The Evolving Nature of Competition in the Wireless Ecosystem: Emergent Opportunities and Threats

by

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Submitted to the System Design and Management Program
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Abstract

By the end of 2008, there are over 4 billion mobile cellular subscriptions worldwide, translating into a penetration rate of 61%. In developed economies like the United States, the penetration rate has reached over 85%. Even though the subscriber numbers are reaching saturation levels, the revenues of mobile operators continue to grow at a double-digit rate. This is primarily because of an increase in data usage over cellular networks. Mobile handsets have become increasingly powerful and rival the capabilities of personal computers from just a few years ago. These devices can be used to run a variety of applications and are fast becoming the medium of choice for accessing the Internet. Cellular networks are also becoming increasingly powerful in their ability to carry large amounts of data. This evolution in capabilities has attracted a variety of new players to the wireless ecosystem changing the nature of interaction within the ecosystem. The central role played by the wireless operators is increasingly challenged by these new entrants creating both new opportunities and new threats for all the participants in the ecosystem. This thesis will explore the structure of the wireless ecosystem as it exists today and analyze how competition between various layers and within each layer has played out. Further, it will look at the new ways in which the participants are competing with each other and how this results in emergent opportunities and threats. Finally, the thesis will draw lessons from the Internet revolution and the personal computing ecosystem to predict how the platform wars are likely to play out and who has the opportunity to become the dominant player in the new ecosystem.

Thesis Supervisor: Michael Cusumano
Title: Sloan Management Review Distinguished Professor of Management

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Chapter 1

Introduction

After tremendous growths over the last 15 years, the wireless industry in most developed nations has reached a mature stage. According to CTIA – The Wireless Association, the US alone has 270M wireless subscribers as of December 2008. This corresponds to a wireless penetration rate of almost 87%. The penetration rate was 84% in December 2007, 69% in December 2005, and only 38% at in December 2000. Further, the percentage of wireless-only households in the US has more than doubled to 17.4% in December 2008 compared to 8.4% in December 2005. The penetration rates in developed economies such as Western Europe, Japan, and South Korea is on par to the penetration in the US.[1] Worldwide, at the end of 2008, there are over 4 billion mobile subscriptions translating to 61% penetration rate.[2] Figure 1-1 shows the sharp increase in wireless penetration rates compared to other communication technologies worldwide.[3]

While the double-digit subscriber growth over the last 10-15 years is a matter of history and there is no opportunity to repeat, the revenues of wireless carriers continue to grow in double digits. The share of overall revenues from voice is slowing, but the revenue from data services is more than compensating it. According to the CTIA, the total wireless revenues in the US in 2007 were $138.9B, a 10.7% increase from 2006. $23.2B of these revenues came from data services, a 53% growth over 2006.

Data revenues are driven by demand for new applications such as ringtones, downloadable music, text, and photo messaging. With the introduction of new and more powerful handsets and deployment of faster networks, the cell phone is increasingly becoming the platform for accessing

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[1]Wireless Quick Facts, http://www.ctia.org/advocacy/research/index.cfm/AID/10323.

[2]ITU, "Measuring the Information Society: The ICT Development Index 2009", p 3, http://www.itu.int/ITU-D/ict/publications/idi/2009/material/IDI2009_w5.pdf.

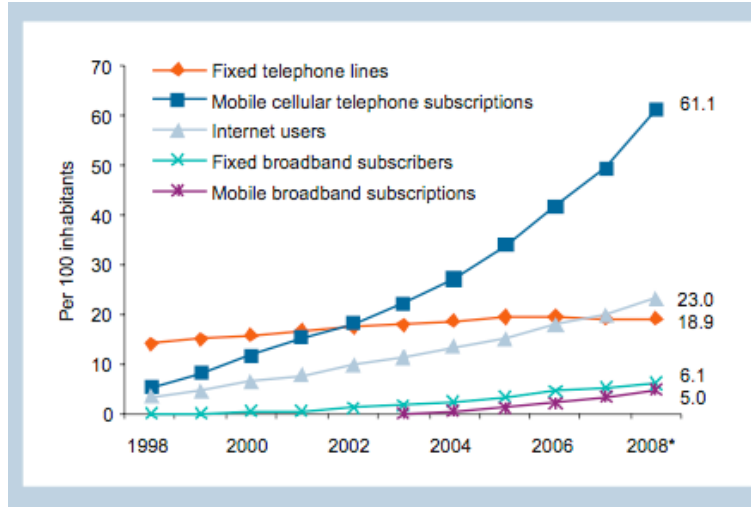[3]Source: ITU World Telecommunication/ICT Indicators Database.

Figure 1-1: Worldwide Wireless Penetration Rates

a multitude of applications enabled by the Internet such as browsing, banking, e-commerce, and social networking. Bandwidth hungry applications like video-on-demand, interactive applications like chat, and integration with back office continue to increase the demand for data services further blurring the distinction between traditional computers, television sets, and mobile phones. With mobile phones fast becoming one of the preferred mediums through which the vast array of applications available on the Internet are accessed, the wireless industry is attracting players from different segments of the technology sector such as Microsoft, Apple, Google, and a host of application and content providers.

Traditionally, the wireless carriers (also called the network operators) have been the key players in the industry owning the customer relationship and deciding what applications (beyond voice, if any) are delivered over their networks. The operators also owned the upstream relationships with handset makers. They heavily subsidized the phones that customers purchased in return for long-term contracts. However, the confluence of a bevy of forces is challenging the operators' grip on these markets. These forces include increased penetration rates, faster and more capable handsets, faster networks, new business models brought along from the PC and Internet markets, and new interactions among the major players in the ecosystem. Figure 1-2 shows the emerging interactions in the wireless ecosystem. Some of the interactions are strong and are shown using a solid line whereas weak interactions are shown using a dashed line. In the following paragraphs, each of these forces is briefly described.

The penetration rate in the US market has started to slow down now that it has surpassed the 80% mark. Because of these high penetration rates, operators do not have much access to
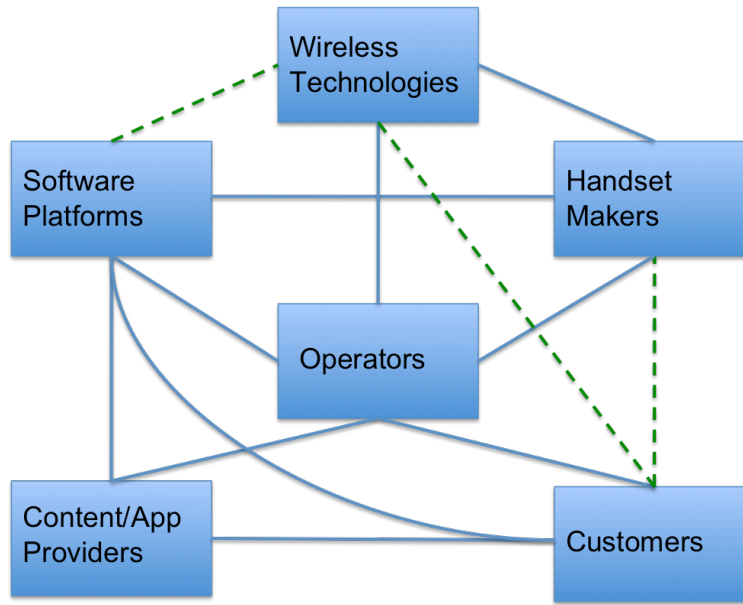
Figure 1-2: Interactions in the Wireless Ecosystem

untapped markets. Operators can try to increase revenues by poaching customers from competition by offering better price plans. This, however, is unlikely to be a viable long-term strategy because it has the potential to drive down the prices to the point where it will not be a differentiator as has happened in the long-distance phone market. Operators also have some scope to growing their revenues by offering incentives to customers to increase their voice usage. This can happen with more households becoming wireless only as they give up their landline service. This strategy also has a very low ceiling. Operators, however, have a ready way to grow their revenues – by getting customers to increase their data usage by offering new applications and services.

