CA170 Introduction to Operating Systems: Group Report

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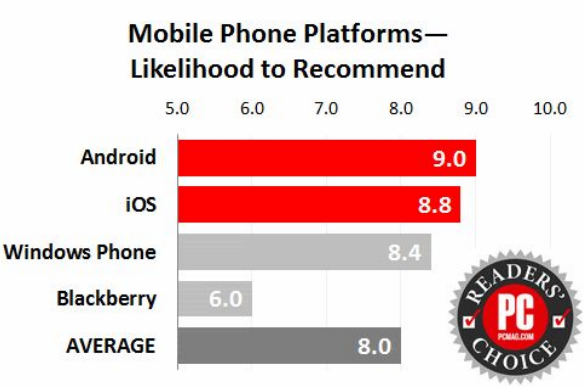
Who is going to win the mobile OS war?

Introduction

As a group, we put a lot of initial thought into this question and all of the potential answers and we guessed that it would be a close run between iOS and Android. As a small sample we recorded the different mobile OS's of all of us in the group. The results were 2 iOS iPhones, 2 Android phones and 1 Windows Phone. Even though it was a small sample, these results encouraged our preconceived estimates. After a lot of research and investigation into the subject we have concluded that we do not believe the so called "war" will have a distinctive end, rather that it will continue to be waged into the foreseeable future. While we think that iOS will continue to contend and compete, we strongly believe that Android will continue to dominate the market as the most popular mobile operating system and therefore we believe Android is on track to win the mobile OS war.

History of Mobile OS

In the past, people would be waiting for the next release to come from Windows as it was the leader in technological development at that time but in the modern world Windows is considered less suitable for handheld devices which are very popular nowadays. This lead to its decline in popularity.[1] Windows has tried to regain its grasp on the technological market place by buying Nokia but they were not very successful in their attempts as Windows OS phones are not very popular as can be seen from the readers' choice awards 2015 results it is less popular than iOS and Android.[2]



iPhone's operating system, iOS, was launched on June 29th 2007 as the first iPhone was released. Apple has updated their OS every summer which is why iOS is such a popular choice. iOS is currently on its tenth version and has come a long way from iOS 1. The first iPhone is one of the most important gadgets of all time. It took ideas from within the budding mobile industry and made them more people friendly. The candy bar sized display defines smartphone design to this day. It also created the basic Springboard app a grid of apps on a screen. The biggest win that iPhone claimed was the idea that an iPod, camera, internet and phone could be packed into one device that fitted in your pocket which gave them the edge over other operating systems.[3]

The T-Mobile G1 was the first Android phone produced in October 2008, 1 year behind the iPhone which meant they started off at a disadvantage to their competitor. Android is a free

1 http://www.instantshift.com/2013/02/07/the-history-of-future-operating-systems-ios-vs-android/

2 http://uk.pcmag.com/google-project-fi/76028/feature/readers-choice-awards-2016-smartphones-and-carriers

3 http://gizmodo.com/a-brief-history-of-ios-1780790760

and open source operating system project that is developed and maintained by Google. This open source format gives Android an advantage over iOS. Android is a highly customizable and low cost operating system which can easily be applied to almost any hardware and made it popular as a low cost choice unlike the high cost of iOS operated phones. Google has released several versions of Android each one better than the last. Over the years, Android has become a little less open-source which has not worked to their advantage as users enjoyed the open-source format from previous years.[4]

Blackberry was the dominant smart phone provider in 2007 pre-dating the iPhone and Android phones. This was a huge advantage to Blackberry as competition was low in the years before the release of the iOS and Android. After their release, Blackberry began to decline in popularity and nowadays, Blackberry is a brand unfamiliar to most people as a result.[5]

Sony were the first phone provider to introduce touch screen when they released the Ericsson R380 in 2000. This gave them an edge over their soon to be competitors at Apple and Google. By 2010 most phones now had touch screen technology meaning it was no longer a special feature. As a result Sony phones became less popular.[6]

History shows that Apple phones have always been more expensive than Android phones as the first iPhone produced cost $499 for the 4GB version and $599 for the 8GB version. These prices were not unheard of at the time as some Motorola flip phones also cost as much if not more than the iPhone but in comparison to Android, they were both very expensive. The first Android phone, the T-Mobile G1 as mentioned previously, was much cheaper when it was first released at the low price of $179. This was $320 cheaper than the iPhone which made it a better choice for those with a low budget.

