Mobile application stores: success factors, existing approaches and future developments

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Abstract

The mobile user experience has been significantly altered with the arrival of mobile broadband widespread deployments, massive improvements in available smartphones, and a shift in user habits towards a more participative, communicative role. In this context, Mobile Application Stores have revolutionized software and content delivery. These stores focus on the applications, building around them an ecosystem of developers and consumers. The store greatly lessens the barrier between these agents, providing significant benefits to both developers and consumers. In this article we analyze this phenomenon, describing its originating factors and fundamental characteristics. We also perform a more detailed study on the two most successful application stores, identifying different approaches for implementing the model.

Introduction

Smartphones have revolutionized mobile phone users experience, thanks to several key technological advances. The deployment of 3G and 4G networks has considerably improved the available mobile bandwidth, enabling the provisioning of content and services powered by the cloud computing infrastructure. In parallel to that, device hardware specifications have improved to the level of personal computers, along with drastic interface improvements and usability enhancements.

Additionally, user habits are shifting from mere consumers to a more participative model. User-generated content is a reality that is fostered by the hardware and network characteristics of these devices. Current-generation phones are equipped with the tools for generating content (e.g. through the installed cameras), as well as the capability to publish it immediately, from anywhere. This has been further promoted by the explosion of social networks, which are a natural match to the personal and mobility characteristics of these devices.

These factors have been leveraged by new players in the mobile ecosystem, resulting in the Mobile Application Store model for content and applications delivery. This signifies a paradigm shift in the mobile landscape, enjoying tremendous success and being currently the model to aim for every remaining player. For the year 2012 reports forecast 15 billion dollars revenue from mobile application stores[1].

In this article we present the main characteristics of Mobile Application Stores. We focus our analysis in two successful stores with different approaches: Apple AppStore for iOS and Google Play (formerly known as Android Market). We first describe the common characteristics of these solutions, identifying the key success factors of these platforms, and outlining the

fundamental value network of this model. Additionally, we compare side by side their differences, as they constitute two different approaches to the ecosystem as regards control and innovation.

The Mobile Application Store

Mobile Application Stores have revolutionized the landscape of mobile applications and services. However, they are not the first attempt at mobile content provisioning. The most important precedent is the Japanese semi-walled garden I-Mode [2], launched in 1999. This model achieved significant local success, but could not be translated to the rest of the world.

This section presents a general overview of the Mobile Application Store model. First we present the technological and social changes over the latest years that have enabled the success of this approach. Once the context has been clearly explained we describe the market through a characterization of the underlying value network, and finally we present the key innovations that have nurtured the ecosystem.

Mobile Application Store Enabling Factors

Over the latest years, technological advances and social changes have modified many aspects of our lives. They have dramatically altered what we can do with mobile communications, as well as what we want to do with them. These factors are fundamental for understanding the success of the Mobile Application Store model.

From the network side, standardization bodies have followed an active roadmap in the definition of mobile communication standards (going from 3G to 4G), that raise the level of mobile connections to wired network broadband standards. These specifications are being deployed by telecommunications operators, as data traffic has become the only way to maintain or increase revenue [3]. These important investments in infrastructure make the mobile Internet a reality, providing an affordable mobile connection comparable to home broadband, barring congestion limitations.

In parallel to the evolution in wireless communications, the capabilities of end user devices are improving significantly. Current-generation smartphones have significantly improved hardware specifications (up to four 1.5 GHz processing cores, 1GB of RAM, plus a dedicated GPU), and are equipped with multiple sensor and actuator interfaces (GPS, camera, accelerometers, capacitive multi-touch screens, multi wireless communication interfaces) [4]. Those hardware enhancements are seamlessly integrated into mature multi-touch user interfaces, fundamentally altering the user experience.

In addition to these changes, the role of users has been altered significantly. Traditionally users were passive consumers of information and content. Nowadays, they play a more active role as prosumers. User-generated content [5] is a reality, thanks to the availability of simple content creation and publication platforms. Audiovisual and journalist content is created by the users, providing huge value to the available platforms for a very small cost. This change of role has been promoted by the arrival of social networks. These communities allow users to communicate, interact, and share through a self-contained platform. Their acceptance has been overwhelming, partially cornering the traditional Web vision [6].