The ability to offer new and interesting applications is made possible by advancements in two areas – handsets and networks. More and more handsets (particularly the Smartphones) pack as much processing power as personal computers did just a few years ago. Miniaturization, increased processing power, new battery technologies (lithium-ion polymer), full-color screens have all worked together to make the handset the basis for a powerful computer. Coupled with multi-tasking operating systems, the handsets are able to run applications with response times and usability similar to those on a PC. At the same time, network standards that enable faster data services have become available. 3G technologies (UMTS and CDMA2000) and investments in the emerging LTE technologies make the networks capable of much faster data upload and download speeds that are critical for the new data intensive applications.

While the availability of fast handsets and networks provides the operators opportunities for
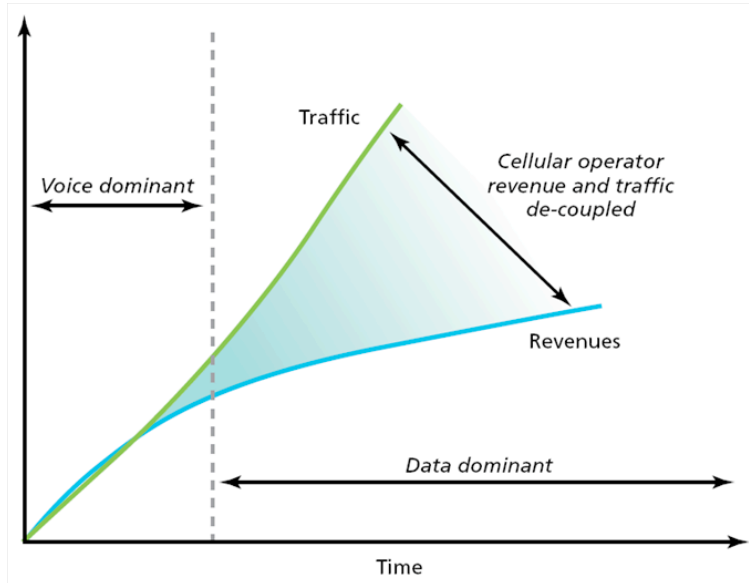
9

Figure 1-3: Disconnect between Revenues and Wireless Traffic

increased revenues from data services, it also provides them with a set of unique challenges. As data replaces voice as the dominant application, there is an increasing disconnect between the amount of traffic and operator revenues as show in Figure 1-3.[4] Further, it is not just operators that can deliver sophisticated new applications on these networks. With handsets becoming another Internet access mechanism, companies that have been successful in making money on the Internet are increasingly focusing their attention on this market. These companies have the distinct advantage that they know how to make and sell applications to end-users whereas the operators have little knowhow in this area. Successful Internet business models such as advertising threaten to weaken the grip of the operators on the wireless market. In the wire line market, most service providers (DSL/Cable, for example) have essentially become bit pipes over which Internet companies deliver their applications. In response, service providers have tried to build walled gardens around their networks limiting the kind of applications their customers can access. This model has generally failed because these providers could never deliver compelling applications similar to those delivered by Internet companies such as Google or Facebook. The wireless operators are potentially in the same boat – they could invest billions in winning spectrum and building fast networks, but could just become a bit pipe for mobile application providers who pay no royalties to the operators.

If any lesson is leaned from the Internet experience, it is that walled gardens are unlikely to succeed. In the wireless world, it is even more difficult to build walled gardens because customers

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[4]IP/MPLS Forum White Paper, "Use of MPLS Technology in Mobile Backhaul Networks", February 2008, `http://www.ipmplsforum.org/tech/IPMPLSBackhaulWhitePaper.pdf`.

have choices not only in wireless operators but also with competing technologies such as WiMAX. This puts the operators in an interesting position – while it is certain that they are going to increase their revenues because of increased adoption of data services, it is not at all certain that they will retain their dominant position in the industry. It is very well possible that application providers (a la Google or Yahoo in the traditional Internet world) will run away with the bulk of the revenues.

Each of the forces highlighted above are discussed in detail in the following chapters. Each of chapters 2 to 5 focus on a different layer in the wireless ecosystem and how competition in that layer has traditionally played out. Those chapters conclude by looking ahead at how the the nature of competition is changing in that layer and what that means to the various major players. Chapter 6 brings together all the layers in the ecosystem and the nature of competition in the new ecosystem.

The detailed organization of each chapter is as follows:

- Chapter 2 provides an overview of the various technologies used in the wireless industry and how they are evolving over time. The chapter includes an introduction to all the various generations of wireless technologies from 1G to 4G. Other competing technologies such as WiMAX and concepts such as "white spaces" are introduced and their viability is evaluated.

- Chapter 3 provides an overview of the handset industry in general and the smartphone market in particular. The chapter describes the strategies of various handset makers and how innovation at this layer has stopped being of huge significance in the ecosystem. Hardware vendors discussed include Nokia, Apple, and Research In Motion. The chapter also describes Palm's spectacular rise and fall in the PDA market and the lessons that it teaches to these hardware vendors.

- Chapter 4 is a discussion on the emerging software platforms for the wireless ecosystem. It includes a discussion of the major platforms using the 4-lever methodology and what each of the vendors can do to establish themselves as the platform of choice. The chapter also discusses if the wireless software platform is a "winner-take-all" market. Software platforms discussed include Symbian, iPhone OS, Android, Windows Mobile, and Blackberry OS.

- Chapter 5 is a discussion on the various operators in the United States. It includes a discussion of the operators' strategies and the challenges they are confronting. The chapter also includes an introduction to NTT DoCoMo's i-Mode service that offers interesting lessons to the operators around the world.

- Chapter 6 brings all the previous chapters together and focuses on the competition between

the two contenders vying for supremacy in the wireless ecosystem: software platforms and the operator platforms. Lessons from the Internet and personal computing industries are used to predict how the competition is likely to play out and draws conclusions on what the future might look like.

Chapter 2

Wireless Technologies

Wireless telephone technology has evolved from analog, voice-only cellular telephone standards known as 1G technologies to the high-speed wireless communications known as 4G (currently under development) over the past 2 to 3 decades. 0G technologies (pre-cellular mobile telephony) preceded the 1G technologies, but aren't of great interest from technology evolution point of view though they are important from a historical point of view. This chapter will discuss various mobile phone technologies, their evolution, and some of the underlying politics. The chapter also introduces other wireless data transmission technologies and concepts such as WiMAX, UMA, "white spaces" etc. that are providing opportunities for many companies to offer wireless services competing with traditional wireless operators.

This chapter is organized as follows: the bulk of the content is about the various technologies available for carrying voice, data, video and other services over wireless networks. The chapter concludes by looking at how competition has evolved and where the competition will be in the coming years.

1G

First-generation wireless technologies provided analog, voice-only cell phone services. These services were first deployed in the 1980's and different standards were used in different places. In the United States, AMPS (Advanced Mobile Phone System), a standard developed by Bell Labs, was deployed. Similar standards include NMT (Nordic Mobile Telephone) used in some European countries, TACS (Total Access Communications System) in UK etc.[1]

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[1] 1G: First Generation wireless technology, `http://www.javvin.com/wireless/1G.html`.

