2011
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BEDRIJFSECONOMISCHE WETENSCHAPPEN

master in de toegepaste economische wetenschappen: handelsingenieur: technologie-, innovatie- en milieumanagement

Masterproef

Strategic analysis of the smartphone market

Promotor :
Prof. dr. Wim VANHAVERBEKE

Jo Swenters

Masterproef voorgedragen tot het bekomen van de graad van master in de toegepaste economische wetenschappen: handelsingenieur , afstudeerrichting technologie-, innovatie- en milieumanagement

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1 Foreword

As part of the education Applied Economical Sciences: Commercial Engineer, I am proud to present my masters' thesis, titled "Uncovering the smartphone market: A market analysis".

First off, I would like to thank my promoter prof. dr. Wim Vanhaverbeke for granting me the opportunity to write this thesis. I have gained insight into modern, complex markets that I would have never had, if it wasn't for this thesis. I am certain this will be an asset to my future undertakings and career. Therefore, I want to thank him for his trust and patience.

Further, I want to thank the people that supported me during this period. In particular: Lore Peeters, Kurt Verstegen, Dries Schreurs, Sepp Tilkens and Christijn VanMol for their valuable feedback and useful opinions. My parents: Marleen Geebelen and Ivo Swenters, for giving me a chance to study at the University of Hasselt.

I wish you a good time reading this master thesis and I hope some of the information can be put to good use.

2 Summary

By 2013, worldwide shipments of converged mobile devices, also known as smartphones, will surpass 390 million units, growing at a compound annual growth rate (CAGR) of 20.9% for the 2009–2013 forecast period. Underpinning the converged mobile device market is the constantly shifting mobile operating system (OS) landscape. In a market that was once dominated by a handful of pioneers, such as BlackBerry, Symbian, and Windows Mobile, newcomers touting open standards (Android) and intuitive design and navigation (Mac OS X) have garnered strong end-user and handset vendor interest. With yearly double digit growth rates since Apple's iPhone redefined the market, smartphones are taking over the overall mobile phone market.

Dealing with a fast changing market landscape, that involves numerous interconnected players and increasing returns, static methods have a hard time to comprehend the full extent of the present market dynamics.

This master's thesis is an attempt to offer a complementary knowledge-basis. It is a more dynamic approach to analyzing the smartphone market. It wants to provide stakeholders with a better understanding of the current events allowing them to make better advised decisions by pursuing the objectives mentioned hereafter.

- The master's thesis provides a thorough understanding of the elements that give direction to the mobile operating system standard war.
- The master's thesis provides a clear view on the positions of the most relevant operating system variations and their main sponsors relative to becoming the technological standard.

The thesis is divided in two parts. The first part is a study of relevant literature that identifies the present market drivers and most important strategic decisions. The second part, applies the acquired insights to the current market situation. The reader will have a clear outline of OS sponsor strategies, their weaknesses, strengths, threats and opportunities.

An operating system is defined as a platform. It creates value by linking device manufacturers, customers, application developers and telecom operators. It is also software, meaning that sponsors face high upfront development cost and very low, marginal production costs. Sponsors are active on a multisided market

that features strong, positive network effects between users and application developers. The ability to impose switching costs on platform members, and to set different pricing structures across member groups are important strategic tools to draw platform members.

Strong network effects supplemented with a high fixed/low variable cost structure, can lead to increasing returns. In a maturing market, a platform offers insurmountable value to members once it gains a competitive advantage that is based on the number of platform members. This value rises whenever new members join, encouraging early market competition.

Early market competition leads to insecurity. Members do not want to commit themselves to a worthless platform. Members need to be convinced that a platform will deliver a high future value, while ensuring their future freedom. Thus, a sponsor has to decide upon the compatibility and openness of its platform. A highly compatible and open platform will generate much value and lowers the risk for potential members. It will be harder for a platform sponsor to extract this value. Open and compatible platforms can attract members easily, but compromise profitability. Special attention is devoted to open source software, because it features a number a unique benefits and challenges.

Based on their strategic profiles, sponsors then decide how they will develop the platform and capture value. By setting a fit governance structure and degree of control, a platform can take advantage of the existing dynamics and create a growing profitable ecosystem that is able to lock-in a market and produce extraordinary profits.

Apple has set up an ecosystem that is fully controlled by Apple. Apple does not seem to pursue a widespread adoption of IOS. It wants to create a very profitable, tightly interconnected, digital environment by offering a range of devices and services that work together seamlessly.

The IOS platform is a crucial part of this plan. Due to their tight ecosystem control, Apple is able to create a profitable platform for application developers and attract a great number of consumers. It does this by successfully facilitating application developers. Apple’s App Store strategy has also created a very profitable user base.

However, Apple appears to be limited by its production and distribution capabilities and in time, if another operating system comes to dominate the entire

mobile phone market, Apple's iOS platform might not seem as profitable as it does now.

Google chases another objective: widespread adoption of mobile internet. They see profitable opportunities in mobile advertisement and attempt to urge mobile internet usage. Google released an open source operating system that can be adopted by every mobile device manufacturer. This strategy allows for a great degree of differentiation and competition, generating various devices at a fast pace. Meanwhile, application developers can serve a large, rapidly expanding market. Google set advantageous terms to recruit numerous and powerful ecosystem members. Thereby, it was able to reduce consumer adoption inertia and expand the market at a fast tempo.

The open structure of the Android platform facilitates fragmentation. Fragmentation complicates every aspect of developing new content and applications, from business model readjustment to testing new products. In order to control project fragmentation, Google does not open many aspects of their governance structure. They provide unequal code access; have no publicly available roadmap or transparency of code contribution processes. These actions compromise Google's commitment to the open source community, and they have the potential to endanger the community's cooperation. Google faces a tricky balancing act, but they are in a beneficial position and, for a large part, they can control their own fate.

Research in Motion is stuck in a negative spiral of lagging market presence and negative expectations. RIM has not been able to transfer its activities successfully from the executive, 'prosumer' market to a mass consumer market. Their absence in the mass consumer markets creates opportunities for competitors to attack their core business of enterprise solutions. RIM's brand loyalty is falling and gradually RIM is losing their competitive edge in the enterprise segment.

They do have a tightly locked-in installed base that buys some time and keeps them alive, pending on highly anticipated new products. These high switching costs make new customers more reluctant to join the BlackBerry platform, but an overwhelming performance of new products might reinvigorate the brand.

Nokia and Microsoft teamed-up recently and face the current market challenges together.

Symbian helped Nokia to establish a smartphone market, and allowed for Nokia to dominate it with their excellent manufacturing capabilities. Symbian could not

transfer Nokia's 1st mover advantage to the mass consumer market and a flawed ecosystem governance structure, prevented Nokia to adequately react on aggressive efforts from Apple and Google.

Microsoft misjudged the future of mobile computing when it first moved to the wireless market. It believed the mobile market would develop from increasingly smaller computers and acted accordingly. Consumers were more interested in enhanced mobile phones than smaller, less capable computers. Microsoft fell behind, struggled to keep up with the competition and developed an incoherent ecosystem. When Apple entered and changed the market rules. It exposed Microsoft's weak ecosystem and showed precisely what applications can mean for a mobile platform. Microsoft was competed into obscurity.

Microsoft and Nokia have the potential to be strong complementary partners. Microsoft brings a competitive operating system with Windows Phone 7 that works well with all windows services and comes with a solid, widespread application development environment. Nokia offers excellent hardware, a global distribution network, a large installed base and excellent mapping services.

Running a solid operating system on qualitative devices and nurturing a vivid platform community are competitive requirements to compete with Google and Apple. Once players comply with these conditions, they can start 'competing' again. Catching up on the established market forces, with all dynamics in play, will be very though. However, the market is still nervous and not yet fully-developed. Single events might still change the entire market landscape. As time passes, these events will have to be increasingly radical and Google's grip on the smartphone market will tighten.

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Introduction

By 2013, worldwide shipments of converged mobile devices, also known as smartphones, will surpass 390 million units, growing at a compound annual growth rate (CAGR) of 20.9% for the 2009–2013 forecast period. Underpinning the converged mobile device market is the constantly shifting mobile operating system (OS) landscape. In a market that was once dominated by a handful of pioneers, such as BlackBerry, Symbian, and Windows Mobile, newcomers touting open standards (Android) and intuitive design and navigation (Mac OS X) have garnered strong end-user and handset vendor interest. With yearly double digit growth rates since Apple's iPhone redefined the market, smartphones are taking over the overall mobile phone market. It is a complicated, fast-growing market that contains great opportunities. These opportunities are accompanied by great risk coming from an emerging standard war between operating systems and are amplified by network externalities that exist within the industry (International Data Corporation, march 2010).

A smartphone is a complex product that is composed of many subsystems linked together (battery, screen, case, CPU, mobile network, Operating System, applications…). Today the most important subsystem is the operating system. Because a smartphone is more complex than a normal cell phone, the linking mechanism gains much importance (Murrman – 1998) and becomes crucial to the smartphone's performance. Mobile operating systems drive smartphone competition. *"Mobile operating systems have become the key ingredient in the highly competitive mobile device market. Although the overall look and feel of the device will still play an important role in the buying process, the wrong choice of operating system coupled with an awkward user interface can mean the difference between success and failure,"* says Stephen D. Drake, vice president, IDC Mobility and Telecom.

Smartphones run a complete operating system that allows users to install advanced applications. The operating systems are fundamentally different with respect to normal cell phone operating systems since they permit third parties to develop and sell applications. Users then choose, buy and install their preferred applications just as they would do on a computer. Applications spectacularly improve connectivity and utility, so in other words, these new operating systems

allow an impressive performance improvement over the prior generation of mobile communication devices. According to Anderson and Tushman (1990) we are dealing with a product discontinue.

Such a discontinuity affects environmental uncertainty, munificence, and organizational growth rates. But more importantly it sets off an era of ferment in a low appropriable industry, during which a dominant design is set. Once a dominant design emerges, future technological progress consists of incremental improvements elaborating the standard. The technological regime becomes more orderly as one OS becomes its standard expression (Anderson & Tushman, 1990) and elevates the industry's efficiency.

A smartphone market can be defined as a platform that encompasses a set of components and rules employed in common in most users' transactions (Boudreau, 2008). The numerous value-adding components and complements bring about a great need for compatibility.

Meanwhile, a smartphone's consumer value is a function of its complements. And market potential for producers of components and complements increases as more consumers adopt a certain platform. Thus, the number of consumers indirectly influences a smartphone's consumer value. Such feedback effects are referred to as network effects.

Since network effects are expected and the smartphone is a platform, there will exist a platform-mediated network composed of users whose transactions are subject to these network effects, along with one or more intermediaries that facilitate users' transactions (Rochet & Tirole, 2003). The Mobile OS provides a crucial part of the interconnectivity between demand-side and supply-side users, and it gains extra importance because of its interface function towards consumers.

Knowing this, and the fact that software is expensive to produce but cheap to reproduce, increasing returns are expected. There is an opportunity to generate huge profits through these increasing returns. Therefore, establishing and controlling this core standard can be of strategic importance and could enhance a firm's performance considerably (Gallagher, 2007).

During the era of ferment the OS will drive the choices made by consumers. A large number of stakeholders from various markets are confronted with several different operating systems and in the absence of a standard, choosing one technology over the other involves substantial risks. When choosing the losing

design, one has to undergo switching costs or forego the benefits of adopting the standard (greater choice of suppliers/clients, price decreases, economies of scale, standard infrastructure...). All of these risks/benefits are amplified by the existence of network externalities and the possibility of a technological lock-in.

The smartphone market is very complex and fast-developing. With numerous players interconnected and with of increasing returns present, theoretical models have a very hard time to predict which design will be dominant and which OS will be the industry standard (Brian, 1989). Standard wars are very sensitive to strategic behavior and random events (Christ and Slovak, 2009; Brian, 1989). It is necessary to respond rapidly to and correct market changes, but market research companies only provide static market forecasts. A more flexible approach is needed in the form a knowledge basis that can help managers and investors understand and effectively evaluate changes in this complex industry.

5 Research Design

5.1 Purpose of research

This master‘s thesis is an attempt to offer such a knowledge-basis by pursuing the objectives mentioned hereafter.

- The master’s thesis provides a clear view on the positions of the most relevant operating system variations and their main sponsors relative to becoming the technological standard;
- The master’s thesis provides a thorough understanding of the elements that give direction to the mobile operating system standard war;
- The master’s thesis helps to interpret and assess implications of significant strategic actions and market events on the market outcome.

5.2 Objects

Each operating system is surrounded by a constellation of firms that sponsors at least one OS. All of them have great strategic interests in their sponsored OS, becoming part of the dominant design. The most relevant operating systems and their main sponsors are:

- Blackberry OS - Research in Motion
- Windows Mobile – Microsoft
- iPhone OS – Apple
- Symbian – Nokia
- Android - Google

These are the operating systems with the largest market shares and best growth perspectives. Symbian is the current market leader. Second is Android OS, followed by iPhone and Research In Motion. Windows Mobile is in fifth place with a decreasing market share. Microsoft and Nokia announced a partnership in order to counter their market share losses[1].

Table 1 Worldwide smartphone sales to end users by operating system in 1Q11 (thousands of units)

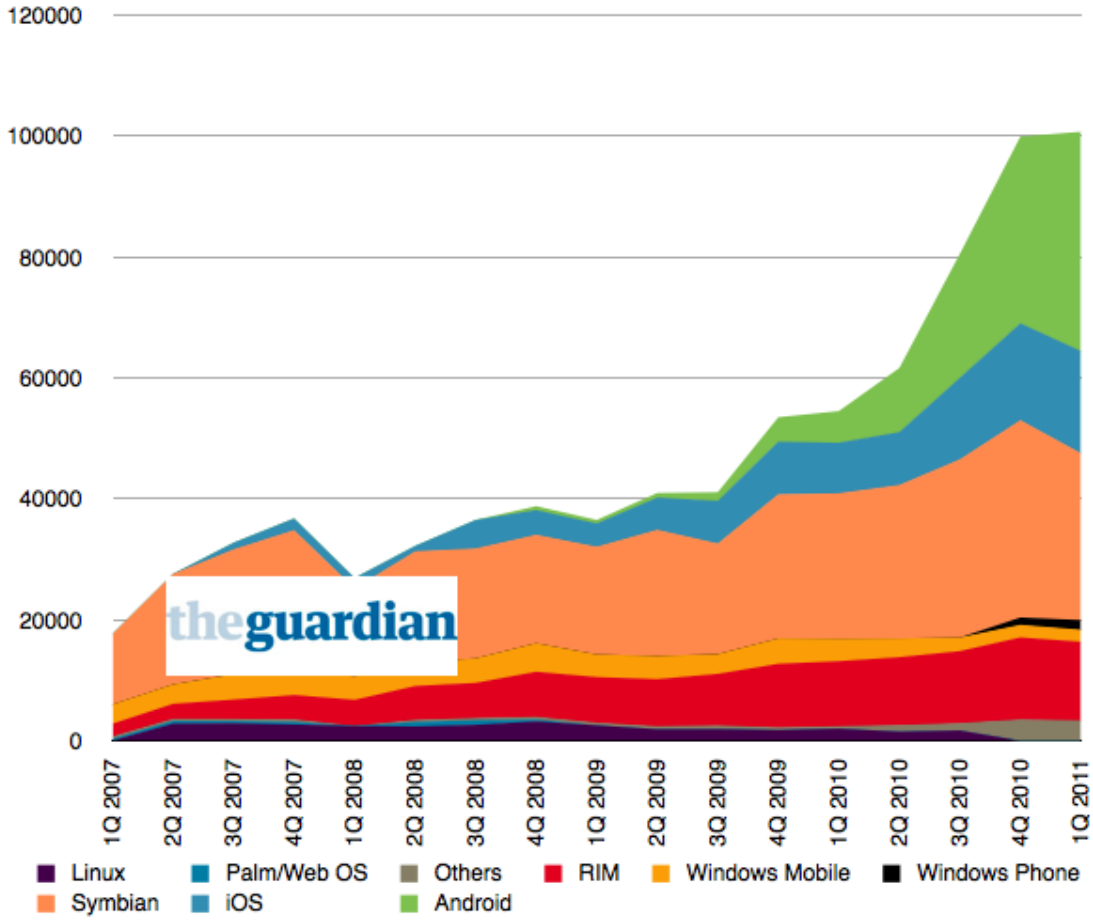
Company	1Q11 Units	1Q11 Market Share (%)	1Q10 Units	1Q10 Market Share (%)
Android	36,267.8	36.0	5,226.6	9.6
Symbian	27,598.5	27.4	24,067.7	44.2
iOS	16,883.2	16.8	8,359.7	15.3
Research In Motion	13,004.0	12.9	10,752.5	19.7
Microsoft	3,658.7	3.6	3,696.2	6.8
Other OS	3,357.2	3.3	2,402.9	4.4
Total	**100,769.3**	**100.0**	**54,505.5**	**100.0**

Source: Gartner (May 2011)

Android has had a late introduction but has performed beyond expectations, rapidly catching up on Nokia's Symbian. However, more recent reports signal an interesting evolution with Android US market share declining slightly, feeding speculation and uncertainty even more[2].

The thesis' proposed definition of *dominant design* played a central role in deciding to use market share as a basis of choice. A dominant design captures more than 50% market share for a significant amount of time when majority customers have entered the market. This definition is based upon 'Anderson & Tushman' (1990) who account a design as dominant when it captures a market share, larger than 50 percent. Van de Kaa et al. (2007) adds 'a significant amount of time' to this definition because market share may change often sometimes and day-to-day fluctuations should be ignored. Finally, it's also important to indicate when this market dominance has to occur. Today Symbian OS is the market leader with a market share of 46,9%. The years before, however, Symbian OS had over 50% of the market for a significant amount of time. But the converged mobile phone market is evolving, and Symbian could not maintain its dominance.

Figure 1 Market share evolution since 2007



Source: The Guardian (May 2011)

Suarez (2003) indicates that the decisive battle over technological dominance occurs when the majority customers have entered the market; when the decisive battle resolves, a clear dominant design emerges. So the OS that captures 50% of the market for a significant amount of time, when the majority customers are buying converged mobile phones en masse, will be the standard OS. One of the selected OS's is most likely to become the industry standard, but which one is not predictable at the moment. However we can study the industry in a structured manner in order to increase our understanding and reduce risks.

This thesis will discuss the worldwide smartphone market. Although market share distribution varies across the world, this is a battle that is being fought worldwide.

Strategies of all 5 main sponsors are generally the same all over the world and literature indicates that a global standard will be set.

5.2.1 Research Questions

What are the positions of the most relevant operating system variations in relation to becoming the standard converged mobile phone operating system?

Answering my central question should directly fulfil the first objective. The positions of the OS towards domination are subjected to the sponsor's profile. The main sponsors have a very large influence on the strategic positions of the OS and therefore on their positions in the standards war.

The other part that determines the positions in this standards war is how the outcome of this standards war is being set. What factors affect the standards war? What drives it? Once this is known, constellation profiles will be reflected and the OS positions towards technological dominance deducted.

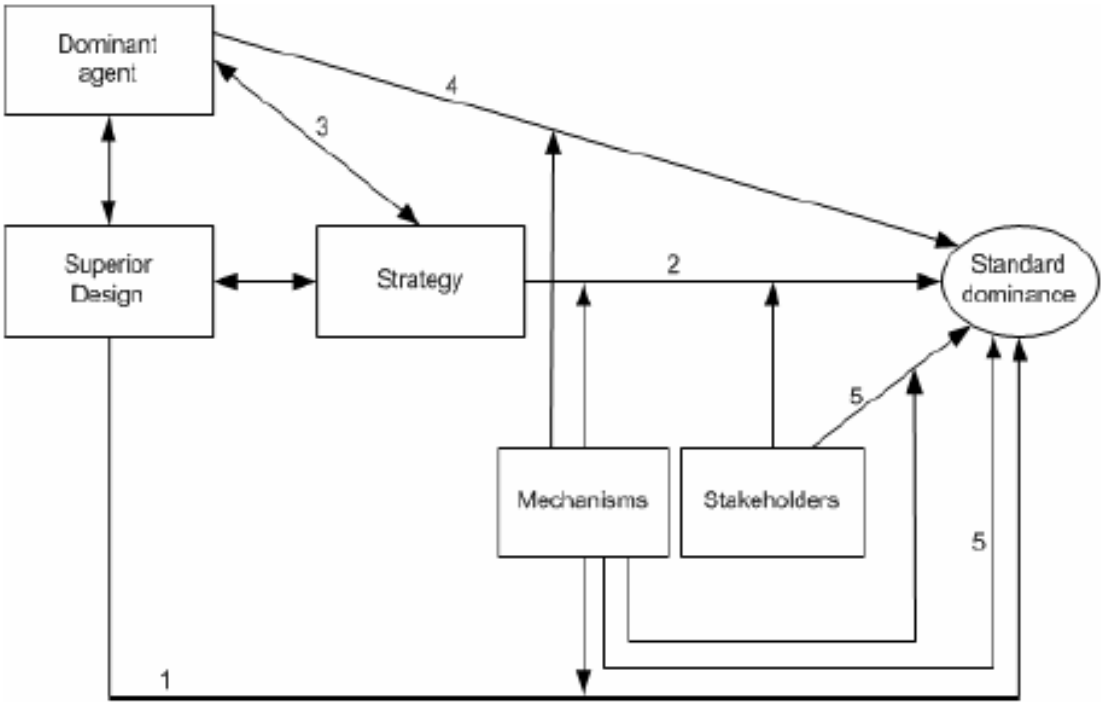
What are the strategic profiles of the main OS sponsors and their constellations?

There is a considerable amount of research available on the subject of dominant designs, standards wars and network externalities, most of it done by studying cases. But according to Suarez (2003) and Van De Kaa et al. (2007) no framework, has linked the ideas and conclusions coming from different studies and streams of literature. By performing a meta-analysis of 103 papers, Van De Kaa et al. identified 31 factors that might influence the outcome of a standard war. They grouped these under five categories: superior design, dominant agent, mechanisms, stakeholders and strategy.

Superior design, dominant agent, strategy and stakeholders are the four components that determine the strategic profile of a sponsor. Superior design encompasses the product offering that a sponsor intends to provide to its consumers. Dominant agent is the collection relevant assets and capabilities a sponsor possesses. Strategy defines the general strategy used by a sponsor to win the market. Stakeholders are telecommunication services, third party applications, device manufacturers, and other groups of interest relevant to the market outcome.

As stated above, it is necessary to determine the profiles of the most important sponsors and their constellations in order to provide the OS positions in the standards war. I will do this by studying relevant strategic analyses, articles, market data and official company communication available on the internet.

Figure 2 Framework for standard dominance



Source: Van de Kaa et al. (2007)

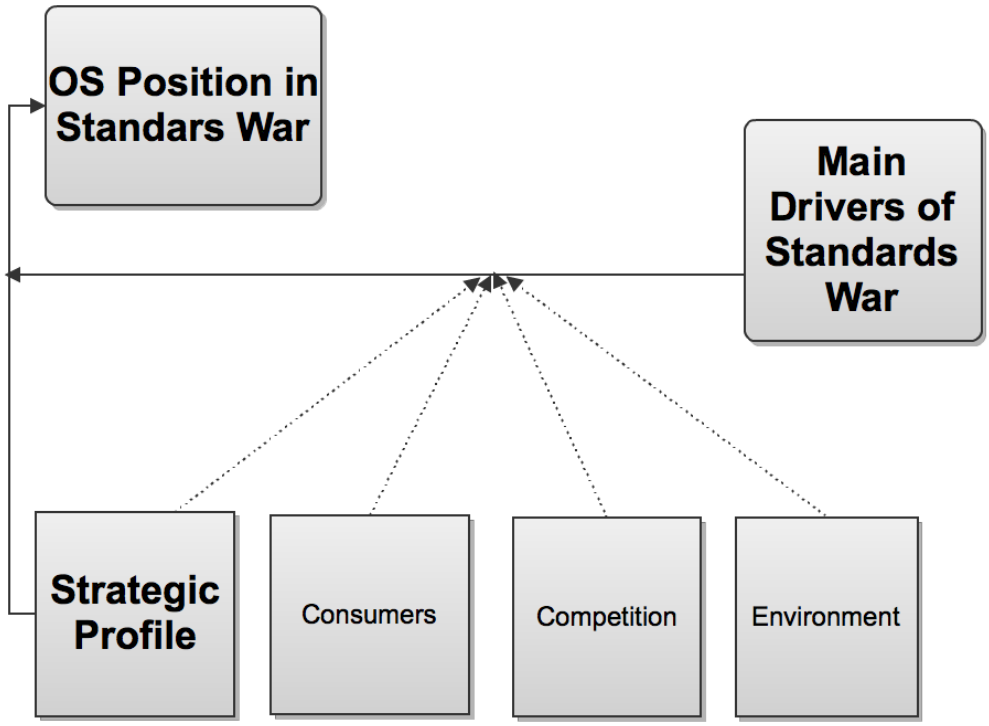
What are the main factors that drive the smart phone OS standards war? In what way do these factors drive the smart phone OS standards war?

The main drivers of the OS standards war are represented in the Van de Kaa figure above as 'Mechanisms'. As indicated before, expected mechanisms that significantly influence the market outcome are increasing returns, two-sided market dynamics, switching costs and network effects. The mechanisms that significantly influence the impact of the strategic profile on market position are defined as 'market drivers'. Once these driving forces are identified and described, I can reflect the strategic profiles upon them and extract the OS positions in the standards war.

5.3 Thesis structure

Part 1, 'Theoretical Framework' will derive the drivers of the Mobile OS market and lay out how they can influence a market outcome. After literature research it became clear that the 'main driver' influence is mediated by diverse factors. For example, the strength of network effects, partly, will depend on consumer heterogeneity. Therefore the next framework is applied during the discussion, designed to derive the strategic positions of the most relevant OS candidates and serving the objectives of this Master's Thesis in a better way then the general framework discussed above.

Figure 3 Adapted framework for standard dominance



Part 2, 'Case Study' will describe all sponsors in a comprehensive way. It directly applies the theory explained in Part1, resulting in a clear positioning of the sponsors and clearly stipulating their strengths, weaknesses. It provides an answer to my central question. Eventually this Master's Thesis will discuss the most important dimensions and dynamics of the standards war in the converged mobile market and present a basis to interpret changes.

The conclusion drawn at the end of each chapter will help position and interpret observable and emerging threats and opportunities. As a result, future directions are indicated as well as a number of key factors to watch closely in the future. It also shows how the knowledge basis can be used to analyze the future market.

Part 1: Theoretical framework

The Smartphone industry shows a de-facto standard setting process of incompatible options, sometimes referred to as a standards war. Sponsors are obliged to develop the smartphone market while they try to extract as much value as they possibly can. Part one will include a theoretical outline of the mechanisms present in the smartphone market, thereby making a profound analysis of the smartphone industry possible.

The first chapter of part 1 will include an overview of increasing returns dynamics. It indicates how they manifest themselves in present economies, how they are related and which strategic implications they hold.

Mobile OS sponsors are active in a multi-sided market. After increasing returns dynamics are discussed, attention will be devoted to this feature as it has a significant impact on competition. The next chapter is devoted to multi-sided market dynamics and their relation to the other market shaping forces.

In chapter 4 and 5, switching costs and network effects will be discussed more thoroughly. By then, it will be clear these are important features that drive information industries and that they are in need of some further explanation.

Lastly, the basic strategic decisions of openness and control are elaborated. A special strategy involving open source software is also considered because Google has incorporated such a strategy. Business models based on open source software have special dynamics that require some theoretical background.

At the end of this theoretical outline, a clear view on standard wars drivers should be acquired that enables a structured analysis of the smartphone OS market.

Definitions

First of all distinction between a standard and a dominant design is made. Gallagher (2007) is followed when distinguishing dominant designs and standards. He considers the two concepts as fundamentally different. A dominant design is an architecture used by more than 50% of new installations in a product category in a certain geographic product market (Anderson and Tushman, 1990). A standard, on the other hand, is a subsystem of an architecture that creates a single network of compatible users (Shapiro and Varian, 1990). If there is a need

for interconnectivity, either with other users, components or complements, then there is a need for a standard. It is a much narrower concept. For instance, VHS and MS-DOS are standards for VCR's and PC's. Standards can be viewed as an essential part for establishing a dominant design when network effects are strong (Gallagher, 2007).

A platform encompasses a set of components and rules employed in most users transactions (Boudreau, 2008). Components include hardware, software, and service modules, along with an architecture that specifies how they fit together (Henderson & Clark, 1990). Rules are used to coordinate network participants' activities (Baldwin & Clark, 2000). They include standards that ensure compatibility among different components, protocols that govern information exchange, policies that constrain user behavior, and contracts specify terms of trade and the rights and responsibilities of network participants (Eisenmann, Parker & Van Alstyne, 2008).

A platform is also considered a multisided market because it enables interaction between two or more sides of a market (Armstrong, 2006). Game consoles enable consumers to play videogames made by third party developers, credit cards provide the means for consumers to perform electronic payments in stores, and even newspapers can be defined as a platform connecting advertisers to readers.

Eisenmann, Parker and Van Alstyne (2008) identify 4 roles in platform-mediated networks, including: 1) *demand-side platform* users or 'end-users', to which will be referred as buyer; 2) *supply-side platform* users to which will be referred as seller; 3) *platform providers*, who serve as users' primary point of contact with the platform; and 4) *platform sponsors*, who exercise property right and are responsible for determining who may participate in a platform-mediated network and for developing its technology. The text refers to both demand-side and supply-side users as platform members, users or agents.

For example, looking at next generation storage disks, now controlled by Blu-ray, the four roles can be identified. Blu-ray is a digital storage platform aimed at high definition movies. Sony sponsored the format, and in smaller amounts, so did Philips and Pioneer. Numerous electronics manufacturers now provide the platform by producing and selling Blu-ray players: JVC, Samsung, Panasonic, Philips, Sony, Pioneer, LG, Yamaha, etc. Supply-side platform users are the companies that provide Blu-ray content. These are film producers like Warner

Bros (Time Warner), 20th Century Fox (Fox Entertainment Group), Paramount Pictures (Viacom), etc. Demand-side platform users are customers that buy Blu-ray disks and watch them at home. Both film studios and customers are platform members.

These platforms often exhibit indirect cross-side network externalities and direct same-side network externalities. Externalities are effects initiated by economical decisions that affect groups and are not taken into account by the decision maker when the decisions are made. Cross-side network externalities then exist when each side of the market has a positive or negative influence on the platform member's utility on the other side. For example, a game console becomes more valuable to consumers when more games become available on the platform.

Network effects occur when externalities go both ways. If more consumers buy a certain console, game developers are more inclined to sell games for this console. When direct network effects exist, each new user, influences the platform value of the existing users on his side of the market indirectly. The following statements are examples of direct network effects: producers might prefer less competition (negative), and, telephone subscriptions are worthless without other subscribers to communicate with (positive).

Increasing returns are expected because of these positive network or coordination effects and the industry's cost structure. Large setup/ low marginal cost structure is an important source of increasing returns. Unit costs fall down accelerated as the number of sold units increases, initiating a positive feedback effect. According to Arthur (1994), such markets have the tendency to adopt one single platform. With increasing returns, a platform that gets ahead, can gradually acquire more market share and enjoy increasing economies of scale – demand and supply- to further strengthen its dominating position. The market is then locked-in or 'tips' towards a single platform. Cost structure is an important source but not the only one. Further on in this discussion other sources such as network effects and learning are brought forward.

Mobile operating systems compete in an environment where switching costs are present. A consumer can buy a smartphone and over time, install applications on his phone. As time passes a buyer becomes more entrenched by his preferred system. For example computer hardware and software, machines and maintenance services, typewriter keyboards and experience with the keyboard. A consumer invested in hardware and additional software; he built up good

relations with maintenance services or gained significant skills in writing with a QWERTY keyboard. Thus, a buyer finds it costly or hard to switch between systems. Because he has to reinvest in software, he will lose extra discounts on maintenance or has to devote extra time in learning to use a new keyboard configuration. In this context, the product is said to exhibit switching costs and can lock-in a consumer on a personal level (Klemperer, 2004).