The Mobile Application Store Value Network

The initial business model for mobile content was based on the semi-walled garden concept, where the operator exercised complete control of the value chain. This has been significantly altered with Mobile Application Stores, which create an open environment. The number of

actors is significantly larger, and the established relationships are more complex. Consequently, traditional value chains are not useful for analyzing this model. Instead, we present a value network analysis, where we identify the key functions and relationships that provide value to the ecosystem [7]. Figure 1 shows the main functions of the ecosystem. The relationships between them show value or information exchange. The three central pieces of the business model behind mobile applications (provider, store, and consumer) are highlighted in a clearer note.

The value of the store is proportional to the contained applications. An enormous variety of assets is offered through this mechanism, ranging from native applications, access channels to subscribed Internet services, consumable content, or device-enhancing software. Current stores are generalist, offering both professional and leisure-related content and applications. Applications cover a wide spectrum of interests, including games, social network access, news, weather, productivity, and health.

Figure 1 The Mobile Application Store Value Network

The left-most function is the supplier to the ecosystem, the **application provider**. This function is key for the success of this model, as it fills the market with applications to be acquired. This is fostered by imposing a low entry barrier to developers. Multiple profiles of application providers coexist, ranging from amateur developers to large enterprises. These actors provide applications, which are defined as native, installable pieces of software, developed using the platform APIs and guidelines, and provisioned through the market.

The producer role is supported by two additional functions. First, mature **creation tools** are necessary, as they enable a productive development process for applications at the targeted platform, as well as support channels for addressing the technical difficulties. Additionally, the always connected nature of the devices becomes a differential factor for many developed applications, as they can rely on content and services hosted at a remote infrastructure (e.g. cloud computing). Therefore, many developed applications rely on a **remote services provider**, which can be the same actor providing the application or a different one in charge of providing support (e.g. online leaderboard services for games). Cloud computing has become a fundamental factor for the success of many applications, as it extends the possibilities of these applications, while at the same time reducing computing costs in centralized servers [8].

On the other end of the value network resides the **consumer** (the end user). S/he accesses the store and consumes the developed applications. In this model this role becomes the center of the ecosystem, interacting with many agents that were previously oblivious.

Mobile applications reach the consumer through a technological framework. The importance of these elements has diminished, as the value now passes through them. The framework is composed by a hardware **device**, installed with the software **platform** (operating system and base services) that can execute the applications and access the store. Additionally, the device needs a mobile or local wireless **network** connection, provided by the telecommunications operator, in order to access the store and the services.

The third main function in this ecosystem is the **mobile applications store**. This function combines the traditional roles of content aggregator and distributor. The store constitutes a direct link between developers and consumers, significantly reducing the barriers between them, as both interact directly with it. From the developer's perspective, the application store provides added value through an integrated **billing** function. This factor lowers the entry barrier for small developers and contributes to creating a rich ecosystem. There is room for different billing providers than the one with the store, but the store always acts as mediator (collaborating with the specific agents).

In principle, the application store is an open market, where every competitor has equal chances to succeed. However, it must be noted that active markets are enormously competitive, with tens of thousands of competing applications. These factors greatly increase the importance of the functions related to **discovery**, **marketing** and **recommendation** of applications (e.g. professional marketing actions, advertising strategies and user opinions), as they play a fundamental role in application success. It must be noted that the first vehicle for application highlighting and search is the application store itself, but there is plenty of room for additional actors providing more complete functions that are able to match consumers with desirable pplications.

Finally, although it is difficult to classify as a single function, the **social network** is a very relevant factor in the ecosystem. The social network connects the application consumers, as well as the developers. Their communication mechanisms are fundamental for the marketing and recommendation functions (e.g. publishing 'achievements' from a game into the consumer social network, or having a direct means of contact with application developers through their social network accounts), as well as for allowing developers to interact directly with the potential consumers.

Success Factors for the Mobile Application Store

A key factor for a successful content provisioning platform is creating a positive feedback loop between content providers and consumers [9]. Content determines the value of the platform. As more consumers adopt the platform, the larger the potential consumer base becomes for provided content. This in turn increases platform value, fostering the growth of the consumer base. The key innovations of the Mobile Application Store model have been designed to take advantage of this loop, attempting to benefit application providers and consumers.