1G technologies, in general, carried each conversation over a separate frequency (FDMA – Frequency Division Multiple Access). Such a system does not scale well because of inefficient use of spectrum that required large bandwidths to support a large number of users. Many 1G standards evolved to carrying conversations using TDMA, which improves spectrum usage, and allowed for improvements in scaling.

2G

Second-generation wireless technologies are the successors to 1G technologies that heralded great cellular penetration levels. 2G technologies are entirely digital allowing for improved spectrum usage as well as introduction of data services. 2G technologies can be broadly classified into two groups – those that use TDMA and those that use CDMA for access to the radio channel.[2] While there are many 2G standards, only two standards account for over 95% of all subscribers around the world. These two standards are:

- GSM

- IS-95 (cdmaOne)

GSM

Global System for Mobile Communications, originally known as Groupe Spécial Mobile, is a TDMA (Time Division Multiple Access) based digital standard developed in Europe by ETSI. It is widely deployed throughout the world and according to GSM world, the trade association representing the interests of GSM operators and manufacturers, has over 3.7 billion customers in April 2009.[3] A pilot GSM network was demonstrated in early 1991 and the first deployment was in late 1992. GSM crossed the 1M-subscriber mark by the end of 1993.[4] In the United States, AT&T Mobility (formerly Cingular) and T-Mobile are the major operators that offer GSM based services.

In a GSM network, all communications including speech and data are encrypted preventing the eavesdropping problems in 1G networks. GSM supports data transfer speeds of up to 9.6 Kbps and has pioneered the use of Short Message Service (SMS), popularly referred to as text messaging. GSM has harmonized the frequencies at which it operates throughout the world thus allowing for worldwide roaming (ex: 900MHz and 1.8GHz bands in Europe, 850MHz and 1.9GHz bands in

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[2]2G: Second Generation Wireless Technology, http://www.javvin.com/wireless/2G.html.

[3]GSM World: Home of the GSM Association, http://www.gsmworld.com/.

[4]History and Timeline of GSM, http://www.emory.edu/BUSINESS/et/P98/gsm/history.html.
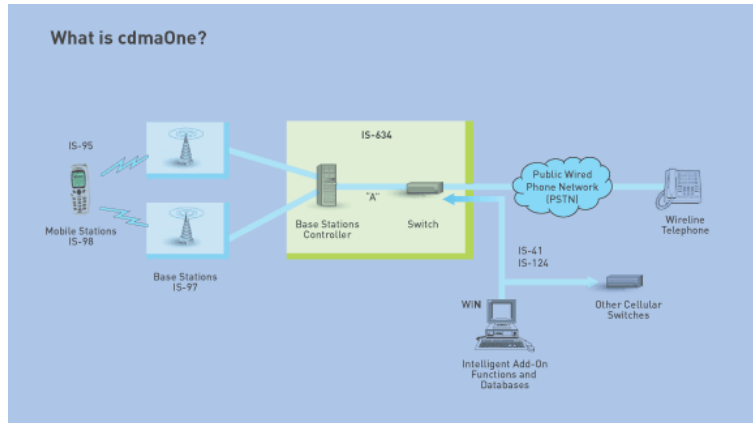
Figure 2-1: cdmaOne Network Diagram

USA).[5] On a GSM network, subscriber information is carried on a detachable smart card called the Subscriber Identity Module (SIM). This allows consumers to easily change handsets as well as operators though in some countries operators lock handsets in an attempt to prevent migration.

IS-95/cdmaOne

IS-95 is a CDMA based digital cellular standard known by the cdmaOne brand name. CDMA (Code Division Multiple Access) is a method of dividing the radio spectrum among users developed by Qualcomm that allows for much more efficient use of the spectrum than FDMA used by 1G technologies and TDMA used by GSM. This allowed for greater scaling as well as requiring fewer cell sites and CDMA systems had 4 to 5 times the capacity of GSM networks. But, according to the CDMA development Group, there are over 550M subscribers in 4Q 2008 worldwide a small fraction of GSM subscribers.[6] In the United States, Verizon Wireless and Sprint Nextel are the major operators that offer CDMA based services. Figure 2-1, from the CDMA group, shows the basic architecture of a cdmaOne network.

IS-95 standards were first published in 1993 and subsequent revisions (IS-95A and IS-95B) were published in 1995. The first commercial network was deployed in September 1995. In addition to voice services, CDMA operators provide circuit-switched data services at 14.4 Kbps.[7] CDMA technology has many advantages over GSM based technologies – capacity, improved call quality, enhanced privacy. However, most of the CDMA technologies are patented and owned by Qualcomm – this coupled with Europe's insistence on using home developed technology has played a role in

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[5]Technology - GSM, http://www.gsmworld.com/technology/gsm/index.htm.

[6]CDMA Development Group, http://www.cdg.org/index.asp.

[7]CDG: Technology: 2G - cdmaOne, http://www.cdg.org/technology/2g.asp.

preventing widespread adoption of the technology. Unlike GSM phones that provide a SIM, CDMA phones are linked to a specific network making it very hard to carry a phone from one operator to the other.

2.5G

2.5G is a marketing term for bridge technologies between the 2nd and 3rd generation of wireless technologies. These technologies enabled basic data services such as email and browsing.

GPRS (General Packet Radio Service) is one of the most widely deployed 2.5G technologies on most GSM networks. GPRS offers a throughput of up to 40 Kbps, speeds similar to dial-up modems.[8] Another enhancement to GPS networks was EDGE (Enhanced Data rates for GSM Evolution). EDGE offered data speeds of up to 3 times the GPRS speeds. EDGE technologies can be deployed in existing GSM networks by doing software only upgrades.[9] EDGE can be considered a 3G technology and some refer to it as 2.75G technology.

On the CDMA side of the world, 1xRTT (Radio Transmission Technology) can be considered a 2.5G technology. 1xRTT has theoretical data capacities of up to 144 Kbps but in practice offers speeds between 50 and 70 Kbps.[10] 1xRTT was the first IMT-2000 technology, a global standard for 3G wireless communications, deployed worldwide.[11]

3G

Third generation wireless technologies are successors to the second-generation technologies providing wide area cellular networks for voice and high-speed data access. These networks provide access to the Internet, mobile applications, and multimedia content.[12,13] The ITU has specified the technical requirements and standards for 3G systems in its IMT-2000 specification.[14] 3G networks are required by the ITU to provide at least 144 Kbps data rates in outdoor environments and 2 Mbps in indoor environments along with capacity and spectrum efficiency over 2G networks. As part of the IMT-2000 specification, ITU has approved five different radio interface technologies. These are WCDMA, CDMA2000, TD-CDMA/TD-SDMA, EDGE, and DECT. Subsequently, a WiMAX

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[8]Technology - GPRS, http://www.gsmworld.com/technology/gprs.htm.

[9]Technology - EDGE, http://www.gsmworld.com/technology/edge.htm.

[10]1xRTT, http://www.javvin.com/wireless/1xRTT.html.

[11]3G - CDMA2000 1X, http://www.cdg.org/technology/3g_1X.asp.

[12]3G: Third Generation Wireless Technology, http://www.javvin.com/wireless/3G.html.

[13]3G, http://www.cdg.org/technology/3g.asp.