The framework used to analyse the smartphone OS market thus focuses on four principles. Increasing returns, two-sided market dynamics, network effects and switching costs, will be used to describe and evaluate the industry. Two main strategic decisions are derived concerning openness and control. Afterwards open-source software literature is reviewed and fitted in the framework. This will result in a solid basis of knowledge that will help the reader understand and evaluated the Mobile OS market in a structured manner.

6 Increasing Returns

The framework this discussion will use to analyse the smartphone OS market first focuses on the increasing returns mechanism. It will help to understand markets with increasing marginal returns. It identifies the drivers of such markets and points out some important implications based upon the efforts of Arthur et al (1994).

Firms enjoy increasing returns when the extra income gained from extra output, increases as the output expands. Unlike diminishing or constant returns, increasing returns generate a positive feedback that has a very particular effect on market properties and dynamics.

Positive feedback or increasing returns emerge from different sources. A cost structure consisting of high fixed and low marginal costs might give rise to incredible strong economies of scale. For example, software is costly to develop, but very cheap to reproduce. Once the first copy is produced, production is virtually unbounded by resources and total costs will continue to decrease. So if a producer can acquire a significant lead upon its competitors, he is in a good position to profit from the emerging increasing returns and to leave its competitors far behind.

Network effects can create the same positive feedback on demand side. They are often referred to as demand side economies of scale. Value is created each time a consumer joins a network making the network more valuable. It then has the potential to attract more users, augmenting its value even further. Again a positive feedback loop is created and the network sponsor can profit from the according increasing returns.

Increasing returns resulting from cost structure and network effects are not uncommon in modern-day economies. They are also expected to be the two most relevant sources of positive feedback in the mobile OS market. However, it is possible to identify more economic increasing returns/positive feedback problems such as information contagion, learning effects that have to be considered. Information contagion describes information sharing among consumers and learning effects describes technological development of products or processes. Learning effects are straightforward and can be interpreted in much the same way as the positive feedback stemming from network effects and cost structure.

Positive feedback resulting from information contagion has a slightly different but useful interpretation and will be shortly mentioned near the end of this chapter.

6.1 Examining increasing return problems

As two standards compete for market share, small economic shifts can become decisive when they're accumulated and magnified by positive feedbacks. With increasing returns or positive feedback effects, predicting the market outcome is very hard. Small economic shifts are provoked by dozens of random events, often small and insignificant. These events are unpredictable and so is their impact on market share. Eventually, as a market evolves, their relative impact on market share diminishes. The market reaches an equilibrium that depends on early, unknown events. Adoption under increasing returns has multiple equilibriums, it is impossible to know in advance which of the many solutions emerges.

For example, two nuclear cooling systems are introduced at the same time. One is a water-cooled reactor; the other is a gas-cooled reactor. As one technology is adopted, this technology is being further explored and becomes cheaper and better. Adoption rates follow current market share, the probability of the leading technology to be adopted next is greater then that of the losing technology. Technologies improve as they are adopted more and more experience is gained that guides further development. Learning effects create a positive feedback loop that amplifies unexpected market share movements over time. The technology that gets an early lead, possibly by chance, can profit from these effects and possibly take in the entire market. However we do not know in advance which technology will dominate the market. It can be any firm depending on the random events and the order of adoption.

Random events are unpredictable, accidental events that have a seemingly insignificant influence on sales but eventually help determine the market outcome. They can be anything: smart advertising, bad product reviews, supply shortages, etc.

Even if preferences and possibilities are known, the market outcome remains unpredictable in advance. From an economic point of view, with constant and diminishing returns, unlike increasing returns, outcomes can be known a priori because they depend on market structure (endowments, preferences, transformation possibilities). Next, the increasing returns equilibrium selection process is contemplated. Studying this process will indicate the driving forces of a market with increasing returns, needed for analysing the mobile OS market.

Arthur's et al (1994) book 'Increasing returns and path dependence in the economy' is a leading work on increasing returns. It provides a dynamic, economic view on increasing returns. It models self-reinforcing mechanisms as a non-linear Polya process[3] and shows increasing returns markets indeed have multiple equilibriums. It adds proof of path dependency, possible lock-in and a possible inefficient equilibrium.

6.2 Main drivers

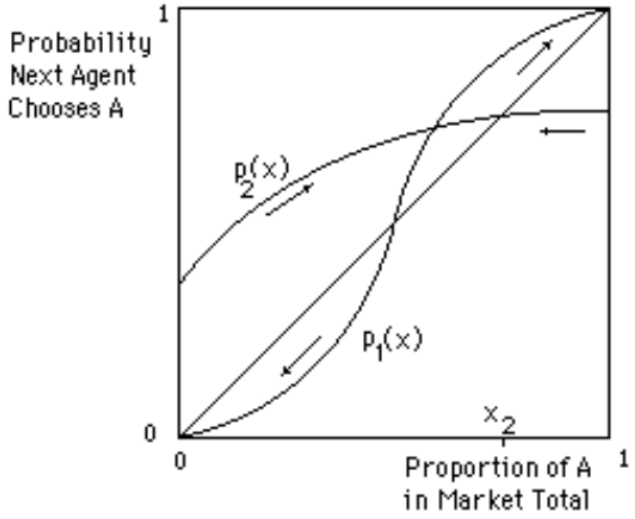
Increasing returns problems that arise from cost structure, network effects, human learning or information contagion can all be modelled to fit a non-linear Polya process. First there will be a focus on clarifying increasing returns from cost structure and network effects. These are the most straightforward problems and directly applicable to the mobile OS analysis.

Arthur's analysis is based on 2 things: relative attractiveness and the current market share. Random events are contained in the sequence of entry and by a perturbation effect with an expected value of zero. This means, that over time perturbation effects are averaged away. In a long run, after a large number adopters have decided upon what alternative to adopt, random events are expected to have no significant effect on market share shifts.

Relative attractiveness includes adopters' heterogeneity and the operative positive feedback effect. Adopters indicate individual value to each option based upon its intrinsic qualities. The intrinsic value assessment is then enhanced by a positive feedback effect.

Relative attractiveness is the total value of an option and forms the basis of the adoption probability that indicates the chance of an option being exercised next. As long as the adoption probabilities do not equal the current market shares, market shares will shift until they do. If the chance of adopting technology A is greater then its current share, this share will increase until it equals the adoption probability. When the adoption probability equals the current market share, the market is in equilibrium.

Figure 4 Adoption probability in function of total market share



Source: Increasing returns and path dependence in the economy, Arthur W. Brian (1994)

If the equilibrium is stable, adoption is direct towards the equilibrium. If it is unstable, adoption is directed away by the adoption probabilities surrounding. P2(x) has stable equilibrium in x2 whereas P1(x) only has stable equilibriums for market proportions x =0 and x=1. The relation between consumer heterogeneity and positive feedback effects determines the equilibrium locations and states. Eventual outcomes are driven by randomness and led by this relation.

6.3 Implications

Keep it mind that, when dealing with increasing return problems, it is not self-evident that one technology dominates the entire market even with strong feedback effects present. It is perfectly possible that in a stable equilibrium, multiple options posses a significant market share. Not because feedback effects are overpowered by heterogeneity but simply because these forces remain balanced as the market evolves. A set of different alternatives then dominates the market. The market is distributed among them in a fixed manner and the set is said to be a dominant set. Competition then proceeds as if no increasing returns are present.

Market structure

However, stronger positive feedback increases the probability of an asymmetric market structure – one dominating firm - to occur. It creates larger gaps between

the regions of prevalence of a product and makes a lock-in more resolute. This gap can be considered a switching cost because advantages cannot be transferred costless from one prevalent alternative to another.

The magnitude of switching cost and the degree of lock-in are determined by the weight of the positive feedback effect as well as its source. Advantages are easier transferable when they arise from coordination effects, then when they arise from learning effects or specialized costs. Switching is always very costly and requires significant subsidies if a lock-in occurs because of learning effects or specialized costs. With switching costs arising from coordination effects it is possible that adopters come to an agreement on what alternative is superior. If it is not their current choice, they will switch at a low cost. However, if there exists uncertainty or considerable heterogeneity then coordination towards the efficient alternative becomes very difficult, because the risk of losing current advantages is very high. The following chapters discuss network (coordination) effects and switching costs thoroughly so these important dynamics are well understood.

A second factor that adds to the probability of an asymmetric market structure is the number of potential adopters. Arthur proofs that with unbounded positive feedback, being sufficiently strong relative to individual preferences, one alternative will be adopted by all but a finite set of firms. Market shares tend to zero for all but one alternative. Off course unbounded positive feedback will not occur, because markets are always limited by a number of potential adopters. However, it shows that positive feedback is stronger in a market that counts a larger number of agents.

Competition under increasing returns

The randomness is pronounced most in the early stages of the process. Here the market can be pushed into an area where it can become self-reinforcing. These are times when competition is expected to be fierce. The market is responsive to strategic actions and unexpected events, focusing competition on these early stages. As the law of large numbers is standing, market share will suffer less from random fluctuations as more people make their adoption decisions.

Asymmetric market outcomes occur more often when positive feedback is strong relative to personal preferences. There is a greater chance one alternative becomes dominant, but strong feedback also effects the pace of structure becoming self-reinforcing. A market with relative strong feedback effects and weak tightly clustered personal preferences will become self-reinforcing fast.

Whereas firms in markets with strong, widely spread, individual preferences tend to have a hard time becoming self-reinforcing.

For example firms A and B are active in a market that enjoys weak network effects. Agents value a large network but to them the intrinsic qualities of A or B are more important. Now, a potential adopter prefers alternative B to A, and feels strongly about B's intrinsic qualities. He will not be convinced easily to adopt A. Alternative A has to offer a large network in order to persuade the agent. Firm A will need more people, hence more time to do this. Competition stretches over a longer period.

Competition is very state depending. Fierce competition is expected when the market finds itself on a turning point, for example when the market is in a shared, unstable equilibrium. Competitors try everything in their power to force the market towards their alternative. Once a market is locked in by one or several options, competition is expected to loosen up as sponsors harvest their efforts or compete as if increasing returns are absent. Expected future profits have an important role here. Arthur discusses these using discount rates. When discount rates are high, producers are less concerned about capturing market share for future exploitation. Low discount rates encourage producers to compete for future market share. Later chapters will show that discount rates are not the only variable influencing future profits and again switching costs and network effects play an important role in evaluating competition in a market with increasing returns.

Information sharing

Lastly, Arthur has developed a model to evaluate information sharing in relation to technology adoption. New adopters base their decisions not only on their own prior beliefs but other opinions influence their adoption decision. Again positive feedback is observed. A product receiving good reviews has a greater chance of being adopted. People adopt the product and positive information will spread faster, creating a feedback loop referred to as information contagion.

If information is constricted and potential adopters find a hard time obtaining information from users, then adoption decisions will be based upon the prior expected utility. And market evolution will depend solely on how agents will make up their mind. However if all private information is available to every potential adopter, then eventually it will become clear which product is the better one. Reality lies somewhere in between. Market evolution might again depend on early

fluctuations, with a possibility of an inferior product getting good reviews in the early stages and help lock-in the market.

Off course the degree of information contagion depends on the load of external information that a potential adopter uses to make his decision. Here risk aversion is a key factor. People, who dislike risk, tend to base their decisions on what is already known. High risk-aversion creates strong information contagion and increases general positive feedback effects. In the network effects chapter, communication problems will be highlighted further.

7 Two-sided market dynamics

Exchanges in platform-mediated networks have a triangular structure (Eisenmann et al, 2006). When a consumer holds a credit card it has only value to him when he is able to use it in stores. Also merchants only want to offer credit card payments if they are widespread among consumers. As smartphones make information access more mobile trough software, buyers will benefit from a wider range of applications and developers will favour platforms with a larger customer base. These interactions bring about a complex market referred to as a two-sided market.

A successful two-sided platform needs both sides to join. Price structure and business model therefore become very important since both sides need to be courted while making money overall (Tirol, 2003). The mobile OS market analysis is approached as a two-sided market connecting two sides, consumers and application developers. In order to analyse this market, an understanding of platform dynamics is needed. And determinants for choosing a business model in a two-sided market are given. Along these lines an insight into the core role of the platform, adding value by making consumer information more mobile, is delivered.

This chapter captures the essential dynamics introduced by two-sided markets. Most of it is drawn from the work of Rochet and Tirole (2006) who first model and discuss two-sided markets that only charge per-transaction fees. Later they add fixed membership benefits. Armstrong contributed an alternative view that emphasized on cross-side network externalities and market power while modelling two-sided markets that only charge fixed membership fees. *Weyl (2008), Krueger(2009), Hagiu and Eisenmann(2006)* provide additional insights interpreting their conclusions.

Eisenmann, Parker and Van Alstyne (2008) identify 4 roles in platform-mediated networks, including: *demand-side platform*, *supply-side platform*, *platform providers* and *platform sponsors*. Most of the rent captured, will go to the platform sponsors, as they are often the biggest force driving the platform. Some of the rents extracted will benefit platform providers (Eisenmann, 2008). In order to understand two-sided market dynamics, a distinction between providers and sponsors is not necessary and they will be referred to as "the platform owner" or

"platform". There are numerous examples of provider and sponsor being the same entity like Apple's Imac and Sony playstation.

7.1 Cross-side network effects

Rochet and Tirole (2006) define a two-sided market as one in which the volume of transactions between end-users depends on the price structure and not only on the overall level of fees charged by the platform. With price discrimination between market sides allowed, it is then still not possible for users to reach an efficient outcome as in a Coasian world[4].

However the Coase theorem fails if transaction costs could make it inefficient to pass additional fees, transaction prices might be restricted by the platform and the mere presence of a member group creates value for the other group. Literature refers to the latter as membership externalities. Membership externalities are present on game console platforms. The mere existence of a large of PlayStation 3 user base, can be a valid reason for game designers develop a new game whether these users will buy the game or not.

Next to membership externalities, usage externalities exist when members enjoy benefits of completing actual transactions. When a merchant allows for electronic payment he exerts convenience benefits on a cardholder, as does the cardholder when he uses his credit card. There are strong complementarities between both sides when interacting but neither of them is able to internalize the benefits exerted on the other side (Lerner & Tirole, 2002).

So members influence the perceived platform benefits of each other by interacting and by just joining the platform. A platform is then able to capture surplus by charging a lump sum or on a per-transaction basis. The main difference between these two fees is that a per-transaction fee can significantly weaken cross-group externalities since net benefits of a transaction are lowered by the extra payment (Lerner & Tirole, 2002).

Armstrong (2006) finds that unless they act to tip the industry to a monopoly, positive cross-group externalities will intensify competition and reduce platform profits. Thus by charging on a per-transaction base a platform can reduce cross-group network externalities, accordingly reduce competition and improve profits. Also if a member only pays a platform when a successful transaction has taken place, then this member does not need to worry about the platform's success on

the other side. It does not have to pay a membership fee in advance, which is an investment and involves substantially more risk.

Membership fees do not erode cross-group externalities, and for an agent to join the platform he must be convinced that his fee can be earned back, the platform has got to get the other group "on board". However per-transaction pricing might not be possible or too expensive because a platform is unable to tax the interaction properly or fixed fees may also be an efficient way of capturing extra end-user surplus**.**

Rochet, Tirole and Armstrong explicitly studied two-sided market trying to determine the logic and the determinants of a price structure that maximizes platform profits. They do this from an economic point of view modelling markets under strict assumptions. Nonetheless they do deliver a knowledge basis that can be used to built further understanding of network markets like the smartphone market.

7.2 Price sensitivity

Rochet and Tirole's (2003) most important finding is that the price of one side was irreversibly related to that side's elasticity of demand. In its simplest form, for a monopoly platform with concave demand functions and no payment between end-users, the price structure is given by equation 1.

Equation 1

$$\frac{p^B}{\eta^B} = \frac{p^S}{\eta^S} = p^b - (c - p^s)$$

Where p^B is the price a buyer pays to the platform, p^S the seller price and η^S, η^B sellers and buyer point-price elasticities. Prices only consist of a per-transaction fee and the end-user is assumed to have no fixed costs or benefits. Keep in mind that η^S and η^S in (1) are not the elasticity functions but point-price elasticities. If η^B and η^S would be seen as functions, then the result of Rochet and Tirole would be counterintuitive. Kreuger (2009) helps understanding this, by pointing out that the point-price elasticities are a functions of the price level.

Let the buyer demand function be an elastic function and the seller demand function inelastic. Because a small price increase would give rise to a large decrease of buyer demand, and the same price decrease would cause the

inelastic seller demand to increase by a smaller amount, it would be favourable for the platform owner to charge a higher seller price and a lower buyer price. As prices decrease and demand increase, the price elasticity decreases. For the seller group with an inelastic demand curve, price is driven up until elasticity of demand is high. So the more elastic group will most likely be subsidized when price structure is determined (Kreuger, 2009).

Notice that the above formula is very similar to the Lerner formula, except cost is replaced by (c- p^{s}) and has to be interpreted as an opportunity cost: under usage pricing, an additional transaction yields p^{s} on the other side and therefore its net cost is c-p^{s}; under membership pricing, the presence of an extra consumer on the buyer side raises surplus on the seller side with b^{j} and therefore allows the platform sponsor to raise the price on that side by the same amount without losing costumers.

Equation 2

$$\frac{p^{b} - \left(-b^{j}\right)}{p^{b}} = \frac{1}{n^{b}}$$

Equation 2 is the price structure of a pure membership model without per-transaction charges or costs as proposed by Armstrong (2006). p^{s} = (A^{b} – C^{b})/N^{j}) with A^{b} fixed buyer membership fee, C^{b} fixed cost and N^{j} number of sellers.

Rochet and Tirole (2006) then combined the pure membership model with the pure usage model and allowed for payments between these. They found that platforms maximize profits by maximizing average social surplus from potential transactions between end-users by setting an optimal usage fee.

Summarized, under the assumptions made by Rochet and Tirole a platform owner will maximize profits by maximizing the expected transaction surplus of the end-users. Two-sided markets also comprise a "seesaw" effect; competition or price controls lower prices on one side of the market, while raising prices on the other side. The rate of passing trough price adjustments from one side to the other is determined by the groups their price elasticities of demand, which are functions of market power and cross-side network effects.

7.3 Single-homing vs. Multi-homing

Single-homing is the term used to indicate that an agent chooses to join only one platform. When an agent uses several platforms he is multi-homing. There are three cases to consider:

- Both groups single-home
- One group single-homes, the other multi-homes
- Both groups multi-home

It is very uncommon for both groups to be multi-homing, if one group joins multiple platforms, the other group is not encouraged to do the same thing because they can already interact with the other group (Armstrong 2006). There will be no further attention devoted to this case.

If one group, say the buyers group, single-homes then it might be more beneficial for a seller to multi-home if the extra benefits exceed the extra costs that accompany the membership of an extra platform. A seller that gains large benefits from each transaction will be more inclined to multi-home. The degree of sellers who are multi-homing also depends on the platform loyalty of buyers.

Assume buyers affiliated with a first platform are utmost loyal to their platform. If all sellers would seize to trade on platform 1 and only conduct transactions on a second platform then the buyers initially transacting on platform 1 would stop transacting. When a platform has many loyal buyers, it makes more sense for a seller to be active on both platforms since buyers won't be very eager to switch platforms when sellers do.

Ignoring a platform will automatically mean large losses of transaction benefits. Thus marketing efforts and price cuts will influence producers less if consumers single-home. This implies that a platform has monopoly power over the seller since they are the only one that can provide access to their members, naturally leading to high prices being charged to the seller side. Armstrong (2006) refers to this as a "competitive bottleneck". In terms of price sensitivity an increase in platform loyalty on the buyer's side induces market power over sellers and a less elastic demand. Consequently sellers will be charged a higher price.

Armstrong (2006) addressed market power in relation to network externalities for a two-sided single-homing model. He concludes that competition will be fierce on the side that values platform differentiation low relative to network effects, has low transport costs, and/or exerts larger externalities on the other group. Further

Hagiu (2009) reinterpreted Armstrong (2006) and Rochet and Tirole (2003) by saying that when the share or profits made on one side of the market relative to the other side is higher, the easier it is to attract the former and the more difficult it is to attract the latter. He showed that if consumers care more about product variety, producers would have more market power and we're easier to attract, the optimal pricing structure shifts towards producers. However, this effect is less pronounced when, in consumer eyes, slightly differentiated platforms compete and large economies of scale exist for multi-homing producers.

Former discussion focused primarily on prices, to ease reading. Platform owner do have plenty more tools at their disposal to steer markets. These tools can be fitted in easily because they affect members' benefits and platform margins.

8 Switching Costs

Switching costs arise in many forms. They can be informational, transactional, contractual or even psychological but they are ubiquitous in an information system markets. A customer can be locked-in by individual or collective switching costs. Intuitively, switching costs can dramatically influence platform competition. If a platform owner is able to steer switching costs he can direct its market position and get an edge on competition.

Lead by the work of Shapiro and Varian, Farrel and Klemperer, this chapter first locates possible sources of switching costs. After locating and better understanding the sources of switching costs, their impact on consumers and later competition will be discussed. Eventually, findings will be situated explicitly in a two-sided market context.

8.1 Sources of switching costs

Sharpiro and Varian (1995) and Klemperer (1995) both identify several types of lock-in strategies, which can be thought of as sources of individual switching costs

The most straightforward sources of switching costs are artificially created switching costs such as contracts, discount coupons etc. Contracts artificially lock-in parties and might grant one party the opportunity to not commit to quality or prices in a later stage by allowing for adjustments in rates, vague definitions or features that are hard to control such as quality. To get out from under a contractual commitment usually a compensatory charge has to be paid which is literally a switching cost. When breaching a contract with a vendor or supplier, others might lower this cost of switching by agreeing to extra introduction discounts. More subtle are fidelity bonuses such as frequent flyer punts that give extra benefits to consumers, which are lost when they switch suppliers (Shapiro and Varian, 1995: Klemperer, 1995).

A consumer can become locked-in if he buys a durable good. There will be a need for compatibility with the initial good and additional expenses are made during its lifetime. Often he has only two options. Either he can buy the follow-on good from the initial supplier or change suppliers and lose all value left from the primary purchase. For example: razors and blades, printers and cartridges. Or

information systems that create and store information are often solely accessible by certain hardware or software. Users gather information and become more locked-in by the information system they are using if there are no means available to convert the stored data. By the time cd players were introduced, plenty people had invested in a LP-collection. So they were reluctant to adopting a cd player since they were not able to listen to their records. They had to buy them all over again (Shapiro and Varian, 1995: Klemperer, 1995).

Suppliers are often able to exert significant market power on their costumers in aftermarket being the sole supplier of follow-on goods. This market power depreciates with the economic value of the initial purchase and the existence of a second-hand market and third party suppliers. Consumers can protect themselves by renting or leasing the durable goods instead of buying it or by negotiating aftermarket sales terms before becoming locked-in (Shapiro and Varian, 1995: Klemperer, 1995).

Switching suppliers often encompass real transaction costs. For example, the effort and gas used to return rented equipment from a firm and afterwards renting it from an alternative supplier. Or costs that come with the closing of a bank account (Shapiro and Varian, 1995: Klemperer, 1995).

Switching costs arise by a product that requires a certain amount of training. As one becomes more and more acquainted with the program, the time spent on learning increases. People tend to be reluctant towards switching because when they do, this learning time is lost and they have to make a investment in the new one. Competitors can lower switching costs by making their product easier to pick-up and afterwards lock-in customers with upgrades and extra capabilities (Shapiro and Varian, 1995: Klemperer, 1995).

In contrast to durable goods, brand specific training and data storage related switching costs increase in function of time. Whereas switching costs of durable goods decrease with time as economic value depreciates (Shapiro and Varian, 1995: Klemperer, 1995).

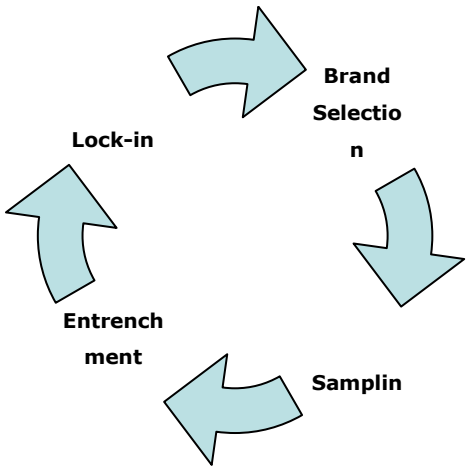
Search costs manifest clearly as finding new suppliers takes more trouble. Search costs now are lower because information is spread easier. However Uncertainty about the quality of untested products remains and rises as diffused opinions reach consumers, increasing switching costs nonetheless (Shapiro and Varian, 1995: Klemperer, 1995).

If consumers exhibit network effects, a new consumer might not have a real choice in choosing a supplier as his personal preferences are overtaken by the benefits of joining a large network of users. Or in other words, customers that are already part of a network won't easily switch to a smaller one, if this switch is accompanied by the loss a significant amount of network benefits. More attention to network effects and resulting switching costs is devoted in the next chapter.

8.2 Consumer behaviour under switching costs

Shapiro and Varian developed a dynamic diagram to discuss lock-in strategies: the Lock-in cycle. This is a four-stage concept that starts at the brand *selection point*, the first time a customer has to make a choice he will not bear any switching costs while making his decision and has endogenous preferences towards a firm. Firms then compete for the customer with marketing efforts, discounts, and samples, all to convince consumers during the sampling stage. Consumers start to become entrenched as they become more familiar with the product and make additional investments in the chosen product. In time the entrenchment accumulates and the customer becomes locked-in. Note however that a lock-in can happen very quickly, for example when a consumer makes a large investment in durable equipment. To complete the cycle, they return to the brand selection point, as a consumer again needs to reconsider his choice. This time switching costs will influence his preferences to a certain degree.

Figure 5 Customer lock-in cycle



Source: Information Rules, Shapiro & Varian (1995)

Competitors structure lifecycle offerings that attract, entrench and extract profits form customers in the best way possible. Consumer preferences and expectations

influence offerings when switching costs arise. Consumers might not be affected by short-term advantages because they are aware that his current choice must also serve his future preferences.

Consumers might even make rational choices and acknowledge the fact that firms will try to lure them and exploit them once they are locked in. Accordingly they oppose to getting locked-in and firms try to advocate openness in a credible way. At the other side there are consumers that do care about current prices and sometimes expect them to be maintained in the future. For example, if they don't know their future preferences or if they have liquidity preferences. These customers have more elastic demands and are susceptible to promotional actions.

Looking at a multisided platform in switching cost terms, a platform owner might commit to prices and quality after locking in a consumer because of strategic implications. Instead, the owner sells access rights to his installed base of customers. He profits from his market power by extracting rents elsewhere but he is still subjected to switching cost laws in attracting and entrenching consumers. He also exerts a degree of market power on locked-in consumers by not being, to a certain extent, committed to deliver quality. The platform might not attract as much users on the other side for example, but this market power (on both sides) is mitigated by two-sided market dynamics.

8.3 Competition under switching costs

Competition focuses on the customer "lifecycle". Roughly said, the firm that makes the best lifecycle offer, ceteris paribus, captures the market. Switching costs give firms a degree of market power over consumer aftermarket purchases or even repeated purchases. A producer can exploit his market power over locked-in customers by charging high prices on later purchases. He will set his prices as high as the rival firm's marginal cost increased by the costumer switching cost. This expected market power and resulting high profits causes intense first period competition.

Klemperer (1995) illustrates that this 'bargain-ripoff' strategy, as mentioned above, particularly applies when new markets emerge, new firms enter or new customers can be distinguished from old ones and served separately. He shows that prices are lower in the first period of competition when switching costs exist then when they don't. Producers are willing to give in to a price war, expecting future profits from the market share won in the preceding period.

However as Klemperer expands his model over more periods, and not allowing discrimination between new and old customers, he finds that competition balances between capturing market share and exploiting their current customer base. Competition depends on future market expectations, customer characteristics and strategic competitor actions.

Market prospects significantly influence competition under switching costs. Rising future market value by new customers will generate aggressive competition and put downward pressure on prices. Firms enlarge their customer bases in order to exploit them later and are willing to forgo current exploiting profits if the expected gains are large enough. If future market value were expected to increase because of customers that are already locked-in, firms would not engage competition but solely raise their prices and exploit their current base. Low discount rates or prospects of increasing returns are two possible incentives for trying to capture market share.

A regulating effect is, that augmented prices result from a preference for passive competition. Firms with smaller market shares to exploit are inclined to be aggressive and attract new customers. Changing its high-price strategy to a low-price strategy makes the incumbent competitor more aggressive as it does not want to lose market share. Opposed to the firm that raises it's price today, whose competitor will gain market share and increase its price tomorrow being less aggressive in the future. Firms have a preference for less aggressive competition, which counteracts its desire to attract new customers.

Lastly, if consumers allow for firms to force large switching costs upon them, then firms have less incentive to horizontally differentiate themselves from each other. Consumers that appreciate differentiation have stronger motivation to purchase from more than one supplier when suppliers are differentiated, weakening their market power. Firms rather go "head-to-head" with identical products or assortments (Klemperer (1992); Lindsay and Mulherin (1992)) giving consumers fewer incentives to buy from more than one producer or switch.

In any case it is important to establish a solid installed base of customers. Large installed bases can be a very strong competitive advantage when economies of scale – demand or supply - are considerable. Firms that establish a locked-in customer base before others enter can make it very hard for new competitors to gain a large market share. New competitors have to overcome switching costs of locked-in consumers and cannot benefit from scale like incumbents. However as

Klemperer indicates successful small-scale entry can be done if a challenger is able to differentiate himself from the incumbents. Since incumbents tend to offer identical deals it might be easy and profitable to enter a market on a small scale and serve only a segment.

The presence of switching costs in a multi-sided market further complicates competition. The power to impose switching costs is important for platform owners. It shapes competition and serves as an important tool to achieve strategic objectives. This presence of switching costs often emphasizes early competition and an awards an installed base of customers.

9 Network effects

Network effects originate from a consumer's desire to be compatible with other consumers. If network effects are strong, this desire outweighs individual preferences. A desire to be compatible can manifest itself in different manners. A consumer might want to be compatible with other consumers like in a telephone network. Compatibility with former systems, or experience might be desired. Or compatible complementary products can augment product value significantly creating network effects.

Positive network effects were already identified as an important source of increasing returns. In this chapter special attention is devoted to positive network effects because they impose a number of specific managerial challenges on their own. There are two varieties of positive network effects: direct and indirect network effects. The chapter discussing two-sided markets showed the presence of indirect network effects but did not discuss them thoroughly.

Again indirect positive network effects are discussed from an economic point of view. Off course some direct network effects are suspected between consumers. However, emphasis is placed on indirect network effects, because they have been recognized as an important driver of two-sided market strategies.

9.1 Dynamics of indirect network effects

Church & Gandall (1992) study the effect of software provision decisions on standardization of incompatible systems. While doing so they determine a number of factors that influence the magnitude of indirect network effects.

Basically for software providers, benefits of cross-side network effects are weighed against the disadvantages of more competition inside a network. Intra-network competition can be seen as a direct network effect. Every new software producer joining the platform intensifies competition. Network value diminishes for other producers but consumers perceive a larger number of software producers as beneficial. Consumers subsequently join the platform, making it more profitable for software producers to join the platform. The interaction of cross-side and same-side network effects eventually has an impact on consumers and the eventual positive feedback.

Obviously the number of members in each group greatly influences the magnitude of network effects on market share. Simply put, the marginal value of a second producer or consumer exceeds the marginal value of the millionth consumer or producers. Church and Gandal (1992) see network benefits in function of network members as a concave function and propose a number of important factors that mediate this function significantly.

If consumers value software variety highly, then software producers have substantial market power. Competition is less intense and producers' profits are higher. With software variety increasing, extra consumers join the platform. These consumers are more profitable when they appreciate software variety and differ in taste. The decision of joining a growing platform thus becomes more appealing for software producers. Church and Gandal (1992) also refer to this valuing of variety as the benefit of software consumption.

