

# The effect of operation systems on consumer population in smartphones market

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**Abstract.** Individual reliance on smart devices such as mobile phones have seen exponential increase in the modern age. Customers now have a wide variety of brand choices, some brands like Samsung and Apple are world-wide products to consumers. Yet, there are only two widely applicable smartphone operation system, which is iPhone's iOS and Android OS. The population of these operation systems are different, in order to figure out what cause the preference of the consumers, we use three measuring points to infer the reason.

**Keywords:** operating system, software, iOS, Android.

## 1. Introduction

With the development of the Internet, the functions of mobile phones become more and more powerful and gradually penetrate People's Daily life. Currently, 95 percent of the mobile phone market is occupied by Android and IOS operating systems, but the number of users of Android and IOS is gradually different due to different development companies. Based on the number of Apple users published by Above Avalon in 2021 and the number of Android users published by Newzoo in 2021, a comparative analysis method was used to analyse what causes the differences in the number of mobile phone users of different operating systems. It is found that the security of the two operating systems has a significant impact on the number of users, and the software support years of the operating system has a certain impact on the number of users, but the age of the users has no significant impact on the number of users..

## 2. The features of iOS and Android operation system

### 2.1. The safety features for two operation systems

iPhone is an all-in-one gadget that is more than just a phone - it also acts as a video and music player, a camera, a portable electronic photo album and much more. iOS, the operating system for the iPhone (and for iPad and other Apple's products). It's an integral presence as the heart of the iPhone [1]. iOS is at the heart of the iPhone's ability to ensure a wide range of substantial services for users, including responsive on-screen touch, a convenient interface and built-in apps[2]. It is what underpins the iPhone's ability to work in such a sophisticated way. Why iOS customers have a higher stickiness than Android customers. There are three main reasons.

The safety features for iOS (mainly for iOS 15) can be the main reason why many people choose to purchase devices which are equipped with iOS. Both hardware and software are closed, that is, Apple itself controls the operation of the operating system. As a closed system, it has its own software release channels, so all software needs to be subject to Apple's internal review before it can be listed. In this regard, Apple officials can help filter some software with privacy security, and software from unknown sources cannot be used in the iOS system. But when it comes to Android that does not have a filter itself, this means that many malicious plugins run automatically on this operating system and

cause disclosure of users' personal information. At the same time, iOS ecosystem has been tightly closed by Apple developers, with a well-established developer certification and app review mechanism. This means that many malicious programs will be directly filtered by apple systems, and there is no possibility of harming user security. Apple said that the new privacy protection for iOS 15 have been updated[1]. Smart Stalking Prevention, now also prevents stalkers from using your IP address to analyse you. By preventing email senders from getting information about your Mail correspondence Mail Privacy Protection can helps protect users' private information. When you choose to turn it on, your IP address will be hired by it so odds of information leakage or positioning will drop. And it prevents senders from seeing if you've opened their email. iOS also has report for its application privacy. It is a section in settings lets you know how often apps have accessed your position, photos, bio-information, microphone, and contacts. It also shows you which apps have been linked to other domains and how they have been linked in recent past. This is a great addition to an app privacy tab, so users can make sure they are happy with how it treats individual's privacy.

However, one of the shortcomings of Android in comparison to IOS is security. Android OS based devices are being used in a vast increasing amount for private and business application. From purchasing stuff to online banking[3]. It has diverse and enormous functions, and this might due to its nature as open source project, which means it is a project under a license in which the copyright holder grants users the rights to use, study, change, and distribute the software and its source code to anyone and for any purpose[4]. Though more developers can contribute to this big platform, they are also more security issues. Android OS is basically constructed by 4 main components[5]: Linux Kernel, native libraries, Android Runtime and Application framework, which provides more high level service. Due to the open source nature of Android OS, numerous research developers are investigating and attacking it for various reasons. Also, the emergence of malware also affected the security of Android OS system, as Android is made by the company Google, hence, The official Channel for Android-based smartphones downloading software is google play. However, in some regions, for example, China, in which has the biggest population for devices, google is being banned, hence, users might try to download apps from secondary software market,[6] where with limited regulations and low barriers of entry, users may easily download malicious app, which will invade user's privacy. All in all, due to its special feature, Android cannot achieve security on a satisfying level.