[14]ITU Activities on IMT-2000, http://www.itu.int/home/imt.html.

derived technology known as WMAN was added to the approved interfaces. Three of the 5 approved standards (CDMA2000, TD-CDMA, and WCDMA) are based on CDMA. Of these interfaces, only WCDMA and CDMA2000 have been the basis for successful 3G deployments. EDGE was used in 2.5G GSM networks and TD-CDMA networks have not been very successful. In the following paragraphs, the 3G networks based on WCDMA and CDMA2000 are described.

UMTS

Universal Mobile Telecommunications System is a 3G cellular network technology that uses WCDMA (Wideband Code Division Multiple Access) technologies. UMTS is often referred to as 3GSM as this technology is the successor for 2G GSM networks.

NTT DoCoMO developed WCDMA as the air interfaces for its 3G network. The ITU accepted WCDMA as one of the 3G technologies in IMT-2000. WCDMA enables richer multimedia applications such as music, video, and Internet access. UMTS networks offer data speeds up to 384 Kbps in addition to voice services.[15] While some attempts were made to come up with a unified standard that encompasses WCDMA and CDMA2000, this did not go too for because of technical and political reasons. A single standard would have enabled roaming across successors of 2G GSM and CDMA networks. Qualcomm's CDMA patents still cover some of the features of WCDMA.

HSPA

High Speed Packet Access is the migration path that improves the performance of 3G/UMTS networks. Two standards, HSDPA and HSUPA are currently available and a new standard HSPA+ (HSPA Evolved) is currently being developed. High Speed Downlink Packet Access (HSDPA) provides a theoretical data rate of 14.4 Mbps on the downstream and 384 Kbps on the upstream. Asymmetric bitrates are fine for most consumer deployments because users download a lot more data than they upload. High Speed Uplink Packet Access (HSUPA) provides improved data rates of up to 5.76 Mbps (theoretical) on the upstream link. Networks based on HSDPA and HUSUPA are currently being deployed throughout the world. The new HSPA+ standard is an IP-centric architecture that aims to provide over 40 Mbps on the downstream link and over 20 Mbps on the upstream link.[16] To contrast HSPA networks with UMTS networks, some refer to them as 3.5G technologies.

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[15]Technology - 3G/WCDMA, http://www.gsmworld.com/technology/3gsm/index.htm.
[16]Technology - HSPA, http://www.gsmworld.com/technology/hspa.htm.

EV-DO

Evolution-Data Optimized is the successor third-generation technology for mobile operators that have deployed 2G CDMA networks. The air interface used by EV-DO is the CDMA2000 standard approved as part of IMT2000. The backend network for an EV-DO system is packet based, thus removing many of the restrictions presented by a circuit switched network. The EV-DO standard is designed to operate as an IP network end to end. The EV-DO standard has evolved over multiple phases and the latest revision is known as Rev B though commercial deployments are at Rev A. EV-DO system supports asymmetric communications, reserving most of their bandwidth for the downstream link.[17]

EV-DO networks are well suited to support delay sensitive applications such as Voice Over IP (VoIP). EV-DO also supports Push To Talk (PTT) applications.[18] Rev A technologies can support theoretical upload speeds of 1.8 Mbps and download speeds of 3.1 Mbps. Rev B networks can support uplink speeds of between 3.6 and 5.4 Mbps and on the downlink between 6.2 and 9.3 Mbps. Similar to HSPA networks, EV-DO Rev B networks are referred to as 3.5G networks in contrast to 1xRTT or Rev A networks. Verizon wireless and Sprint Nextel have implemented EV-DO based networks in the United States over the past few years.

4G

Long Term Evolution (LTE) is the name for the fourth generation wireless network standard being developed by 3GPP as the evolutionary path for 3GSM wireless operators. LTE is expected to support 100 Mbps downstream speeds and 50 Mbps upstream speeds. LTE is designed to be backward compatible with HSPA networks.[19] The radio access is MIMO (Multiple In Multiple Out) in combination with OFDMA (Orthogonal Frequency Division Multiple Access) on the downstream link and single carrier FDMA on the upstream link. LTE will be based on TCP/IP, the core protocols of the Internet, and all applications will be delivered on this infrastructure.

Ultra Mobile Broadband (UMB) is a technology that was under development by Qualcomm to provide a migration path for the CDMA2000 3G networks. In November 2008, this technology was abandoned in favor of LTE.[20] It appears that most mobile operators, when they eventually move to LTE networks, will be using the same air interface enabling roaming agreements between all carriers.

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[17]3G - CDMA2000 1xEV-DO Technologies, `http://www.cdg.org/technology/3g_1xEV-DO.asp`.

[18]EV-DO Technology, `http://www.airvana.com/technology/technology_ev_do.htm`.

[19]Technology - LTE, `http://www.gsmworld.com/technology/lte.htm`.

[20]Sinead Carew, "Qualcomm halts UMB project, sees no major job cuts," *Reuters*, 13 November 2008, `http://www.reuters.com/article/marketsNews/idUSN1335969420081113?rpc=401&`.

WiMAX

As defined by the WiMAX forum, WiMAX is a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to wired broadband like Cable and DSL.[21] WiMAX provides fixed and mobile broadband connectivity without the need for direct line of sight to a base station. WiMAX is based on IEEE 802.16 standard and it comes in two flavors: 802.16d or fixed WiMAX and 802.16e or mobile WiMAX.

WiMAX has started out as an alternative to last mile broadband technologies but has the ability to be an alternative to traditional mobile technologies like UMTS. While WiMAX can theoretically support up to 70 Mbps speeds on the uplink and downlink, in reality this is close to 10 Mbps at 10 Km range. The shorter the range, the higher is the speed delivered by the network. WiMAX's air interface is similar to the interface in the proposed LTE networks – a combination of MIMO and OFDMA.

WiMAX can operate in the 10 to 66 GHz range but in order to improve interoperability, the WiMAX Forum has settled on the 2.5 GHz frequency. The 3.5 GHz frequency will be standardized next. WiMAX devices will operate in the 2.4-2.6 GHz range and 3.4-3.6 GHz range. The next evolution of 802.16 called 802.16m is an alternative to the 4G LTE technologies.[22]

UMA

Unlicensed Mobile Access (UMA) is a technology that provides roaming between a GSM network and 802.11 (Wi-Fi) networks.[23] UMA is not a competitor for cellular and WiMAX technologies but can be seen as a complementor. The idea behind UMA is to have dual mode handsets i.e. devices that can access two different networks – for example, a GSM network and an 802.11 network. The device can switch between the two different networks based on its current location. When a consumer is at home the device may decide to switch to the Wi-Fi network and when the consumer is driving, it can use the regular GSM network. This allows wireless operators to leverage existing 802.11 networks without having to install base stations everywhere. It also reduces the load on the cellular network by directing some of the traffic on an alternative network. Figure 2-2, from UMA Today, shows how UMA technology works.

One of the disadvantages of UMA is that the handsets should be capable of supporting two differ-

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[21]Technology Overview | WiMAX Forum, `http://www.WiMAXforum.org/documents/`.

[22]Frequenty Asked Questions | WiMAX Forum, `http://www.WiMAXforum.org/resources/frequently-asked-questions`.

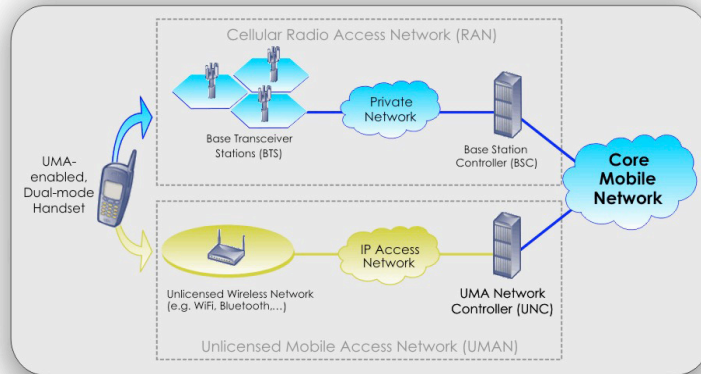[23]UMA Technology: Overview, `http://www.umatechnology.org/overview/`.