Following this rationale, a relatively high software or hardware price lowers the available budget for extra software consumption. Additional consumers are worth less and might not justify bearing increased competition. Software producers might not join the expanding network. Resulting network effects are stronger when variety of software is appreciated and sufficient budget for complementary products is available.

Lastly Church and Gandal (1992) identify the degree of platform differentiation as an important determinant. Highly differentiated consumers prefer different platforms that align better with their needs. A large network of complementary software might be needed to lure away consumers from the platform they initially preferred. This creates a threshold for network effects to become active and give rise to demand economies of scale.

Accordingly for a platform to be exclusively adopted, without software producers having to come to an agreement, network effects have to be sufficiently strong and a platform needs a critical minimum amount of software provision. This means that if hardware technologies are not differentiated too much, prices of hardware and software are relatively low and the benefit from software consumption is high. Network effects subsequently give rise to demand economies of scale.

9.2 Coordination problems

A self-reinforcing system resulting from network effects could accumulate a competitive advantage that forms a potential barrier for switching to another platform. Collective switching costs are created. Although advantages are easier transferable when stemming from coordination effects (Arthur, 1994), Shapiro and Varian (1998) argue that in many information industries collective switching costs are the biggest single force working in favour of incumbent platforms.

There is an important difference between Arthur his findings and those of Shapiro and Varian. Arthur says a lock-in resulting from coordination effects are easier to overcome because switching can be done for free. However, he briefly mentions the necessity of coordination among adopters, in order to switch for free. It is this coordination that Shapiro and Varian emphasize on. They find coordination can be hard and resulting collective switching costs are very hard to overcome.

Collective Switching Costs

Collective switching costs become increasingly larger as the platform attracts more members. Assume two networks compete with a third network. All networks are incompatible. The first one counts one hundred members and the second one only ten. It then becomes a lot harder for the third network to convince a person from the first network to join his network then it is to convince a member from the second one. This is evident because members of a larger network bear greater opportunity costs when switching networks. New platforms entering a market, most likely have a hard time stealing away customers from their competitors. Therefore, a large installed base of users can be of crucial importance.

As mentioned in previous chapters, switching costs change agents' behaviour and affect platform strategies. Network size as a source of switching costs and a dimension of a customer's decision making process further complicates behaviour. Agents risk getting stranded in a small network, or they fail to adopt a standard network and miss out on substantial network effects. Even if they agree upon which platform to join in order to receive the most benefits, they might become locked-in by a technology that does not have the best long run potential because they might not be able to accurately identify future benefits. In combination with other switching costs market lock-in can be vast and switching to a better platform may be hard (Arthur 1994). So there is plenty of uncertainty and unpredictability present that causes sincere problems.

Literature recognizes these problems as **coordination problems** or adoption problems. Platforms strategies in relation to network effects subsequently focus on overcoming these problems and smoothen adoption. First, the manifestation of coordination problems is further elaborated.

Simultaneous adoption without communication and coordination would be a matter of luck as everybody bases their decision on their preferences and believes without being influenced by others. Fortunately this is a very uncommon situation and sequential adoption is a realistic assumption. Based on this assumption, Farrel and Saloner (1985) build a two period model where agents can switch each period between an incumbent platform and a new better one. Switching is irreversible. It assumes incomplete information about other agents' preferences and endogenous timing of switching. That is, the first agent to switch platforms is the one most inclined to the new platform. Agents' preferences are dependable on current network size and an exogenous bias towards on network or the other which is distributed uniformly. Users then have three actions: (i) they never switch; (ii) they switch in period 2 if other users have switched in period 1; (iii) they switch in period 1.

Excess Inertia

Farrel and Saloner argue that, under these circumstances, two agents (or groups of agents) might only switch platforms in the second period if some switching already occurred. Then if none of them are willing to switch in period 1, both are stuck on an inferior platform. This is called excess inertia; there is a tendency to do nothing although it would be beneficial for both parties to do something.

This 'bandwagon' behaviour is very common when agents use earlier adoption to form their decisions. It also gives power to earlier adopters. Suppose group 1 prefers "all adopt A" while group 2 prefers "all adopt B". With strong network effects, if group 1 moves first, group 2 will follow – even though the 2nd group's preferences for B were stronger. They choose compatibility with group 1 over their own preferences. Early adopters lead the way and are a very important lock-in. However if a second group is large enough, or does not value network effects high, then the first group is not pivotal. Early adopters would rather be compatible with the second group and adjust their adoption decision accordingly (Farrel and Klemperer, 1997).

Understanding and coordinating the adoption process is key in network industries, managers should look for pivotal consumers and try to find out how they form

their expectations. In network industries, consumers base their decisions on expectations. They do not know how a network will evolve so they base their decision merely on arbitrary cues (marketing signals, price, brand reputation, technology sponsors, and previous adoption…) and individual reasoning, varying from one person to another.

Consumers make adoption decisions overtime. They are able to form expectations lead by earlier adoption and make better-founded decisions. Their reasoning here is clear: with positive network effects, high previous adoption comes with a higher chance of future adoption and greater utility. They are also able to communicate with each other, adding extra information to their decision-making process. In the next section the relations between sequential adoption and expectations and communication and expectations are further explored and other expectation drivers are described.

Summarized: which group of adopters get the bandwagon rolling, mainly is determined by the way expectations are derived, the distribution and value assessment of platform intrinsic preferences and compatibility preferences, consumer risk aversion and group size. Network sponsors can manipulate these determinants to a certain extent in order to facilitate or impede adoption.

9.3 Adoption coordination

Under network effects, selection decisions are hard and adoption is laborious. Agents basically have to decide what product suits them best, before they know for sure which product actually will fit them best. Coordination towards a single network is clumsy. Not only because everyone has different preferences but also because different indicators are used to determine which product is expected to have the most benefits. Under network effects, expectations are king (Farrel and Saloner, 1997).

For network sponsors to steer the adoption they must focus on how consumers form expectations and break ties. What is the importance of previous adoption in expectation forming? How well can they communicate their decisions, what other cues are used and how does all this influence competition? When this is cleared out, pivotal customers will become clear, and strategic actions are imposed on network sponsors

Expectations

Expectations are a very important driver of the adoption process. Consumer expectations are critical, because the current attractiveness of a technology is greater and more future consumers are expected to choose it (Katz & Shapiro, 1992). Under the right circumstances, expectations of what is likely to prevail become self-fulfilling. If network effects are strong and; (i) the utility of every consumer in a network of zero size is zero or (ii) there are immediate and large external benefits to network expansion for very small networks, or (iii) there exists a significant density of high-willingness-to-pay consumers who are just indifferent on joining a network of approximately zero size, then expectations can become self-fulfilling (Economides, 1996). Katz and Shapiro (1983, 1985) show the same in a case of competing standards. Arthur (1994) confirmed this and added that expectations of a lock-in narrow switching boundaries and increase the possibility of a lock-in. Expectations of a market lock-in exacerbate market instability.

With expected technology quality levels constant, Katz & Shapiro's (1992) argue that networks, which are not expected to win future sales, will not engage in penetration pricing. It can only win when expectations turn to its favour. Farrel and Saloner (1997) derive from this, that price terms do not affect expectations and no buyer is pivotal. Firms will compete solely and excessively on quality. More accurately, on creating a perception of quality and favourable expectations. Of course a true quality difference is a considerable advantage, but deep pockets, history or reputation, a convincing road map for future products, control of key complements, control of formal standards effort or marketing can be significant forces.

When expectations track surplus**,** people want to make sure they have the best lifetime value thus they will be less sensitive to temporary actions undertaken by a sponsor. Katz and Shapiro (1986) argue that such commitment issues favour technologies that are expected to perform better in the future. When two technologies compete over a standard and consumers agree on value; then under most circumstances, they will have to capture the early market in order to lock it in and profit from network effects in later stages. However, if a technology B outperforms technology A in later stages but not in the early ones, it can credibly invest its second period advantage in early consumers to win the market. Technology A excels in the first periods and can do this too in the later periods, but why would it? If it already took in the market, it has monopoly power and can

easily ask prices equal just under switching costs. It cannot credibly promise to invest in consumer in later periods, whereas B is obligated to do so in the early periods if it wants to win. As a result, quality or process advantages in later stages are more likely to dominate a market when consumers track surplus. Rational consumers prefer technologies that are efficient over time because only they can credibly promise to generate a greater surplus. Again, the importance of quality expectations is considerable.

Communication: Information contagion

People's perception of value is usually different and toughens coordination towards a single dominating network. As mentioned above, good communication among consumers facilitates adoption when people agree on the difference in value. However when they do not, they become more aware of their differences and the risks involved, inertia rises and expected future network efficiencies lose some of their importance in the decision process (Farrel & Saloner, 1985). However note that this paragraph, describes communication prior to adoption, influencing expectations before any decisions are made.

Consumer communication adds an extra dimension to the adoption process when previous experiences spread and complement the ex ante expectations. They can be good or bad and amplify existing network effects. It is different from basing decisions on prior adoption. Ten people adopting a network give the impression of a successful technology that is about to dominate the market. However if the same ten people adopt the same network and complain about it, the eleventh person will not likely adopt this network. Arthur et al. (1994) says, that with full-public knowledge there will be strong market domination of one product. And if one option is clearly far superior then the other, consumers will find out about this eventually and it will dominate.

So a technological advantage is more conclusive when other opinions are easy accessible and appreciated by the decision maker. This is so when people are risk averse. They tend to place more value on what they know then on what they believe (Arthur & Lane). High-risk aversion makes expectation forming more conservative. Incumbent networks, strong brands, personnel positive prior experience, ext. become more important indicators of future success as consumers rather exploit the known then explore the unknown technologies[5]

On the other hand new technologies that suffer from conservative behaviour and prior under-appreciation can benefit extra when they deliver a compelling strong

performance. Unanticipated effectiveness has a stronger positive effect on adoption than anticipated effectiveness. This is especially pertinent to new breakthrough innovations, which are harder to anticipate on.

Expectations and communication drive the adoption process. It is important for a sponsor to find out how these forces guide the process and how they fit in the market structure. Previous chapters have shown how cost structure and network effects can ignite a positive feedback loop and generate increasing returns. The strength of network effects is an important consideration. This chapter indicated how indirect externalities (software variety appreciation, need for complements…), platform differentiation appreciation and available budget drove network effects. Earlier two-sided markets were studied. Price structuring matters in this context, it has an impact on the available budget and can directly influence network externalities. Lasty, through positive feedback, network effects create collective switching costs, so switching cost dynamics are also relevant in network markets.

Network sponsors, in this case, standards sponsors, are able to manipulate this market environment to certain extent. For example, they can create switching costs, amplify or reduce network effects according to their assets and objectives. When dealing with the present, increasing returns sponsors make decisions towards market development and capturing the market. Two important strategic decisions have to be taken that have been briefly mentioned but not fully discussed. The degree of compatibility and openness of the standard are discussed in the next chapter.

10 Compatibility and Control

This chapter will provide some key insight on the principal strategic decisions following from the present market dynamics explained earlier.

Platform sponsors will face a trade-off between developing the market and extracting value from the market. Until a certain level they can mould their environment to their advantage. However the main strategic issues can be divided into horizontal and vertical strategies. Horizontal strategies deal with the issues of direct platform competition. They deal with compatibility decisions, distribution issues and the optimal degree of core standard openness.

Vertical strategies consider the relationships with components and complements. A standard sponsor connecting different components has to develop the platform while maintaining control and the ability to leverage it. The same applies to dealing with complement suppliers. Attracting suppliers of complements is crucial to the adoption of an OS standard. However, some components and complements can become very powerful, endangering the sponsor's acquired or future strategic position. He has to take measures retaining his position. Although these problems are more pronounced over time, they have to be taken under consideration before engaging a standards war.

According to literature, these are considerations about the openness of a platform. Decisions to open up a platform entail trade-offs between adoption and appropriability (West, 2003). Opening a platform can spur adoption by harnessing extra network effects, reducing users' concerns about lock-in, and stimulating production of differentiated goods. At the same time, opening a platform typically reduces users' switching costs and increases competition among platform providers, making it more difficult for them to appropriate rents from the platform (Eisenmann et al., 2008).

In chapter 2, four roles in platform-mediated networks where identified by Eisenmann (2008): Demand-side platform users, supply-side platform users, platform providers and platform sponsors. No distinction was made between providers and sponsors when discussing two-sided market dynamics. Examining the openness of a platform, each of the roles may be open or closed and a distinction is necessary. A platform can be open on any level, where open means: 1) no restrictions are placed on participation in its development,

commercialization or use; or 2) any restrictions are reasonable and non-discriminatory (Eisenmann et al., 2008).

Table 2 Example Open/Closed systems

	Linux	Windows	Macintosh	iPhone
Demand-Side User (End User)	Open	Open	Open	Open
Supply-Side User (Application Developer)	Open	Open	Open	**Closed**
Platform Provider (Hardware/OS Bundle)	Open	Open	**Closed**	**Closed**
Platform Sponsor (Design & IP Rights Owner)	Open	**Closed**	**Closed**	**Closed**

Source: Opening platforms, Eisenmann et al. (2008)

For instance, Microsoft's Windows platform is closed at the sponsor level but open with respect to other roles. Microsoft controls the OS around which the PC architecture is designed, and licenses it to multiple hardware vendors, promoting adoption. It publishes Application Programming Interface's (API) for third party software developers to use. However it retains control over the API and the windows source and enjoys monopoly rents (West, 2003). Unlike Apple's Macintosh platform, which is closed at the sponsor and provider levels but open with respect to both user roles. Linux then is an open system because it is freely available. Anyone can make applications on Linux, provide it, and even improve it.

10.1 Horizontal Strategy

Horizontal strategies target a sponsor's existing and prospective rivals and platform providers. In this context, opening a firm's platform means: 1) allowing interoperability between platforms; 2) allowing direct third party participation in commercializing the platform; 3) allowing third parties to help developing a platform (Eisenmann et al., 2008).

Interoperability with rival platforms can be achieved by making standard interfaces compatible. When two platforms become interoperable, they become more open: users of different platforms can interact with each other, including supply-side users who offer complements (Eisenmann et al., 2008). A sponsor will have to decide if he wants to go head-to-head with its competitors or if negotiating a market standard with them is the way to go. While doing so he has to fabricate an advantageous position from which to go into battle or negotiations.

Controlling a key standard in a present-day information industry can bring about extremely large gains and fierce competition. The alternative is that sponsors agree on making their products compatible. Competition then shifts from inter-technology competition to intra-technology competition (Besen & Farrel, 1994).

Following a strategy of inter-technology competition or intra-technology competition basically is an evaluation of expected returns compared to the expected competition. The focus of competition (creating an installed base of users, persuading suppliers, managing expectations, etc.) becomes more conventional, such as price, service and product features (Besen & Farrel, 1994).

Inter-technology Competition

When a sponsor decides to go head-to-head with other standards a standards war is born. Pre-emption is a great strategic advantage in a standards war. Possession of an installed base before rivals is incredibly valuable. Because consumers tend to be inert, a positive feedback loop is ignited faster and expectations benefit from a large installed base of users. Such a base can be obtained by entering the market before the competition, by penetration pricing or by making the standard backward compatible (Shapiro & Varian, 1994).

It is obvious how first movers can profit from their early entry. However, later entrants can still gain hold of an installed base. They can set low prices and penetrate the market, when they are more efficient or have deeper pockets then their competitors. Or they can transfer an old user base by making their technology backward compatible. By doing so, they offer their customers a migration path. Switching costs and risks are reduced so present customers are more inclined towards a backward compatible solution (Besen and Farrel, 1994). Backward compatibility will be further elaborated in the next section as it is a vertical strategy.

Opening up the platform on the provider level or broadening sponsorship can increase adoption and development speed. By Licensing, platform diffusion becomes better, competition puts a downward pressure on prices, and providers can offer innovative versions of platform products serving a more diverse market. Downsides are that there might be free-riding providers that drain away profits from a strong growing market and there might arise conflicts about rent division and strategic direction of the platform. It might also be profitable, for example in a young market, for a sponsor to be the sole platform provider. This way he will

be able to control the pricing structures better and sponsor a user group (Eisenmann et al., 2008).

Broadening sponsorship involves recruiting partners that help develop the platform. However, as will be shown in the section considering open-source software, platform sponsors will only open-up the sponsoring role in special circumstance. If possible, they will always prefer capturing the superior rents of proprietary sponsorship (West, 2003).

It is possible with, some sponsors come to an agreement to jointly develop a standard and others rather don't. Or two groups of sponsors agree on a different standard. Alliances are found, with providers, third party component/complement producers, other sponsors or even beyond this scope (Shapiro & Varian, 1994). This is because they can improve speed, cost and expectations and reduce risk by: 1) building new businesses, 2) accessing new markets, 3) acquiring additional skills, 4) gaining scale, 5) improving the supply chain effectiveness and 6) creating network value (Bamford, Gomes-Casseres & Robinson, 2003).

Though these are important benefits, opening up a standard, sharing control with more contestants has its liabilities. Markets and standards evolve and engagements have to be reviewed and adjusted overtime. There exists a constant tension between the partners of an alliance. Each has its own objectives and vision on how to develop the shared standard and these do not always coincide nicely. In order to prevent stagnation or grave incompatibilities, a clear direction and regulation is needed. This becomes harder as more firms join the alliance and the standard opens further up. The standard can even be vendor independent and commonly available. But it would still be in need of clear guidance and leading investors (Bamford et al, 2003).

By now it must be clear how essential it is to manage consumer expectations if incompatibility is chosen. Besen and Farrell (1994) add that sponsors often go a long way, past regular advertisement and promotions to convince a consumer. They try to exaggerate and push sales figures by giveaways and internal users as if they involved sales to customers. This is possible because the installed base is not able to perfectly observe the already installed base. Other often observed behaviour is that of preannouncements by which sponsors try to stifle competition sales. However this is a risky tactic as consumers might stop buying the sponsors own standard pending on the improved version.

Last on this subject Shapiro and Varian (1994) mention the value of a strong reputation and brand name. These have always been valuable assets in any large market but in network markets, where expectations are crucial, this is even more so.

Intra-technology Competition

If ordinary intra-technology is expected to be more profitable than inter-technology, a cooperative standard setting process emerges. The standard in question is opened industry-wide, under agreed regulation. Firms that have strong manufacturing and innovation abilities welcome a collective standard. It expands the market, reduces uncertainty and reduces customer lock-in. Competition focuses on components and conventional dimensions. Firms can then compete like on a conventional market, exploiting capabilities like excellent manufacturing and effective innovation. But before a standard is set, negotiations take place.

Before such an industry-wide standard is set, crucial negotiations take place. Besen & Farrel (1994) describe the negotiations as a bargaining problem where tactics include commitments and concessions. Commitments are actions that strengthen a bargain position. They visibly reduce a firm's payoff from agreeing to an outcome it does not prefer, or increase its payoff when its preferred outcome emerges. While negotiations are going on, participants can still invest in R&D that can give them an edge, once an agreement is reached or continue to build an installed base which loses part of its value when a standard is set. Then the participant will be able to demand compensation.

Concessions comprise actions towards an agreement. Besen & Farrel (1994) propose a number of actions that help in achieving cooperation. Low-cost licensing, hybrid standards, joint future development commitments, shift standard development to a neutral third party and promises of timely information sharing. All these actions are intend to keep competition focused on components. They prevent any firm from enjoying significant advantages of developing the standard in their favour.

Profitability can be strongly dependent on negations and the structuring of standard licensing. Next to the standard competition dynamics, many of the benefits and difficulties that come with shared control manifest in industry-wide standard agreements.

10.2 Vertical Strategy

From within the platform, threats exist towards leading platforms sponsors, referred to as divided technical leadership (DTL). Next, we will see what DTL is and how exactly it influences platform strategy.

In a case study of Microsoft's anti-competitive behaviour, Bresnahan (2001) explains vertical compatibility and illustrates its importance in the computer industry. This industry shows much resemblance to the present smartphone industry. Microsoft controls the PC's central standard, the OS but its value comes from interaction with components and complements. Network effects are active and users suffer from switching costs. Microsoft, being the sole OS sponsor, has enjoyed spectacular increasing returns in the 1990's and great incentives to protect its dominant position.

One of the threats it faces directly embodies the issue of vertical compatibility. It is the threat of divided technical leadership by indirect entry. Specialized firms advance key components and complements used by more applications bring technological and market eras to an end. In these so-called epochal changes, lie opportunities for these key complements or components to establish a divided technical leadership and lower entry barriers other standards (Bresnahan, 2001).

Innovation with divided technical leadership depends on the platform sponsorship. As a proprietary platform, Microsoft will pursue systematic innovation, leveraging its ability to control the pace and direction of all subsystems improvements. By contrast, modular and component innovation is more likely to occur when sponsorship is shared (Greenstein, 1996). So under shared sponsorship divided technical leadership is more common, and initial key standard sponsors have a harder time protecting against a power shift is more likely to occur when more sponsors are involved (Brasnahan, 2001).

Looking at the PC platform, there was at some time a divided technical leadership between IBM and Compaq (computer), Microsoft (OS), Intel (CPU), Netware (networking OS), WordPerfect and Lotus (near-universal applications). Now this has been reduced to Microsoft (OS, networking OS, near-universal applications) and Intel (CPU) (Bresnahan, 2001). Microsoft has incorporated many functions into windows through absorption of standalone applications provided by third parties. This can be seen as closing a platform. Microsoft uses it as a protection mechanism against DTL one of the strategic advantages bundling provides (Eisenmann, 2008).

Bundling can also provide quality and efficiency gains for customers, economies of scope and price discrimination gains for the platform sponsors. Sometimes a platform sponsor can evoke consumer adoption by providing in-house complements (Eisenmann, 2008)

Earlier was shown, how backward compatibility can help establish an early installed base by transferring old users. Introducing a backward compatible technology might often be hard because of technological or legal difficulties and it admits a compromising performance. This leaves an opening for a competitor to enter the market with superior technology delivering an outstanding performance. Such a revolution strategy often requires a lot of muscle and is essentially very risky. But if the incumbent technology lags far behind, the market is growing rapidly and consumer lock-in is mild, then entering the market might not be to much of a speculative undertaking (Shapiro and Varian, 1994). Also, component or complement producers can induce an epochal change more easily thereby creating opportunities. It can try to claim a leadership position itself or new competitors can enter through this way.

According to Fudenberg & Tirole (1998), backward compatibility doesn't matter when a platform provider can price discriminate between users. If not and technical improvements are small, then it should be offered against a price, high enough to prevent the incumbent users from adopting and low enough so new users will adopt the platform (Choi, 1994).

A second tool that helps installing a network is category agreements. Platforms can grant third party producers of compliments and components an exclusive right to supply on their platform. These producers will then be less reluctant to make platform specific investments, because they will not have to deal with competitors stealing their business. Contracts can also be used the other way around. Convincing a producer to provide his product exclusively on a platform makes the platform more attractive for demand-side users (Eisenmann et al., 2008).

The relations and compatibility issues in such industries are very important as they drive adoption and technical advancement. Again balancing between market development and control is key. Only now action is situated between the different layers of a system. Threats are being even subtler and harder to observe. As mentioned before, firms in one layer can drive innovation in another causing epochal changes and opportunities for entering the other layer. When an

opportunity arises, such a sponsor might enter himself, sponsor other entrants or prevent less dominant options from leaving. This rivalry is particularly strong when interface standards between layers are affected or when the newly gained capabilities are used by applications (Bresnahan, 2001). Again 'open' strategies and alliances, have great benefits, but the potential to put a sponsor in a weak position. Although, these are long run implications, they are essential to a sponsor's strategy.

10.3 Open Source Software

With the widespread diffusion of the Internet, it is possible to enable worldwide volunteer programmers to develop software together on an unpaid, voluntary basis. Such software is called open source software. A severe way of opening up a platform, is by integrating such software as a key standard and allowing the community to co-develop it.

This section will first explain how open-source software works. Then it will shed a light on the motivations of the programmer community. Lastly, it will look at the benefits and risks of integrating open software into the platform and derive some strategies from historic examples.

Lerner & Tirole (2002) use a definition of "open source" applied by the Open Source Initiative and discussed by Perrens (1999). They give a good summarization of the definition. A program license is "open source" when:

- The source code for the program must be available at little or no charge
- Redistribution of the program, in source code or other form, must be allowed without fee
- Distributions of modified software must be allowed without discrimination
- The distributions of those modifications on the same terms as the original program must be permitted

Note that the open source license may not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license may not require a royalty or other fee for such sale (Perrens, 1999).

Apple's Mac OS X, has an open source core incorporated, named Darwin. Apple then builds proprietary code on top of the publicly shared open source code and sells IMac's containing Mac OS X operating software against a premium price (West, 2003).

Licenses

On this day many different licenses are available that fit the open source definition. General Public License (GPL) and Lesser General Public License (LGPL), Berkley Software Distribution License (BSD L), Artistic License and the Apache Software License are the most common. All fit the above the OSI definition, however some licenses imply more rules and restrictions then others.

Lerner & Tirole (2002) identify four categories of licenses. Highly restrictive licenses imply that the program cannot be compiled with proprietary programs and the source code from modifications to the program must be made available. Restrictive licenses do not impose the compilation restriction. An example of a highly restrictive licence is the GPL. It prohibits mixing of open and closed software and insures all derivative work remains subject to the same license. LGPL is less restrictive and allows greater flexibility towards the "mixing" requirement. Programs can link with non-open source software. BSD Licenses and Artistic licenses are alternative licenses that allow users to make commercial use of open source software. Lastly, commercial firms, that wanted to open up some proprietary code, launched licenses like the Apache Software License. The restrictiveness of the licenses will, among other things, affect the project's appeal to programmers greatly.

Programmer Incentives

The unpaid programmer faces a variety of benefits and costs when working on an open source project. The programmer incurs an opportunity cost of time for which he does not get paid for, unless he works with a commercial company or research institute. There are several benefits that motivate voluntary programmers to participate in an open source project.

Most programmers contribute because they want to fix a bug or customize the program for their own benefit (Lerner, Pathak & Tirol; 2004). Kogut and Metiu (2001) report, that more than 70% of the Linux and Apache contributors had made only one change to the source code. In the short-run, the programmers might also find intrinsic pleasure from working on a "cool" open source project, learning new skills or to become personally fulfilled.

Future rewards cover some more complex motivations. Programmers have career concern incentives for working on open source projects. They hope their work leads to future job offers, shares in commercial open source-based companies or access to the venture capital market. Further, they have ego gratification

incentives that stem from a desire for peer recognition. Both of these long-term incentives are stronger when: 1) their performance is more visible to peers, labour market and VC community; 2) the impact of their efforts has a clear effect on software performance; 3) there is pronounced relation between performance and talent (Lerner & Tirole, 2000).

These signalling effects are stronger in open source projects. Outsiders can assess the effort very precise because they have access to the code and the programmer takes full responsibility for his work. Efforts can also be transferred easier to new programs or work environments which makes programmers more valuable to future employers. Programmers will thus prefer to work on more open projects favouring for instance GPL and LGPL licensed projects in this regard. The choice of license has a big impact on appealing programmers but other factors such as: the quality of the released code, the licensor's reputation and the demand for the product have significant contributions to the project's appeal as well (Lerner & Tirole, 2000).

Other considerations that the licensor has when evaluating licenses, is the interaction with other software, hijacking by other commercial vendors, the impact on the incentives of complementary software producers, the familiarity of the licenses and forking threats (Lerner & Tirole, 2002).

Forking happens when competing groups of programmers take the project into different direction. Without clear leadership or vision, objectives might be insufficiently congruent and the project spins-off different versions. Leading to a loss of scale, inducing risk and porting costs to complementors. There will also exist a stigma attached to the existence of a conflict that can endanger the existence of the project altogether. Some form of leadership is necessary for an open source project to be successful. A commercial company cannot simply claim such a role because it can't internalize enough objectives of the open source movement. In order for a commercial firm to credibly commit itself to an open source project, it will need some careful governance structuring (Lerner & Tirole, 2000).

Firm Incentives

In previous sections, it became clear what the benefits and risks where when sponsors opened their platforms. The sponsor will always choose to stay as closed as possible. However, closed strategies may only be available to a few competitors in industries like the computer industry. Most have to open-up their

platform. A specific, radical way of doing so was to make source code available of key platform standards that can be shared with competitors (West, 2003).

Open source strategies drastically improve R&D scale, resulting in more reliable and stable software. Open software is naturally auditable, cheap and flexible. All of these properties combined form a very attractive solution when such features are desired. According to West (2003) reasons for adopting an open source strategy are:

- Gaining R&D scale
- Improve adoption
- Buyer demands
- Dominant open standards prevent competitive proprietary standards from becoming dominant.
- Shifting competition to another layer

Those benefits come at a cost. Customer switching costs are reduced, competition increases and the sponsor's options to capture rents are less straightforward then when a more integrated approach is used. Firms will find it difficult to achieve competitive advantages with these new strategies (West, 2003). Sponsors need innovative ways of capturing open source value.

In a nutshell, firms can profit from open source projects capturing benefits from their expertise in some segment whose demand is boosted by the success of a complementary open source program (Lerner & Tirole, 2000).

IBM promotes middleware that leverages the Linux OS and other open source software. It competes on service (consulting, integration, support and training), and offers an integrated system that relies on a mix of open source software and proprietary applications using Eclipse. Its key revenues were in mainframe and midrange systems where only a few competitors where left. With either service differentiation or a few real competitors, software commoditization is not much of a threat. The mere fact of open source software reducing costs and increasing demand was reason enough for IBM to incorporate open source software (Eisenmann, 2008; West, 2003).

Other times, so called hybrid strategies are needed. West (2003) identifies two categories of hybrid strategies. 'Opening parts' and 'partly open' strategies. The former consist of deliberately hand over control of certain platform layers while retaining full control of others. The latter discloses technology making it more

valuable to customers while making it difficult to be directly employed by competitors. Elaborated examples are found in West (2003). Apple employs the 'open parts' strategy by building its Mac OS X operating system on top of an open source project. Sun on the other hand, made proprietary Java code publicly available to fuel its adoption, hoping to establish a new platform with a common set of API's that could run on a wide range of computer systems.

West and Galagher (2006) look at open source as an innovation strategy in more detail. They argue that open source strategies are open innovation strategies because they share the right to use technology and the technologies are developed in a collaborative manner. Through open source it becomes easier for a sponsor to practice open innovation. By admitting external sources of technology into a company's innovation process, it increases the number of possible sources of innovation. Thereby, it becomes more dynamic and can increase more opportunities for future businesses (Chesbrchesough, 2004).

11 Conclusion

The 1st part introduced and carefully explained how 4 main drivers that characterize the smartphone operating system competition: increasing returns, switching costs, network effects and platform dynamics. It showed how competition is moved to the early market and these drivers could be used to leverage a company's capabilities and assets in general.

Early market competition leads to insecurity. Members do not want to commit themselves to a worthless platform. Members need to be convinced that a platform will deliver a high future value, while ensuring their future freedom. Thus, a sponsor has to decide upon the compatibility and openness of its platform. A highly compatible and open platform will generate much value and lowers the risk for potential members. It will be harder for a platform sponsor to extract this value. Open and compatible platforms can attract members easily, but compromise profitability.

Based on their strategic profiles, sponsors then decide how they will develop the platform and capture value. By setting a fit governance structure and degree of control, a platform can take advantage of the existing dynamics and create a growing profitable ecosystem that is able to lock-in a market and produce extraordinary profits.

Part 2: Case Study

12 Market Overview

Before Apple entered in 2007, handset manufacturers and mobile service providers saw their margins declining in a saturated mobile market. Advanced smartphones and mobile data usage and were perceived as solutions for the commoditization of the mobile market at the turn of the century. However mass adoption of these devices lagged and data services were not often used. Neither manufacturers nor providers could not profit from a new fast growing market as they had anticipated. With new competition arriving from upstream and downstream markets, manufacturers and operators gradually competed on price again (West & Mace, 2009).