## 2.2. The compatibility of two operation systems

A key function which the system needs to equip with is to read the data people want from the server. This means that the system needs to achieve data connectivity with the server. So, it is vital to make sure server is suitable for operation system and is compatible for devices. Not like iOS, which is only designed and applied for Apple's devices. Android has an Android Open-Source Project, so it can be redeveloped by using source code. This means some functions are not totally suited with the devices. iOS has a high upgrade rate, which means that if the software developer supports two major versions of iOS, it can be listed normally on the Apple store. For example, if the latest version is iOS13, then as long as the software can support a large version of iOS13 or 12, it will work fine, and so on. The iOS system can support several versions of the software, so the software's API can still be connected to the system after the update. This means that for Apple users, many times even relatively old models can support the use of some newer versions of the application software. This can extend the life span for smartphones because users do not need to change their electronic devices too frequently because their phones do not support the latest version of applications or functions.

The backward compatibility [8] for android OS is also a disadvantage. Backward compatibility is a feature of operating systems that ensures interoperability for older version legacy system and its complementary concept: forward compatibility means a product is design for cater for future versions system. Android OS shows a big problem in its backward compatibility. When seeking for the intentions of software developers, most of them shows noticeable violation [9] against compatibility

Recommendations that While it is advised to specify minSdkVersion, only 0.32–1.24% of benign applications and 0.39–16.88% of malware do so, during the same time that 0.52–6.1% of benign apps and 0.14–2.71% of malware who specify maxSdkVersion. It is also a fact that, the benign software developers even invented to shorten the periods of compatibility than malware developers. However, it is the benign software that are mainly used by the majority and won't affect much on security Which made the overall backward compatibility that a user can enjoy even less. They admitted that the compatibility intentions were not always fulfilled either according to many compatibility issues occurring persistently such as device-specific issues which can only get triggered on certain device [10]models and non-device-specific issues which can be triggered as long as under certain API level. These issues might lead to inconsistent app behavior among devices, which creates huge trouble for users. Sometimes, the rate of update version for software is way much slower than the rate of update for Android OS, which means during specific period, much software is limited to be used merely due to its backward compatibility. In a nutshell, the weakness of backward compatibility of Android OS is also a big concern for users.

### 2.3. The consistency of two operation systems

The consistency is also vital. iOS's software and hardware systems have a higher degree of integration than other systems and are not as fragmented as Android. The key role for an operation system is understand what users want from the server. Therefore, the stability of the iOS operating system is relatively higher, and the phenomenon of stuck machines or crashes occurs less. In addition, different devices with same operation system, which is iOS, can transfer files or other images to the devices equipped with iOS. At the same time, in terms of operation, Apple's closed-source operating system makes all devices using iOS have a very consistent user interface and usage. For example, users will find that whether they use an iPhone, iPad or Apple's laptop, the method of use is basically the same. They don't need to adapt to a new operating system and change their habits in order to change their devices. But this situation will not occur on Android operation system because different developers need to customize different system. The way that iOS used to operate the system is clear: The librarian can update one or more access control lists associated with the local cloud or content, including identified users. At the same time, the librarian may receive instructions from the user as to which devices the user wants to grant access to. In some embodiments, the librarian may modify or edit a database to give other users permission to access the local cloud. Alternatively, each device in the local cloud may be initially notified by the librarian that other users are authorised to access the content on that device. This may then allow other users to see the shared content or local cloud appear on the user's device.

Yet, the consistency of Android is also a factor affecting the number of users. As Android is a big operating system company which provides to different companies, the range of users and regions it covered is huge. It is criticized as inconsistent many times. A classic example that can illustrate the problem is that: sometimes when two application looks quite different from the general level, thy UI(user interface) is quite similar, Research found out that by description, 630apps , about 5.3% of the total amount of apps are identical, which can be viewed as inconsistent as in fact, most apps don't have near identical apps[12]. Not only from camera permissions and similarities which is shown in the previous data, many other categories such as other types of permissions, statistics. Content ratings, advertisement and category labels can also reflect the inconsistency of Android OS. From the user level, which is easier to understand, though working under the same system, devices of different companies might have their own UI (user interface), however, the using logic of these interface might be different, and it takes time for single user to get used to one UI, which causes time consumption and inconvenience.

### **3. The comparison of the measuring points**

#### **3.1. The differences of the safety**

The safety of operating system is the first measuring quantity to be compared to analyze the reason why the number of users is different within two systems. The Android OS is a platform which designed as an open-source software, which means that any users can type various individual contents into the operating system, therefore it is not only beneficial for Google developers', but also beneficial for third-party developers [13]. Google opened the entire source code, added with the network and telephony support, many producers are free to add extensions without making them available to the open-source community. But the IOS OS is different from Android OS,[14][15] because operating system and the final products are only protected and developed by the same companies. You can't get an iOS OS to run on a different device, because there is no license to install an iOS operating system on other hardware that has not been authorized by Apple. Today there are only simulators on the market for iOS OS[16].