Figure 2-2: How UMA Technology Works

ent radio standards. Femtocells are one way to work around this problem – consumers deploy small base stations at their homes that can transmit the right wireless signal, for example, GSM/UMTS signals. The base station will connect back to the core through the consumer's broadband network in a manner analogous to the Wi-Fi devices. A few UMA based services have been deployed around the world. T-Mobile has announced a UMA service in the United States that also takes advantage of T-Mobile HotSpots that are deployed throughout the country.[24]

White Spaces

"White spaces" is a generic name for frequency bands that don't require a license to be used. In the United States, white spaces exist near the frequencies used by broadcast television channels. In November 2008, the FCC approved to open up the "white spaces" spectrum for wireless broadband.[25] This could allow for greater access to wireless broadband services for consumers. The frequencies in the white spaces are considered very valuable because they can go over long distances without interference – many people believe that this can be the backbone of a Wi-Fi network with much broader range (Wi-Fi on steroids[26]). This spectrum could provide an opportunity for new operators to provide voice and data services competing with traditional mobile and WiMAX operators.

The approval by FCC should be seen in the broader context of opening up the wireless industry. Traditionally, the wireless operators have bid for spectrum and have been able to control what ser-

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[24]HotSpot @Home by T-Mobile | Unlimited Wi-Fi Cell Phone Service Plan, http://www.theonlyphoneyouneed.com/.

[25]Leslie Cauley, "FCC approves 'white space' for broadband", *USA Today*, 4 November 2008, http://www.usatoday.com/tech/news/2008-11-04-white-space_N.htm.

[26]Larry Page talks about Google's vision of Wi-Fi on steroids", http://googlepublicpolicy.blogspot.com/2008/05/larry-page-talks-about-googles-vision.html.

vices can be delivered and what devices can access the networks they have built over that spectrum. The FCC also imposed the regulation that one of the valuable pieces of spectrum put up for auction in January 2008 (the C-band) should have open access i.e. any operator that wants to build a network over the frequency band should provide access to all devices.[27]

Looking Ahead

As a general rule, there is a range of competing technologies that are candidates for any application and wireless technologies are no exception. In the initial phases of mobile telephony, the application was voice services. As seen above, the two dominant technologies that have survived are based on GSM and CDMA standards. As the application has evolved from voice only to data services, the two standards extended their architectures to support these emerging applications.

The technological evolution for these standards is such that this duopoly has survived into the emerging 3G applications market. However, as 4G networks start becoming prominent, it is likely that this duopoly will die away. But it does not mean that LTE will be the only technology competing for the emerging 4G applications such as video on demand, multimedia content everywhere etc. WiMAX is a viable technological contender for this application. WiMAX, depending on how network rollouts happen, may even be a contender for 3G applications in the next year or two.

Both GSM and CDMA standards have evolved over time by increasing the bandwidth available for upstream and downstream links. Whenever these technologies have reached their performance envelopes (the flattening out of the technology S-curve as the technology bumps against the physical limits), innovation happened on a different curve. This new curve required wholesale upgrade of network infrastructure and customer equipment (handsets, base stations, core devices etc.).

This has generally worked out well for traditional wireless operators, as they were able to continue monetizing their existing infrastructure while rolling out new networks. An operator rolling out a WiMAX network faces the flip problem – building a new network infrastructure requires a lot of capital investment and without a revenue stream similar to what the traditional operators have, it just may not be viable. In the United States, Sprint/Clearwire have been trying to roll out a WiMAX based nationwide network, but have run into difficulties because of Sprint's weak position in the traditional mobile market.

One avenue that could be a viable challenge to the traditional technologies is a network that could provide services in "white spaces" or open spectrum. The capital expenditures for such a network

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[27]Bryan Gardiner, "FCC Auction Ensures Open Access — If in Name Only", *Wired*, 1 February 2008, `http://www.wired.com/techbiz/it/news/2008/02/open_access`.

will be somewhat lower because there is no outlay required for buying the spectrum. However, the open spaces are a patchwork of frequencies that may not be available in every location. It is more likely that operators providing services in a small geographical region or a city will spring up. Such operators may be helped by two distinct trends – changing nature of customer demand and evolution of software on handsets.

Consumer demand for wireless services has primarily been voice only until recently. However, the demand for data services is increasing and even for traditional operators, the bulk of the revenue will come from data. This provides operators providing data services a clear opportunity as long as consumers can access the traditional wireless network and a data network simultaneously. Here emerging handset technologies are helping them – new devices such as Apple's iPhone and HTC's Dream support a Wi-Fi interface in addition to the 3GSM interface. A user with a Wi-Fi account (similar to T-Mobile Hotspot) could decide to switch from the 3GSM interface to the Wi-Fi interface based on cost, availability, performance and a myriad other factors. While this interface is Wi-Fi today, it could be WiMAX or any other new technology. In fact, technologies like Wi-Fi that do not require licensed spectrum (unlike WiMAX) may be more viable competitors.

In conclusion, the traditional technologies (GSM and CDMA) have been competing against each other for wireless applications. It is increasingly clear that new technologies and changing regulatory structure will challenge them for the emerging wireless applications. Cost of rolling out a network may be the biggest advantage traditional technologies have over new emerging technologies. This advantage may however be weakened by the increasing availability of open spectrum.

Chapter 3

Handsets

Handsets are increasingly becoming powerful enough to rival the computing capabilities of personal computers. Miniaturization, low power consuming processors, touchscreen technologies, improved batteries are all making handsets viable replacements to personal computers for many applications. The nature of competition among handset vendors is evolving to something similar to what has happened in the personal computing ecosystem. In the personal computer industry, control of the software and hardware platforms has been decisive in winning market share and capturing the vast bulk of profits. Microsoft controlled the software platform through Windows and Intel controlled the hardware platform through the x86 architecture. On the software front, the mobile industry is quickly following the path taken by the personal computer industry. Decisive battles for controlling the software platform are happening between Apple, RIM, Microsoft and other vendors that are described and analyzed in detail in Chapter 4.

On the hardware front, the competition in the mobile industry is somewhat more interesting that the one in the personal computing industry. At the processor level, just as in the PC industry, there is very little competition. Processors based on the ARM architecture are present in well over 90% of the mobile phones sold around the world and are the preferred choice because of their low power consumption architecture.[1] Intel introduced the Atom technology as a competitor to the ARM technology and while the platform has become the preferred processor for netbooks, it has had little success in displacing ARM's near monopoly hold in the mobile industry.

The more interesting battle on the hardware front has been in the handset space. Unlike personal computers, users expect to carry their mobile devices with them everywhere they go. This has

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[1]Tom Krazit, "ARMed for the living room", *CNET News*, 3 April 2006, `http://news.cnet.com/ARMed-for-the-living-room/2100-1006_3-6056729.html`.