Confusing interfaces, difficult set-up procedures, slow mobile data speeds and inferior Internet browsing experiences were the main raisons of consumer disappointment and slow smartphone adoption. Expensive, feature rich devices were used for little more than voice calls and SMS. The devices were perceived as dysfunctional and complex. They failed to deliver a satisfying user experience that could attract the masses and spur mobile data usage[6].

Especially insufficient browsing capabilities appeared to be a strong barrier for adoption, because consumers wanted the same Internet experience they had on PC's. Mobile carriers and manufacturers searched for new value in the creation of proprietary data networks. Their closed approach restricted the available content and an inferior Internet experience was further developed (West & Mace, 2009).

Four major roles can be identified in the current mobile market: mobile service providers (AT&T, T-Mobil, Verizon, Vodafone…), smartphone manufacturers (HTC, LG, Apple, RIM, Nokia, Samsung, Motorola…), operating system developers (Google, Apple, RIM, Microsoft…) and numerous application developers. The market is clustered in ecosystems that are centred around a mobile operating system. Companies are active in one or multiple ecosystems and can have plural relations with each other.

Early mobile devices[7] that combined cell phone features with PDA features offered added functionality by combining E-mail, WAP browser, fax, organiser, etc with existing cell phone features. The devices were sold to customers that were willing to pay a premium price and invest time in the complicated devices.[8]

Apple effectuated a strong force towards accelerated market growth and surged mobile data [9] by setting a new dominant design. They combined great functionality with unanticipated usability and simplicity. Thereby, Apple took away most of the barriers that prevented strong market growth[10]. The iPhone redefined the industry. It set a standard architecture for handheld computing, returned more bargaining power to manufacturers over mobile carriers and gave new opportunities to mobile application developers[11].

Manufacturers

Manufacturers are active in a quickly evolving and highly competitive environment. Hardware components (camera resolution, touch screen, battery...) become more commoditized and manufacturers no longer emphasize hardware specifications. With components commoditizing, it becomes increasingly harder for mobile device OEM's to differentiate themselves on hardware functionality. The key to differentiating is the integration of hardware, software and services bundled by a stunning design[12]. Consumers buy into experiences. Their purchases are not based solely on features and functions [13]. As most important linking mechanism, a solid OS is an imperative contributor to such an experience (Murrman – 1998).

Currently, there exist three sorts of operating systems: (1) proprietary, (2) licensable, and (3) open source. Apple, RIM and HP/Palm developed a proprietary OS, and offer end-to-end solutions to customers. Microsoft licenses Windows Phone 7 to third party smartphone manufacturers. It is cheaper to license an operating system then develop one in house, but manufacturers have fewer options to differentiate because the OS's adaptability can be limited by the licensor. Last, open source OS's such as Android, Symbian or MeeGo allow free use and customization providing a costless basis upon which manufactures can build their own OS[14]. Most non-proprietary systems enjoy lower margin[15] because most of them support similar OS systems. However, by customizing the platform and adding exclusive applications that improve software functionality, manufacturers can still distinguish themselves.

Third-party Application Developers

Third-party applications add a great amount of value to a smartphone.

Particularly email, games, Internet browsing, social networking, instant messaging, mapping & directions, music & radio, weather are expected to drive the application market over the next few years [16]. Compatibility with other

electronic devices and software applications becomes more important The industry shifts towards an ecosystem focus, increasing the system's value and lock-in consumers[17].

The applications market exhibits important network effects impose significant switching costs on consumers. Attracting developers becomes is important because they can give a platform an overwhelming competitive advantage that might not be overtaken easily.

Mobile Service Providers

Mobile service providers enable network access and can significantly influence user experience by delivering poor service quality and support. Because they subtract revenues from network usage, providers heavily subsidize handsets and have a capital impact on the price[18]. Since the introduction of the iPhone, their power has been drastically reduced. However, as consumers spend more time on their mobile network and use more data, they became progressively important to value network and regained some of their power[19].

Current Situation

Today, the worldwide smartphone market is growing rapidly. Reports expect the market to grow 49.2% in 2011. With an estimated 420 million shipments, smartphones will acquire a total market share of 28% of the global handset market[20]. Large numbers of consumers are entering the market, causing a very unstable and highly competitive current market situation[21]. Five powerful actors with diverse backgrounds, interests and strategies (Apple, Google, RIM, Nokia and Microsoft) have engaged in a battle for market dominance.

Their battle takes place in a highly charged arena due to existing increasing returns a possible positive feedback loops. Increasing returns stem from multiple sources:

- network effects between consumers and applications
- high up-front costs and low marginal costs
- fast and widespread diffusion of user experiences

There exists a strong focus to deliver a satisfying user experience, while strong technical restrictions have to be met. Devices are mobile and small. They have slower CPU's, less memory, a limited energy source and much smaller screen

sizes then conventional information consummation technologies. They leave little room for development errors. Every technical deficiency affects the user experience and weakens the market position. Consequently, mobile devices have a great need for an impeccable cooperation between components, operating system and applications. And strategies have to take this into account.

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13 Apple inc.

13.1 History

Steve Jobs and Steve Wozniak found Apple Computer, Inc. in 1976. Two years later they revolutionized the PC industry with the Apple II. It was the first easy-to-use computer that was mass-produced and consumer oriented. They introduced the computing experience we know today. The Apple II was a closed system relative to the PC architecture introduced by IBM. Then, the PC architecture took over the computer market, the highly anticipated Macintosh underperformed and Steve Jobs was removed from his operational role. Apple had rough years, suffering significant losses until Jobs returned to Apple (Yoffie & Slind, 2008).

When Steve Jobs returned to Apple in 1997 after an absence of 12 years Apple urged for change. More than a decade, they struggled to get a grip on the ever-expanding computer industry. Multiple CEO's tried to turn the tide without success and left Apple with a large number of unsuccessful product lines, under budgeted R&D and a weak brand. When Jobs was reinstated he brought back the initial focus of Apple, trying to bring the personal computing experience to students, educators, professionals and consumers. He reduced the number of product lines from 15 to 3, he increased R&D spending and reenergized the Apple brand to a hip alternative for Windows PC's (Yoffie & Slind, 2008).

In 2001, Steve Jobs elaborated Apple's vision on the computer industry. They saw the PC as a 'digital hub', interconnecting electronic devices and enhance their value greatly through powerful computer applications. Apple sees their fully integrated approach as an enormous strength in achieving such a vision. In order to successfully create a digital hub, hardware, operating system, applications, the internet and marketing had to be streamlined.[22]

Today Apple Inc.[23] is multibillion-dollar company. Under the reign of Steve Jobs Apple established a business model based on a forward vision and a customer lock-in strategy that is driven by smart branding and spectacular innovations.

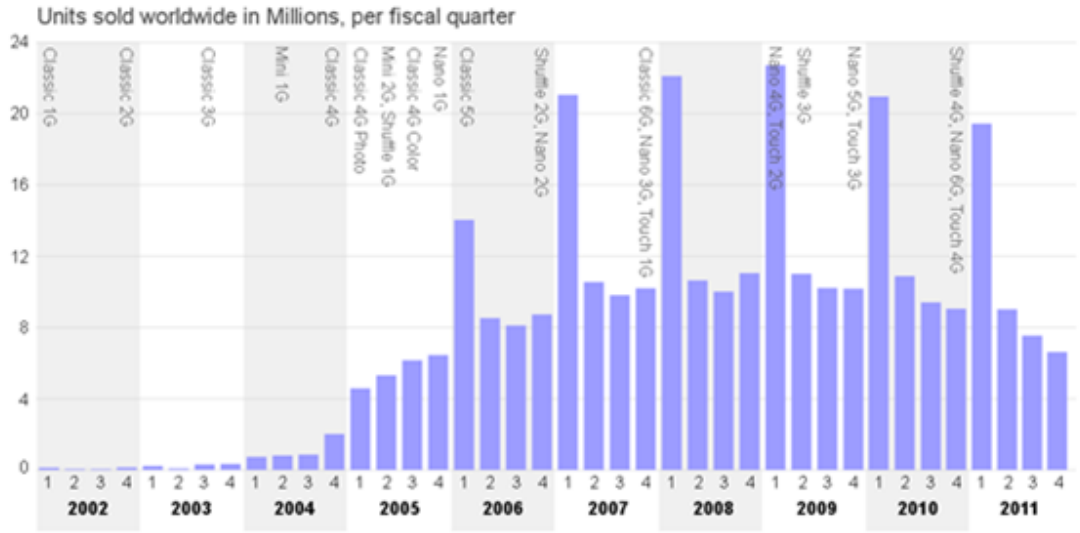
13.2 Business Model

Today Apple differentiates itself by offering a fully integrated 'digital hub' composed of four hardware product lines and supplemented by complementary

hardware, software and services. The core hardware lines are Mac, iPod, iPhone, iPad. Mac is a line of desktop and portable computers (iMac, Mac mini, MacBook, MacBook Air…). The IPod is a revolutionary music player. Together with the iTunes online music store, it set the terms of digital music listening and undermined the existing music industry. With the iPhone and iPad apple set the standard for smartphones en tablets creating two new billion-dollar markets[24].

These products stand out with their 'ease of use', security, high quality and design. All of Apple products are cutting-edge, fully integrated devices that limit user freedom but take credit in the fact that 'everything just works' and even more so 'everything just works together' (Yoffie & Slind, 2008). Every product can work individually but their value increases significantly when they are connected to other products. For example when the iPod was introduced, there already existed a number of hard drive mp3 players. The iPod took off relatively slow and it wasn't until the release of the iTunes store that iPod became a hit.

Figure 6 : Quarterly iPod sales since 2002



Source: Apple.com

Apple ecosystem Lock-in

Apple built an ecosystem of electronic devices that enhanced each other's value, persuading a customer to invest increasingly more in the apple products. Again,

the iPod-iTunes combination provides a clear and very aggressive example. Due to Apple's digital rights management setup, music bought from the iTunes store could only be played in three places: iPods, iTunes and a few Motorola phones. Switching to another device meant losing an entire music library (Yoffie & Slind, 2008). Apple uses this strategy also in the smartphone market as will be shown later.

Apple applies the same strategy for the OS (OSX) of Mac computers and core software. Core software such as iMovie (video editing), Garage Band (recording), Aperture (photo editing) for example, is software that acclaims a very good reputation and delivers quasi-professional output. Yet these programs are given away for free or against a low price, just like OSX updates. Apple subsidizes this software with their high-margin hardware[25].

Follow-on and replacement products are most likely purchased from Apple because they function better with the already owned Apple products and complements. Apple raises switching costs and generates extra income. For example, Apple was also able to converge iPod users into mac users, stimulating mac sales. And in February 2006, the New York Times reported that for every 3$ spend on an iPod, 1$ was spend on accessories. Around this time, the iPod accessory market had become a billion dollar market and Apple claimed a progressively larger part[26].

Lock-in drivers

Apple has the ability to deliver products that amaze people. The products exceed expectation[27] and create an unanticipated effectiveness. They disrupt markets and are adopted relatively quickly.

Apple releases products that provide basic simple features. However, these simple features describe a revolutionary concept, unanticipated by customers and other stakeholders. Next, Apple starts to iterate versions of the initial release: adding features, boost performance, diverge the line or even discard some versions of the product. Apple grabs attention with totally new concepts that are simple to understand and adopt. Later on, it adapts these concepts turning them into powerful platforms that provide a much larger functionality then the initial version conform to the customer reactions.

Take a look at the iPod assortment (Apendix 2). Other music players used buttons to navigate. Navigating 1000 songs was a struggle on these devices.

Apple introduced an intuitive way of scrolling through such large data collections, improving the user experience drastically. The first iPod had a Scroll wheel with four buttons around the wheel. Later models had a click-wheel using touchscreen technology. First, the buttons were placed above the click wheel, but a year later this was dismissed and the buttons where integrated back into the wheel. When the iPod matured Apple noticed that the shuffle function, which resided on a second level menu, was very popular. So first they moved it into the top-level menu and later, Apple released a very cheap iPod version based on this function known as the iPod shuffle.

The above strategy also enables Apple to create diverse product lines and provide a well-targeted migration path into the ecosystem. Apple is often perceived as an expensive brand. However, they do offer cheaper, less powerful alternatives to most of their products.

But, the migration path doesn't start there. Apple uses the interconnectivity described earlier to create even lower transition barriers. Free applications like Safari (internet browser), QuickTime (video player) and iTunes are distributed for free serving as a first Apple experience. They encourage private consumers to further explore Apple products. Naturally, the next step is the adoption of low-end, lower-risk products, designed to make the transition as smooth as possible. The simplicity and ease-of-use Apple is known for, plays a key here. So does the standardized look and feel of all apple products[2829]. The interconnectivity Apple provides locks in customers but it is also a key asset to attracting new customers.

The Apple ecosystem offers and delivers a great user experience. Apple has nurtured this and it built the world's most valuable brand on top of it (Apendix 3). Apple communicates feeling and emotion through slick design and smart advertising[30]. Apple communicates how their products can improve customer lives. They don't show off features and specs, but they show how people feel. Customers should feel smart, involved, inspired and challenged when they use Apple products. The strong emotional, experiential branding practices enhance the superior user experience and create a very loyal audience (Brakus, et al., 2009). Apple accomplished to set up a premium brand image. They charge premium prices and grow customer desire through great customer satisfaction and an emotional attachment that spreads among users (Apendix 4).

Supply Chain Control

Apple exercises an incredible amount of control on the entire value network. They control suppliers, secure crucial components and are committed to the smallest detail of their stores.

Apple controls component suppliers and assemblers with cash. Over the years, apple has accumulated incredible amounts of free cash. In Q4 2005, they had just under 10 billion free cash available, by the end of 2007 just under 20 billion. In Q1 2011, Apple recorded over 50 billion dollars of free cash. Apple uses their incredible amount of cash for strategic supplier purposes. It buys quantities of crucial components in advance and subsidizes third party component producers and assemblers in order to keep them competitive and innovative[31].

For example, in 2006 Apple bought an estimated volume of NAND flash memory used in iPods and iPhones, equal to 20% of the world's supply. It paid almost 70% of the 1,8 billion-dollar purchase price in advance and used only 208 million dollar worth of memory in the fiscal year 2006. Apple receives huge discounts and creates a scarcity of crucial components, forcing competitors to even higher prices for their components.

Apple holds a tight grasp on commercial content, supplied by iTunes, as well. Here's how they controlled their music supply. Back in the day, Apple provided a powerful answer to illegal downloading. Since then, Apple has become a major player and can prescribe nearly all terms of agreement. Initially, Digital Right Management software was used to prevent customers from copying and distributing music bought on iTunes. The software benefitted both parties, it provided security for record labels and it forced consumers to buy an iPod. ITunes used a fixed, 99 cent/song pricing scheme, offering cheap songs in clear way. This was necessary since the songs served as a loss leader for the iPod adoption.

ITunes thrived and the music business bounded their losses. Apple opened up iTunes for a much wider audience without losing total control of the pricing scheme. Prices could range from 69 cent to 1,29 dollar and not a single song was allowed to be cheaper elsewhere[32]. Now iTunes serves as an easy way for customers to become acquainted with Apple products.

Lastly, Apple maintains strict control over its retail channels. It uses proprietary stores and third-party resellers under strict conditions. Third party resellers provide reach, and relative fast diffusion of apple products. Apple does impose restrictions that assure 'the Apple experience'[33] and low retail margins[34].

Meanwhile, Apple carefully expands their proprietary chain of retail stores. These retail stores where created by Apple after bad experiences with retailers who lacked commitment to sell Apple products[35]. Apple doesn't compete with specs but with experiences, so the selling process had to be adapted accordingly. They set up stores with a unique layout, space for demo's, services, and workshops. There is even space for socializing. The concept proofed valid and retail chain grew to become one of the most productive in the world. They sold over $4,000 of products per square foot, in comparison, number 45 in the 2011 retail fortune 500 list, Best Buy, sells five times less per square foot[36].

In the fiscal year 2011, Apple will open between 40 and 50 stores all over the world. Apple's powerful position and superior shopping experience allows it to open stores wherever it wants, regardless of nearby third-party retailing presence.

Constant innovation, a well-thought migration path, smart branding enabled Apple to lure and lock-in millions of consumers worldwide in a very profitable way. A tight control over every aspect of their value network allows Apple to sell and deliver experiences instead of products. A customer experience, envisioned by Jobs in 2001 as a 'digital hub,' that became tangible with the introduction of the iPod.

13.3 iOS

IOS was introduced on the first Apple iPhone in 2007 and later on the iPod touch and iPad as an extension of the initial iPhone strategy. IOS diffusion naturally depends on the diffusion of the iPhone and the other devices.

iPhone 2G

Apple introduced their iPhone as a revolutionary product that combined a phone, the iPod and an internet communications device. It included a cell phone, a video iPod, an e-mail terminal, a web browser, a camera, an alarm clock and an organiser. The iPhone had the largest screen on the mobile market, no physical keyboard, and a multi-touch screen that allowed adaptable, intuitive user interfaces. Most features were already included in earlier rival models but what made the iPhone so successful was the internet browser[37].

When the iPhone 2G was launched, numerous attempts had already failed to successfully introduce mobile data services on a large scale. Consumers were accustomed to unlimited, free, high-speed data by using desktop internet. Every attempt delivered limited and mobile surfing experiences. Apple noticed this

unmet need and released a device that offered a desktop surfing experience (West & Mace, 2009). The iPhone was a breakthrough product that enabled a satisfying internet experience and set the dominant design for future mobile internet access. It was the first mobile device that offered a browser that complied to the PC standard.[38].

Initially Apple had a straightforward plan. It captured iPhone value by selling the device against a premium price. They charged $499 for a 4-GB model and €599 for the 8-GB model, enjoying an estimated gross profit margin above 55%[39]. In addition, Apple demanded a share of the operator's subscriber fee instead of letting the operator subsidize the initial purchase price of the device. In return, Apple granted nationwide exclusivity[40].

Previous efforts by Symbian, Palm, RIM and Microsoft embraced the idea of a converged device that could add new functionality through third-party software. Apple clearly did not and focused on web browsing, music and video rather than a providing a full converged phone. ITunes and Safari (preinstalled web browser) were the only applications that gave access to value added content provided by third parties. Apple said to believe in web-based applications instead of user-installed applications (West & Mace, 2007). However, Adobe Flash and Microsoft Silver light were not incorporated because Apple supported HTML5 development[41].

Apple leveraged their existing business in numerous ways. First off, their ability to innovate created a new market. It broke the handset device free of its commodity status and provided a solution for generating substantial mobile data usage. Apple also controlled a large, locked-in and loyal iPod/iTunes user-base that could be transferred to iPhone. This user-base together with the performance disparity gave apple a clear advantage in negotiating with providers. They could charge premium prices, benefit from data usage and retain control of the downstream supply chain[42].

Although the iPhone did not initiate a direct competitor response, the chosen business model also left Apple with some vulnerability. There was the high price and the slow network[43] but not offering third party software that would increase the iPhone's functionality appeared to be the greatest weakness of the iPhone[44].

iPhone 3G

At the launch of the iPhone 3G, apple introduced the iTunes App Store and a new pricing strategy. Instead of claiming operator income, Apple let operators

subsidize the device. Their new strategy tackled three, major shortcomings of their first proposition. Apple upgraded the network, reduced purchase prices and allowed third party applications. All the existing iPhones got a free OS update so they ran the same OS the iPhone 3G[45]. Meanwhile, the iPhone was introduced in an additional 64 countries and Apple was willing to sign up more than one wireless carrier per country[46].

Apple now aimed at a widespread adoption of the iPhone and sold over 5 times more iPhones in 2008[47]. Apple allowed subsidizing instead of shared subscription revenue, spurring adoption. Apple did not receive a percentage on data usage but recaptured value by selling applications through its App Store and charging a 30% revenue fee.

It was able to attract 500 applications when it launched the App Store. The number of applications swelled to 800 during the first weekend and they got downloaded over 10 million times. From here on, the number of downloads and available applications grew exponentially. On July 7 2011, Apple announced over 15 billion apps were downloaded from the App Store[48].

Apple controls every aspect of their mobile application market network. They designed the market; they have full control over the operating system, the hardware and the payment system; they provide comprehensive development support. Apple offers mobile application developers an end-to-end environment to create and distribute mobile applications.

iPod touch and iPad

Four months after the iPhone was released, Apple introduced the iPod touch. The iPod touch was positioned between the iPod video and the iPhone, a new high-end iPod or a cheaper iPhone. The iPod ran the latest version of iOS and was updated accordingly to run third party applications[49]. In January 2010, Apple launched the iPad, a multimedia device featured iOS on a large screen. It ran all of the apps available on the App store while addressing new customers.

13.4 Discussion

With the iPhone, Apple was able to introduce revolutionary product without abandoning an already lock-in user-base. ITunes and Safari were essential to their strategy. ITunes provided a migration path that decreased iPod users' switching costs. They could transfer their acquired music and video's effortless from an iPod to an iPhone. Since the iPhone had an intuitive easy-to use interface,

the only serious switching costs left were the initial investment, some accessories and switching costs imposed by carriers. Apple tried to compensate this by offering a compelling user experience and branding.

Despite these efforts, serious barriers of adoption still existed, Apple's pricing decisions, network and application choices were not encouraging adoption. However, once these were gone and distribution expanded, iPhone adoption rose sharply. Lower prices and added functionality supported by a faster network and third party applications, drove iPhone sales[50]. The introduction of the App Store was an incredible success and network effects naturally spurred iPhone adoption. Drawing upon The theory, there are a number of reasons that explain this success.

Apple had an installed base of users when it introduced the App Store, giving developers a potential market. Apple learned that there existed a substantial demand for third party applications and introduced the first end-to-end mobile application market. Being in control of almost every aspect surrounding the App Store allows apple to provide a great user experience[51] – fostering downloads- and low developer entry barriers[52] - attracting application developers.

Positive feedback effects took off quickly because there was an installed base and strong positive expectations. Expectations were fed by unexpected effectiveness, past successes (iPod/iTunes, iMac) and a powerful brand. Strong network effects are fostered by low transaction costs, and the fact that consumers appreciate application variety[53], adds strength to these network effects resulting into an exponential use of the App Store.

Apple employed a reverse razor-and-blade business model to capture value from the iTunes and iPod. Instead of selling razors cheap and make money of the blades, they sold the variable element cheap and profited from the iPod (Yoffie & Slind, 2008). Apple employs the same strategy with the iPhone. The App Store runs just about breakeven, the 30% revenue share and small upfront fee gently cover expenses[54]. The App Store clearly functions as a loss leader in order to sell more iPhones.

When Apple introduced the iPod, they recognized the value of digital music and found a way to drive hardware sales. When they observed the value consumers assigned to iOS applications, they switched their original iPhone business model. Initially, Apple exploited their strong position, but later found it more profitable to

nurture it by attracting new customers to their ecosystem via easy accessible and cheap applications and selling them high margin iPhones. Later, more devices where added that ran iOS. The App Store was successful and via more diverse products lines, Apple extends its reach and lock-in even more consumers.

Apple has the ability to impose strong switching costs upon consumers making them extremely profitable. Every time an apple customer considers a new purchase: a new computer, a tablet, a new smart phone, he has valid incentives to purchase an Apple product[55]. Apple is able to profit from high margins on these purchases because Apple also has a strong control over their entire value network , turning Apple into one fastest growing smartphone manufacturers[56] both in sales as in market share.

13.5 Conclusion

iOS' market presence is evolving modest in terms of market share. Android OS profits from a fast diffusion being supported by multiple manufacturers whereas Apple develops, produces and distributes each device. Although doubling its quarterly sales in one year is quit impressive, Apple appears to be limited by its production and distribution capabilities to become the smartphone OS standard.

Their iPhone 4 release in June 2010 was perceived as a chaotic and aggravating experience. Apple's Pre-order system broke down due to heavy traffic. Nonetheless, pre-orders sold out within the day[57]. 600,000 units on the first pre-ordering date made Apple freeze the pre-orders and push back the shipments date from June 24 to July 14[58]. When the device finally went on sale, Apple sold over 1.7 million devices[59] but missed out on even more sales[60]. Missing out on sales, hurts the Apple brand and drives potential customers to competitive platforms. This will result in a weaker Apple ecosystem, and stronger competitive platforms.

Developers are essential to Apple's strategy since they determine the attractiveness of Apple's best selling devices. Apple is inquired to maintain the developer profitability[61]. It has to counter a larger potential market of Android users with higher efficiency, and platforms users that are more profitable. To date, the App Store has been an overall success and turned IOS into a very profitable environment for developers to deploy new applications.

IOS still enjoys the most developer interest[62] due to their great usability and a strong dominance on the tablet market. The iPad dominates the tablet market,

with 68% of all tablets running iOS. This enhances Apple's capabilities of attracting developers significantly[63]. As long as the iPad can dominate the tablet market, the iOS platform remains the preferred option for most developers. But once this dominance disappears, and competition becomes more intense, iOS will be less of a clear choice to deploy new applications, especially if the criticism on the approval process persists.

However it seems Apple is not aiming to become the mobile device-operating standard, it is out to advance their profitable business of creating an interconnected, personal, digital environment. They would rather set up a powerful ecosystem that is very well interconnected, than pursuing widespread adoption. With cloud services being launched this appears to be the direction the consumer electronics industry is heading. Looking beyond the smartphone market, Apple seems to be setting itself up for al long-term strategy that goes beyond smartphones domination. However it will be crucial, for them, to remain a significant mobile OS competitor, and a powerful force to be reckoned with.

14 Google Inc.

14.1 History

Google is a software company founded in 1998 by Larry Page and Sergey Brin. They were one of the frontrunners of a new business model that develops and provides services and software paid by advertisement money. They created an business of content and advertising stemming from a superior search engine and an innovative way of monetizing through advertisement (Eisenman & Herman, 2006).

Before Google started, search engines users were frustrated. Search algorithms were based on the frequency of keyword references. Engines could be spammed by adding certain keywords to a website resulting in increasingly irrelevant information. Page and Brin introduced their PageRank algorithm that favoured pages that were referenced more by other pages. This approach produced more reliable results (Eisenman & Herman, 2006)

Initially, Google licensed their technologies to third-parties. But in a later stage, Google adopted a variant of Overture's paid-listings model. Paid listings are short text ads identified as "Sponsored Links" generating revenue each time a link was clicked on. Because announcements were linked to related searches, they were more effective and marketers only paid when their ads were visited (Eisenman & Herman, 2006).

Marketers tended to bid high on popular keywords that were closely related to their products. In Overture's system, firms could bit on popular keywords that were not relevant. As a result, keyword bids were high but click-through rates were low. Overture would only receive money if visitors clicked on the sponsored link so high bids don't necessarily meant high incomes. Google introduced a Quality Score that helped to ensure bids generated income. A Quality Score consists of factors like, CTR of the keyword, CTR history advertiser, quality of landing pages, load time of landing pages, performance of the ad account, relevancy, etc.[64] The Quality score provides more relevant advertisement, and it maximized Google's revenues (Eisenman & Herman, 2006).

14.2 Business Model

Google's mission statement says "Google is in the business of making all the world's information universally accessible and useful65". Google resides in a two-sided market. More users generate more advertisers and higher bids. Search engine users exhibit positive network externalities on advertisers. More engine users result in more potential sales. Advertisers do not exhibit similar effects. They rather repel users when their presence is too obvious and harming users' experience.

Google's Business Model focuses on two pillars:

- Improving advertisement efficiency
- Enlarging and securing a user base

Google charges a cost per click and no fee in advance. This reduces upfront investments and lowers advertiser risks. However, usage fees reduce network externalities imposed by engine users on advertisers, which is unfavourable to Google. Google prefers strong user-to-advertiser externalities because then their efforts towards users will be more effective.

So to increase positive network effects without charging a fixed fee, Google maximizes returns on advertisement investments by improving advertisement efficiency.

The 2nd pillar focuses on the user experience. Actions include: 1) improving user experience; 2) engaging users; 3) expanding the potential user base. It is important to attract and retain users, in order to convince advertisers and reap the benefits of the existing network effects.

Google's efforts are focussed on attracting, pleasing and involving users. They try to lure them back over and over again. Search engines exhibit no switching costs[66], so Google assures qualitative, objective search results to lure customers and locks them in with their 'free' software products. (Eisenman & Herman, 2006).

Search

Google assures objective and relevant search results at high speed. They try to communicate their integrity concerning search results as much as possible, stating and delivering non-compromised search results. They state never to adjust these results for extra short-term advertisement revenue and they avoid

all editorial interference. Most of their R&D is devoted to developing new search algorithms and expanding their search domain (Google video, Google scholar…) in order to deliver more relevant results, faster. Search is Google's focus and it's what they do well. Google also dedicates many resource to the innovation of their servers, increasing speed once more. Google keeps the engine's webpage clear and simple to create a straightforward user experience. It avoids pop-up and flash advertisement in their results and believes advertisement can be as effective without[67] (Eisenman, & Herman, 2006).

Google Products

In an effort to keep users involved, – still being in-line with their mission statement- Google expanded their activities away from 'just' search (Eisenman & Herman, 2006). It has created products like Google Earth, Google Maps, Picasa, Gmail, Chrome… and provided as much connectivity between them as possible.

First off, these products make users more committed. They address a variety of consumer needs by developing specialized software products, offering them for free, accompanied by advertisement (Eisenman & Herman, 2006). Applications such as Gmail can easily lock-in a user, overtime. Users get accustomed to the interface; their Gmail-address is spread among people, and they collect hundreds of mails and contacts in Gmail. Google improves this lock-in effect further by interconnecting many of their applications.

Second, Google applications leverage Google's ability to obtain marketing data. Google is able to assemble rich profiles of individual users by tracking demographics, psychographics and online behaviour. Thereby they can target advertisement better and enhance the Search/ CTR efficiency for advertisers[68] (Eisenman & Herman, 2006).

Lastly, the products extend Google's reach and they enhance internet usage. With desktop applications such as Google Earth, Picasa or Google Desktop, Google facilitates internet access and profits from increased Internet usage and has shown much effort to develop overall usage. Andy Rubin stated at the Mobilize 2009 conference, "*what is good for the Internet, is good for Google. As long as the web moves forward, more people access the web and the services become are available, globally… that is going to be good for Google. Since our core business is advertising*."[69]

Mobile Advertisement

Predictions indicate mobile advertising spending will rise with a compounded rate of 34% from 2009 until 2014. In 2014, this will be a multi-billion dollar market which gives Google a good reason to focus their extension efforts on mobile Internet[70]. They envisioned new possibilities that take maximum advantage of the mobile device capabilities. Directly calling a firm from a search query, using a photo as query input or engaging interactive in-app advertisement are some the new advertisement possibilities on mobile devices. This way, Google hopes to broaden their user base and usage frequency while targeting their advertisements even more specific.

14.3 Android OS

Google acquired Android Inc. in 2005 and used its open-source mobile software platform as basis for the Android Open Source Project. In October 2008, after more than three years of proprietary development, Android OS has been released to the public, allowing everyone to contribute to the development and improvement of Android. Here, Android's technical structure is addressed.