So, it is significantly to understand that the safety of the IOS OS is much higher than the Android OS because third-party producers cannot attack in your personal account to steal messages. However, in recent years, Android OS made their effort to improve their OS, but only some parts of libraries and APIs are not fully open source before 2014, the version 5.1 of the Android OS is an operating system known as "Lollipop Android", the Android platform used a virtual machine called Dalvik as a just-in-time process (JIT) for compiling the code obtained from Java byte code. Dalvik compiles the application each time it is launched. Linux is just part of this architecture and is placed at the lowest level. As in the case of the OS from Apple, we do not see the Android OS as a Linux operating system, and thus most developers do not have access at this level.[17] So obviously we can see that the safety level of the Android OS has been proved since 2014. Though the safety was totally improved in 2014, but in 2013, there were more than 1 billion Android OS smartphones was sold, compared with only 150 million sales of IOS OS phones. And this situation continued in 2021 as well, according to the Newzoo 2021, there are more than 3.5 billion Android OS users and only 1 billion IOS OS users. As we can see that the IOS OS has already reach version 12.3.1 and they provide monthly upgrade bags for the users to fix the bugs and they provide health report to every personal accounts. But Google rarely provide warnings to you when you want to open some websites or advertisements, and you are not sure whether third-party communities will invade your information. So, under this huge comparison, the differences of the user's population are still high, so we can conclude that the safety of the OS cannot affect the populations of the users.

#### **3.2. The differences of the software support**

The software that provided by these two OS have significant differences which may affect the population of consumers as well. For the most apparent one is the app stores which are google play and Apple app store for Android and iOS respectively[18]. According to the data, in the app store of iOS operation system, there are more than 300,000 apps with over 10 billion downloads collectively. That is mainly because of the iOS software development kit (SDK), which much information for the code, and tools people need to develop, test, run, debugging, and tune apps for iOS. This material can illustrate how complete and mature the software system of the iOS operation system. From the perspective of software developer, the application publication fees should be considered. Both the Android and iOS operation system take 30 percent of app revenue, but it does not need any fee for signing in the Android system, while developer who sign up on Apple need 99 dollar per year.[19] To publish their app in Apple Store, the developer must pay \$99 annually, on the other hand, Android only charged developers \$25 for one-time registration and they can release the same app in another app market. restriction for it. High software publication fees may affect the software developers' preference. Some of them may not be willing to publish their applications in the iOS operation system due to the high fees, and this will lead those consumers who need these kind of software inelastically choose to buy the devices with the Android operation system. This is a crucial factor that cause a

great loss of consumers for the iOS system. To look at the openness of the operation systems, iOS is famous for its unique closed features and the iOS users can only download the applications from the app store. Look back to the Android system, the devices with Android system can download the software even with the file of apk. This can bring a lot of advantages to the users of Android operation system. From the perspective of API virtualization [20]. The third-party developers need API virtualization to statically provide custom code that replaces the initial implementation of a platform API class. Through injecting the code into a binary of an Android app, the original API implement can replace the custom code of the appliances without requiring any platform modification. This makes open innovation in the mobile platforms more feasible. According to this material, openness is an important characteristic for an operation system to have some operation with high level of freedom such as the API virtualization. However, Apple also tried to change the circumstance caused by the openness of system. [21] Apple's success is largely due to other unusual openness — sharing and collaboration. As one of the most advanced hardware pieces, but the key point of being so successful is not through this. By opening what are called “application programming interfaces,” Apple can provide its customers and the software developers over the world to create apps on its platform. According to this, Apple's corporate borders are quite open and porous. It is a key and significant technical at the heart of an enormous smart phone and operation system developers and software producers — based on openness. Through this paragraph, we can see that the change of Apple and iOS have acquired a group of users and loyal fans. Another key determinant that influences the population of consumers for these two operation systems is the software support[22]. On Android, the norm was two years of updates and that's it. In mid-2021, no Android manufacturer offers five years of support on its devices, but we are getting closer and closer to that amount of time: the median software support is now upwards of three years, while select devices can enjoy even four yeas of continued support. In the daily life of the using Android devices, some type of phones will continue getting stuck after using for several years. However, from the daily life, the software maintenance is much better than the software support of Android.