Most innovations are targeted at lowering the entry barrier for application producers. Development tools are affordable and high-quality, and licensing costs to publish applications to the market are very reduced. This is complemented with high-level programming languages and developer-friendly APIs, exposing the capabilities of these new devices while providing an abstraction layer over low-level, hardware-related concerns.

Additionally, the platform provides ready to use services and interfaces for advertising, security, cloud storage, or push mechanisms. The publication process is open to every developer and more streamlined, resulting in much lower time-to-market. Moreover, full application lifecycle management is provided by the platform, including automatic update notifications for consumers and smooth management interfaces.

Finally, the revenue sharing approach is very attractive for developers (with their share being generally 70% of the benefits, even more in some stores), and is automatically managed by the store through the billing service (greatly helping small developers, and handling regional regulations, such as tax management).

In principle there is no discrimination between great companies and independent developers, although in practice larger entities have better tools to prosper a competitive market. Nonetheless, the store is a natural fit for the long tail business model [10], enabling niche developers to push and succeed in the commercialization of innovative, specific products.

Developer diversity has also been motivated by the rise of multiple business models that complement traditional purchases [11]. Free to download applications generate an economic profit through a variety of mechanisms, including in-app purchases (also known as microtransactions), integration with advertising mobile platforms and periodic subscription models for content access. Moreover, applications are increasingly developed for intangible

benefits: as a means of advertising for a company, as a support element for an associated premium event (e.g. a music festival), or as an access mechanism for a subscription service, enhancing its perceived value (e.g. allowing access to a music or video service anywhere).

From the consumer perspective, the changes presented in this model improve the user experience for the market browsing and purchasing process. The store can be accessed through the same device that will execute the applications (as well as from external devices such as computers), providing a simple interface for browsing the store, searching for specific applications, paying and accessing them instantly. Additionally, the positive feedback loop provides an ever-increasing catalogue of elements, and enables an affordable pricing model, as well as alternate means to monetize apps (such as ad-sponsored, or freemium).

Comparative Analysis of AppStore and Android Market

Up to this point we have presented the main elements of the Mobile Application Store model. Apple defined most of these innovations with the launch of the AppStore in July 2008. The translation of the iTunes music delivery model to applications and services for IPhone devices supposed a tremendous success. Less than four years later (March 2012), the AppStore hosts more than 600000 applications, and total downloads surpass 25 billion. Although the proposed value network displaces telecommunications operators from the central role, they report increased profits from these users (60% higher ARPU in the case of AT&T). This is originated by the traffic generated by application downloads, as well as by the traffic generated by using the applications for accessing content and cloud services.

Following the success of Apple, each relevant company in the mobile ecosystem has attempted to replicate their model. This way, platform developers, device manufacturers (e.g. Samsung Application Store for Bada) and telecommunications operators (Vodafone 360 AppStore) have launched their own Mobile Application Stores. However, it is still premature to determine which of them become successful (gathering a critical mass of developers and consumers). At this time only Google Android (and its associated store, Google Play), can be classified as a successful positive feedback loop, when comparing rate of growth of applications and rate of selling devices [12]. Android is an open source mobile operating system developed by Google, and supported by the Open Handset Alliance, an association of more than 20 mobile hardware manufacturers. After a slow start, Google Play has gathered 450000[1] applications since its launch in October 2008, as it can be seen at Fig. 2[1].

[1] AppStore and Android Market apps figures taken from official Apple and Google reports and statements