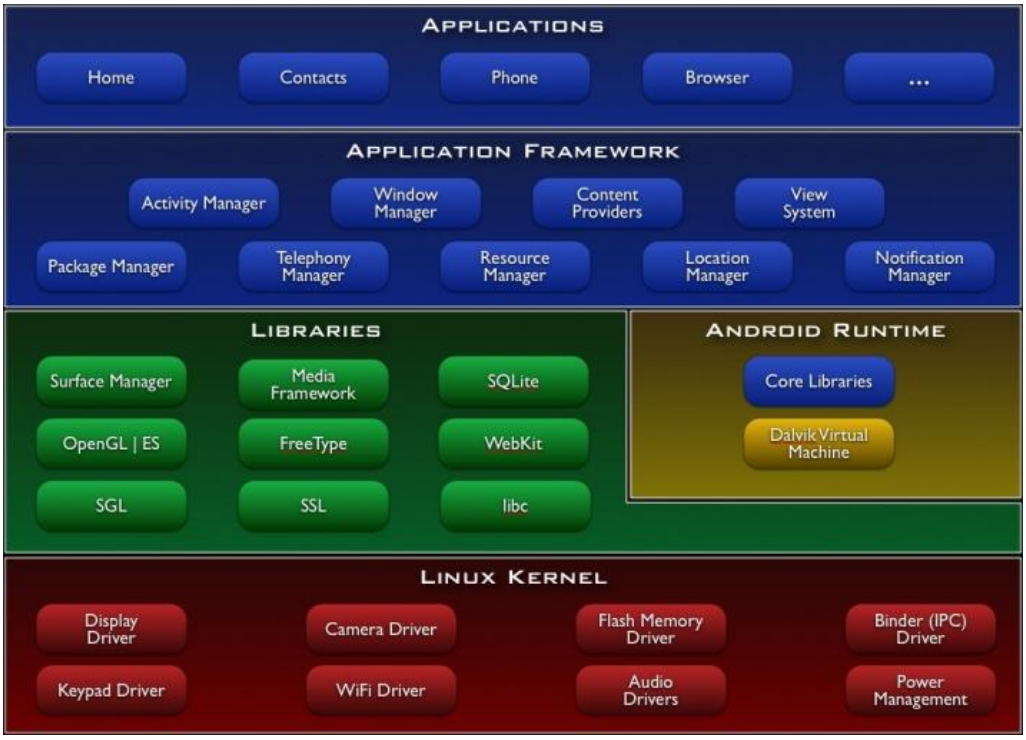
Android is a software stack for mobile devices that includes an operating system, middleware and key applications. The various components are designed as a stack on top of a Linux kernel and it is originally designed for cell phones. (Amit Kumar Saha, 2008). The Linux kernel, a General Public Licence (GPL) licensed software core that has already proven its value in other IT businesses. IT is a stable, secure, compact and open software core. It includes hardware drivers; it does memory management, process management and includes a network stack.

On top of the Linux kernel, there are native language libraries that can be accessed by developers through an extensible application framework. Android applications are written in Java Program Language and run in a virtual machine especially designed for android, the Dalvik Virtual Machine. This is a more efficient interpreter of the java programming language. It uses less memory and energy than a classical JPL interpreter because it can run multiple instances of Dalvik at the same time[71].

All layers are released under open source licences. The Linux kernel is released under a GPL license. Other layers are released under an Apache Software Licence (ASL). ASL is a permissive licence that has been used for many years by the open-source software community and has been approved by the Open Source Initiative. The ASL licensing attracts handset manufacturers in two ways.

The software is free and it is flexible enough to enable device differentiation. The open source nature ensures a software package that is reliable and stable because anyone can look into the source code[72].

Figure 7 Android OS architecture



Source: developer.android.com

Unlike a less permissive licence like GPL, ASL allows android code to be combined with proprietary code and commercially exploited without the obligation of returning the added code to the community. This provides incentives for licensees to innovate and compete. With ASL, manufacturers can generate profits using android without drastically changing their business model. They can keep on making money by creating and selling new devices with unique features[73] [74]. All together, Android OS aspires to be the preferred OS of platform providers. It tries to be the cheapest OS option while still offering the performance and flexibility needed to develop a competitive unique mobile device.

14.4 The Android Open Source Project

The Open Handset Alliance

Google has released Android as the flagship project of the Open Handset Alliance. The alliance consists of operators, handset manufacturers, semiconductor companies, commercialization companies and other software companies. Today, the alliance counts 82 technology and mobile companies. Members are committed to accelerate innovations and create an inexpensive and better mobile experience. They contribute significant amounts of software code, deploy mobile devices or support the mobile ecosystem through products and services that will improve the availability of the devices (Annex 5).

Google leads the OHA. It formed, structured and maintains the alliance and thereby the Android Open Source Project [75]. Google operates the project development and is responsible for the strategic direction of Android as a platform and a product.

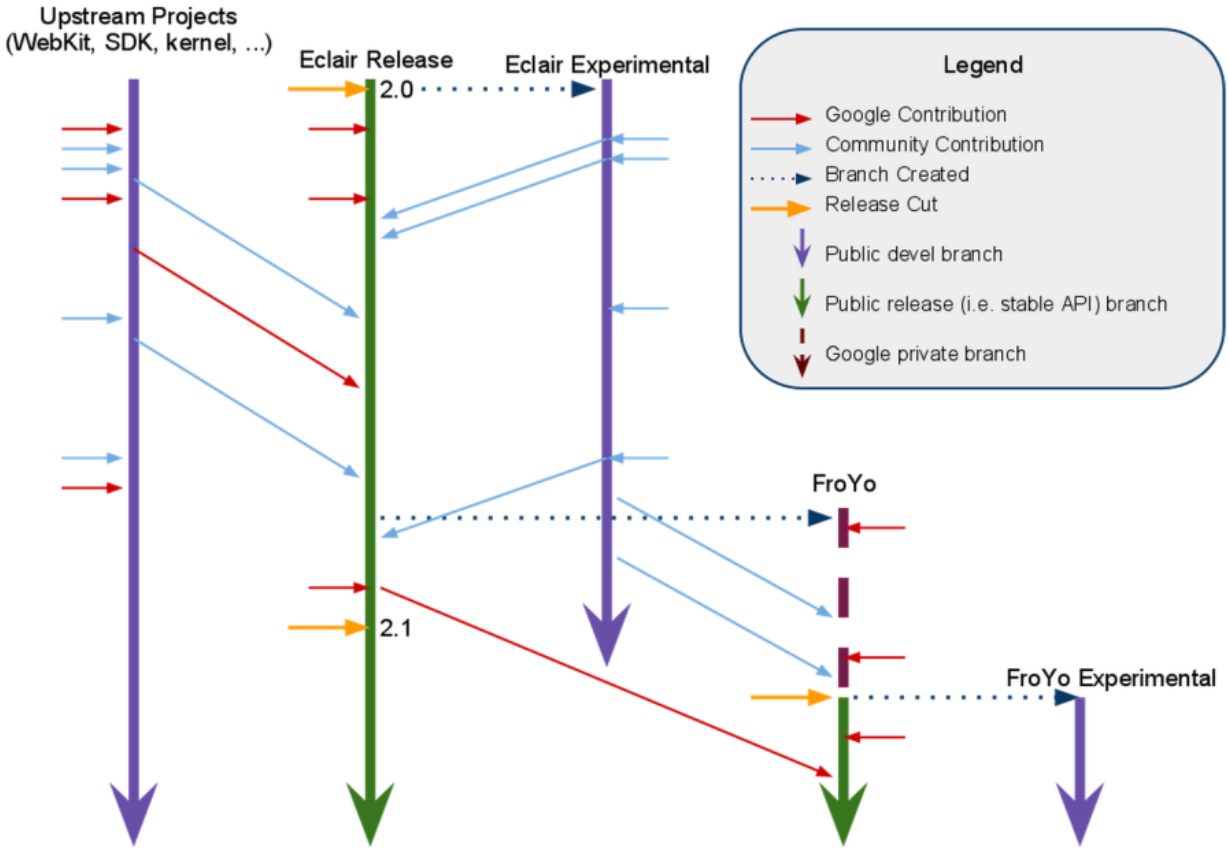
In cooperation with a number of OHA core members, Google prepares new official platform releases in-house. These are the "n+1"th versions known as Android 1.5 (Cupcake), 2.0 (Éclair), and 3.0 (Honeycomb). These are stable versions that feature new abilities and that are stable enough for consumer usage and adjusted to work well with a number of flagship models[76]. The success of Android depends how the OHA can come together to create desirable user experiences. Crucial to this are great devices and lively communities that grow the ecosystem.

Manufacturers and providers are left a great degree of freedom to differentiate. Google wants to control possible diversion with the Android trademark[77]. In order to sell a telephone with Android OS, a device manufacturer has to comply to Google's terms and conditions specified by a non-fragmentation agreement, signed by the OHA. Members of the OHA promise not to modify the Android code in a non-compatible way, in order to assure interoperability. The objective is to keep the android platform from fragmenting into different versions. Fragmentation would make it harder for the market to adopt the Android platform as the standard OS and it would slowdown mobile internet usage as a whole[78].

The Open Source Comunity

Next to this, the entire developer community can contribute software code to the in public branches. These are experiments of current platform versions and upstream projects (Webkit, SDK, kernel, Dalvik,…). During the lifetime of an "n+1"th version, a number of adjusted versions is released such as 1.6 (Donut), 2.2 (FroYo), 2.3 (Gingerbread). Resulting releases are slightly adjusted and improved "n+1"th versions, based on community and in-house improvements.

Figure 8 Android development tree



Source: developer.android.com

Community contributions are vital to the development of Android. Exertions not only come from the OHA, they come from an entire community of voluntary open software developers.

Google puts great effort in fostering and maintaining a healthy open source community since numerous Google products prosper from external input. Google is a strong advocate of the open-source movement since many of their products incorporate open-source code. Next to this Google contributes to existing open-source projects, funds others and organizes Open Source events. Large yearly conferences, programming competitions and a student-mentoring program are some of their more explicit actions.[79].

Furthermore, Google hosts the Android Open Source Project and other projects on Google code, a collaboration space for open-source developers. Via Google Code and other dedicated platforms[80], developers are able to create open source

projects, find fellow developers, access a number of tools that simplify programming and enhance the code's quality, track on projects and other developers and much more[81].

By doing this, Google enables the creation of more open-source code on which Android and many other Google products run. They nurture future generations of programmers and they win community sympathy for being a supporter of the open-source community. It is a carefully balanced relationship that Google has with the open source community. Google contributes to the community but takes plenty from it. The open source community is an essential ally of Google and Android, but they tend to be very critical so Google has to develop their relationship and open source strategy with great caution[82].

Applications Developers

Android is open source, so it also allows a lot of freedom for app developers. Developers have access to the source code. They can implement and extend their ideas. A large open source programmer community provides wide and easy accessible support. Application developers don't have to pay licensing fees and are only subject to the policies of Google while they are able to distribute their applications for multiple devices.

Android app developers choose how and where they offer their applications. Google established an Android marketplace through which applications can be distributed. Developers can offer their applications on this market against a 30% royalty fee and in compliance with Google's marketplace policies. They can choose to distribute them on alternative markets or through proprietary channels. Google assures the existence of at least one decent platform for application sharing. However, it appears that Google relies on market forces to regulate this aspect, since their Android market shows a rather limited functionality[83].

A third aspect that favours android as an application development platform is that applications can be written in Java Programming Language. JPL is reliable, generally applicable and relatively easy to learn. Since JPL is already widely utilized, learning costs for many developers are moderate and switching to Android application development is enhanced.

14.5 Discussion

Google's main objective is to develop mobile advertisement as fast as possible. Google attains their rational of improving advertisement efficiency and enlarging

and securing an operative user base. They promote internet usage and create innovative new ways of advertising.

Google has a sincere disadvantage by entering the market late. A year and a half after Apple had introduced the IPhone, the first was Android phone was introduced. The market was developing fast and present network effects and collective switching costs, put Google in an unfavourable starting position.

The Open Handset Alliance provided the credibility to the project that was crucial to attract a critical number of early application developers and form a lively Android open source community. With a strong majority of the industry supporting the project, Google gathered enough positive expectations to ignite adoption.

Google's open strategy allows for great degree of differentiation and competition, generating various devices at a fast pace. Meanwhile, application developers can serve a large, rapidly expanding market. Google set advantageous terms to recruit numerous and powerful ecosystem members. It was able to reduce consumer adoption inertia and expand the market at a fast tempo. Google ensured a fast adoption pace and prevented incompatible systems from crowding the market. It moves a large part of inter-technology competition to intra-technology competition on a widely accepted platform that pushes mobile internet usage. Being the main-sponsor of the platform, allows Google to branch its mobile activities and control the mobile advertising market.

The open strategy did what was expected, it enabled a fast development and adoption. Since its release, Android devices diffused at an incredible pace. With 6 798 000 units in 2009 augmented to 67 224 500 units in 2010. Android OS market share rose from 3,9 to 22,7 in one year (Gartner, February 9 2011) [84]. Applications pursue the same trend, growing exponentially to more then 200 000 available applications[85].

14.6 Conclusion

The future for Android looks bright with a growing number of developers and consumers. Android is well on its way to lock in the smartphone market and set the operating system standard. There are some concerns that need to be addressed by Google before they seriously damage their market position.

The open structure of the Android platform facilitates fragmentation. Different device measurements, different features, customized API's, user and operator

diversity, are all bases of diversification. Fragmentation complicates every aspect of developing new content and applications, from business model readjustment to testing new products. It reduces quality, narrows the market, raises costs, increases time to market and slows down market growth[86].

Google made the OHA sign a "non-fragmentation agreement" but developers still experience increased fragmentation[87]. Because resources like battery life, small screens, small CPU's etc. restrain mobile devices. Every element of the system has to respond and work together seamlessly, in order to create a good user experience. With more devices supporting the Android platform and applications becoming increasingly demanding, concerns about fragmentation become more relevant. They should be addressed in time, as it already affects developers' interest[88].

Android an open source project but to control project fragmentation, Google does not open many aspects of their governance structure. They provide unequal code access; have no publicly available roadmap or transparency of code contribution processes. These actions compromise Google's commitment to the open source community, and they have the potential to endanger the community's cooperation[89].

A last concern involves Google's recent struggles with patent claims. Google is largely depended on open software and does not have many proprietary licensable patents. The legal landscape in high tech industries consists of settling infringements by cross licensing patents. In 2011, the Android has been under some heavy attacks from Oracle and Microsoft, who are claiming infringements and demanding licensing fees from device manufacturers[90]. Until now (august 8 2011), Google has been unable to settle these claims by counterclaims and cross licensing. They do not possess the intellectual property to protect their platform. If the manufacturers have to pay licensing fees, Android loses an important asset. Google might lose its leading position and unload their grip on mobile advertisement.

15 Research in Motion

15.1 History

Mike Lazardis founded Research in Motion in 1984 in Ontario, Canada. RIM started as an automation contractor and became a developer of digital wireless systems in the early 1990's. During this period, they gained much experience in setting up wireless email systems. In 1997, RIM commercially released a two-way pager, named Inter@ctive Pager that enabled users to send and receive emails. The 'smart pager' featured a QWERTY keyboard and a four-line text display. RIM sold the Inter@ctive Pager mainly to large companies as IBM and Panasonic for use by their field service representatives[91].

RIM extended their operations in 1999, by setting up the BlackBerry mobile email solution that actively transferred emails onto the device. Instead of calling in to the corporate server or PC to read new messages, users received a notification when new messages arrived. Instead of working with special addresses, they could use their regular email address. Users could access their mail effortless and quickly respond to them. The technology also allowed Blackberries to synchronize a built-in address book and calendar with desktops.[92].

RIM was able to offer a full end-to-end solution to businesses. They combined network services, server software, handheld devices and desktop software. The ease of use and strong encryption were strong selling propositions, RIM built upon over the next years. They added more functionality with features like web browsing and telephony. By 2002, approximately 321,000 people and 14,400 organizations subscribed to BlackBerry[93].

Over the following years, BlackBerry was able to fend-off some powerful competition from converged mobile devices that threatened the BlackBerry enterprise business and they could profit from elevated consumer interest. By the time the iPhone was introduced, RIM had become an important player in the smartphone market[94].

15.2 Business Model

Research in Motion their value offer focuses on the integration of data transport. It is mainly directed at enterprises, but scalable to the needs of individuals. They offer a complete mobile solution brought together by BlackBerry devices and

BlackBerry OS. It consists of mobile devices, mobile device software, desktop software, server access, technical support, training and a number of other components that improve to the mobile experiences of their corporate and SME customers. Individual users are targeted with high-end devices, supporting software and data plans. They can buy smartphones, download free desktop software to synchronize the phone and subscribe to BlackBerry service plans via mobile network providers[95].

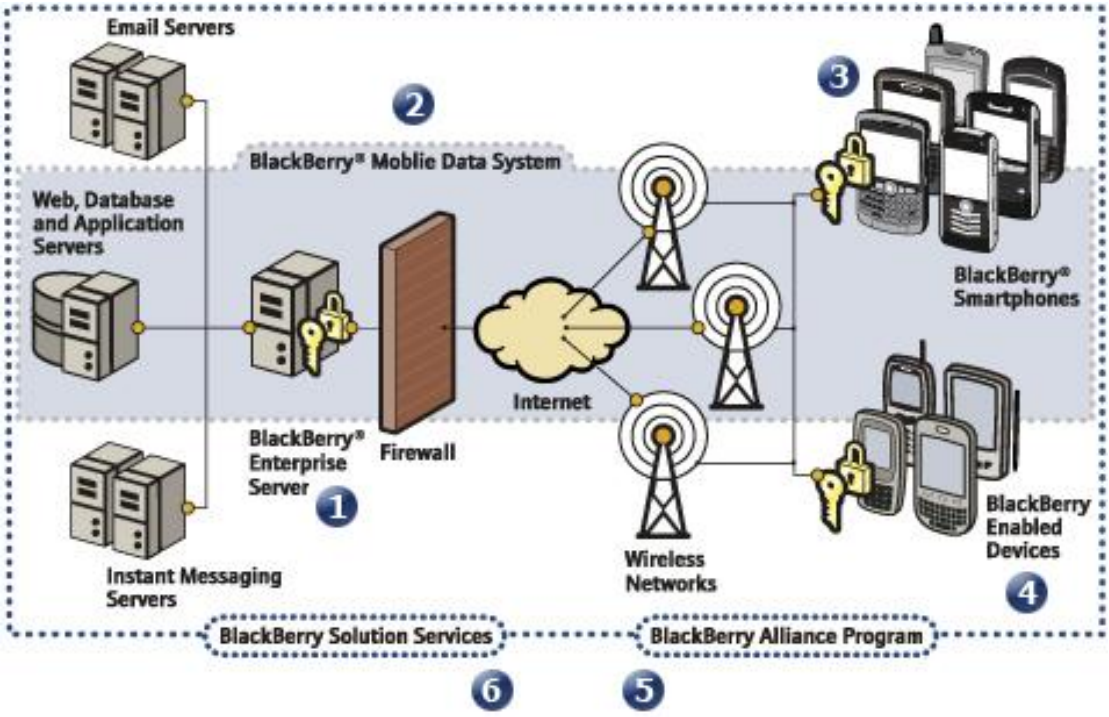
The BlackBerry Enterprise Solution is more comprehensive in order to address corporate needs and enable personal usage. It is based on the BlackBerry Enterprise Server (BES) software and the BlackBerry devices. BES is a middleware platform that is used to optimise wireless corporate email delivery, enterprise messaging and personal information management tools. BES software is compatible with popular email server software such as Windows Exchange, IBM Lotus Domino and Novell GroupWise[96]. The layered architecture of the BES and the BlackBerry Mobile Data System (MDS) enables custom management applications development and deployment[97]. MDS represents server capacity, developer tools and device software that run the applications[98].

RIM enhanced their ecosystem by making their BlackBerry Enterprise Solution available at numerous mobile networks and offering a wide range of services[99]. They also assembled independent software vendors, system integrators and additional solution providers who offer customized applications and services[100]. RIM brings together all aspects to mobilize a company. They are able to offer out-of-the-box solutions next to customized solutions that are flexible and have powerful security features[101]. The BlackBerry Enterprise Solution centralizes all IT management tasks and distributes corporation content wireless. It makes corporation content highly available and easy to manage[102] in a cost-effective manner.

RIM's captures most value by selling high margin BlackBerry devices (80,2% of all revenues in February 2011)[103] at a premium prices[104]. The ecosystem generates smartphone sales and locks in customers. RIM is able to effectively lock users into their ecosystem and extract more value by enhancing and updating their phones and services on a regular basis. Not only do they lock-in consumers via their employers. BlackBerry Internet Services creates significant switching costs for individual consumers[105]. Switching costs that stem from network providers are now supplemented by switching costs imposed by RIM.

However, because RIM's end-to-end offer is unique and beneficial to some customers, they are less discouraged by the switching costs BlackBerry enforces.

Figure 9 BlackBerry Enterprise Server architecture



Source: BlackBerry.com

15.3 BlackBerry OS

BlackBerry devices currently run BlackBerry OS 7, a proprietary, java-based operating system especially designed for BlackBerry devices. Not much is published about the operating system's underlying structure aside from the absolutely necessary information to develop applications. On top of this structure there is an internally developed Java Virtual Machine that translates the Java code. Both Java ME API's and proprietary BlackBerry API's can be used to write applications [106] . BlackBerry OS supports standard application development technologies such as HTML/HTML 5 and Java. BlackBerry also supports hybrid applications, called Widgets that are standalone applications based on web technology[107].

Figure 10 BlackBerry OS architecture

Source: BlackBerry.com

In August 2010, almost 3 years after the iPhone release, BlackBerry launched their first mobile device that featured a multi-touch screen. The lack of multi-touch capabilities crippled the BlackBerry's browsing experience, and limited mobile applications development. BlackBerry appealed to professionals because of their robust hardware and messaging system, but lacked the entertainment capabilities that attracted mass-market consumers. Ever since the iPhone opened up the market, blackberry is catching up and has failed to fully profit from the exponential market growth[108][109].

Although BlackBerry OS 6 delivers an enhanced multimedia experience, and BlackBerry still possesses a considerable market share, application developers do not seem to be very interested in the platform. BlackBerry App World, the proprietary application store owned by RIM, offers over 30.000 applications whereas Android OS features over 200.000 and the App Store consists of over 425.000 applications.

Developer interest has fallen fast during 2011[110] and recently, developers started to abandon the BlackBerry platform. Main reasons are a steep learning curve and high development costs because of device differentiation. Devices come in different shapes and sizes, some have touchscreens, and others have a thumbwheel, a keyboard or shortcut keys. But all of them run different BlackBerry OS versions. Combined with a declining consumer market share, developing BlackBerry applications, does not seem to be a profitable activity[111].

The devices are still catching up on competition. Development tools are not perceived well by the developer community[112]. The brand has not been able to garner much loyalty or attract recreational users[113]. Increasingly more and more

enterprises adopt iPhone and Android based wireless solutions, eating away RIM's core business and forcing them to release cross platform versions of BES[114].

15.4 Discussion

RIM is struggling with competitive pressures from Apple's iPhone and Android phones. RIM is a closed, proprietary system, but has not managed to create a uniform platform for application development. BlackBerry OS systems have failed to respond fast and adequate to a rapidly evolving market. BlackBerry OS suffers from negative consumer and developer expectations and is slipping into a negative spiral of decreasing interest. A negative spiral ignited by unsatisfactory consumer experiences, relative to iOS and Android devices, and by low profitability for application developers.

RIM has not been able to transfer its activities successfully from the executive, 'prosumer' market to a mass consumer market. Their absence in the mass consumer markets creates opportunities for competitors to attack their core business of enterprise solutions. RIM's brand loyalty is falling and gradually RIM is losing their competitive edge in the enterprise segment. This results in declining device margins, RIM's most importance source of income.

Luckily, customers (especially enterprises) and developers bare high switching costs. Enterprises have complete wireless communication systems build upon the BlackBerry platform. They made investments, built relations, trained their personal and are often very much depending on the platform. Individuals are locked into a lesser degree bye their BlackBerry Internet Services contracts. These overall high switching costs administer some time for RIM to come up with solutions for their current weak market position.

However, there is a downside to these high switching costs. Negative future outlooks and high switching costs make new customers more reluctant to join the BlackBerry platform. Haunted by negative expectations, barely or moderately outperforming the leading platforms will most likely not be enough to turn the tides[115].

15.5 Conclusion

Research in Motion has to create a profitable environment for applications developers. It needs a growing user base to turn expectations around and a redesign the developer environment. These have become basic requirements to compete in the current smartphone market. Once they posses a self-reinforcing

application platform, they can leverage their former competitive advantages and gain an edge on the competition.

Research in Motion has a new operating system coming in 2012. The QNX operating system already powers the PlayBook tablet and will support the next generation of BlackBerry smartphones. The QNX operating system is technologically very advanced. It is a scalable, efficient and reliable operating system based on a microkernel the enables true multi-tasking on multi-core CPU's[116].

The QNX should power devices that can compete with Apple, Android and Windows Phone 7 devices. How these devices will look or perform is hard to tell at this moment. But RIM has developed an emulator for the PlayBook to run Android Applications next to BlackBerry Java apps, multiplying the total amount of available applications. RIM also released a new SDK for C/C++ application development[117]. A huge drawback is the development of a new BES that is taking longer than expected. A lack of BES support could jeopardise the entire launch of RIM's QNX devices. Their core customers, who depend upon BES, might not be willing to wait much longer[118].

RIM has a few cards up their sleeves and a strong, locked-in customer base. But with negative expectations targeting RIM, every single customer won or lost is crucial. Research in Motion cannot afford any future mistake setting up a new ecosystem.

16 Nokia

16.1 History

Nokia is a Finnish company, founded in 1865. Nokia started as a paper manufacturer and evolved into a major industrial force, active in the rubber, cable and eventually electronics industry. During the late 1960's, Nokia moved to become one of the pioneers of mobile communication technology and they deployed the first GSM system in 1991. Rubber, cable and consumer electronics divisions were abandoned in order to fully concentrate on the emerging mobile telecommunication industry. Nokia's Core business became manufacturing mobile phones and telecommunications systems[119].

Nokia emphasised three key attributes, product innovation, flexibility and rapid market responsiveness. They took great interest in customer needs and focused their research and development on the entire value chain. Nokia is a co-founder of important industry standards such as GSM, WAP, 3G Bluetooth and retained the ability to quickly employ these technologies in new devices. Over the years, they were able to build a strong brand and establish good relations within the telecom industry[120].

16.2 Business Model

Nokia's business model paid off and Nokia became a world leader of the mobile phone industry by the beginning of the 21st century. Growing from a paper manufacturer to a high-tech telecommunications company, Nokia gained experience in strategically manoeuvre in a changing environment[121]. Their ability to transfer their core capabilities to new businesses is the foundation of their mobile strategy.

Nokia was very involved in industry development and their customer focus allowed them to identify and act on niche opportunities. They were able to cause industry shifts and gain first-mover advantage. Departing from a niche market they would carefully listen to their customers and move to mass markets with innovative, well-designed, high-quality products exploiting their early market-entry. This pre-emptive strategy enables Nokia to leverage a first-mover advantage into a sustainable competitive advantage[122].

The company has strong, mutually beneficial long-term relationships with value chain partners. They were actively involved in research and developing of both upstream and downstream processes. However, Nokia outsourced the execution of these processes, allowing them to focus solely on their core business[123]. In 2010, mobile devices and services accounted for over 68% of Nokia's operating income[124].

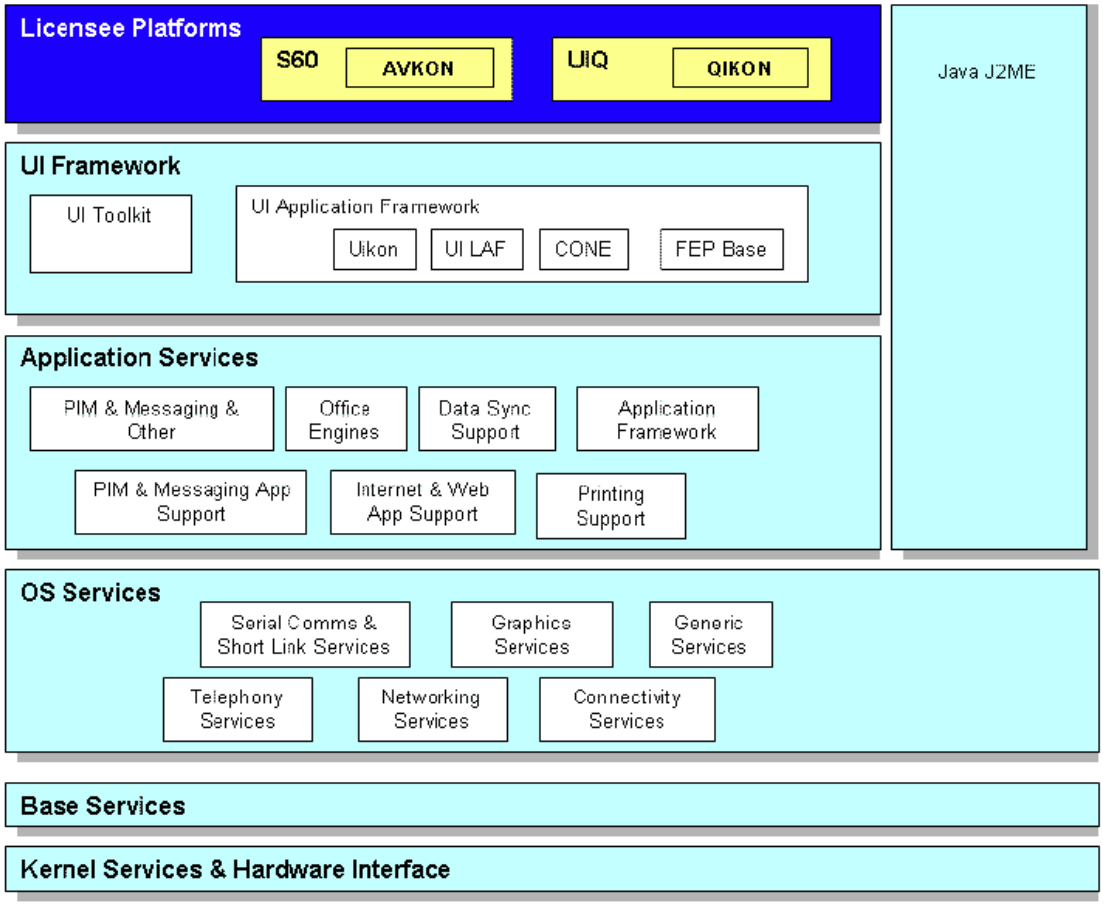
16.3 Symbian OS

Symbian OS is a smartphone operating system based on EPOC OS developed by Psion. Symbian was first released on the Ericsson R380 and Nokia 9210 Communicator in 2000. It is modelled in five layers completed by a Java ME engine.

The base of Symbian OS is a micro kernel extended by a highly adaptable services layer that contains low level libraries and frameworks, device drivers, and device-driver framework support (xml, file servers…), which provides operating system primitives and abstraction frameworks. Symbian is a modular operating system that can be easily ported to new specific standard interfaces and hardware products[125]. Leveraging this modularity, allows the OS to keep up with fast evolving hardware technology. Flexibility, a large design range and a high development speed are important aspects of Symbian OS (Sanchez & Manhoney, 2005).

For example, the top layer is a user interface (UI) framework. This framework enables the customization of the UI interface. Manufacturers who license Symbian OS could develop a unique graphical user interface (GUI) or they could license a GUI developed by a specialist such as UIQ Technology AB, NTT DoCoMo or Nokia. Underneath the UI framework is the application services layer. Application developers can program web applications in Java ME, Flash Lite, Python, Ruby, .NET, or Web Runtime. Native applications are developed Symbian C++. The UI framework and the customized GUI mediate all applications. Applications are highly dependent on the frameworks supplied by UI variants. Handset manufacturers can provide API's to integrate the GUI better and extend functionality. Symbian is largely responsible for the underlying logic (Morris, 2007).

Figure 11 Symbian OS architecture



Source: Nokiadeveloper.com

Symbian Ecosystem

In 1998 Nokia, software company Psion and Ericsson founded a joint venture named Symbian Ltd. The venture was created to develop and support a new mobile operating system, Symbian OS. Nokia envisioned a future smartphone market that would be very lucrative. They anticipated the convergence of mobile phones with computing. Consequently, they drew parallels with the PC industry, which is dominated by two standard controlling firms, Microsoft and Intel (West & Wood, 2007).

Microsoft and Intel dominate the PC industry. Two large companies who controlled the two most important standards: the operating system and processor. The "Wintel" duopoly grew the market and extract high rents from PC manufacturers and software developers. PC-manufacturers have merely become

assemblers of commoditized parts, and add little value to the PC (Yoffie, et al; 2004).