Hardware

The actual system specifications of a mobile phone has a generally larger influence on the customer's decision on what brand and in our case, which mobile operating system they're going to go with.
A key case where this is inherently visible was during the late 2000's when the majority of the mobile phone consumer base transitioned from using phones such as Nokias and Blackberrys towards 'new' touch phones such as iPhones and Samsungs.
The main causes for these changes was that with the newest innovations into touch screen technology, the massive keyboards supported by Blackberry, which made them a hit in the professional market due to the ease of use for writing emails, became obsolete as while the new interactive 'touch keyboard' was not as reliable when it was released then, it is now. It allowed for a much better user experience as without the space limitations provided by the keyboard the new phones were able to provide a much larger screen while not losing any of its utility.

4 https://www.cnet.com/uk/news/a-brief-history-of-android-phones

5 http://www.librarypoint.org/android_history

6 http://www.imore.com/history-iphone-original

Some very notable hardware developments were; the utilisation of accelerometers to allow for responsive view change from portrait to landscape, implementing proximity sensors to deactivate the screen when covered or during a call in order to save battery and ambient light sensors which allowed for the screen contrast to be automatically adjusted based on light level to be softer on the user's eyes while the screen still remained visible.

Also due to rapid technological advances; memory and microprocessors rapidly became a lot more cost efficient and small enough to be used in mobile devices.[7] This coincided with investment into physical services for internet cables and phone towers with mobile data. Both Apple and Samsung were quick to seize this opportunity quickly developing phones with enough processing power and memory that they could support mobile browsers at an agreeable rate.

A by product of this development was that not only could these new devices support internet browsing and video streaming but they also had the necessary hardware to run more complicated programs such as games etc. This birthed the app market which has also played a large part in the rise in dominance of Apple and Android based devices as they each run exclusive marketplaces for their operating systems and most apps are developed exclusively for these devices, either exclusive to one or both.

While these hardware features and developments have lead to both Apple and Samsung distinguishing themselves from the rest of the competition's devices, what key features separate these two corporate giants? The main deciding factor between them is in our opinion the memory of the devices. A key problem with Apple's operating system in the current age is that while they've steadily incremented memory on their devices, due to their regular release model, there's still many 'old' models in use.
The problem that has resulted from this is one of the most basic problems surrounding operating systems; Apple's newest operating systems are too large for the capacity of older models. As a result many Apple users consistently refuse updates in order to not have to delete their personal data to free up enough space for installation.
Apple has been attempting to rectify this problem since iOS 8 but have yet to find a solution that will suffice.[8] This problem is unique to Apple in this sense as many Android phones have an SD card based memory system. This allows both larger storage than an iPhone and also the ability to freely upgrade storage by purchasing an SD card with larger storage space.

However this comes at a cost. Because Google only produce the OS and not the handsets themselves there have been multiple security flaws in the designs of both the phones and by proxy the OS.[9] These security flaws have varied in severity over the years but the frightening

7 http://www.apple.com/ie/iphone/compare/

http://www.samsung.com/us/compare/#category/N0000002/products/SM-G930TZKATMB,SM-N910PZKESPR,SM-N900TZKETMB,SM-G935VZSAVZW

8 http://bgr.com/2016/06/17/16gb-iphone-6s-ios-10/

9 http://www.recode.net/2016/8/8/12403088/android-security-mess-quadrooter

frequency and the sheer volume of users this affects every year has had huge impacts on consumer trust and on which kind of phone to choose when purchasing.

OS Features

Customizability and User Interface

The user interface of iOS is much simpler and easier to navigate than that of Android's. This has its advantages and disadvantages for iOS. Although simple and easy to navigate, it comes at the cost of customizability. The opposite can be said for Android which is very customizable but lacks simplicity in the user interface.

Android's customizability is above and beyond that of iOS's. With Android, it is possible to customize almost every aspect of the OS such as the lock screen, default user applications, widgets, ringtones and more. For example, it is possible to change the lock screen theme and add additional functionality to it. iOS severely limits customizability. On iOS, the only change that can be made to the lock screen is the ability to change wallpapers. While it is possible to choose wallpapers and ringtones, an iOS user is unable to choose default apps like on the Android operating system.
Android allows the user to specifically choose default applications for certain tasks e.g. the browser. Although there are plenty of third-party browsers available on the iOS App Store to download, links will always open in the default iOS browser, Safari. iOS does not let the user change the default browser away from Safari. Android, on the other hand, allows you to install third-party browsers and set them to default. This allows all links to open in the browser the user chooses and therefore allows them to completely ignore the built-in browser entirely. This kind of functionality is favoured by users and is a reason why Android will win the mobile OS war.