Vendor	2008 Market Share	2007 Market Share
Nokia	39.7%	38.3%
Samsung	16.7%	14.1%
LG Electronics	8.5%	7.1%
Motorola	8.5%	13.9%
Sony Ericsson	8.2%	9.1%
Others	18.5%	9.4%

Table 3.1: Mobile Phone Market Share

resulted in many interesting hardware designs with vendors having multiple avenues to differentiate their products from competition – physical size, weight, standby time, talk time, keyboard type, input mechanisms, display size, display resolution etc. Moreover, when a consumer uses their mobile phone in the public, they are seen with the device. This makes them important fashion accessories – many people are conscious of being seen with the most stylish device possible. This has opened up new avenues of differentiation in the mobile space that did not exist very much in the personal computing space where Apple's positioning of the Mac as the stylish choice did not help it a lot.

In addition, today's smartphones evolved from what used to be two distinct sets of devices – the cell phones and the PDA's. The functionality of the cell phone and the PDA are essentially combined into one in smartphones. Most of the dominant smartphone makers today have origins in one of the two industries: for example, Nokia comes from the cell phone space and RIM comes from the PDA space. The big exception is Apple that entered into the mobile space as a smartphone maker with no legacy designs.[2] Some of the very successful device makers from both industries have failed to transition into the smartphone space (Motorola from the cell phone space, Palm which was the industry leader in PDAs).

According to IDC, the top 5 worldwide mobile phone vendors at the end of 2008 are Nokia, Samsung, LG Electronics, Motorola, and Sony Ericsson.[3] Together, they shipped 81.5% of the 1.181 billion mobile phones shipped in 2008. Table 3.1, based on IDC data, shows the market share changes from 2007 to 2008.

Motorola is quickly falling behind the other device makers considering that it had over 22% of the market share in 2006. The two South Korean manufacturers (Samsung and LG Electronics) have shown rapid growth in the past couple of years. While Samsung and LG have not really pioneered many innovations in this space, they have been quickly out with devices that mimic some of the popular features from other successful hardware vendors. Both companies release almost 100 new

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[2]Apple introduced one of the earliest PDA's, Newton, in the early 1990's that did not succeed. However, that device has little impact on Apple's iPhone devices.

[3]IDC - Press Release, "Worldwide Mobile Phone Market Declines by 12.6% in Fourth Quarter, More Challenges To Come Says IDC", 4 February 2009, http://www.idc.com/getdoc.jsp?containerId=prUS21659209.

devices each year. However, the biggest reason for their success lies in the favorable export rates.[4] The South Korean Won has slid 25% against the dollar in 2008 and has slid another 16% so far in 2009.[5] The Korean government has recently changed its policies to not support the currency as it further slides in the hope that it would fuel its exports driven economy and help the country out of its economic slump.[6]

Other than Nokia, the most important and interesting hardware makers fall in the "Others" category in the above table. Apple has shipped about 0.9% of the mobile phones in 2008 (1.3% in Q4 2008)[7] whereas Blackberry's market share is about 2.8%.[8] Both Apple and Blackberry have been leading the innovation in the smartphone space and hold much bigger shares of the market in the faster growing smartphone market.

This chapter will take a look at some of the dominant hardware vendors in the smartphone space (Nokia, Apple, RIM) and how they are attempting to differentiate themselves. While the ultimate success in this space will probably still go to the dominant software platform, there will be much competition based on hardware for some more years. This chapter will also take a look at the demise of Palm and its failure to transition from PDA's to smartphones.

Nokia

Nokia Corporation, headquartered in Finland, is the world's leading mobile phone supplier and a leading supplier of mobile and fixed telecom networks.[9] Nokia is rated as the fifth most valuable global brand[10] and accounted for 25% of Finland's exports and 4% of GDP.[11] Nokia's net sales are down to 50.7 billion Euros in 2008 compared to 51.06 billion Euros in 2007 and operating profit is down to 4.966 billion Euros from 7.985 billion Euros in 2007.[12]

Nokia has been developing mobile phones for well over a quarter century. In 1982, Nokia introduced one of the earliest mobile phones called Mobira Senator that was used on the car-based mobile

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[4]"Korean Cell Phones Increase Global Market Recognition", *Digital Chosunilbo (English Edition)*, 19 March 2009, http://english.chosun.com/w21data/html/news/200903/200903190011.html.

[5]Gwen Robinson, "Korea's weak won and the 'Japan factor'", *Financial Times*, 25 February 2009, http://ftalphaville.ft.com/blog/2009/02/25/52897/koreas-weak-won-and-the-japan-factor/.

[6]Lee Shin-hyung and Yoo Choonsik, "South Korea fin min suggests changed stance on won", *Reuters*, 25 February 2009, http://www.reuters.com/article/mergersNews/idUSSE05145220090225?sp=true.

[7]Michael W. Jones, "So what if iPhone market share is tiny?", *BLORGE*, 10 March 2009, http://mac.blorge.com/2009/03/10/so-what-if-apples-cell-phone-share-is-tiny/.

[8]BlackBerry Market Share, http://stats.getjar.com/statistics/world/manufacturer/BlackBerry.

[9]Nokia - Nokia on the Web, http://www.nokia.com/.

[10]Best Global Brands 2008, *Interbrand*, http://www.interbrand.com/images/BGB_reports/BGB_2008_US_Format.pdf.

[11]The Story of Finland, http://www.finnfacts.com/english/country/story/worldeconomy/nokia.html.

[12]Quarterly and Annual Information 2008, http://www.nokia.com/about-nokia/financials/quarterly-and-annual-information/quarterly-and-annual-information-2008.

telephony system delivered by NMT (Nordic Mobile Telephony).[13] In 1984, Nokia introduced the Mobira Talkman, the world's first portable car phone, which boasted 8 hours of standby time, 1 hour of talk time and cost £2500. The Mobira Cityman, introduced in 1987, was one of the worlds first handheld phones weighing only 800 grams.[14] Nokia was actively involved in the development of the GSM standard and the world's first genuine GSM call was made in Finland with equipment supplied by Nokia in 1991. Nokia introduced the first GSM hand portable in 1993. On these 2nd generation digital phones, Nokia also pioneered the concept of soft keys and scroll and select user interface (Nokia 2110, 2140). By 1994, Nokia introduced hand portable phones for all the major mobile network standards (GSM, TDMA, PCN, Japan Digital).

In 1996, Nokia introduced the Nokia 9000 Communicator, one of world's earliest smartphones. The devices in the communicator series appear as phones from the outside but have a large LCD screen and a keyboard inside. The latest version of the phone in the Communicator series is the E90, a 3G smartphone introduced in 2007. The E90 weighs about 210g and runs the Symbian Operating System.

While Nokia is the largest mobile phone maker in the world, it has had a very tough time breaking into two of the important wireless markets in the world – US and Japan. Nokia has generally harbored ambivalence towards US market because of the control wireless carriers exert in the US and the US market traditionally is not as advanced in Europe.[15] Further, Nokia could reap huge profits outside US without having to operate at the whim of the operators. Complications in dealing with Qualcomm, owner of the CDMA patents, also soured Nokia on the US market. The success of iPhone, however, has made the US market a thought leader in the wireless industry and Nokia realizes that it has to start competing in the US again if it does not want to lose the leadership role it has around the world. As such, Nokia is entering back into the US market with a new phone, Nokia E71x, which looks very much like a traditional BlackBerry. In response to Apple's touchscreen technology in the iPhone, Nokia has announced that it will release the N97 that includes both a touchscreen display as well as a QWERTY keyboard.[16] Nokia also failed to garner any market share in Japan (less than 1%) and has decided that it will leave the Japanese market in late 2008.[17] Foreign handset makers have had little success in Japanese market traditionally where

[13]Nokia Timeline, `http://www.newlaunches.com/entry_images/1107/12/nokia_timeline.php`.