Nokia, being a device manufacturer, wanted to avoid such a scenario. They attracted Psion and industry leader Ericsson to set an industry wide OS standard. The standard was developed, supported and controlled by Symbian ltd, a Psion spin off. The ecosystem, composed of handset manufacturers, hardware components suppliers, user interface companies, software developers, consultancies and network operators was structured to prevent power consolidation and maximize differentiation on an industry wide platform (West & Wood, 2007).

Handset manufacturers controlled the ecosystem. They were represented in a "supervisory board" and set licensing terms and conditions. They allocated the largest part of Symbian's resources, which depended on handset manufacturers. Symbian was bounded by resources and not able to deliver adequate support for both component suppliers and software developers at the same time. Support was necessary because neither of the environments provided the means for autonomous, profitable growth (West & Wood, 2007).

To prevent divided technical leadership and reduce the threat of new competitors entering, the platform was partly open to most ecosystem members. Component suppliers, network providers and application developers relied on Symbian Ltd. and the device manufacturers for information and support. Information exchange between those partners was regulated and limited. Multiple sub-platforms existed and slowed down all innovative processes. Application development was further impeded by security measures imposed by network operators, long learning times and high development costs due to the Symbian C++ custom language and mixed platform control (West & Wood, 2007).

Symbian became the dominant smartphone OS. Supporting over 60% of the device sold worldwide in 2007. An estimated 77,6 million devices were shipped during that year, approximately 78% were Nokia devices. Symbian was able to set an industry standard however the aspired exponential growth was held up[126].

Meanwhile Symbian had a weak market position in the US smartphone market that was controlled by Research in Motion. After Apple disturbed the market, Symbian's deficiencies were exposed and the ecosystem was not able to keep up with the competition. Its Market share fell and members bridged to other

platforms[127]. Entrenched by their installed base, Nokia tried to turn the tides by buying Symbian stocks in 2008 and license the OS as open source software[128] and merging user interfaces. This plan proved a failure and more members left the ecosystem leading to a future cooperation with Microsoft and gradually abandoning Symbian[129].

16.4 Discussion

Symbian's mobile phone strategy is based on the exploitation of a first movers' advantage. Entering the market in a niche segment and successfully expanding to majority adopters by making use of their gained experience. Nokia has excellent innovation and manufacturing capabilities and aimed for intra-platform competition. They needed a common, non-proprietary platform to compete on, while maintaining enough freedom to diversify.

The Symbian platform was open towards devices manufacturers. And partly open for other ecosystem members. Nokia made sure they were able to capture significant value from the ecosystem in the long run. But the measurements that enabled this, prevented the formation of a healthy ecosystem. Nokia set up an unsustainable ecosystem that needed constant support and help from the sponsors to grow.

Symbian helped Nokia to accomplish the first part of their strategy. It established a smartphone market dominated by a non-threatening operating system and Nokia was dominating competition on this platform. However, Symbian failed to successfully transfer Nokia's 1st mover advantage to mass consumers. It could not fully leverage their capabilities and deliver an experience that appealed to those customers.

Multiple sub platforms, restricted source code access and information sharing slowed hardware innovation down and hindered market growth. If hardware development is to slow, then the deployment rate of new devices will be to low. Their prices will remain too high for too long in order to attract enough new customers, to grow the market and create a profitable application developer business.

Software developer profitability is crucial to set off positive feedback. Symbians ecosystem deficiencies affected the platform's profitability badly. A steep learning curve, troubling security compliances and multiple sub-platforms raised development costs. Network providers imposed high switching costs on

customers and controlled all data traffic. Neither Symbian nor Nokia delivered a user experience that customers would value high enough to switch network providers. Network providers held a monopoly on subscriber access. Applications were sold through provider portals and developers had to give up more then half of there revenues. Combined with relative high development costs, application development was not particularly profitable.

IOS and Android attacked these weaknesses, were able to gain a foothold in the market and overthrow Symbian's dominance. When Apple entered the market, it was able to unlock the monopoly on subscriber access, by-pass the provider portals and stimulate application profitability. At the same time, they decreased developer costs by offering one integrated system. Android entered shortly after Apple and outperformed Symbian on the manufactures side by making the entire source accessible to everyone involved in the ecosystem, for free. IOS and Android-based devices developed the mass consumer market and captured it fast. They basically undermined Nokia's entire strategy by aggressively changing the market rules and preventing Nokia from exploiting their 1st mover advantage. Nokia was left behind on a platform that was perceived as inferior, unable to attract new developers or manufactures. Nokia was forced to take drastic measures, and eventually, it announced a partnership with Microsoft to build Windows Phone 7 devices[130].

17 Microsoft

17.1 History and Business Model

Bill Gates founded PC industry giant Microsoft in 1975, which deployed its first operating system, MS-DOS 1.0 on an IBM PC in 1982. His understanding of this emerging business led him to assess the importance of applications correctly. Gates assembled numerous independent software firms to work on the MS-DOS platform and by 1984, MS-DOS had achieved a 85% market share. In 1990, Microsoft introduced a MS-DOS based graphical operating system. Windows 3.0 offered an advanced graphical user interface while being backward compatible with DOS programs. It moved forward without abandoning it's installed base of users and software developers, by consistently upgrading its operating system (Yoffie, et al; 2004).

Microsoft gained a strong position because of a superior offer of third party applications. Then, it locked in customers further by taking over and controlling windows productivity applications such as Excel, Word and Outlook. This put them in direct competition with one of the most valuable assets of their platform, third-party software applications. Microsoft had to carefully balance their activities, supporting the independent software developer community on the one hand, and aggressively expand there proprietary application offerings on the other hand. (Yoffie et al, 2004).

Microsoft also had to maintain and foster their relations with hardware manufacturers in order to grow the PC market without endangering their dominant position. They provided the necessary tools and information to drive hardware innovation and sales. They protected their dominant position with tactical pricing policies and critical limitations on information and technology access. (Yoffie et al, 2004). Microsoft shared control with Intel. Together they had control over the strategic direction and pace of the PC platform. Both preferred a gradual evolution and did everything in their power to prevent a market disruption that would create opportunities and shake up market positions.

17.2 Windows Mobile

Microsoft entered the wireless industry in 1996 with Windows CE running on small laptops called Handheld PC's. Later, in 2000, with their Pocket PC 2000 operating system. An OS based on Windows CE[131] adapted and optimized for supporting

handheld PDA's. Devices that run Pocket PC 2000 had large touch screens that functioned with styluses. They were big and heavy, but relatively advanced for that time. Microsoft designed and marketed Pocket PC 2000 as an extension of their windows franchise and targeted businesses and executives. The Devices featured a user interface that resembled Windows operating systems and leveraged resized windows applications such as Pocket Word, Pocket Excel, and Pocket Outlook to gain an advantage on Palm OS[132].

Mobile devices became more convergent. PDA's picked up phone capabilities and Phone's picked up data capabilities. Microsoft renamed their Pocket PC software 'Windows Mobile' in 2003[133]. Windows Mobile is a highly customizable platform based on Windows CE. Device manufacturers and operators could work together and release custom windows mobile devices. These could range from large touchscreen PDA's to small keyboard enable smartphones with very limited capabilities. Devices only had to comply with a few basic requirements. They could also decide whether they provided updates for their devices or not[134]. Granting this freedom, Microsoft attracted a network of OEM's stemming from the PC industry or network providers[135].

Application development was encouraged by integrating support for the accessible Microsoft .NET Compact Framework. An extensible development platform, derived from the popular .NET application framework. Developers could use familiar development tools, such as Visual Studio, to create applications that could be connected to enterprise server software like Microsoft Exchange Server and Microsoft SQL Server[136]. Overtime, many OS versions and devices were circulating. Finding and installing applications was not very user-friendly. Applications were spread around on the web, mostly provided by licensees. They were available in different extensions that required different installation processes[137]. And not all applications were fixed to work since they were not necessarily optimized for one specific model.

Nonetheless, Microsoft had set up a large, thriving network surrounding Windows Mobile. In the fourth quarter of 2004 over 1,3 million shipments were recorded counting for a 48,1% market share of the PDA market[138].

However unconnected PDA devices were losing ground to converged mobile phones[139]. People seemed to appreciate the permanent connectivity and phone abilities the smartphones offered over powerful bulky PDA devices. PDA users carried two devices, a mobile phone and a PDA. One device was used for instant

messaging and calling, and one device to access the Internet, email, and other content. Most found this inconvenient and were willing to scarify extensive capabilities for the convenience of one device and permanent connectivity. Also mobile carriers could sponsor smartphones, making the initial purchase cheaper[140].

By the end of 2005, Microsoft found itself in a difficult position. It captured a 5.5% market share in a market dominated by Symbian[141]. Large mobile phone manufacturers Nokia, Ericsson, Siemens and Matsushita had already clustered around Symbian. This left Microsoft with a smaller number of strong, potential partners and an OS that wasn't originally designed for smartphones. It had to refocus their wireless strategy and gain upon a serious lag in market share.

It took Microsoft until mid-2007 to come up with answer for the Symbian domination. Windows Mobile 6 was a well-received improvement of their previous operating systems. Unfortunately, Microsoft did not manage to revolutionize their mobile platform[142]. Six months after Windows Mobile 6 was released, the iPhone disrupted the smartphone market and later Android took it over. Microsoft answered with a number of updates but these proofed inadequate [143] and Windows Mobile was pushed into obscurity.

17.3 Windows Phone 7

In October 2010, Microsoft discontinued Windows Mobile and released Windows Phone 7 (WP7). The new platform is more closed then previous versions. It grants manufacturers and providers less freedom to develop and integrate the device. Microsoft keeps control of the intuitive UI and API's. Licensees can make minor changes, but the overall user experience rests in windows hands. Manufactures can add a limited number of custom apps, choose the default Internet Explorer search engine and install Direct3D Drivers[144].

WP7 is tightly integrated with Microsoft's online services. Microsoft Live ID combines al these services on windows phone, enabling smooth access to contacts and email via Windows Live, Office Live, Zune, Xbox Live, Pictures, Sky Drive and the Apps Marketplace. The press, who mentioned a great user experience and a fresh, inventive user interface received the tightly controlled platform positively[145].

Again Microsoft focuses on third-party applications. This time, the updating procedure and applications distribution is centralized. Application developers can

offer applications in the Apps Marketplace owned by Microsoft against a 99$ subscription fee and 30% royalty on all sales[146]. The application development still happens in the .NET framework strengthened by Microsoft Silverlight support. Silverlight is a development platform that takes advantage of the .NET framework and enables complex, visual dynamic applications[147]. To increase Windows Phone 7 applications further, Microsoft released an API mapping tool that facilitates porting iOS applications to the Windows Phone platform[148]

Lastly, Microsoft announced a partnership agreement with Nokia to set-up a new global mobile ecosystem. Nokia will produce hardware devices incorporating Windows Phone and add some standard key applications and services to the platform. Nokia will pay royalties to Microsoft and receive al large lump sum from Microsoft to strengthen their cash position and spur R&D on devices. With Nokia, Microsoft landed a very strong partner to help them catch up on Android and iPhone[149].

17.4 Discussion

Microsoft misjudged the future of mobile computing when it first moved to the wireless market. It believed the mobile market would develop from increasingly smaller computers and acted accordingly. Following their vision, Microsoft was able to leverage key applications, experience and relationships from the PC industry in the PDA market. However, consumers were more interested in enhanced mobile phones than smaller, less capable computers.

By the time Microsoft switched their focus, Nokia dominated the existing smartphone market by setting an industry-wide standard platform with other large manufacturers. Symbian was growing relatively slow but locked in the mobile market. Microsoft lagged and struggled with a platform and ecosystem that was not fit to radically overthrow Symbian. A spectacular performance improvement was needed to convince customers, who were accustomed to Symbian and Nokia. This basically meant Microsoft had to disrupt a slowly maturing market. But Microsoft was hesitant and not equipped to leave the Windows Mobile platform or radically change it. It kept on improving the user experience of their incumbent platform and eventually caught up and surpassed Symbian's performance early 2007.

Trying to beat Symbian's OS on this one front, Microsoft paid less attention to application development and deployment issues that arose. Microsoft had released a number of different Windows Mobile versions of each update destined

for different classes of devices. Device manufacturers used their freedom. They tried to diversify themselves and fragmented the platform. Applications were spread across the web in different extensions targeting different devices. This was a platform that was not suitable to stimulate application usage.

When Apple entered and changed the market environment. It exposed Microsoft's incoherent ecosystem and showed precisely what applications can mean for a mobile platform. Microsoft was competed out of the market. It did not have a strong user base or solid ecosystem and its market share was falling quickly. But this market disruption also created new opportunities for a new Microsoft platform. They learned from their previous mistakes, and offered a more closed, competitive platform, backed by their former number one competitor, Nokia.

17.5 Conclusion: Nokia - Microsoft partnership

On September 2011 Nokia and Microsoft announced a close partnership to set up a new mobile ecosystem. Both companies learned over the past years that a viable, sustainable ecosystem was a crucial aspect of the new mobile business. Both companies believe that joining their complementary strengths will create such a system.

Microsoft brings a competitive operating system with Windows Phone 7 that works well with all windows services. The operating system is released with a solid, widespread application development environment. Nokia offers excellent hardware, a global distribution network and a large installed base. Nokia also brings their excellent mapping services to the ecosystem. These will enable powerful location base application and improve Microsoft's Bing search engine and AdCenter. Nokia still has a strong presence in developing countries where competition is less fierce and setting up licensing agreements and infrastructure costs a significant amount of money and time[150].

Microsoft's new platform needs credibility and a user base to jumpstart the attraction of developers. Nokia is a strong worldwide brand that can add an amount of credibility and positive expectations to the new project. Their widespread presence is a strong argument for developers to join the ecosystem. However, Nokia has a special status within the ecosystem. It can influence platform specifications to their advantage and it is granted more freedom to customize their devices then other manufacturers. Fair intra-platform competition seems comprised. Nokia is in a position to make up of most of the Windows Phone devices, possibly putting off more device manufacturers[151].

By joining the Windows Phone 7 ecosystem, Nokia regains the possibility to focus on the creation of great devices. Microsoft has a great platform and application development environment that enables such devices. Nokia was able to negotiate a more powerful position then other OEM's. They have more sources of income and more possibilities to differentiate. Microsoft can also offer a gateway to the US market; a place Nokia was never able to get traction. On the other hand, Nokia has to transfer their entire Symbian network. This creates more opportunities and is a valid reason for partners and customers to discontinue their relationships with Nokia. The first results of the Nokia-Microsoft collaboration are highly anticipated and devices should arrive early 2012.

18 General Conclusion

A comparison between the smartphone operating system war and the PC operating system war seems straightforward. In both systems the operating system is indispensable and its success is driven by applications. Windows showed how a platform sponsor could successfully win the market by emphasizing application development and encourage competition between hardware manufacturers. Both Nokia and Windows entered the mobile market with a slightly adjusted strategy. Both considered applications as valuable and encouraged competition by allowing a degree of freedom for the manufacturers to diversify. Nokia held control and funding with the hardware manufacturers. Microsoft allowed more freedom for hardware manufacturers then it did in the PC industry.

But Mobile devices are inherently different from PC's. PC's have superfluous specifications for most mass consumer applications. They have large screens, fast CPU's, and strong graphic capabilities. Smartphones are limited in resources and benefit more from an integrated approach. Nokia and Microsoft's initial approaches did not effectuate this very well, leading to a fragmentation that discredited the users' experience. A focus on the integration of all components is indispensible to compete.

Another essential condition to compete in the smartphone OS market is the possession of a lively and large application network. Applications contribute an incredible amount of value to a platform and are indispensible in today's smartphone market. The two best-positioned operating platforms, iOS and Android, rely on a steady growing application developer base. They have put effort in creating a profitable environment for them to deploy applications and thereby encouraged network effects. Research in Motion released solid, well-working devices but could not establish a network of applications developers and lost customers due to the lack of applications.

Both Microsoft and RIM announced the release of adaptor technologies that would allow them to tap into the applications offers of both iOS and Android. Microsoft will facilitate porting iOS applications and RIM has developed an emulator that runs Android apps. If they succeed in their efforts then it becomes very easy for

application developers to multi-home. Application networks effects will decrease and the industry rearranged.

Platforms that comply with these two conditions can compete on other elements.

Apple has beautiful interconnected set of products that elevate the iPhone and create a beloved user experience. Apple benefits from a strong emotional brand, which reinforces consumer lock-in. Google has a large reach with numerous devices entering the market every month. These devices range from very cheap and simple to expensive and advanced, addressing multiple consumers segments. Google has a massive assortment of software products that can work well with android devices. These can move the Android mobile experience beyond the mobile phone and upgrade the smartphone user experience. Research in Motion can play out their strong business solutions and lock-in customers via employers. The Microsoft-Nokia platform can profit from a combination an innovative, high performance hardware and the Microsoft services that are connected and integrated with Windows. Being the number one PC platform, this is a potentially huge future asset.

For now competition still remains focussed on applications. Android and Apple dominate, but the market is still growing fast and both leaders leave room for opportunities. Android has to deal with fragmentation issues, their open source community and aggressive legal attacks. Apple manages a very closed ecosystem. Apple is doing well as a device manufacturer but they leave plenty of room for more open competitors to annex consumers and challenge the frontrunners. The smartphone war is not over yet and is still there to be won.

19 Appendix

19.1 Apendix 1 – An extract from Apple annual report.

Source: Anual report Apple Inc., 2010. Available at:

<http://files.shareholder.com/downloads/AAPL/1309219758x0x461502/19ecf031-e284-4b01-9131-4ebbabc128fb/AAPL_Q2FY11_10Q_04.21.11.pdf>

Net Sales

The following table summarizes net sales by operating segment and net sales and unit sales by product during the three- and six-month periods ended March 26, 2011 and March 27, 2010 (in millions, except unit sales in thousands and per unit amounts):

	Three Months Ended			Six Months Ended		
	March 26, 2011	March 27, 2010	Change	March 26, 2011	March 27, 2010	Change
Net Sales by Operating Segment:						
Americas net sales	$ 9,323	$ 4,993	87%	$18,541	$11,085	67%
Europe net sales	6,027	4,050	49%	13,283	9,074	46%
Japan net sales	1,383	887	56%	2,816	1,670	69%
Asia-Pacific net sales	4,743	1,886	151%	9,730	3,699	163%
Retail net sales	3,191	1,683	90%	7,038	3,654	93%
Total net sales	$24,667	$13,499	83%	$51,408	$29,182	76%
Net Sales by Product:						
Desktops (a)	$ 1,441	$ 1,532	(6)%	$ 3,172	$ 3,224	(2)%
Portables (b)	3,535	2,228	59%	7,234	4,986	45%
Total Mac net sales	4,976	3,760	32%	10,406	8,210	27%
iPod	1,600	1,861	(14)%	5,025	5,252	(4)%
Other music related products and services (c)	1,634	1,327	23%	3,065	2,491	23%
iPhone and related products and services (d)	12,298	5,445	126%	22,766	11,023	107%
iPad and related products and services (e)	2,836	0	NM	7,444	0	NM
Peripherals and other hardware (f)	580	472	23%	1,173	941	25%
Software, service and other sales (g)	743	634	17%	1,529	1,265	21%
Total net sales	$24,667	$13,499	83%	$51,408	$29,182	76%
Unit Sales by Product:						
Desktops (a)	1,009	1,147	(12)%	2,236	2,381	(6)%
Portables (b)	2,751	1,796	53%	5,658	3,924	44%
Total Mac unit sales	3,760	2,943	28%	7,894	6,305	25%
iPod unit sales	9,017	10,885	(17)%	28,463	31,855	(11)%
iPhone unit sales	18,647	8,752	113%	34,882	17,489	99%
iPad unit sales	4,694	0	NM	12,025	0	NM

(a) Includes iMac, Mac mini, Mac Pro and Xserve product lines.
(b) Includes MacBook, MacBook Air and MacBook Pro product lines.
(c) Includes sales from the iTunes Store, App Store, and iBookstore in addition to sales of iPod services and Apple-branded and third-party iPod accessories.
(d) Includes revenue recognized from iPhone sales, carrier agreements, services, and Apple-branded and third-party iPhone accessories.
(e) Includes revenue recognized from iPad sales, services, and Apple-branded and third-party iPad accessories.
(f) Includes sales of displays, wireless connectivity and networking solutions, and other hardware accessories.
(g) Includes sales from the Mac App Store in addition to sales of other Apple-branded and third-party Mac software and Mac and Internet services.
NM = Not Meaningful

19.2 Apendix 2 – An overview of Apple product iterations

Source: http://support.apple.com/kb/HT1353#scrollwheel

iPod touch (4th generation)

iPod touch (4th generation) is available in a 8 GB, 32 GB, or 64 GB configuration. It has two built-in cameras and is available in white and black.

iPod nano (6th generation)

iPod nano (6th generation) is available in six colors in a 8 GB or 16 GB configuration.

iPod nano (PRODUCT) RED Special Edition is available only from the Apple Store, in 8 GB or 16 GB configuration. Apple contributes a portion of each iPod nano (PRODUCT) RED Special Edition purchase to the Global Fund to fight HIV/AIDS in Africa.

iPod shuffle (4th generation)

iPod shuffle (4th generation) is available in five colors in a 2 GB configuration.

iPod shuffle (3rd generation Late 2009)

iPod shuffle (3rd generation Late 2009) is available in 5 colors in a 2 GB or 4 GB configuration.

The iPod shuffle (3rd generation Late 2009) also comes in a Special Limited Edition 4 GB model only available from the Apple Store. It comes in polished stainless steel.

iPod classic 160 GB (Late 2009)

The iPod classic 160 GB (Late 2009) is a hard drive-based iPod featuring a large, widescreen color display, a Click Wheel, and the capability of displaying photos and videos. Like other models, it uses USB for syncing. The iPod classic is available in silver and black, and has an anodized aluminum and polished stainless steel enclosure.

iPod touch (3rd generation)

iPod touch (3rd generation) features a 3.5-inch (diagonal) widescreen multi-touch display and 32 GB or 64 GB flash drive. You can browse the web with Safari and watch YouTube videos with Wi-Fi. You can also search, preview, and buy songs from the iTunes Wi-Fi Music Store on iPod touch.

The iPod touch (3rd generation) can be distinguished from iPod touch (2nd generation) by looking at the back of the device. In the text below the engraving, look for the model number. iPod touch (2nd generation) is model A1288, and iPod touch (3rd generation) is model A1318.

iPod nano (5th generation)

The iPod nano (5th generation) is available in 8 GB or 16 GB capacity and comes in 9 colors.

The iPod nano (5th generation) is distinguished from previous iPod nano models by:

- Its taller screen when compared to iPod nano (4th generation)
- Its polished anodized aluminum finish
- The inclusion of a camera and microphone on the back of the device

iPod shuffle (3rd generation)

iPod shuffle (3rd generation) includes a single 3-position switch that toggles between off, play in order, and shuffle similar to the original iPod shuffle. It also includes a headphone port that also is used to for connecting to a computer's USB port as well as a clip similar to the iPod shuffle (2nd generation). iPod shuffle (3rd generation) is smaller that either of the previous two models and has one status light compared with two on previous generations of iPod shuffle.
iPod classic (120 GB)

The iPod classic (120 GB) is a hard drive-based iPod featuring a large, widescreen color display, a Click Wheel, and the capability of displaying photos and videos. Like other models, it uses USB for syncing. The iPod classic is available in silver and black, and has an anodized aluminum and polished stainless steel enclosure.

iPod touch (2nd generation)

iPod touch (2nd generation) features a 3.5-inch (diagonal) widescreen multi-touch display and 8 GB, 16 GB, or 32 GB flash drive. You can browse the web with Safari and watch YouTube videos with Wi-Fi. You can also search, preview, and buy songs from the iTunes Wi-Fi Music Store on iPod touch.

The iPod touch (2nd generation) can be distinguished from previous iPod touch models by its contoured design and oval shaped antennae cover in the back upper left corner.

iPod touch

iPod touch features a 3.5-inch (diagonal) widescreen multi-touch display and 8 GB, 16 GB, or 32 GB flash drive. You can browse the web with Safari and watch YouTube videos on the first-ever Wi-Fi iPod. You can also search, preview, and buy songs from the iTunes Wi-Fi Music Store on iPod touch.

iPod classic

The iPod classic is a hard drive-based iPod (80 GB or 160 GB) featuring a large, widescreen color display, a Click Wheel, and the capability of displaying photos and videos. Like other models, it uses USB for syncing. The iPod classic is available in silver and black, and has an anodized aluminum and polished stainless steel enclosure.

You can distinguish the iPod classic from the iPod (5th generation) by the last three digits of the serial number. The iPod classic serial number's last three digits will be one of the following: Y5N, YMU, YMV, and YMX.

iPod nano (4th generation)

The iPod nano (4th generation) is available in 8 GB or 16 GB capacity and comes in 9 colors.

The iPod nano (4th generation) is distinguished from previous iPod nano models by:

- Its taller screen
- Its curved surface
- Its oval shape when seen from the top or bottom
- The inclusion of an accelerometer that is used by the Shake feature.

iPod nano (3rd generation)

The iPod nano (3rd generation) is available in 4 GB or 8 GB capacity, and comes in 5 colors.

iPod nano (3rd generation) is distinguished from previous iPod nano models by:

- Its wider screen
- Hold switch location on the bottom
- Its ability to play video

You can also distinguish the iPod nano (3rd generation) by the last three digits of the serial number. The iPod nano (3rd generation) serial number's last three digits will be one of the following: YOP, YOR, YXR, YXT, YXV, YXX.

iPod (5th generation Late 2006)—also known as iPod with video or Fifth Generation iPod

You can distinguish the iPod (5th generation Late 2006) from the original iPod (5th generation) by the last three digits of the serial number. The iPod (5th generation Late 2006) serial number's last three digits will be one of the following: V9K, V9P, V9M, V9R, V9L, V9N, V9Q, V9S, WU9, WUA, WUB, WUC, and X3N. The Fifth Generation U2 Special Edition iPod (30 GB Late 2006) serial number's last three digits are W9G.

iPod (5th generation)—also known as iPod with video or Fifth Generation iPod

The iPod (5th generation) is a a hard drive-based iPod featuring a large, widescreen color display, a Click Wheel, and the capability of displaying photos and videos. Like iPod nano, it uses USB for syncing and comes in white and black.

iPod nano (2nd generation)

iPod nano (2nd generation) is distinguished from other models by:

- Its smaller size.
- Its colors.
- The dock connector and headphones port are both located on the bottom of the unit.

The iPod nano (PRODUCT) RED Special Edition is an iPod nano (2nd generation) available in red and with a 4 GB or 8 GB drive capacity. With each iPod nano (PRODUCT) RED purchased, $10 from the sale goes directly to the Global Fund to fight AIDS in Africa.

iPod nano

iPod nano is smaller than iPod mini and has a color screen and a Click Wheel but has flash memory instead of a hard drive. Song and photo syncing only occurs over USB 2 (not FireWire). iPod nano comes in white and black. The capacity of the iPod nano is engraved on the back of the case (1 GB, 2 GB, or 4 GB).

The dock connector (1) and headphone jack (2) are both on the bottom of the iPod nano.

iPod shuffle (2nd generation)

iPod shuffle (2nd generation) is smaller than the original iPod shuffle and has no USB connector.

You can distinguish the iPod shuffle (2nd generation Early 2008) 2 GB from previous models by the last three characters of the serial number. The iPod shuffle (2nd generation Early 2008) 2 GB serial number's last three characters will be one of the following: 1ZH, 1ZK, 1ZM, 1ZP, 1ZR.

iPod shuffle

iPod shuffle is smaller than iPod mini and has no display. There are LED lights on the front and back. The capacity of the drive is engraved on the front USB connector.

iPod mini

iPod mini is distinguished from other models by:

- Its smaller size.
- Its colors.
- The Hold switch, which is on the top-left side.
- The Click Wheel's button labels, which are on the wheel itself.

iPod mini (2nd generation)

The iPod mini (2nd generation) models are distinguished from the original iPod mini models by:

- Hard drive size engraved on back of unit.
- Click Wheel text color matches iPod mini (2nd generation) color

iPod with color display

iPod and iPod photo are now one and the same, with every white iPod boasting a full-color display. They continue to have the same controls as iPod (Click Wheel) but now all models have a color display like iPod photo - ideal for viewing album artwork and playing slideshows. These are considered fourth generation models along with iPod (Click Wheel).

iPod (Click Wheel)

iPod (Click Wheel) models have a Click Wheel like the iPod mini, but are larger and the hold switch is on the top-right side. iPod (Click Wheel) models have a monochrome display. iPod (Click Wheel) is referred to as the fourth generation iPod.

iPod Special Edition U2

The iPod Special Edition U2 is a standard iPod model with certain external differences including: Black plastic exterior, red Click Wheel, signatures of the U2 band members engraved on the back, and "iPod Special Edition U2" engraved on the back. The first model was based an iPod (Click Wheel) with a 20 GB hard drive. In June 2005 a new version of the iPod Special Edition U2 was introduced that was based on an iPod with color display Generation iPod . These are both also considered fourth generation iPod models. In June 2006, a new version of the iPod Special Edition U2 was introduced that is based on a Fifth Generation iPod (also known as iPod with video) with a 30 GB hard drive. In Sept 2006 a model based on the Fifth Generation iPod (30 GB Late 2006) was introduced. You can distinguish Fifth Generation U2 Special Edition iPod (Late 2006) from the Fifth Generation U2 Special Edition iPod by the last three digits of the serial number. The Fifth Generation U2 Special Edition iPod (30 GB Late 2006) serial number's last three digits are W9G.

iPod Special Edition Harry Potter

The iPod Special Edition Harry Potter is a standard iPod model with the Hogwarts Crest engraved on the back:

The first model was based an iPod with color display with a 20 GB hard drive. In October 2005 a new version of the iPod Special Edition Harry Potter was introduced that was based on an Fifth Generation iPod with a 30 GB hard drive.

iPod photo (also known as iPod with color display)

iPod photo models are functionally and visually identical to the iPod with color display (see above photo).

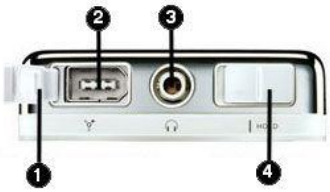
iPod (dock connector)

iPod (dock connector) models have a dock connector as illustrated here.

Newer iPod models like iPod (Click Wheel) and iPod mini also have a dock connector, but the iPod (dock connector) has a touch wheel instead of a Click Wheel and the four control buttons are above the touch wheel. iPod (dock connector) models are referred to as third generation iPod models.

iPod (touch wheel)

All iPod (touch wheel) models have a FireWire port cover. Scroll wheel models don't, and dock connector models don't have a FireWire port. The iPod (touch wheel) model controls look similar to the iPod (scroll wheel) but the touch wheel itself does not turn. iPod (touch wheel) models are considered second generation iPod models. The top of an iPod (touch wheel) model is shown here:



FireWire port cover

1. FireWire port
2. Headphones port
3. Hold switch
4.

iPod (Scroll wheel)

iPod (scroll wheel) models have a scroll wheel that physically turns. The controls (Play, Menu, Next, Previous) appear in a circle around the wheel. iPod (scroll wheel) models are referred to as first generation iPod models.