Android is open-source[10]. This means that developers can build on its source code and create modified versions of Android with additional features. Developers start with Android's source code and build on it to create their own community-developed version. These are known as "custom ROMs", which can completely change the look and functionality of the device on which it is installed[11].

iOS is closed-source. Unlike Android, the only people that can change the look and add additional features to iOS are the developers at Apple. While it is possible using Cydia on a jailbroken iOS device[12], it is not recommended by Apple as it comes with increased security risks and possibility of malware.

10 http://source.android.com/source/index.html

11 https://www.howtogeek.com/121374/6-ways-to-customize-android-that-ios-users-can-only-dream-about/

12 http://www.pcworld.com/article/249091/geek_101_what_is_jailbreaking_.html

Security

Security on an operating system is extremely important, especially today as cyberattacks and hacking become more prevalent. Therefore, both Android and iOS have gone to extensive lengths to achieve security on their respective operating systems. However, both have been victim to malware in the past.

In November 2016, a malware called 'Googlian' had infected at least 1.3 million Android devices running Android 4 and 5. As reported by Forbes, "Together, those operating systems account for 74 per cent of Android devices in use today, totalling around 1.03 billion".[13] Android fragmentation meant that most users were still exposed to the malware even after an update patch was released.
iOS is more secure than Android as a result of Apple controlling the hardware, software and firmware on all iOS devices. Although iOS has been subject to malware before, it is very rare and on a small scale in large part due to Apple's strict App Store approval process.

It can be argued that Android has less security due to its open-source nature. There have been countless vulnerabilities found in the OS over the past few years that the public have been made aware of. However, surprisingly the open-source nature of Android benefits it such that when a vulnerability has been detected, it can be easily and quickly patched and an update can then be released. This is not possible on iOS.

The main downfall in Android's security is that Android is extremely fragmented in comparison to iOS. Only 1.2% of all Android devices are running the latest Android 7 compared to 79% of iOS devices running iOS 10[14]. Because of this fragmentation, less users can avail of the latest updates until their device manufacturer releases an update which can take anywhere from days to months. This leaves the devices vulnerable.

Android and iOS are both relatively secure operating systems but iOS is currently superior. However, Android has already been making improvements such as implementing a similar app approval process as Apple's to the Google Play Store to increase security.[15] This will be

[13] https://www.forbes.com/sites/thomasbrewster/2016/11/30/googlian-android-malware-1m-google-account-breaches-check-point-finds/#10f050131ad8

[14] https://www.scmagazineuk.com/fragmentation-nation-only-12-of-android-devices-use-latest-os/article/640080/

[15] http://www.theverge.com/2015/3/17/8231125/android-apps-now-reviewed-by-google

a factor in how Android will win the mobile OS war.

Market Share and Revenue

It is not very surprising that the competition among software companies to have the most dominant operating system for mobile phones has been led by two of the largest multi-national companies in the world, Apple and Google. In 2016 Apple topped Forbes[16] annual market study by showing a market value of approximately $154 billion while Google was the runner-up with a market value of $82 billion, though their revenue isn't as reliant on the mobile industry as Apple's. Apple is able to create such huge revenue by using branding and marketing to command a higher price for their smart phones. Chris Mills of BGR[17] estimates that it costs Apple $200 to produce each iPhone which is usually sold for three times that cost.

However, in terms of market share it is actually Google's Android OS that dominants over Apple's iOS. In an article in The Telegraph[18] newspaper in Britain it was reported that Andoid held around 75% and 65% of the mobile market in Europe and the United States respectively. This trumps the 20% share that Apple holds in the market. Android's dominance over Apple is a result of the open-source nature of the platform. The Android OS is used by both premium smartphone companies like Samsung and HTC as well as low cost phone brands like Alcatel. This range of options for consumers led to a 7% migration rate of former Windows phone users to Android. Apple, meanwhile, not only designed the iOS system as a closed-source exclusive to their phones, but they only produce premium standard phone's with the cheapest iPhone model available on their website being the iPhone SE[19] which would cost consumers €500.