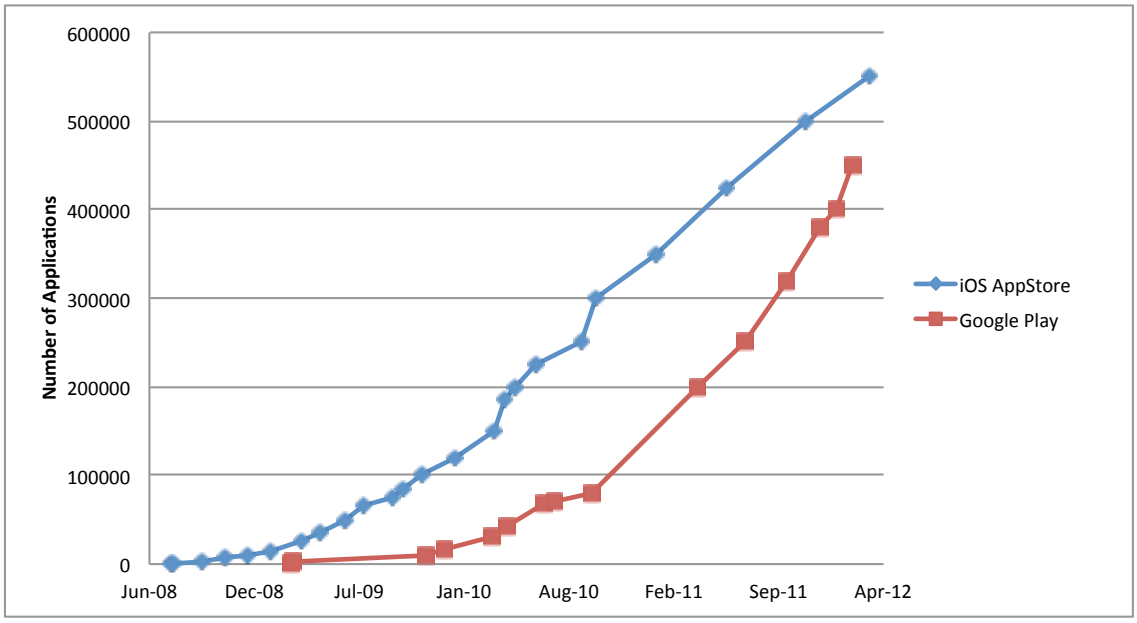

Figure 2 Evolution of Apple AppStore and Google Play available applications[1]

For obtaining additional insight on the Mobile Application Store phenomenon we will analyze these two initiatives. The AppStore is the main exponent of this model, being the original implementation, as well as currently the largest ecosystem in number of applications and economic value. Android has experienced tremendous growth rates over the last three years, becoming currently the fastest growing mobile smartphone platform, with more than 850000 devices activated daily worldwide in February 2012.

While these two platforms follow the same fundamental principles (explained in the previous section), in some aspects they apply opposite approaches. The AppStore follows a closed model. Apple controls the device specification, platform and store, and exercises limited control over the available applications in the market in order to preserve the end user experience. On the other hand, Android is aligned with the open mobile innovation principles [13]. Platform development follows an open source, collaborative effort, and applications have fewer restrictions to join the ecosystem. The following table provides an overview of the main differences found between these two initiatives.

Criteria	***Apple AppStore***	***Android Market***
Platform (OS)	iOS	Android OS
Platform source code license	Propietary	Open Source
Licensing costs	99$ Yearly	20$ once fee
Revenue share	70% Developers 30% Apple	70% Developers 30% Google / Telco carriers
Billing Mechanisms	ITunes	Google Checkout Carrier Billing
Refund policy	Not allowed	Users can return any application over the 15 minutes after the purchase
Development	Attempted to limit	Available open source development

restrictions	development tools and programming languages. Restriction relaxed in June 2010	tools. Freedom to choose any development tool, programming language or framework.
Application submission restrictions	Review guidelines discourage submission of amateur, unpolished applications	No restrictions. End-User Programming is enabled through Google AppInventor
Development tools	Closed IDE for specific OS (XCode), and additional supporting tools	Open Source reference tools (Eclipse-based). Freedom for different approaches
Approval Process	Internally managed Restrictive criteria Pessimistic publication	Crowdsourced Permissive criteria Optimistic publication
Typical Approval Time	One week	Almost Instantaneous
Partnered Telco Operators	Initially one per country, open to all since July 2010	Every major operator (with some devices sold exclusively)
Main Programming Language	Objective C	Java
Device vendors supporting the platform	Apple	Open Handset Alliance (20 members including Samsung, HTC, and Motorola)
Device models	IPhone (2G, 3G, 3GS, 4, 4S), IPod Touch (4 editions) IPad (3 editions)	>200 (midrange and high-end smartphones, tablets)
Hardware heterogeneity	Fixed platform with yearly device upgrades	Minimum set of capabilities but large flexibility for device manufacturers (e.g. physical keyboard or not, multiple screen size and resolutions, touch control technology)
Platform customizability	Disallowed. Applications overlapping existing functionality are rejected	Base platform functions (e.g. keyboard, authentication), can be replaced by market applications
Application Install sources	Exclusively the AppStore	Google Play, alternate markets (e.g. Amazon Appstore), apk files
Look and feel	Homogeneous (safeguarded by by approval criteria, device characteristics)	Large diversity in hardware and software user interface. Point of vendor differentiation. Danger of fragmentation