### **3.3. The differences of the consistency.**

The consistency of two OS is also different. This phenomenon is cause by the quality of the chip. In 2020, Apple announced its self-developed computer chip M1 for the first time. After more than two years of several iterations, the M1 series of chips now includes M1, M1Pro, M1Max and M1Ultra. In addition, M1 has entered Apple's tablet, laptop, desktop multiple product matrix. According to Apple, the M1Ultra chip features 114 billion transistors, a 5nm process, a 20-core central processing unit, up to a 64-core graphics processor, and up to 128 gigabytes of unified memory [23]. But for Android chips, there are 5 main factories to design the chips to support the Android OS, and their quality is different, prices are different as well. These 5 companies are Qualcomm, Samsung, MTK, Intel and Huawei Kirin. Among these five, Qualcomm Snapdragon and Samsung Exynos are top two of the world, and only these two companies have production lines. Other three chips are produced to fit the mid-market, and MTK were only provide low-end market before 2011. And these three chips are made by other two foundries, one is TSMC, another is Samsung.

So, every company have their own chips, and differences of quality of the chips are huge. For IOS OS, according to Apple, the M1Ultra chip has 114 billion transistors, a 5nm process, a 20-core central processing unit, up to a 64-core graphics processor. Based on CPU and GPU enhancement, it can perform up to 22 trillion operations per second and support the simultaneous playback of up to 18 8K ProRes video streams. [24]In terms of CPU performance, Apple showed that the M1Ultra outperforms Android CPUs by 90% on the same power, the GPU runs faster than Android vendors' high-end GPUs, and the power consumption is even reduced by 200 watts. Notably, the M1Ultra innovates at the packaging level, with Apple reportedly using a Die-to-die connector hidden in the M1Max to combine two M1Max devices. Nowadays, packaging technology to obtain higher computing power has become a trend.

In Android products, Samsung Exynos is the top chip which are invented in 2019. The Exynos 980 chip supports both NSA and SA 5G networks, bringing more benefits to consumers. Exynos980 realizes ultra-high speed data communication, which can be downloaded up to 2.55 Gbps in 5G communication environment, namely sub-6 GHz frequency band. The download rate is up to 3.55 Gbps in 4G-5G dual connection state.[25]According to the data and users' feedbacks, it is hard to criticize which company's top CPU and chips are better, because their transfer speed and reaction time is closed to each other, and in real market, consumers won't carefully read the data of the CPU, the only thing they like to do is to try them practically. As we all know, it is impossible for consumers to detect the differences which are just 0.01s, so these high-end mobile phones or laptops will only be sold to fit the preferences of the users. So, we can conclude that in high-end market, both Android OS and iOS OS are competitive, however, the balance is broke in mid-market and low-end market. In 2022, the new product of Apple in middle-end is low-end, but it contains A15 chips in iPhone SE, which is the best chips Apple has now. In Samsung, their best 8 cores processors even have less efficiency than the A15 due to the CPU and GPU power. Those differences are not huge in top devices, but in low-end market, Samsung just use Exynos 1280 as their main chips in different devices. Compare with the A15 chips in iPhone SE, the low-end market and middle market was nearly dominated by the Apple. The resolution ratio, battery efficiency, CPU cruising ability, iPhone SE beat even all Android OS mobile phones in mid-market. So, we can conclude that the population of the consumers is significantly affected by the consistency of the OS, considering quality of the chips which connected with the prices, more consumers prefer to choose IOS OS devices to make sure their devices are durable and quickly.

#### 4. Conclusions

We studied the difference in population and sticking power of IOS device user and Android device user by learning about the difference of two operating systems from three perspectives: security level, backward compatibility and consistency. Our research focused on how the security of these two operating systems differs owing to system differences, how backward compatibility and consistency differ, and how device users value these aspects and base their judgments on them. We discovered that: 1. The reason for iOS' excellent security level is that it is a closed system, whereas Android is an open-source system. However, Android also has the issue of having a secondary software market, which leads to the emergence of harmful apps. 2. Compared to Android, which has relatively weak compatibility since its creators don't want to make it compatible, iOS has great backward compatibility and can work with numerous devices of various generations at once. 3. IOS has incredible consistency since it only serves Apple and has a single interface for all devices, whereas Android serves many different firms and uses a variety of user interfaces. 4. According to user population data for goods and health bug-fixed bags, safety is not a significant factor influencing users' choices of gadgets; nevertheless, backward compatibility and consistency do influence users' preferences. Via the learning for the effect that an operating system can have towards the preferences for users on certain devices, we see the significance for this study as it can apply to the field of economics and marketing for firm to learn about the behaviors of consumers, the latest focus and trend in the market, and how firms should allocate their funds to different areas in order to attract more consumers and hence make the whole market works well. The difference of operating systems can affect the user population for technology products, reflecting how technology plays a significant role influencing economy as well.

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