[14]Towards Telecommunications, `http://www.nokia.com/NOKIA_COM_1/About_Nokia/Sidebars_new_concept/Broschures/TowardsTelecomms.pdf`.

[15]Olga Kharif and Jack Ewing, "Nokia Targets the U.S. Market", *Business Week*, 30 March 2009, `http://www.businessweek.com/technology/content/mar2009/tc20090329_098616.htm?campaign_id=rss_tech`.

[16]Nokia Press Release, "Desktop. Laptop. Pocket: The era of the personal Internet dawns with the Nokia N97", 2 December 2008, `http://www.nokia.com/A4136001?newsid=1274500`.

[17]Joel Dreyfuss, "Nokia Surrenders in Japan", *Red Herring*, 28 November 2008, `http://www.redherring.com/Home/25582`.

domestic makers work in close cooperation with carriers and produce devices that are highly tuned to local tastes.[18]

Research In Motion

Research In Motion (RIM), a Canadian company, based in Waterloo, Ontario, makes the BlackBerry handheld communication devices. Revenue for the fiscal year ended February 28, 2009 was \$11.07 billion, up 84% from \$6.01 billion the year before.[19] RIM shipped approximately 26 million devices during fiscal 2009. The revenue breakdown for the fourth quarter of fiscal 2009 was 83% for devices, 12% for service, 2% for software, and 3% for other revenue. RIM's net income for fiscal 2009 was \$1.89 billion, up 46.3% over fiscal 2008.

The first model of BlackBerry was introduced in 1999 as a two-way pager (850 series) with a built-in keyboard. Users typically use their thumbs to type on the keyboard in a process called thumbing. Even with these early models, users could access corporate data, calendaring, and organizer functionality.[20] The successor pager (857/957 series) included a much larger display (16-20 lines instead of 8-10) and looks much like the modern BlackBerry.

RIM added phone functionality to its pager in the BlackBerry 5810 released in March 2002. The device was targeted at business users rather than consumers and operated only on GSM networks. The first CDMA BlackBerry (6750) was released in Q2 of 2003 for Verizon Wireless. This was followed by the 7000 series that were the first color models. 2/3rds of the devices were for GSM networks and the rest were for CDMA networks.

RIM introduced the 7100 series in late 2004 with SureType technology that was marketed to non-business users. Devices until this point were too big compared to other cell phones in the market for consumers because of the full QWERTY layout. RIM reduced the size of the BlackBerry by assigning two letters to each key instead of the traditional 3 per key that helped it improve typing accuracy substantially.

Starting with the 8700 series ('Electron') introduced in November 2005, RIM started competing aggressively in the consumer marketplace. This was followed by the 8800 series introduced in February 2007 and included the trackball for the first time. This was followed by the BlackBerry Curve (8300 series) introduced in May 2007 and included a camera for the first time. RIM intro-

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[18]Martyn Williams, "Nokia to Pull out of Japanese Handset Market", *IDG News Service*, 27 November 2008, http://www.pcworld.com/article/154619/nokia_to_pull_out_of_japanese_handset_market.html.

[19]Research In Motion Press Release, "Research In Motion Reports Fourth Quarter and Year-End Results for Fiscal 2009", 2 April 2009, http://press.rim.com/financial/release.jsp?id=2248.

[20]Joe Pawlikowski, "The history of the BlackBerry", BBGeeks, 15 April 2008, http://www.bbgeeks.com/blackberry-guides/the-history-of-the-blackberry-88296/.

duced the BlackBerry Bold (9000 series) in May 2008 with more consumer friendly features. In response to iPhone's touchscreen technology, RIM introduced BlackBerry Storm (9500 series) for CDMA networks in late 2008. The device received considerable criticism mostly because of the bugs in software.

A large part of BlackBerry's success was its ability to receive email in real time that made the device famously addictive and was referred to in popular culture as CrackBerry. Despite making the successful transition from being a business-oriented device to a consumer-oriented device, BlackBerry remains the device of choice for most businesses. RIM has been a key innovator in the smartphone space and has generally been at the forefront of innovation with its hardware. This position is now increasingly challenged by Apple causing RIM to duplicate some of the hardware functionality that Apple has. RIM has also been behind Apple in realizing the central role of software in mobile devices and that has put it in a catch up position to some extent.

Apple

Apple is one of the largest consumer electronics and software companies in the world based in Cupertino, California. Following its tremendous success with the iPod brand of portable media players, Apple entered the smartphone market in June 2007 with the iPhone. Apple shipped over 3 million iPhones in 2007 and over 11 million phones in 2008.[21]

Just as it did with the iPod, Apple rethought the interface for a mobile phone with the iPhone. Unencumbered by any legacy devices and designs, Apple brought its own brand of industrial design, aesthetics, and distinctive style to the mobile phone space upending the existing order. Fueled by Apple's eye-catching marketing campaigns, iPhone monopolized the thought space and disrupted the plans of many competitors by making them respond to what it has done.

The biggest innovation in iPhone on the hardware front was to do away with a physical keyboard completely. Apple introduced a virtual keyboard that allowed users to type on the capacitive touch-screen made of scratch-resistant glass.[22] The iPhone also included an accelerometer that detected the orientation of the phone and adjusted the screen accordingly. The iPhone operates only on GSM networks. The iPhone was followed by the iPhone3G that was introduced in July 2008. iPhone3G works on the faster 3GSM networks and is very similar to the original iPhone in other ways.

The other big innovation in the iPhone has to do with the software platform. iPhone provides an

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[21]Gartner Press Release, "Gartner Says Worldwide Smartphone Sales Reached Its Lowest Growth Rate With 3.7 Per Cent Increase in Fourth Quarter of 2008", Gartner, 11 March 2009, `http://www.gartner.com/it/page.jsp?id=910112`.
[22]iPhone3G Technical Specifications, `http://www.apple.com/iphone/specs.html`.

open API that allows 3rd party application developers to develop games, new software etc. for the iPhone. Apple has built an easy to use iPhone store that lets users buy and download applications directly from the phone itself. The impact iPhone's open API's and iPhone store had on the mobile ecosystem are discussed in detail in Chapter 4.

Palm[23]

While Palm is not an important handheld maker in the smartphone space, its failure to transition from being the leading PDA maker offers some lessons for the competitors in the mobile space. Palm made one of the most successful PDA's and was the market leader from 1997 to 2003. At its peak, Palm held 66.5% of the market in 2000. Starting in 2001, Palm steadily lost its leadership role to Windows CE based devices.[24]

The Palm technology was based around the handwriting recognition software developed by Palm founder Jeff Hawkins. The first device introduced with this technology was called Zoomer and came to the market in 1992. Zoomer competed with Apple's Newton PDA and both devices failed to win many consumers. The handwriting recognition software did not work particularly well and the devices were overloaded with features and cost too much ($700-$1000). After the failure of Zoomer, Hawkins decided to make a much simpler product that did few things (organizer, for example) well. The device was also required to fit in a shirt pocket and run quickly. Instead of having software recognize multiple varieties of handwriting, users were required to learn the Palm way of writing (Graffiti). The PalmPilot was introduced in 1996 and Palm sold more than 3 million devices by the end of 1998 quickly becoming the market leader.

A major contributor for Palm's success was its successful courting of application developers. Thousands of applications started appearing for the PalmPilot that improved the value of the platform tremendously. Palm decided to license its operating system to other vendors and many hardware makers including Nokia and Sony made Palm based devices. Handspring, a hardware maker founded by Hawkins after he left Palm, also made hardware for the Palm platform. Palm was eventually split into two companies – PalmSource that licensed the OS and PalmOne that made hardware.