Table 1 Apple AppStore and Google Play Differences

These differences clearly reflect the philosophy behind each platform. While being considerably more open than the semi-walled garden, the AppStore model controls the central elements of the value network (Store, Device, Platform, initially the network). Developers have to follow stricter acceptance requirements, also restricting what type of applications can be published. This enforces minimum quality levels for the available applications, as well a homogeneous end user experience.

On the other hand, Google Play model follows a more open approach, with considerably less restrictions and more diversity for every function of the ecosystem. This approach attempts to benefit from the force of the crowd in every aspect: hardware manufacturers support the

platform with a wide variety of devices, the open source nature of the project allows its rapid evolution, as bug fixes and improvements are committed by third parties, and a non-restrictive publication policy for Google Play fosters the influx of applications, enriching the ecosystem. However, platform diversity can lead to its fragmentation, increasing developer effort when compared to a more homogeneous platform. Additionally, there is the risk that alternative appstores (such as Amazon AppStore, and the Kindle Fire) can segregate from the Google ecosystem.

A significant number of these differences are related to the process of publishing applications to the market. Unlike previous models, the AppStore is open to any licensed developer, but it imposes restrictions to applications before they can be published to the market. These requirements include legal aspects (e.g. copyright restrictions), thematic limitations, and platform homogeneity enforcement, mandating that approved applications follow every style guideline, and do not replace any functionality. On the other hand, Google Play restrictions are limited to the legal aspects. These differences cause that the time to market for applications submitted to Google Play is almost instantaneous (since the moment the developer submits a publish request), whereas in comparison the review time for AppStore submissions takes several days. In order to better describe both approaches we present in Figure 3 two state diagrams with the current approval and publication processes for the two platforms.

Figure 3 AppStore and Google Play Approval Processes

The left-hand side of the picture shows the AppStore approval and review process. While the entrance to the process is open to everybody, there are multiple controls and filters before approving applications for sale at the store. Apple manually inspects every submission, applying its defined review criteria. The review can either approve its release to the market, or reject the application, including in this case the rationale for the decision. In this case, the developer can develop a new version, addressing Apple's objections, and submit it again to the process. Since its inception, this process has been internally optimized and clarified, in order to address the complaints about lack of transparency and excessive review time. As an example, since September 2010, the list of review criteria is public, allowing developers to preemptively address most of the concerns.

On the other hand, Google Play approval process follows an optimistic approach. Submitted applications are automatically checked (for security concerns) and are immediately published to the market. The acceptance criteria are checked through crowdsourcing. Developers are liable for the submitted applications, and users detect and report unacceptable applications. After sufficient reports are raised, the suspicious application is inspected by Google, removing it if the reviews are founded. Malicious applications can be detected by users before any installation, as the OS shows the user what services and permissions will it use from the phone (e.g. accessing the camera, Internet connection, location information or performing calls). However, this approach brings additional risks, as it can be hard to understand the impact on battery consumption, mobile data, or privacy implied by the requested permissions

The differences between both approaches are clearly seen. The AppStore model exercises a stronger control, which is supported by the power of its brand, as well as its status as the larger and most mature application ecosystem. Google Play approach is riskier, facing dangers such as increased application piracy, potential fragmentation of the ecosystem due to the heterogeneity in devices, or a flood of low quality applications that ruin the user experience. However their adoption of the open mobile innovation paradigm enables faster evolution[13], allowing it to complete against a more established platform. Hardware-wise, the diversity in devices opens up the range of potential customers. Regarding software, there are many

applications that could not be approved under the AppStore, because their innovations compete with the core platform services, that can bring additional value to the ecosystem (e.g. innovative keyboard input methods, or window management systems).