Apendix 3 – Most valuable brands 2011

Source: Millward Brown, 2011. Most valuable brands. Available at: <http://www.millwardbrown.com/Libraries/Optimor_BrandZ_Files/2011_BrandZ_Top100eport.sflb.ashx>

#	Brand	Brand Value 2011 ($M)	% Brand Value Change 2011 vs. 2010	#	Brand	Brand Value 2011 ($M)	% Brand Value Change 2011 vs. 2010
1		153,285	84%	26		24,312	23%
2	Google	111,498	-2%	27	TOYOTA	24,198	11%
3	IBM	100,849	17%	28	HSBC	22,587	-4%
4		81,016	23%	29	Bai du 百度	22,555	141%
5	Microsoft	78,243	2%	30		22,425	3%
6	Coca-Cola*	73,752	8%	31	TESCO	21,834	-15%
7	at&t	69,916	N/A	32	Gillette	19,782	-4%
8	Marlboro	67,522	18%	33	中国人寿 CHINA LIFE	19,542	N/A
9	中国移动通信 CHINA MOBILE	57,326	9%	34	Pampers	19,350	11%
10		50,318	12%	35		19,102	248%
11	ICBC	44,440	1%	36		17,597	N/A
12	vodafone	43,647	-2%	37	中国银行 BANK OF CHINA	17,530	-20%
13	verizon	42,828	N/A	38	Disney	17,290	15%
14	amazon.com	37,628	37%	39	RBC	17,182	3%
15	Walmart	37,277	-5%	40		17,115	23%
16	WELLS FARGO	36,876	97%	41	ExxonMobil	16,973	10%
17	ups	35,737	35%	42	TD	16,931	19%
18	hp	35,404	-11%	43	中国农业银行	16,909	N/A
19	Deutsche Telekom T **	29,774	N/A	44	cisco	16,314	-2%
20	VISA	28,553	15%	45	Budweiser ***	15,952	0%
21		27,249	N/A	46	L'ORÉAL	15,719	11%
22	ORACLE	26,948	9%	47	citi	15,674	17%
23	SAP	26,078	7%	48	docomo	15,449	19%
24		25,524	22%	49	accenture	15,427	5%
25	BlackBerry	24,623	-20%	50		15,344	12%

*The Brand Value of Coca-Cola includes Likes, Diets and Zero
**Deutsche Telekom is in the process of re-branding its business to 'T', which incorporates T-Mobile, T-Home and T-Systems
***The Brand Value of Budweiser includes Bud Light
****The Brand Value of Pepsi includes Likes, Diets and Zero

Apendix 4 – The American customer satisfaction index.

Source: The american customer satisfaction index, 2011. Available at: <http://www.theacsi.org/index.php?option=com_content&view=article&id=210:acsi-scores-september&catid=14&Itemid=265>

	Base-line	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	Previous Year % Change	First Year % Change
Personal Computers	**78**	**75**	**73**	**70**	**71**	**72**	**74**	**71**	**71**	**72**	**74**	**74**	**77**	**75**	**74**	**75**	**78**	**78**	**0.0**	**0.0**
Apple	77	75	76	70	69	72	75	73	73	77	81	81	83	79	85	84	86	87	1.2	13.0
HP (Hewlett-Packard)	78	80	77	75	72	74	74	73	71	70	71	73	75	76	73	74	77	78	1.3	0.0
Dell	NM	NM	NM	72	74	76	80	78	76	78	79	74	78	74	75	75	77	77	0.0	6.9
All Others	NM	70	73	72	69	69	68	67	70	69	71	74	77	75	72	74	77	77	0.0	10.0
Acer (includes Gateway)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	72	74	77	77	0.0	6.9
Compaq (Hewlett-Packard)	78	77	74	67	72	71	71	69	68	68	69	67	72	73	70	74	74	75	1.4	-3.8
IBM	78	78	74	71	74	73	75	71	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	N/A	N/A
Gateway	NM	NM	NM	NM	76	76	78	73	72	69	74	72	73	75	#				N/A	N/A
Packard Bell	NM	NM	71	66	67	66	#												N/A	N/A

Legend

NA	Not available
#	Company merger
†	Company defunct
NM	Not measured
^	Industry aggregated

Notes

ACSI releases industry results monthly and updates the national index quarterly. Baseline measurements are from the summer of 1994.

The "All Others" score for an industry represents the remainder of the total industry market share, less the market shares of the ACSI-measured companies. It is an aggregate of a representative number of customer interviews from each of potentially hundreds of smaller companies within the industry. Individual company scores within the "All Others" category cannot be derived without additional data collection (see "ACSI Services," or to generate your own ACSI score using the ACSI methodology, see "ACSI Monitor^{SM}").

19.3 Apendix 5 – Apache License

Source: Apache, 2004. Apache software license. Available at:

<http://www.apache.org/licenses/LICENSE-2.0.txt>

Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/

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Apendix 6 – Open Handset Alliance FAQ
Source: <http://www.openhandsetalliance.com/oha_faq.html>

What is the Open Handset Alliance™?
The Open Handset Alliance is a group of 84 technology and mobile companies who have come together to accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience. Together we have developed Android™, the first complete, open, and free mobile platform. We are committed to commercially deploy handsets and services using the Android Platform.
What types of companies are in the Open Handset Alliance?
All parts of the mobile ecosystem are represented in the Alliance. Members include mobile operators, handset manufacturers, semiconductor companies, software companies, and commercialization companies. The current list of members can be found here.
What have members of the Alliance committed to?
All members of the Alliance have committed to making the initial version of the platform a commercial success. Some companies have contributed significant intellectual property to the Alliance that will be released under the Apache v2 Open Source license. Others are working to make sure their chipsets support the platform. Handset manufacturers and mobile operators are working to develop handsets based on the platform. Commercialization partners are working with the industry to support the platform via a professional services model.
Why is an open platform good for consumers?
Consumers will see cheaper and more innovative mobile devices and services, which will inevitably feature more engaging, easier-to-use interfaces — as well as a rich portfolio of applications.
Why is an open platform good for mobile operators?
The overall cost of handsets will be lower and mobile operators will have complete flexibility to customize and differentiate their product lines. Furthermore, they will see much more rapid innovation in handsets and in services.
Why is an open platform good for handset manufacturers?
Handset manufacturers will benefit from lower software BOM (bill of material) costs and faster time-to-market for handsets. In addition, they will have greater flexibility to customize and differentiate their product offerings.
Why is an open platform good for semiconductor companies?
As cellphone-on-a-chip becomes closer to reality, semiconductor companies will need access to more sophisticated software that takes advantage of the enhanced features of these solutions. The processors of tomorrow will be multi-core and have access to shared peripherals such as 3D graphics, signal processor cores and dedicated blocks for multi media acceleration, etc. Without support for these peripherals in the platform, semiconductor companies have no clear way to give 3rd party developers access to this enhanced functionality. An open platform helps semiconductor companies add support for their newest products in a timely manner.
Why is an open platform good for software companies?
An open platform allows for simplified integration of software components into a complete mobile platform, and the lower acquisition cost of the mobile platform will increase the ability of handset manufacturers to invest in high value and differentiated software components.
Why is an open platform good for developers?
Developers will be able innovate rapidly because they will have comprehensive API access to handset capabilities that are web-ready. They will experience increased productivity because they will have comprehensive and easy-to-use developer tools. And because open source offers a deeper understanding of the underlying mobile platform, they can better optimize their applications. Finally, the distribution and commercialization of mobile apps will be less expensive and easier.
Who can join the Open Handset Alliance?
The Open Handset Alliance brings together companies in the mobile ecosystem that each contribute to the effort in various ways. We welcome companies willing to make serious and ongoing contributions to openness in the mobile world.
Who do we contact to learn about joining the Open Handset Alliance?
Email us at info@openhandsetalliance.com
http://www.openhandsetalliance.com/oha_faq.html

19.4 Apendix 7 – Applications Developer agreement

Source: <http://www.openhandsetalliance.com/tos.html>

1. The Open Handset Alliance, Google, and You
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1.3 Unless otherwise agreed in writing with Google, your agreement with Google will include the terms and conditions set out in this document. These are referred to below as the "Alliance Website Terms." Some of the Services provided through the Open Handset Alliance Website may include their own terms and conditions. Your agreement with Google will also include these terms and conditions, referred to below as the "Additional Terms." Where Additional Terms apply to a Service, these will be accessible for you to read either within, or through your use of, that Service.
1.4 The Alliance Website Terms, together with any Additional Terms, form a legally binding agreement between you and Google in relation to your use of the Services. It is important that you take the time to read them carefully. This legal agreement is referred to below as the "Terms."
1.5 If there is any contradiction between the Additional Terms and the Alliance Website Terms, then the Additional Terms shall take precedence in relation to those specific Services to which they apply.
2. Accepting the Terms
2.1 In order to use the Services, you must first agree to the Terms. You may not use the Services if you do not accept the Terms.
2.2 You can accept the Terms by:

- (A) clicking to accept or agree to the Terms, where this option is made available to you in the user interface for any Service; or
- (B) by actually using the Services. In this case, you understand and agree that Google will treat your use of the Services as acceptance of the Terms from that point onwards.

2.3 You may not use the Services and may not accept the Terms if (a) you are not of legal age to form a binding contract with Google, or (b) you are a person barred from receiving the Services under the laws of the United States or other countries including the country in which you are resident or from which you use the Services.
2.4 Before you continue, you should print off or save a local copy of the Alliance Website Terms for your records.
3. Language of the Terms
3.1 Where Google has provided you with a translation of the English language version of the Terms, then you agree that the translation is provided for your convenience only and that the English language versions of the Terms will govern your relationship with Google.
3.2 If there is any contradiction between what the English language version of the Terms says and what a translation says, then the English language version shall take precedence.
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18.2 You understand and agree that if you use the Services after the date on which the Alliance Website Terms or Additional Terms have changed, Google will treat your use as acceptance of the updated Alliance Website Terms or Additional Terms.

19. General Legal Terms

19.1 Sometimes when you use the Services, you may (as a result of, or through your use of the Services) use a service or download a piece of software, or purchase goods, which are provided by another person or company. Your use of these other services, software or goods may be subject to separate terms between you and the company or person concerned. If that case, the Terms do not affect your legal relationship with these other companies or individuals.

19.2 The Terms constitute the whole legal agreement between you and Google and govern your use of the Services (but excluding any services which Google may provide to you under a separate written agreement), and completely replace any prior agreements between you and Google in relation to the Services.

19.3 You agree that Google may provide you with notices, including those regarding changes to the Terms, by email, regular mail, or postings on the Services.

19.4 You agree that if Google does not exercise or enforce any legal right or remedy which is contained in the Terms (or which Google has the benefit of under any applicable law), this will not be taken to be a formal waiver of Google's rights and that those rights or remedies will still be available to Google.

19.5 If any court of law, having the jurisdiction to decide on this matter, rules that any provision of these Terms is invalid, then that provision will be removed from the Terms without affecting the rest of the Terms. The remaining provisions of the Terms will continue to be valid and enforceable.

19.6 You acknowledge and agree that each member of the group of companies of which Google is the parent shall be third party beneficiaries to the Terms and that such other companies shall be entitled to directly enforce, and rely upon, any provision of the Terms that confers a benefit on (or rights in favor of) them. Other than this, no other person or company shall be third party beneficiaries to the Terms.

19.7 The Terms, and your relationship with Google under the Terms, shall be governed by the laws of the State of California without regard to its conflict of laws provisions. You and Google agree to submit to the exclusive jurisdiction of the courts located within the county of Santa Clara, California to resolve any legal matter arising from the Terms. Notwithstanding this, you agree that Google shall still be allowed to apply for injunctive remedies (or an equivalent type of urgent legal relief) in any jurisdiction.

November 5, 2007

20 Bibliography

Al-Debei, M. M. (2010). Value Networks for Developing Mobile Innovations: The Case of Apple iPhone. *2010 International Conference on Management Science and INformation Engineering* (pp. 255-259). Chungli: IEEE.

Anderson, P., & Tushman, M. L. (1990). Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. *Administrative Science Quarterly , 35*, 604-633.

Arthur, B. W. (1999). Complexity and the Economy. *Science , 284*, 107-109.

Arthur, B. W. (1995). Complexity in Economic and Financial Markets. *Complexity , 1* (1).

Arthur, B. W. (1994). *Increasing Returns and Path Dependence in the Economy.* Ann Arbor: University of Michigan Press.

Arthur, B. W. (1994). Inductive Reasoning and Bounded Rationality (The El Farol Problem). *American Economic Review , 84*, 406-417.

Arthur, B. W. (1999). The End of Certainty in Economics. *Einstein Meets Magritte* (pp. 1-6). Brussels: Kluwer Academic Publishers.

Bamford, J. D., Gomes-Casseres, B., & Robinson, M. S. (2003). *Mastering Alliance Strategy.* San Francisco: Jossey-Bass.

Boudreau, K. J., & Hagiu, A. (2008, September 18). *Platform Rules: Multi-Sided Platforms as Regulators.* Retrieved 08 15, 2011 from SSRN: http://ssrn.com/abstract=1269966

Boudreau, K. (2010). Open Platform Strategies and Innovation: Granting Access Devolving Control. *Management Science* , 1849-1872.

Brynjolfsson, E., & Kemerer, C. F. (1996). Network Externalities in Microcomputer Software: An Econometric Analysis of the Spreadsheet Market. *Management Science , 42* (12), 1627-1647.

Brakus, J. J., Schmitt, B. H., & Zarantonello, L. (2009). Brand Experience: What is it? How is it Measured? Does It Affect Loyalty. *Journal of Marketing , 73*, 52-68.

Cusumano, M. (2010). The Evolution of Platform Thinking. *Communications of the ACM , 53* (1), 32-34.

Cimoli, M., & Dosi, G. (1995). Technological paradigms, patterns of learning and development: an introductory roadmap. *Journal of Ecolutionary Economics , 5*, 243-268.

Chen, J., Doraszelski, U., & Harrington, J. E. (2009). Avoiding Market Dominance: Product Compatibility in Markets with Network effects. *RAND Journal of Economics , 40* (3), 455-485.

Chen, P.-y., & Forman, C. (2006). Can Vendors Influence Switching Costs and Compatibility in an Environment with Open Standards? *MIS Quarterly , 30*, 541-562.

Chesbrough, H. (2004). Managing Open Innovation. *Research Technology Management , 47* (1), 23-26.

Christ, J. P., & Slowak, A. P. (05). *Why Blu-Rau Vs. HD-DVD is not VHS Vs. Betamax: The Co-evolution of standard-setting.* Hohenheim: Forschungszentrum FZID.

Christensen, C. M., Suarez, F. F., & Utterback, J. M. (1998). Strategies for Survival in Fast-Changing Industries. *Management Science , 44* (12), S207-S220.

Economides , N., & Katsamakas, E. (2006). Two-Sided Competition of Proprietary vs. Open Source Technology Platforms and the Implications for the Software Industry. *Management Science , 52* (7), 1057-1071.

Economides, N., & Katsamakas, E. (2006). Linux vs. Windows: A Comparison of Application and Platform Innovation Incentives for Open Source and Proprietary Software Platforms. In J. Bitzer, & J. H. Schröder, *The Economics of Open Source Software Development* (pp. 207-218). Amsterdam: Elsevier B.V.

Eisenmann, T. R., & Herman, K. (2006, November). Google Inc. *Harvard Business School Case 910-036* , 1-33.

Elbaum, S., & Zhao, L. (2003). Quality Assurance under the Open Source Development. *Journal of Systems and Software , 66* (1), 65-75.

David, P. A., & Greenstein, S. (1990). The Economics of Compatibility Standards: An Introduction to Recent Research. *Economics of Innovation and New Technology , 1*, 3-41.

De Vries, H. J., De Ruijter, J. P., & Argam, N. (2009). *Dominant Design or Multiple Designs: The Flash Memory Card CAse.* Rotterdam: Erasmus Research institute of Management.

Farrel, J., & Besen, S. M. (1994). Choosing How to Compete: Strategies and Tactics in Standardization. *Journal of Economic Perspectives , 8* (2), 117-131.

Farrel, J., & Klemperer, P. (1992). Coordination and lock-In: Competition with Switching costs and Network Effects. *40* (1), 85-103.

Farrell, J., & Saloner, G. (1985). Standardization, Compatibility, and Innovation. *Rand Journal of Economics , 16* (1), 70-83.

Gandal , N., & Church, J. (200). Systems Competition, Vertical Merger, and Foreclosure . *Journal of Economics & Management Strategy , 9* (1), 25-51.

Gandal, N., & Krause, D. (2008). Indirect Network Effects and Adoption Externalities. *Review of Network Economics , 7* (3), 337-358.

Gilbert, R. J. (1995). Networks, Standards, and the Use of Market Dominance: Microsoft (1995). In J. J. Kwoka, & L. J. White, *The Antitrust Revolution: Economics, Competition, and Policy* (pp. 409-429). Oxford University Press.

Hagiu, A. (2006). Pricing and Commitment by Two-Sided Platforms. *RAND Journal of Economics , 37* (3), 720-737.

Hagiu, A. (2009). Two-Sided Platforms: Product Variety and Pricing Structures. *Journal of Economics & Management Strategy , 18* (4), 1011-1043.

Henderson, R. M., & Clark, K. B. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly , 35*, 9-30.

Katz, M. L., & Shapiro, C. (1985). Network Externalities, Competition, and Compatibility. *The American Economic Review , 75* (3), 424-440.

Katz, M. L., & Shapiro, C. (1992). Product Introduction with Network Externalities. *The Journal of Industrial Economics , 40* (1), 55-83.

Katz, M. L., & Shapiro, C. (1994). Systems Competition and Network Effects. *Journal of Economic Perspectives , 8* (2), 93-115.

Kenney, M., & Pon, B. (2011). Structuring the Smartphone Industry: Is the Mobile Internet OS Platform the Key? *Keskusteluaiheita Discussion Papers , 1238*, 1-30.

Klemperer, P. (1995). Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organization, Macroeconomics, and International Trade. *The Review of Economic Studies , 62* (4), 515-539.

Netanel, W. N. (2007). Temptations of the Walled Garden: Digital Rights Management and Mobile Phone Carriers. *Journal on Telecommunication & High Technology Law , 6*, 77-100.

Murmann, J. P., & Tushman, M. L. (1997). Dominant Designs, Technology Cycles, and Organization Outcomes. *Risk, Managers and Options Conference in Honor of Ned Bowman.* Philadelphia: The Wharton School.

Manenti, F. M., & Ernesto, S. (2008). One-Way Compatibility, Two-Way Compatibility and Entry in Network Industries. *International Journal of the Economics of Business , 15* (3), 301-322.

Margolis, S. E., & Liebowitz, S. J. (1994). Network Externality: An Uncommon Tragedy. *Journal of Economic Perspectives , 8* (2), 133-150.

Morris, B. (2007). *Architecture sourcebook: Design and evolution of a mobile phone OS.* West Sussex: Symbian press.

Parker, G., & van Alstyne, M. (2008, July 24). *Innovation, Openness & Platform Control.* From SSRN eLibrary: http://ssrn.com/abstract=1079712

Peppard, J., & Rylander, A. (2006). From Value Chain to Value Network: Insigths for Mobile Operators. *European Management Journal , 24*, 126-141.

Suarez, F. F. (2004). Battle for Technological Dominance: an Integrative Framework. *Research Policy , 33*, 271-286.

Sanchez, R., & Manhoney, J. T. (2005). Modularity, flexibility, knowledge management in product and organization design. *Strategic management journal , 17*, 63-67.

Schilling, M. A. (1998). Technological Lockout: An Integrative Model of the Economic and Strategic Factors Driving Technology Success and Failure. *Academy of Management Review , 23* (2), 267-284.

Shapiro, C., & Varian, H. R. (1999). *Information Rules.* Boston: Harvard Business School Press.

Tirole, J., & Lerner, J. (2002). Some Simple Economics of Open Source. *The Journal of Industrial Economics , 50* (2), 197-234.

Tirole, J., & Rochet, J.-C. (2003, june). Platform Competition in Two-Sided Markets. *Journal of the European Economic Association* , 990-1029.

West, J. (2003). How Open is Open Enough? Melding Proprietary and Open Source Platform Strategies. *Research Policy , 32*, 1259-1285.

West, J., & Wood, D. (2011). Tradeoffs of Open Innovation Platform Leadership: The Rise and Fall of Symbian Ltd. *Standford Social Science and Technology Seminar* (pp. 1-46). San Fransico: SIEPR Working Paper.

West, J., & Wood, D. (2011, March 30). Tradeoffs open innovation platform leadership: The rise and fall of Symbian. Stanford.

West, J., & Gallagher, S. (2006). Challenges of Open Innovation: The Paradox of firm Investment in Open-Source Software. *Faculty Publications. Paper 3* .

West, J., & Mace, M. (2010). Browsing as the Killer App: Explaining the rapid success of Apple's iPhone. *Journal Telecommunications Policy* , 1-24.

West, J., & Mace, M. (2007). Entering a Mature Industry Through Innovation: Apple iPhone Strategy. *DRUID Summer Conference* (pp. 1-41). Copenhagen: Routledge.

Yoffie, D. B., & Slind, M. (2008). Applice Inc., 2008. *Harvard Business School Case 708-480* , 1-32.

van de Kaa, G., van den Ende, J., de Vries, H. J., & van Heck, E. (2007). The Emergence of Standards: a Meta-analysis. *Proceedings of the 40th Hawaii International conference on System Sciences* (pp. 1-10). IEEE.

21 Endnotes

[1]Microsoft, 2011. Nokia and Microsoft sign definitive agreement ahead of schedule. [Press Release] April 21, 2011. Available at: <http://www.microsoft.com/presspass/press/2011/apr11/04-21msftnokia.mspx> [12-04-2011].

[2]Android US market share drops slightly in Q1 2011. <http://www.telegraph.co.uk/technology/google/8590205/Googles-Android-phones-lose-market-share-in-US.html>[12-04-2011].

[3] A non-linear Polya process is a statistical model based on a Polya urn model. A Polya urn model describes an urn filled with two types of balls, red and blue. Whenever a ball is drawn and observed it, is put back into the urn together with a new ball of the same colour. So chances of drawing a red ball increase each time a red ball is drawn. A non-linear Polya process is a variation where the number of balls put back in the urn is a function of a draw.

[4] Coase (1960) states that if outcomes are inefficient – a platform charges sellers a higher fee then buyers - and nothing prevents bargaining, people negotiate an efficient outcome. When market sides bargain, price structure has little influence on the entire market size. The market basically functions as a normal one-sided market with overall price level as the important determinant.

[5] See Arthur (1994), '*Increasing Returns and Path Dependence in the Economy'* on human learning chapter c 8

[6] Mobile content user experience (2008)

WDS, 2008. Mobile content: The user experience. [PFD] February 02, 2008. Available at: <http://www.wds.co/news/whitepapers/20082202/mobile_content_user_experience_wdsglobal_int.pdf >[12-04-2011].

[7] Examples of such early devices are Nokia 9000 and Ericsson GS88 concept phones. They were released in 1996 and 1997. The Ericsson GS88 was the first device labelled as a smartphone but was never released.

Smartphone-guide, 2010. A short history of the smartphone. [Website] Available at: <http://smartphone-guide.com/a-short-history-of-the-smartphone.html>[12-04-2011].

[8]WDSGlobal Industry Briefing 2010 highlights some of the challenges that will face wireless carriers as they look to increase the population of smartphones within their portfolio and attached to their networks.
WDS, 2010. Smartphones: Building profitability and loyalty in the mass consumer market. [PDF] Available at: <http://www.wds.co/enlightened/smartphone_profitability/smartphone_profitability_and_loyalty_wdsglobal.pdf>[12-04-2011].

[9] Om Malik, 2009. How iPhone 3.0 will impact wirless Networks. *Gigaom.* [Online] June 17, 2009. Available at: <http://gigaom.com/2009/06/17/how-iphone-3-0-will-impact-wireless-services/>[12-04-2011].

[10] Dan Frommer, 2011. History lesson: How the iPhone changed smartphones forever. *Business Insider.* [Online] June 6, 2011. Available at: < http://www.businessinsider.com/iphone-android-smartphones-2011-6?op=1> [12-04-2011].

[11]Fred Vogelstein, 2008. The untold story: How the iPhone blew up the wireless industry. *Wired.* [Online] September 01, 2008. Available at: <http://www.wired.com/gadgets/wireless/magazine/16-02/ff_iphone?currentPage=1> [12-04-2011].

[12] Id.

[13] Ryan Garner, 2010. The smartphone market is there to be won... In 2011 the 'mobile ecosystem' will be critical to driving loyalty. *GFK TechTalk.* [Online] November 30, 2010. Available at: <http://www.gfktechtalk.com/2010/11/30/the-smartphone-market-is-there-to-be-won-in-2011-the-mobile-ecosystem-will-be-critical-to-driving-loyalty/> [12-04-2011].

[14] Id.

[15] Estimation of the smartphone manufacturers average, not weighted operating margin. http://www.asymco.com/2010/08/13/phone-incumbents-average-operating-margin-4-5-rim-and-apple-34/

[16]Reports on the Mobile application market . http://www.brighthand.com/default.asp?newsID=16947&news=Smartphone+Apps+Growt <http://www.wds.co/news/whitepapers/20100719/smartphone_profitability_and_loyalty_wdsglobal.pdf>[12-04-2011].

[17] Articles on future mobile industry trends.

Dan Butcher, 2010. Competition in smartphone market is heating up: Juniper Research. *Mobile Marketer. [Online] May 18, 2010. Available at:* <http://www.mobilemarketer.com/cms/news/manufacturers/6285.html>[12-04-2011].

Gartner, 2011. Gartner says 428 million mobile communication devices sold worldwide in first quarter 2011, a 19 percent increase year-on-year. [Press Release] May 19, 2011. Available at: <http://www.gartner.com/it/page.jsp?id=1689814> [12-04-2011].

Gartner, 2011. Gartner says 428 million mobile communication devices sold worldwide in first quarter 2011, a 19 percent increase year-on-year. [Press Release] May 19, 2011. Available at: <http://www.gartner.com/it/page.jsp?id=1689814> [12-04-2011].

Ryan Garner, 2010. The smartphone market is there to be won... In 2011 the 'mobile ecosystem' will be critical to driving loyalty. *GFK TechTalk.* [Online] November 30, 2010. Available at: <http://www.gfktechtalk.com/2010/11/30/the-smartphone-market-is-there-to-be-won-in-2011-the-mobile-ecosystem-will-be-critical-to-driving-loyalty/> [12-04-2011].

Neil Has, 2010. Smartphone war part1: Smartphone OS the differentiating factor. *4G WirelessJobs.com.* [Online] Februari 02, 2010. Available at: <http://www.4gwirelessjobs.com/articles/article-detail.php?Smartphone-War-Part-I-Smartphone-OS-the-differentiating-factor&Arid=MTAz&Auid=Njk>[12-04-2011].

Kent German, 2011. Cell phone buying guide. *CNET.* [Online] November 14, 2011. Available at: <http://reviews.cnet.com/2719-7609_7-262-2.html?tag=page;page> [12-04-2011].

[18] Id.

[19] Fred Vogelstein, 2008. The untold story: How the iPhone blew up the wireless industry. *Wired.* [Online] September 01, 2008. Available at: <http://www.wired.com/gadgets/wireless/magazine/16-02/ff_iphone?currentPage=1> [12-04-2011].

[20] Gartner, 2011. Gartner says 428 million mobile communication devices sold worldwide in first quarter 2011, a 19 percent increase year-on-year. [Press Release] May 19, 2011. Available at: <http://www.gartner.com/it/page.jsp?id=1689814> [12-04-2011].

IMS Research smartphone market forecast 2011. Available at: <http://imsresearch.com/press-release/Global_Smartphones_Sales_Will_Top_420_Million_Devices_in_2011_Taking_28_Percent_of_all_Handsets_According_to_IMS_Research> [12-04-2011].

IDC smartphone market forecast 2011. Available at: <http://www.idc.com/getdoc.jsp?containerId=prUS22762811> [12-04-2011].

[21] Ryan Garner, 2010. The smartphone market is there to be won... In 2011 the 'mobile ecosystem' will be critical to driving loyalty. *GFK TechTalk.* [Online] November 30, 2010. Available at: <http://www.gfktechtalk.com/2010/11/30/the-smartphone-market-is-there-to-be-won-in-2011-the-mobile-ecosystem-will-be-critical-to-driving-loyalty/> [12-04-2011].

[22] Steve Jobs explains apple's vision in 2001 http://www.youtube.com/watch?v=9046oXrm7f8&feature=player_embedded

[23] In 2007, Steve Jobs announced that Apple Computer, Inc. would from then on be know as Apple Inc. because computers where not the main focus anymore.

[24]Apple's financial reports demonstrate this division (Annex 1).

[25] Five examples of customer lock-in tactics applied by Apple. Dan Tynan, 2004. Bad Apple: Five classic Apple marketing tactics that lock you in. *PCWorld.* [Online] November 2009. Available at: <http://www.pcworld.com/article/181200-2/bad_apple_five_classic_apple_marketing_tactics_that_lock_you_in.html> [12-04-2011].

[26] Articles on the iPod halo-effect boosting iMac and accessory sales.

Jo Best, 2004. iPode 'halo effect' boosting Apple's hardware sales. *ZDNet.* [Online] 24 November, 2004. Available at: <http://www.zdnet.co.uk/news/desktop-hardware/2004/11/24/ipod-halo-effect-boosting-apples-hardware-sales-39174910/> [12-04-2011].

Susan Lerner, 2005. Apple shines on upgrade. *Market Watch.* [Online] March 18, 2005. Available at: <http://www.marketwatch.com/story/apple-shines-on-morgan-stanley-upgrade> [12-04-2011].

Damon Darlin, 2006. The iPod ecosystem. *MIFI.* [Online] February 3, 2006. Available at: <http://www.nytimes.com/2006/02/03/technology/03ipod.html> [12-04-2011].

[27] Ndubuisi Ekekwe, 2010. Mastering the Apple game of customer perception. *HBR Blog Network: Ndubuisi Ekekwe.* [Blog] October 28, 2010. Available at: <http://blogs.hbr.org/cs/2010/10/mastering_the_apple_game_of_cu.html> [12-04-2011].

[28] In 2005, 2 years before the release of the iPhone, Apple offered two core lines of hardware products: the iPod line and Mac line. The product lines ranged from mass-market iPod Shuffles and Mac mini to the high-end, expensive and cutting edge iPod Photo and Power Mac G5. The cheap devices are intended as entry models into the apple ecosystem that includes software, services and accessories next to the main hardware products

[29] For a complete product release overview of apple product from 1999 until today, visite http://www.mactimeline.com/list

[30]Multi-media Overview of Apple's most important advertisement campaigns.

Brandrepublic, 2011. Apple's ads: How Steve Jobs bult the world's most valuable brand. [Press Release] October 10, 2011. Available at: <http://www.brandrepublic.com/advertising/article/1069551/apple-ads-built-worlds-valuable-brand/> [12-04-2011].

[31] Jason Perlow, 2011. Apple's secret ipad advantage: the supply chain. ZDNet. [Online] February 7, 2011. Available at: <http://www.zdnet.com/blog/perlow/apples-secret-ipad-advantage-the supply-chain/15813>[12-04-2011].

Philip Elmer-Dewitt, 2011. A fantastic use for apple's cash. *CNNMoney.* [Online] January 23, 2011. Available at: <http://tech.fortune.cnn.com/2011/01/23/a-fantastic-use-for-apples-cash/ > [12-04-2011].

[32] Brand Stone, 2009. Want to copy iTunes music? Go Ahead, Apple Says. [Online] The New York Times. Available at: <http://www.nytimes.com/2009/01/07/technology/companies/07apple.html> [12-04-2011].

Tim Arango, 2009. Despite iTunes accord, music labels still fret. [Online] The New York Times. Available at: <http://www.nytimes.com/2009/02/02/business/media/02apple.html?_r=2&emc=tnt&tntemail0=y> [12-04-2011].

[33] Summary of reseller requirements and benefits.

Apple Inc., 2011. Apple reseller program summary. [Online] Available at: <http://www.apple.com/ca/channel/programs/channel_reseller_summary.html> [12-04-2011].

[34] Jason Hiner, 2011. Advantage apple: Retailers only get a 3% discount on iPad. [Online] Available at: <http://www.zdnet.com/blog/btl/advantage-apple-retailers-only-get-a-3-discount-on-ipad/45988> [12-04-2011].

[35] Story of how Apple got in to Retailing.

Tom Hormby, 2008. The roots of Apple's retail stores. [online] LowEndMac. Available at: <http://lowendmac.com/orchard/08th/roots-of-the-apple-store.html> [12-04-2011].

[36]Shareen Pathak, 2011. The real genius of Apple retail. [Online] Fins Technology. Available at: <http://it-jobs.fins.com/Articles/SB130688440763820723/The-Real-Genius-of-Apple-Retail> [12-04-2011].