Although, it is in this market that Apple is able to dominate over their Android based competitors. By the end of 2016, it was reported[14] that Apple sold over 70% of phones in the premium smartphone market compared to the 17% sold by their nearest competitors Samsung. Apple consumers also show a more substantial interest in new iterations of the iOS system than Android users have in their updates. Following the release of iOS 10, Business Insider[20] reported that 34% of Apple users had updated their devices to the new version of the operating system, while 0.1% of Android were on the newest Android OS version known as Nougat. In fact, the most popular iteration of the Android system is the Lollipop version that was released in 2014 and is used by 35% of its users, closely followed

16 https://www.forbes.com/sites/kurtbadenhausen/2016/05/11/the-worlds-most-valuable-brands/#16155b5436ec

17 http://bgr.com/2017/02/03/apple-vs-samsung-sales-2016/

18 Williams, Rhiannon, "Android roars back in strongest growth in two years, as iOS shrinks", The Telegraph, 17th May 2016

19 http://www.apple.com/ie/shop/buy-iphone/iphone-se

20 http://uk.businessinsider.com/ios-vs-android-device-share-chart-2016-9?r=US&IR=T

by the KitKat iteration from 2013 with 27 per cent.

As for software developers, while it seems that they prefer to develop applications for Android, they earn more revenue through developing for iOS. Android Authority[21] reported in 2015 that Android's Google Play Store had 1.4 million apps available to download compared to 1.2 million on the Apple App Store. Android users also download 70% more apps than iOS users. Developers prefer Android as it can be developed for on any PC operating system while a Mac is required for iOS development. With that said, the majority of apps on Android[22] have options for producing sales revenue as only 196,000 apps on Android have a download price and less than 110,000 free apps have in-app purchases. The App Store[23], on the other hand, produces 75% more revenue than the Google Play Store with $1 billion in revenue being produced in December 2016 alone.

In conclusion, Android's user, manufacturer and developer friendly structure has allowed them to dominate the mobile market with a high amount of phone options & application supply to suit consumers with any kind of income. But it is Apple that is able to make the most revenue in the mobile market by selling expensive devices at an inexpensive cost to consumers that are loyal to their brand and that are willing to spend more money on phones and applications than their Android counterparts.

Conclusion

In the past ten years or so, smartphones have gone from being somewhat popular to being an absolute essential device. Most people can now work or study from their handheld screens. In fact it is actually hard for a lot of people to refrain from checking their mobile phones for even small periods of time. They allow us to communicate instantly from anywhere in the world, watch the latest film on demand or get directions to the nearest restaurant. "Mobile devices have already outpaced the majority of media we rely on every day, including computers. Today, more people access the Web via a mobile device than via a computer"[24]. This means that the big companies such as Apple or Google need to shift a lot of focus onto the mobile operating system war as the operating system on these mobile devices is a crucial factor people must consider when buying a new smartphone.

Tablet computers are another example of mobile devices that have surged in popularity over the past ten years or so. When the Apple iPad was released in 2010, it revolutionised the tablet computer industry. It was extremely popular and came followed by tablet computers of other companies such as Samsung, Lenovo and HP. This gave iOS the head start when it came to mobile operating systems on tablets and they still remain the lead selling tablet manufacturers. Having said that, smartphones are still the more popular mobile device and the margin is widening. As tablets become less popular over time, we believe that Android will continue to be the triumphant mobile operating system.

This project was written collectively by George Chelaru, Dermot Fields, Kieran Flynn, Sam O'Leary and Shane Clare. In terms of collaboration, we met several times after the group

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21 http://www.androidauthority.com/google-play-store-vs-the-apple-app-store-601836/

22 http://bgr.com/2016/07/20/ios-vs-android-developers-profits-app-store-google-play/

23 https://9to5mac.com/2016/01/20/app-store-ios-downloads-vs-android-revenue/

24 Brian Fling/Steven Weiss, *Mobile Design and Development,* O'Reilly Media 2009, Chapter 3, <https://www.safaribooksonline.com/library/view/mobile-design-and/9780596806231/ch03.html> [16-03-2017]

was formed to decide which question we would answer and what we would discuss in the answer. We split the work into sections and assigned each section to a group member. We created a Google Doc and shared it between all of us so that we could review each other's work as we went along to stay coherent and spell check. When the document was complete we all reviewed it to give it the ok to submit.

Footnotes number 18 and 24 are the two non-internet references, from an article and a book respectively.

The following is a list of what work each group member did:

George Chelaru: OS Features
Dermot Fields: History of Mobile OS
Kieran Flynn: Market Share and Revenue
Sam O'Leary: Hardware
Shane Clare: Introduction, Conclusion