According to app developer surveys [13], the Google Play approval process is more popular. However, we believe that consumer trust towards the individual applications from the platform is influenced by the approval process, and consequently the willingness of users to pay. AppStore's initial control protects against malicious apps, whereas Android users have to assess the trustworthiness of each application and developer. While trust is not the only factor, the majority of applications is free in the Android market (65%) whereas the same percentage represents paid applications in the AppStore[2]. On the other hand, one of the fastest growing alternative Android stores, the Amazon AppStore, has a percentage of paid applications similar to Apple AppStore.

These processes are continuously evolving in order to adapt to changes in the ecosystem as well as to react to competitors. AppStore requirements were less strict when the market was less mature, and turned progressively more restrictive. However, recently Apple has slightly opened its policy (e.g. relaxing restrictions on what programming languages are apps developed with) because of the competition. On the other hand, Google Play is favoring developers with new measures (harsher return policy, authentication services for piracy-fighting - which is substantially easier on a more open platform), and improvements of the consumer store experience.

The difference in approaches can also be seen when analyzing how both platforms nurtured a critical mass of applications, initiating the positive feedback loop. The AppStore attracted from its inception considerable developer interest, thanks to the combination of an initial installed base of several million devices, and an application model with considerable benefits for the developers. In the case of Google Play, a critical mass of applications was gathered by a combination of incentives. First, as it has been discussed they initially embraced an open platform model to attract developers, including open source development tools. The install base was also fostered by offering a wider arrange of Android devices, as well as freedom to select the mobile operator and data plan when compared to the initial iPhone restrictions. Additionally, they provided high-quality versions of the leading Google services (e.g. mail and maps) as Android applications, with features not available in competing platforms, such as GPS navigation. Finally, they organized application developer contests (with two editions of the Android Developer's Challenge), with important monetary prizes that populated the ecosystem with a large number of free applications.

Discussion

We have presented in this article the Mobile Application Store model, and its main two implementations. Both are linked to a development platform, namely the iOS and the Android operating systems, competing directly with the remaining platforms: Symbian, Windows Mobile 7, and Blackberry. In this market, application stores have become a fundamental factor for their success or failure. Therefore, the concepts described in this article can also be applied to these initiatives. As an example, we have presented the approach followed by Google for attracting developers to the store and platform. In order to nurture their ecosystems, competing application stores must find a way to bring that value to their platforms. However, the need for gathering a minimum amount of applications and consumers limits the number of potentially successful initiatives.

[2] Statistics taken from Distimo's Application Store Reports

The nature of a successful Application Store ecosystem depends on a complex combination of multiple factors (trust, brand, platform services, user profile, supported devices). We believe that the decisions on how to implement the Application Store model have a significant impact in the resulting ecosystem. Both analyzed approaches have created a positive feedback loop, but the economic nature of each ecosystem differs significantly (in this case, with the Apple Appstore being more satisfactory revenue–wise for developers [13]). As an example of those differences, several top applications in both systems pursue different monetization strategies (as an example, Angry Birds is a premium app in the Apple Appstore while it is ad-supported in Google Play).

Another relevant question is about whether there is room for specialized application stores in addition to generalist stores. As the number of application keeps growing, finding quality applications and offering them to potentially interested users becomes a major challenge. A potential way of addressing this problem is to segregate specialist stores, offering professional applications for a sector, a specific age sector, or tailored for a local region. The general long tail principle that powers the applications can be applied to the store itself - as long as a critical mass of interested consumers can be gathered.

We have limited this study to Mobile Application Stores. However, there are other successful applications of this model: The market tablet is the best known example, but also digital game distribution for consoles and PC platforms follow similar principles and have recently experienced considerable growth. This has motivated multiple attempts to replicate this model in additional domains and markets. There are ongoing initiatives to create application stores for operating systems, web applications, television systems, or vehicle systems. This expansion of the model raises additional questions, such as the relationship between the life cycle of the developed applications and the execution platforms. Different device types show different usage habits and favor different types of applications, raising some concerns about the convenience of a unified store.

In summary, the model benefits providers, and it is simpler and more limited for the users, at the same time improving user experience. Consequently, as long users keep demanding this model, it can be successfully extended to additional domains and device types, where the possibility to create an ecosystem exists.