Jerry Useem, 2007. Apple: Americ's best retailer. [Online] CNN Money. Available at: <http://money.cnn.com/magazines/fortune/fortune_archive/2007/03/19/8402321/> [12-04-2011].

[37] Apple Inc., 2007. Apple reinvents the phone with iPhone. [Onlin] Available at: <http://www.apple.com/pr/library/2007/01/09Apple-Reinvents-the-Phone-with-iPhone.html> [12-04-2011].

[38] Examples of how the iphone was initially reviewed upon its release.

Sasha Segan, 2007. iPhone analysis: Apple's revolution for the few. [Online] PCmag.com. Available at: <http://www.pcmag.com/article2/0,2817,2081082,00.asp>[12-04-2011].

David Pogue, 2007. The iPhone matches most of its hype. [Online] The New York Times. Available at: <http://www.nytimes.com/2007/06/27/technology/circuits/27pogue.html?pagewanted=all> [12-04-2011].

[39]Rachel Metz, 2007. Apple Rises on iPHone margin report. [Online] The Washington Post. Available at: <http://www.washingtonpost.com/wp-dyn/content/article/2007/07/03/AR2007070301488.html> [12-04-2011].

[40] Tom Krazit, 2007. Piper Jaffray: AT&T paying Apple $18 per iPhone, per month. [Online] Cnet.com. Available at: <http://news.cnet.com/8301-13579_3-9803657-37.html> [12-04-2011].

[41]Daniel Lonescu, 2009. Three reasons why iPhone won't get Adobe Flash. [Online] PCworld. Available at: <http://www.pcworld.com/article/173092/3_reasons_why_iphone_wont_get_adobe_flash.html>[12-04-2011].

[42] Apple Inc., 2007. AT&T and Apple announce simple affordable service plans for iPhone. [Press Release] June 26, 2007. Available at: <http://www.apple.com/pr/library/2007/06/26AT-T-and-Apple-Announce-Simple-Affordable-Service-Plans-for-iPhone.html> [12-04-2011].

[43] The orginal iPhone offered an EDGE network connection that was 5 times slower than 3G which other smartphone were able to use.

David W. Gardner, 2007. The iPhone's Achilles' heel: AT&T's slow Edge network. [Online] Informationweek. Available at: <http://www.informationweek.com/news/200001399> [12-04-2011].

[44] John Markoff, 2007. Phone shows Apple's impact on consumer products. [Online] The New York Times. Available at: <http://www.nytimes.com/2007/01/11/technology/11cnd-apple.html> [12-04-2011].

Arik Hesseldahl, 2007. Why I won't Buy an iPhone. [Online] Bloomberg Businessweek. Available at: <http://www.businessweek.com/technology/content/oct2007/tc2007105_056012.htm> [12-04-2011].

[45] Apple Inc., 2008. Apple introduces the new iPhone 3G. [Press Release] June 9, 2008. Available at: <http://www.apple.com/pr/library/2008/06/09Apple-Introduces-the-New-iPhone-3G.html> [12-04-2011].

[46] Arik Hesseldahl and Jennifer L. Schenker, 2008. iPhone 2.0 Takes on the World. [Online] Bloomberg Businessweek. Available at: <http://www.businessweek.com/technology/content/jun2008/tc2008065_290813.htm> [12-04-2011].

[47] John Timmer, 2009. Aplle floats above recession on a wave of iPhone sales. [Online] ARS Technica. Available at: <http://arstechnica.com/apple/news/2008/10/apple-floats-above-recession-on-a-wave-of-iphone-sales.ars> [12-04-2011].

[48] Apple Inc., 2011. Apple's App Store downloads top 15 billion. [Press Release] July 7, 2011. Available at: <http://www.apple.com/pr/library/2011/07/07Apples-App-Store-Downloads-Top-15-Billion.html> [12-04-2011].

[49] Apple Inc., 2007. Apple unveils iPod Touch. [Press Release] September 5, 2007. Available at: <http://www.apple.com/pr/library/2007/09/05Apple-Unveils-iPod-touch.html> [12-04-2011].

[50] WDSGlobal industry 2011 consumer survey

WdsGlobal, 2011. Smartphones: Protecting profitability and loyalty in the mass market. [pdf] Available at: <http://www.wds.co/enlightened/smartphone_profitability/smartphone_profitability_and_loyalty_wdsglobal.pdf> [12-04-2011].

[51]Matt Hamblen, 2009. App Store success could change software-buying habits. [Online] Computerworld.com. Available at: <http://www.computerworld.com/s/article/9138618/App_Store_success_could_change_software_buying_habits_> [12-04-2011].

[52] Seth Weintraub, 2008. Apple App Store's greates strength is also its biggest shortcoming. *Computerworld.com* Apple versus Google. [Blog] December 13, 2008. Available at: <http://blogs.computerworld.com/apple_app_stores_greatest_strength_also_its_biggest_downfall> [12-04-2011].

Brians X. Chen, 2008. iPhone developers go from Rags to Riches. *Wired.com* Gadget Lab. [Blog] September 19, 2008. Available at: <http://www.wired.com/gadgetlab/2008/09/indie-developer/> [12-04-2011].

[53] An average iPhone user downloads 37 different applications, diversifying creating a smartphone functionality tuned to their personal needs. The average number of applications is expected to rise further.

Nielsen, 2010. The State of Mobile Apps. Nielsen Wire. [Blog] June 1, 2010. Available at: <http://blog.nielsen.com/nielsenwire/online_mobile/the-state-of-mobile-apps/> [12-04-2011].

[54] The App Store made an estimated $189 million of application sales since its existence. Approximately 1% of the total profits made over the same period. Using subscription fees to cover developer support costs.

Philip Elmer-DeWitt, 2010. App Store: 1% of Apple's gross profit. CNNMoney. [Online] June 23, 2010. Available at: <http://tech.fortune.cnn.com/2010/06/23/app-store-1-of-apples-gross-profit/> [12-04-2011].

Philip Elmer-DeWitt, 2009. How Apple profits from the App Store. CNNMoney. [Online] May 14, 2009. Available at <http://tech.fortune.cnn.com/2009/05/14/how-apple-profits-from-the-app-store/> [12-04-2011].

[55] According to a survey conducted by Zokem, Apple has the highest loyalty ranking and 85% of iPhone owners would repurchase an iphone.

Zokem, 2011. In the US market, iPhone outperforms other mobile platforms in user loyalty by a wide margin, Android is second, BlackBerry fourth. *Arbitron mobile.* [Online] January 18, 2011. Available at: <http://www.zokem.com/2011/01/in-the-us-market-iphone-outperforms-other-mobile-platforms-in-user-loyalty-by-a-wide-margin-android-is-second-blackberry-fourth/> [12-04-2011].

[56] According to Gartner apple's market share rose with more then 60%. It sold more then double the amount of units in 1Q11 then it did in 1Q10

Gartner, 2011. Gartner says 428 million mobile communication devices sold worldwide in first quarter 2011, a 19 percent increase year-on-year. [Press Release] May 19, 2011. Available at: <http://www.gartner.com/it/page.jsp?id=1689814> [12-04-2011].

[57] MG. Siegler, 2010. Even with pre-order failures, iPhone 4 sells out under a day. *TechCrunch*. [Online] June 15, 2010. Available at: <http://techcrunch.com/2010/06/15/iphone-4-sold-out/> [12-04-2011].

[58] Tina Teng, 2010. Apple's iPhone 4 delivery difficulties in might open up company to risk. *iSupply*. June 29, 2010. Available at: <http://www.isuppli.com/Mobile-and-Wireless-Communications/News/Pages/Apples-iPhone-4-Delivery-Difficulties-in-Might-Open-Up-Company-to-Risk.aspx>[12-04-2011].

[59] Apple Inc., 2010. iPhone 4 sales top 1.7 million. [Press Release] June 28, 2010. Available at: <http://www.apple.com/pr/library/2010/06/28iPhone-4-Sales-Top-1-7-Million.html> [12-04-2011].

[60] Dave Caolo, 2010. Apple taking risk with iPhone shortages. *Túaw*. [Online] June 30, 2010. Available at: <http://www.tuaw.com/2010/06/30/apple-taking-risk-with-iphone-shortages/> [12-04-2011].

Tina Teng, 2010. Apple's iPhone 4 delivery difficulties in might open up company to risk. *iSupply*. June 29, 2010. Available at: <http://www.isuppli.com/Mobile-and-Wireless-Communications/News/Pages/Apples-iPhone-4-Delivery-Difficulties-in-Might-Open-Up-Company-to-Risk.aspx>[12-04-2011].

[61] According to a platform interest survey of 2,733 Appcelerator application developers from June 15-17-2010, iOS preferred by developers because of its store capabilities and app 'discoverability'. However in long term developers think Android is more profitable

Appcelerator, 2010. Q2 mobile develop survey. [PDF] June 23, 2010. Available at: < http://www.appcelerator.com/assets/appcelerator-mobile-developer-survey-june-2010.pdf> [12-04-2011].

[62]Appcelerator/IDC, 2011. Q2 mobile developer. [PDF] April, 2011. Available at: < http://www.appcelerator.com/company/survey-results/mobile-developer-report-april-2011/#get_report> [12-04-2011].

[63] Erick Schonfeld, 2011. Chart: Apple's tablet OS share will shrink to 47 percent by 2015. *TechCrunch.* [Online] April 11, 2011. Available at: <http://techcrunch.com/2011/04/11/chart-apples-tablet-os-share-will-shrink-to-47-percent-by-2015/> [12-04-2011].

[64]Google.com, 2011. What is the Adwords "Quality Score" and how is it calculated?. [Online] Available at: <http://adwords.google.com/support/aw/bin/answer.py?hl=en&answer=10215> [12-04-2011].

[65] Google.com. Google's mission is to organise all information and make it universally available. [Online] Available at: < http://www.google.com/about/corporate/company/> [12-04-2011].

[66] Search engine usage is free and other search engines are merely a click away.

[67]Google.com. Our Philosophy. [Online] Available at: <http://www.google.com/intl/en/about/corporate/company/tenthings.html> [12-04-2011].

[68] Julia Bonstein, 2008. Does Google know too much? *Spiegel Online* . [Online] October 30, 2008. Available at: <http://www.spiegel.de/international/germany/0,1518,587546,00.html> [12-04-2011].

[69] Andy Rubin explains Google's interest in mobile internet.

CBS Money Watch, 2009. How the smartphone could disrupt Business. [Video Online] September 14, 2009. Available at: <http://www.bnet.com/videos/how-the-smartphone-could-disrupt-business/341967> [12-04-2011].

[70] BIA Kelsey, 2010. BIA/Kesley forecast U.S. mobile advertising to reach $2.9 billion in 2014. [Press Releas] December 1, 2010. Available at: <http://www.biakelsey.com/Company/Press-Releases/101201-U.S.-Mobile-Advertising-to-Reach-$2.9-Billion-in-2014.asp> [12-04-2011].

[71] Developer.android.com. What is Android. [Online] Available at: <http://developer.android.com/guide/basics/what-is-android.html> [12-04-2011].

[72] Yankee Group, 2007. Android from planet Google to save mobile universe. [PDF] November 6, 2007. Available at: <http://www.yankeegroup.com/research/downloads/rna_google.pdf> [12-04-2011].

[73] Google refers to this article in there Android Open Source licensing FAQ. It answers to the question "Why are you releasing the code under the Apache License instead of GPLv2?".
Ryan Paul, 2007. Why Google chose the Apache software license over GPLv2 for Android. [Online] November 6, 2007. Available at: <http://arstechnica.com/old/content/2007/11/why-google-chose-the-apache-software-license-over-gplv2.ars [12-04-2011].

[74]Apendix 64 shows the apache 2.0 license. A clear interpretation of the license can be found on (Apendix 5) .

[75] Google appears to be just a member of the OHA. However the open handset alliance terms of service (Apendix 6) clearly state Google is in charge.
All use of products, software, services and websites in connection with the Open Handset Alliance is subject to the terms of a legal agreement between Google and the user. The Android's website – that includes the SDK's- terms of service, the alliance main project doesn't even mention the alliance. (Apendix 7)

[76] Android Open Source Project. Android code-lines. [Website] Available at: <http://source.android.com/source/code-lines.html> [12-04-2011].

[77] Overview of brands owned by google
Google Inc., 2011. Permission of Google. [Website] Available at: <http://www.google.com/permissions/guidelines.html> [12-04-2011].

[78] David Meyer, 2007. Google 'guarantees' Android compatibility. *ZDNet.com.* [Online] November 13, 2007. Available at: <http://www.zdnet.co.uk/news/networking/2007/11/13/google-guarantees-android-compatibility-39290713/> [12-04-2011].

[79] Google Inc., 2011. Open Source at google. [website] Available at: <http://google-opensource.blogspot.com/> [12-04-2011].

[80] Google Code, 2011. The Google open source programs office. [Website] Available at: <http://code.google.com/opensource/open_source_faq.html> [12-04-2011].

[81] Google Code, 2011. Frequently Asked Questions. [Website] Available at: <http://code.google.com/faq.html> [12-04-2011].

[82] Interview with Chris Dibona, Google's manager of open-source programs. http://fredpalma.com/100/googles-open-source-balancing-act/

[83] Limited functionality because non-accurate search, very few filters ect. https://market.android.com/

[84] Gartner, 2011. Gartner says worldwide mobile device sales to end users reached 1.6 billion units in 2010; smartphone sales grew 72 percent in 2010. [Press Release] February 9, 2011. Available at: <http://www.gartner.com/it/page.jsp?id=1543014> [12-04-2011].

[85] AppBrain, 2011. Number of available Android applications. [Website] available at: <http://www.appbrain.com/stats/number-of-android-apps> [12-04-2011]

[86] Damith C. Rajapakse, 2008. Fragmentation of mobile applications. *MobileFragmentation.info* . [Online] April 28, 2008. Available at: <http://www.comp.nus.edu.sg/~damithch/df/device-fragmentation.htm#Tutorials/Guides> [12-04-2011].

[87] Appcelerator/IDC, 2011. Q2 mobile developer. [PDF] April, 2011. Available at: < http://www.appcelerator.com/company/survey-results/mobile-developer-report-april-2011/#get_report> [12-04-2011].

[88] Id.

[89] For instance, Google released the new Honeycomb source code to favoured partners before they released it to the public, leading to much criticism from the community.

Ashlee Vance & Brad Stone, 2011. Google holds Honeycomb tight. *Bloomberg Businessweek.* [Online] March 24, 2011. Available at: <http://www.businessweek.com/technology/content/mar2011/tc20110324_269784.htm> [12-04-2011].

[90] Jay Greene, 2011. Oracle and Microsoft could cash in big on Android. *CNet.com.* [Online] July 8, 2011. Available at: <http://news.cnet.com/8301-1035_3-20077979-94/oracle-and-microsoft-could-cash-in-big-on-android/> [12-04-2011].

Matt Rosoff, 2011. Oracle wants to put Android out of business. *Business Insider.* [Online] June 7, 2011. Available at: <http://www.businessinsider.com/oracle-wants-to-put-android-out-of-business-2011-6> [12-04-2011].

[91] Funding Universe, 2003. Company histories and Profiles: Research in Motion Ltd. [Website] Available at: <http://www.fundinguniverse.com/company-histories/Research-in-Motion-Ltd-Company-History.html> [12-04-2011].

[92] Id.

[93] Ashton Applewhite, 2002. The BlackBerry business. *Pervasive Computing.* [PDF] June, 2002. Available at: <http://www.lcc.gatech.edu/~bogost/courses/spring06/lcc6314/docs/blackberry.pdf> [12-04-2011]

[94] Philip Elmer-DeWitt, 2008. iPhone grabs 30% of U.S. smartphone market. *CNNMoney.* [Online] December 2, 2008. Available at: <http://tech.fortune.cnn.com/2008/12/02/iphone-grabs-30-of-us-smartphone-market/ [12-04-2011].

[95] BlackBerry, 2011. What is BlackBerry? [Website] Available at: <http://us.blackberry.com/ataglance/blackberry.jsp> [12-04-2011].

[96] BlackBerry, 2011. BlackBerry enterprise solution architecture. [Website] Available at: <http://us.blackberry.com/ataglance/solutions/architecture.jsp> [12-04-2011].

[97] Blackberry, 2007. Case study: custom BlackBerry application benefits auto glass repair leader. [PDF] Available at: <http://www.blackberry.com/products/pdfs/Safelite_IT_CS_final.pdf> [12-04-2011].

[98] BlackBerry, 2011. BlackBerry mobile data system. [Website] Available at: <http://us.blackberry.com/apps-software/mobile.jsp> [12-04-2011].

[99] Services include: technical support, training and development programs that help operations set up their wireless activities.

Blackberry, 2011. Support programs. [Website] Available at: <http://us.blackberry.com/support/programs/> [12-04-2011].

[100]BlackBerry, 2011. BlackBerry partner sphere. [Website] Available at: <https://partners.blackberry.com/web/guest;jsessionid=54E56BC21F9636705D2C779183088B50> [12-04-2011].

[101] Andrew Berg, 2011. Interviews renew BlackBerry encryption debate. *Wireless Week.* [Online] April 15, 2011. Available at: <http://www.wirelessweek.com/News/2011/04/Interview-renew-blackBerry-encryption-debate/> [12-04-2011].

[102] BlackBerry, 2008. BlackBerry Enterprise Solution. [PDF] Available at: <http://www.marketweb.ca/BES-Overview-Brochure.pdf> [12-04-2011].

[103] Research in Motion, 2010. Annual report 2009-2010. [Online] Available at: <http://www.rim.com/investors/documents/pdf/AIF/AIF_Fiscal_2010.pdf> [12-04-2011].

[104] Trefis, 2011. Research in Motion. [Website] Available at: <http://www.trefis.com/company#/RIMM/n-0459?from=sankey> [12-04-2011].

[105] Mobistar, 2011. Hoe werkt BlackBerry internet? [Website] Available at: <http://business.mobistar.be/go/nl/sma/internet_en_data/mobiele_data_en_internet/blackberry_internet/Hoe_werkt_dit.cfm> [12-04-2011].

[106] Josh Schiffman, 2009. BlackBerry OS Report 2. Network and Security Research Center: Department of Computer Science and Engineering. [PDF] Available at: <http://www.cse.psu.edu/~enck/cse597a-s09/slides/appmodel_blackberry.pdf> [12-04-2011].

BlackBerry Support Community, 2010. Introduction to BlackBerry Development Options. [Video Online] August 24, 2010. Available at: <http://supportforums.blackberry.com/t5/Java-Development/Introduction-to-BlackBerry-Development-Options/ta-p/503185?name=IntroBlackBerryDev> [12-04-2011].

[107] Id.

[108] BlackBerry Storm was RIM's first answer to the iPhone. It was a full touch screen device that was badly received.

Yardena Arar, 2008. RIM's BlackBerry Storm: awkward and disappointing. *PCWorld.* [Online] November 20, 2008. Available at: <http://www.pcworld.com/article/154212/rims_blackberry_storm_awkward_and_disappointing.html> [12-04-2011].

Joshua Topolsky, 2008. BlackBerry Storm review. *Engadget.* [Online] November 19, 2008. Available at: <http://www.engadget.com/2008/11/19/blackberry-storm-review/> [12-04-2011].

[109] Bonnie Cha, 2010. BlackBerry OS 6 hands-on. *CNet.* [Online] August 4, 2010. Available at: <http://www.pcmag.com/article2/0,2817,2367293,00.asp> [12-04-2011].

Sasha Segan, 2010. BlackBerry 6 OS. *PCMag.com.* [Online] August 4, 2010. Available at: <http://www.cnet.com/8301-17918_1-20012729-85.html> [12-04-2011].

[110] Appcelerator/IDC, 2011. Q2 mobile developer. [PDF] April, 2011. Available at: < http://www.appcelerator.com/company/survey-results/mobile-developer-report-april-2011/#get_report> [12-04-2011].

[111] IB Times Staff Reports, 2011. RIM Losing developers for its BlackBerry phones. *International Business Times.* [Online] June 27, 2011. Available at: <http://www.ibtimes.com/articles/170083/20110627/rim-apple-iphone-5-blackberry-android-google.htm> [12-04-2011].

Devin Banerjee, 2011. RIM loses Miami Dolphins fans as software developers defect. *Bloomberg.* [Online] June 27, 2011. Available at: <http://www.bloomberg.com/news/2011-06-27/rim-loses-miami-dolphins-fans-as-software-developers-defecting-to-iphone.html> [12-04-2011].

The Canadian Press, 2011. RIM losing some app developers, veterans sticking around. *CTV.ca.* [Online] June 26, 2011. Available at: <http://ottawa.ctv.ca/servlet/an/local/CTVNews/20110626/RIM-app-developers-110626/20110626/?hub=OttawaHome> [12-04-2011].

[112] The vice president of operations at Metova, says they develop their own application development tools.

The Canadian Press, 2011. RIM losing some app developers, veterans sticking around. *CTV.ca.* [Online] June 26, 2011. Available at: <http://ottawa.ctv.ca/servlet/an/local/CTVNews/20110626/RIM-app-developers-110626/20110626/?hub=OttawaHome> [12-04-2011].

[113] Mike Schuster, 2010. Why BlackBerry users will defect. *Minyanville.* [Online] Marche 16, 2010. Available at: <http://www.minyanville.com/businessmarkets/articles/blackberry-rim-apple-google-windows-palm/3/16/2010/id/27311> [12-04-2011].

[114] Matt Rosoff, 2011. RIM gives in to iPhone and Android in the enterprise. *Business Insider.* [Online] May 2, 2011. Available at: <http://www.businessinsider.com/even-rim-doesnt-expect-companies-to-standardize-on-blackberry-2011-5> [12-04-2011].

[115] Jonathan S. Geller, 2011. BlackBerry Bold review. *BGR.* [Online] August 11, 2011. Available at: <http://www.bgr.com/2011/08/11/blackberry-bold-9900-review/> [12-04-2011].

[116] QNX, 2011. QNX Neutrino RTOS. [Website] Available at: <http://www.qnx.com/products/neutrino-rtos/neutrino-rtos.html> [12-04-2011].

[117]Jason Cipriani, 2011. Official: BlackBerry PlayBook to run Android apps. *KnowYourCell.* [Online] Marche 24, 2011. Available at: <http://www.knowyourcell.com/news/824705/official_blackberry_playbook_to_run_android_apps.html> [12-04-2011].

Jason Perlow, 2011. RIM's Android compatibility for BlackBerry PlayBook and QNX will be a big game of chase. *ZDNet.* [Online] April 20, 2011. Available at: <http://www.zdnet.com/blog/perlow/rims-android-compatibility-for-blackberry-playbook-and-qnx-will-be-a-big-game-of-chase/16820>

[118] Jonathan S Geller, 2011. RIM's first QNX phone revealed: BlackBerry Colt to launch in Q1 2012. *BGR.* [Online] August 8, 2012. Available at: <http://www.bgr.com/2011/08/08/rims-first-qnx-phone-revealed-blackberry-colt-to-launch-in-q1-2012/> [12-04-2011].

Brad Molen, 2011. BlackBerry colt may be RIM's first QNX smartphone, will lack BES support out-of-box? *Engadget.* [Online] August 8, 2011. Available at: <http://www.engadget.com/2011/08/08/blackberry-colt-may-be-rims-first-qnx-smartphone-will-lack-bes/> [12-04-2011].

[119] Nokia, 2011. The Nokia story. [Website] Available at: <http://www.nokia.com/about-nokia/company/story-of-nokia> [12-04-2011].

[120] Summaries.com, 2001. The Nokia revolution: The story of an extraordinary company that transform an industry, by Dan Steinbock. [PDF] Available at: <http://hattonconcepts.com/media/papers/book-summaries/The%20Nokia%20Revolution.PDF> [12-04-2011].

[121] Id.

[122] Id.

[123] Id.

[124]Nokia, 2010. Nokia in 2010. *Annual report 2009-2010.* [Online] Available at: <http://www.nokia.com/NOKIA_COM_1/About_Nokia/Sidebars_new_concept/Annual_Accounts_2010/Nokia_in_2010.pdf> [12-04-2011].

[125] Nokia Developer, Symbian OS internals: Introducing EKA2. [Website] Available at: <2011http://www.developer.nokia.com/Community/Wiki/Symbian_OS_Internals/01._Introducing_EKA2> [12-04-2011].

[126] Garnter, 2009. Gartner says worldwide smartphone sales reached its lowest growth rate with 3,7 per cent increase in fourth quarter of 2008. [Press Release] March 11, 2009. Available at: < http://www.gartner.com/it/page.jsp?id=910112> [12-04-2011].

[127] http://siepr.stanford.edu/system/files/shared/documents/2011-03_WestWood_SIEPR.pdf

[128] Johanthan Fildes, 2010. Symbian phone operating system goes open source. *BBC News.* [Online] February 4, 2010. Available at: <http://news.bbc.co.uk/2/hi/technology/8496263.stm> [12-04-2011].

[129] Jason Mick, 2011. Nokia left scrambling as customers abandon Symbian Platform. *Daily Tech.* [Online] May 31, 2011. Available at: <http://www.dailytech.com/Nokia+Left+Scrambling+as+Customers+Abandon+Symbian+Platform/article21773.htm> [12-04-2011].

[130]Robin Wauters, 2011. Nokia confirms Microsoft partnership, new leadership team, organization changes. *TechCrunch.* [Online] February 10, 2011. Available at; <http://techcrunch.com/2011/02/10/nokia-confirms-microsoft-partnership-new-leadership-team/> [12-04-2011].

[131] Windows CE was orginally designed for small PC's, called 'Handheld PC' and later adapted support devices such as Pocket PC's, Pocket PC Phones and Smartphones.

[132] http://www.sans.org/reading_room/whitepapers/pda/pdas-corporate-environment_255

[133] SANS Institue, 2001. PDA's in the corporate environment. [PDF] Available at: <http://www.infoworld.com/d/hardware/microsoft-phase-out-pocket-pc-smartphone-brands-232> [12-04-2011].

[134]Reed Robinson, 2008. The Windows Mobile ecosystem for developers. *MSDN Blogs: Reed and Steve stuff.* [Blog] 22 July 2008. Available at: <http://blogs.msdn.com/b/hegenderfer/archive/2008/07/22/the-windows-mobile-ecosystem-for-developers.aspx> [12-04-2011].

[135] Overview of Windows Mobile Pocket PC and Windows Mobile Smartphone platforms: Geekzone, 2011. Windows Mobile device directory. [Website] Available at: <http://www.geekzone.co.nz/smartdevices.asp?page_no=20> [12-04-2011].

[136] Hardware Analysis, 2003. Microsoft unveils Windows Mobile 2003 software for Pocket PC. *Hardware Analysis.* [Online] June 23, 2003. Available at: <http://www.hardwareanalysis.com/content/article/1636/> [12-04-2011].

[137] Arnoud Wokke, 2008. Windows Mobile-gebruikers ontwikkelen eigen 'App Store'. *Tweakers.net.* [Online] December 26, 2008. Available at: <http://tweakers.net/nieuws/57527/windows-mobile-gebruikers-ontwikkelen-eigen-app-store.html> [12-04-2011].

[138] IT Facts, 2004. Microsoft gets 48,1% PDA OS market share in Q3 2004. *IT Facts.* [Press Release] November 12, 2004. Available at: <http://www.itfacts.biz/microsoft-gets-481-pda-os-market-share-in-q3-2004/2003> [12-04-2011].

[139] News Wire, 2003. IDC sees bleak future for the unconnected PDA. *News Wire.* [Press Release] August 18, 2003. Available at: <http://www.prnewswire.com/news-releases/idc-sees-bleak-future-for-the-unconnected-pda-70955292.html> [12-04-2011].

[140] Softpedia, 2005. Smartphone sales will grow at a compounded rate of 28% through 2009. *Softpedia.* [Press Release] February 17, 2005. Available at: <http://news.softpedia.com/news/JupiterResearch-Announces-Smartphone-Sales-Will-Grow-at-a-Compound-Rate-of-28-through-2009-290.shtml> [12-04-2011].

Bill Hughes, 2006. Smartphone 2006: Whose definition is it anyway? *Instat.* [PDF] October 9, 2006. Available at: <http://www.instat.com/panels/pdf/2006/oct06smartphones.pdf> [12-04-2011].

[141] Bill Hughes, 2006. Smartphone 2006: Whose definition is it anyway? *Instat.* [PDF] October 9, 2006. Available at: <http://www.instat.com/panels/pdf/2006/oct06smartphones.pdf> [12-04-2011].

[142] Chris Ziegler, 2007. Windows Mobile 6 review roundup. *Engadget.* [Online] March 1, 2007. Available at: <http://www.engadget.com/2007/03/01/windows-mobile-6-review-roundup/> [12-04-2011].

Anton Kotov, 2006. Review of Windows Mobile 2006 for PPC operating system. *Mobile-Review.* [Online] November 21, 2006. Available at: <http://mobile-review.com/pda/articles/wm-crossbow-en.shtml> [12-04-2011].

[143] John Herrman, 2009. Windows Mobile 6.5 Review: Ther's no excuse for this. *Gizmodo.* [Online] October 6, 2006. Available at: <http://gizmodo.com/5374876/windows-mobile-65-review-theres-no-excuse-for-this> [12-04-2011].

Greg Kumparak, 2009. Windows Mobile 6.5 review: It still sucks. *TechCrunch.* [Online] October 6, 2009. Available at: <http://techcrunch.com/2009/10/06/windows-mobile-6-5-review-it-still-sucks/>

[144] WMPoweruser, 2010. Leaked Windows Phone 7 architecture guide reveal more OS info. *WMPoweruser.* [Press Release] April 19, 2010. Available at: <http://wmpoweruser.com/leaked-windows-phone-7-architecture-guide-reveal-more-os-info/> [12-04-2011].

[145] Harry McCracken, 2010. Starting over: the Windows Phone 7 review. *PCWorld.* [Online] Ocotober 22, 2010. Available at: <http://www.pcworld.com/article/208436/starting_over_the_windows_phone_7_review.html> [12-04-2011].

Joshua Topolsky, 2010. Windows Phone 7: In-depth preview. *Engadget.* [Online] July 19, 2010. Available at: <http://www.engadget.com/2010/07/19/windows-phone-7-in-depth-preview/> [12-04-2011].

Matt Buchanan, 2010. Windows Phone 7 in depth: A fresh start. *Gizmodo.* [Online] July 19, 2010. Available at: <http://gizmodo.com/5590327/windows-phone-7-in-depth-a-fresh-start> [12-04-2011].

[146] MSDN, 2011. The payouts. [Website] Available at: <http://msdn.microsoft.com/en-us/library/hh202925(v=VS.92).aspx> [12-04-2011].

[147] Microsoft, 2011. About Silverlight. [Website] Available at: <http://www.microsoft.com/silverlight/what-is-silverlight/> [12-04-2011].

[148] Pieterjan Van Leemputten, 2011. Microsoft brengt iOS-apps naar Windows Phone 7. *ZDNet België.* [Online] May 4, 2011. Available at: <http://www.zdnet.be/techzone/127361/microsoft-brengt-ios-apps-naar-windows-phone-7/> [12-04-2011].

[149] Microsoft, 2011. Nokia and Microsoft sign definitive agreement ahead of schedule. [Press Release] April 21, 2011. Available at: <http://www.microsoft.com/presspass/press/2011/apr11/04-21msftnokia.mspx> [12-04-2011].

[150] Microsoft, 2011. Nokia and Microsoft announce plans for a broad strategic partnership to build a new global mobile ecosystem. [Press Release] February 11, 2011. Available at: <http://www.microsoft.com/Presspass/press/2011/feb11/02-11partnership.mspx?rss_fdn=Press%20Releases> [12-04-2011].

[151] Stuart Miles, 2011. Nokia: We can change Windows Phone 7 interface. *Pocket-Lint.* [Online] February 11, 2011. Available at: <http://www.pocket-lint.com/news/38495/nokia-windows-phone-7-changes>

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