high performance, heavy load environment. Different memory systems respond in different ways for different purposes.[7].

4. Security

Security in operating system is the process of ensuring operating system integrity, confidentiality and availability. It refers to the steps or measures that are used to protect the operating system from viruses, malware, threats or remote hacker intrusions. This Security encompasses all preventive control techniques which safeguard all computer assets capable of being stolen, edited or deleted if security is compromised.

In terms of security features, different operating systems have different mechanisms for securing its data. There are different types of security concerns present today which may be due to less attention given to the security of that particular operating system while designing the operating system. The attacks on operating systems may be due to various reasons, some attacks for personal data, stealing information, network information, logins etc. There are some type of applications designed for specific type of attacks on operating systems for both handheld and desktop devices which are usually third party applications. Some Of these applications change the system files or system default settings which play a vital role in the security of the operating system.

Most modern information computer systems provide concurrent execution of multiple applications in a single computing hardware (which may contain multiple processing units). Such a multitasking, time-sharing environment, individual application jobs share the same resources of the system, e.g., CPU, memory, disk, and Input/Output devices, under the control of the operating system. In order to protect the execution of individual application jobs from possible interference and attack of other jobs, most contemporary operating systems implement some abstract property of containment, such as process or task and Task Control Block, virtual memory space, Inter Process Communication, file and port etc. An application is controlled that only given resources it can access, and given operations (e.g., execution) it can perform. However, the limited containment supported by most commercial operating systems (MS Windows, Unix, etc) bases access decisions only on user identity and ownership without considering additional security-relevant criteria such as the operation and trustworthiness of programs, the role of the user, and the sensitivity or integrity of the data. As long as users or applications have complete discretion over objects, it will not be possible to control data flows or enforce a system-wide security policy. Because of such weakness of current operating systems, it is rather easy to breach the security of an entire system once an application has been compromised.

In android operating systems Dalvik virtual Machine(DVM) is responsible for security. In the design of DVM, no application would perform any task that is dangerous for any other application, operating system and user. This technique is forcefully implemented using this DVM and fundamental Linux platform using the file permission and UNIX user identifiers. Unlikely, many linux desktop operating systems, where applications will execute from the same user ID, and each

application executes its own virtual machine in different process with its own user ID. From this it is clear that Android cannot get code or access from other.
In iOS, it has its own utilities and store for its applications and stuff, which makes it safe from different threats and viruses, but in case of android and stuff, which makes it safe from different threats and viruses, but in case if android and windows, security lacks as they use third party applications for utilities. Android is an open source platform which makes it even more dangerous because many viruses and worms can easily attack it but windows and iOS are not open source. [5]

Conclusion

The main objective of this report is to reflect he similarities and dissimilarities of mobile and traditional operating systems. We have explained about the mobile operating systems and later provide some contradiction between mobile and computer operating systems using several criteria such as security, memory management, booting process and hardware requirement. Mobile and traditional operating system that are used with laptops and desktops are both built to provide the functionality that lets user interact with the hardware. Each of these operating systems provides huge amount of features and better usability but still developers are trying hard to make it more better and customizable.

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