When analyzing the impact of the Mobile Application Store model to existing stakeholders, telecommunications operators have been affected the most. Their controlled semi-walled gardens did not create a thriving content and applications ecosystem, and have been completely replaced by application stores. Today, operators face the risk of becoming a mere connection pipe for transferring value from developers to customers, without receiving additional benefit from it. Additionally, the forecasts for required bandwidth usage point to an enormous increase in demand, due to the expected growth in the smartphone installed base. On the one hand, this can lead to a revenues increase, but on the other hand it forces them to invest heavily in infrastructure, as currently they are facing some congestion problems. With these perspectives in mind, operators are already moving across the value network. WAC (Wholesale Applications Community) [14] is a consortium lead by the main operators, which is looking to provide their own alternative to the application store model based on Web standards. However, it is unclear what value can they provide when compared with the current solutions. Nonetheless, even in the current model it seems carriers can also benefit from part of the business. In addition to traffic-generated revenue, the Android Market and other application stores (such as Nokia's OVI Store) provide the option of carrier-based billing. This privileged position of the operators can get them a share of the benefits.

Over this analysis we have identified system openness as a fundamental factor to separate from previous models, and even to differentiate between competing platforms. Clearly the

general tendency leads towards a more open model and more freedom for the users, although the interest of the intermediate agents in the value network pushes towards the opposite direction. In this struggle, the role of public authorities can be decisive, as they are currently debating how acceptable closed systems are. As an example, the American Copyright Office has acknowledged [15] the right to "jailbreak" mobile phones (for installing applications from different sources), which goes against the total control policy promoted by Apple and several Android device manufacturers (e.g. Motorola, HTC) that have installed in the past mechanisms to prevent custom versions of the operating system to be loaded.

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Bibliography

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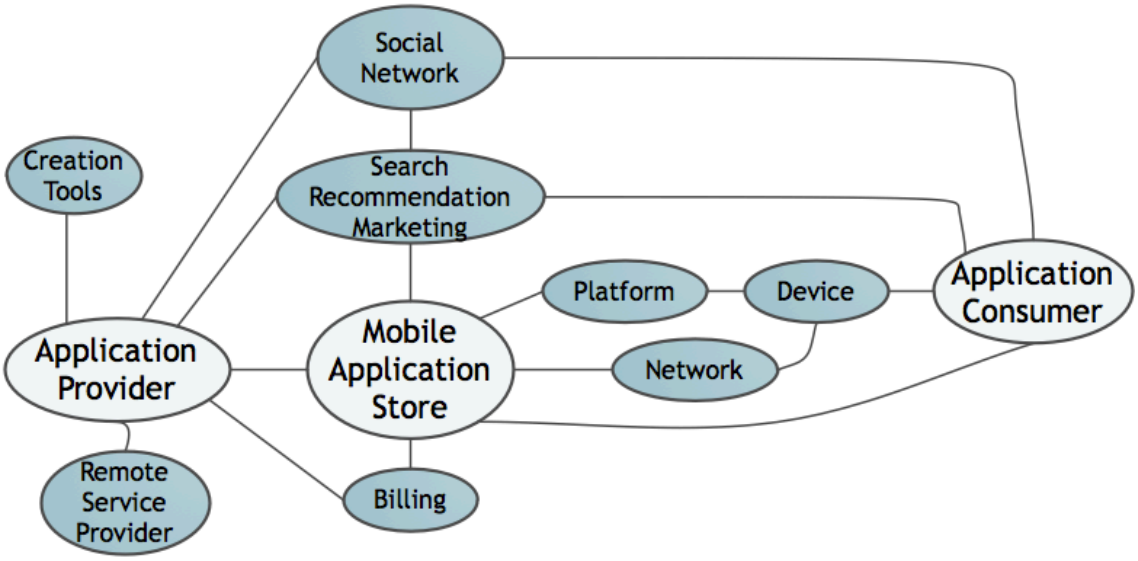


Figure 1 The Mobile Application Store Value Network

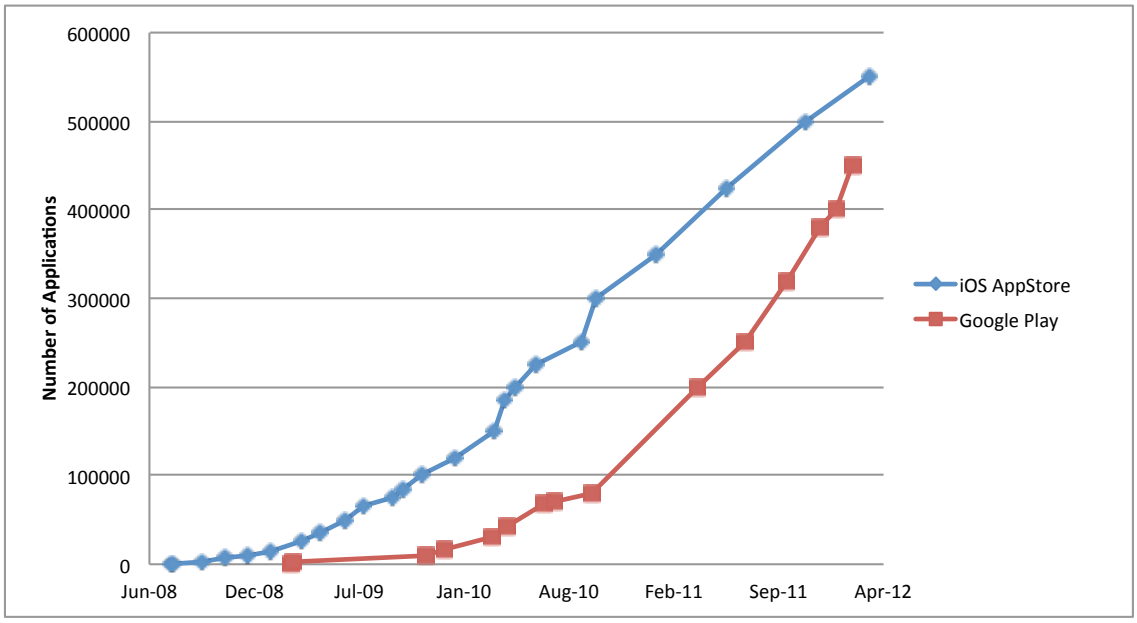
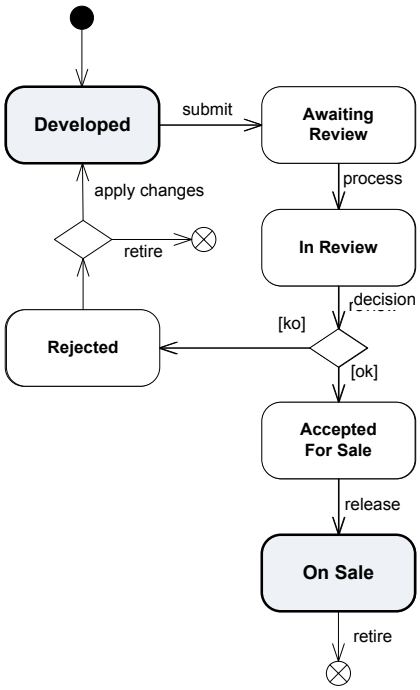


Figure 2 Evolution of Apple AppStore and Google Play available applications[1]

AppStore Approval and Review process



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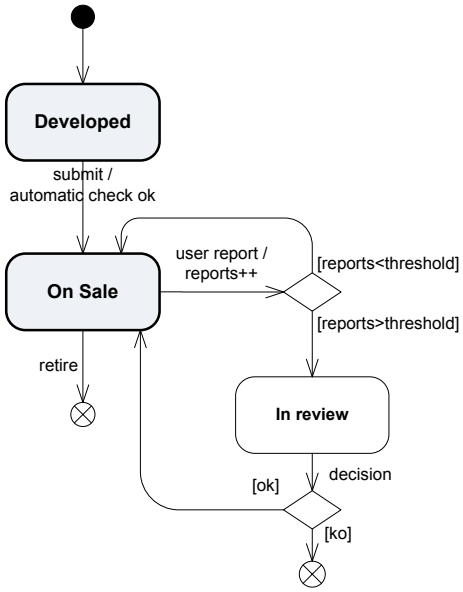

Figure 3 AppStore and Google Play Approval Processes