Microsoft, after some initial stumbles, repeated its successful strategy from personal computing in the PDA space. It licensed its operating system to hardware makers and the software included an

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[23]David S. Evans, Andrei Hagiu, and Richard Schmalensee, *Invisible Engines: How Software Platforms Drive Innovation and Transform Industries* (Cambridge: MIT Press, Second Edition, 2004), 155-181.
[24]Source: IDC Reports.

Internet browser, media player, and email. Palm remained loyal to its original strategy of simplicity but as the hardware capabilities improved, PDAs based on Microsoft's software provided a richer variety of applications than Palm did. In addition, the mismanagement and squabbling at Palm and its acquirers (US Robotics first and 3M subsequently) meant that Palm did not update its software strategy. Unable to decide whether it is a software company or a hardware company or how much it should be integrated vertically, Palm only made a few efforts to develop PDAs with communication capabilities like RIM did.

Others

One emerging hardware company to keep an eye in the coming years is High Tech Computer Corporation (HTC), a Taiwan-based manufacturer of portable devices. HTC used to be primarily an Original Design Manufacturer (ODM) and many of the leading mobile phone operators sold HTC devices under their own brand name. HTC is a member of the Open Handset Alliance (OHA), a business group led by Google that develops open standards for mobile phones. Android is the open source mobile operating system introduced by OHA. HTC has started introducing mobile phones that conform to the OHA specifications under its own brand name starting in 2008. The first Android based phone, T-Mobile G1 (HTC Dream) was made by HTC. HTC Magic unveiled by Vodafone in February 2009 followed the Dream. While other vendors including Motorola, Huawei, Lenovo, Sony Ericsson, Samsung, and Acer have announced Android based phones, HTC is the only vendor to have devices in the market today.

Looking Ahead

As discussed in the introduction, software platforms will decide which players will ultimately succeed in the mobile phone market. However, as devices with unique constraints on size, weight, battery consumption etc. hardware can and does play a role in this space. This is seen repeatedly in the mobile market – Motorola's RAZR was tremendously successful because of its super sleek, fashion-friendly style.[25] The RAZR had impressive hardware and decent software features but it was always about its striking appearance and style. The same happened with iPhone. One of the biggest reasons for iPhone's success is it software, but its sleek hardware design, touchscreen technology, determining orientation through the accelerometer all helped in its success. Even when BlackBerry

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[25]Kent German, "Razr refresh: Motorola's fashion cell phones", *CNET Reviews*, 9 November 2005, `http://reviews.cnet.com/4520-3504_7-5670915-1.html`.

introduced the Storm platform as its answer to iPhone, a good chunk of the commentary was related to whether it was sleek enough, looked great etc.

There are, however, limits to what a mobile phone maker can do with innovation in hardware. Motorola's RAZR again offers a striking example. Until iPhone overtook it, RAZR was the highest selling handset of all time.[26] While RAZR remains an iconic cell phone, Motorola couldn't repeat its success. In fact, Motorola has been steadily losing market share and is unlikely to be very relevant in this space any more. The main reason for this is software – Motorola never built a successful software platform around its hardware. It couldn't execute a successful platform strategy that attracted developers to build software for the phone. RAZR, for all its beauty, is a one-time hit because Motorola, at its core, is a hardware vendor that either didn't understand or couldn't execute on the importance of software.

Nokia, despite its comfortable market share lead, has the potential to go down the path of Motorola and Palm. Nokia still makes impressive hardware but unless it gets its software house in order will continue to see decreases in market share as has been happening in the past few quarters. Nokia and Motorola did understand the importance of software and tried to build a software ecosystem around Symbian but as discussed in Chapter 4, did not get it right. This leaves them vulnerable to competitors like Apple and RIM that have shown the knack of executing both the hardware and software strategies. Motorola, very likely, has run out of time and Nokia has a very small window of time before it will run of time too.

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[26]Brennon Slattery, "Apple's iPhone: So Far, the Best Phone Ever?", PC World, 11 November 2008, `http://www.pcworld.com/article/153666/apples_iphone_so_far_the_best_phone_ever.html`.

Chapter 4

Software Platforms

The majority of the mobile phones sold so far have been voice only devices with support for a few basic applications such as Address Books, Call Logs, Text Messaging, simple games etc. The phones typically had low processing power, small amounts of RAM, and limited battery life that constrained the kind of applications that could be built. As the capacity of the phones increased other applications such as music playing, cameras etc. have been added. With advances in processor technologies bringing forth CPU's that consume very little power and improvements in battery technology, the devices produced in the recent past are approaching the capacities of Personal Computers from just a few years ago. Such devices are a lot more than phones – they are often referred to as 'smartphones' and can support a wide variety of applications.

This evolution in hardware capabilities has had a significant impact on the software running on the devices. Early phones had custom built operating systems that were designed specifically to run the basic applications in an efficient manner. As the phones became general-purpose devices, general-purpose operating systems have sprung up enabling a myriad of applications. These operating systems are better thought of as platforms – technologies whose value increases geometrically with the addition of complementary products and services. These platforms are increasingly multi-sided – they attempt to bring together consumers, application developers, and content providers among others.

This chapter is an introduction to the various smartphone platforms that are jockeying for position in being the platform of choice for the emerging smartphone market. After introducing the major platforms, the chapter uses Cusumano's four levers to analyze the strengths and weaknesses of each platform. This is followed by a discussion of whether one of the wannabe's can either core

Vendor	Q3 2008 Shipments	%share	Q3 2007 Shipments	%share	Growth
Total	**39,850,100**	**100.0%**	**31,156,240**	**100.0%**	**27.9%**
Nokia	15,485,690	38.9%	16,025,690	51.4%	-3.4%
Apple	6,899,010	17.3%	1,107,460	3.6%	523.0%
RIM	6,051,730	15.2%	3,298,090	10.6%	83.5%
Motorola	2,313,930	5.8%	2,058,500	6.6%	12.4%
HTC	2,308,210	5.8%	850,400	2.7%	171.4%
Others	6,791,530	17.0%	7,816,100	25.1%	-13.1%

Table 4.1: Worldwide Smartphone Market

Vendor	Q3 2008 Shipments	%share	Q3 2007 Shipments	%share	Growth
Total	**39,850,100**	**100.0%**	**31,156,240**	**100.0%**	**27.9%**
Symbian	18,583,060	46.6%	21,219,390	68.1%	-12.4%
Apple	6,899,010	17.3%	1,107,460	3.6%	523.0%
RIM	6,051,730	15.2%	3,298,090	10.6%	83.5%
Microsoft	5,425,470	13.6%	3,797,360	12.2%	42.9%
Linux	2,028,490	5.1%	1,361,810	4.4%	49.0%
Others	862,340	2.2%	372,130	1.2%	131.7%

Table 4.2: Worldwide Smartphone OS Market

or tip the platform in its direction. The chapter will conclude with a discussion of whether the smartphone platform is a "winner-take-all" market or if there is a potential for multiple platforms to co-exist.

Software Platforms

According to Canalys, a technology focused independent analyst house, global smartphone shipments in Q3 of 2008 rose 28% hitting a new peak of 39.9 million.[1] Note that the number of smartphones shipping each quarter is a small percentage of the total mobile devices shipping in that quarter though the percentage is increasing in the recent past (11% in Q2 2008 compared to 13% in Q3).[2] Table 4.1, based on Canalys estimates, shows the vendor shares in the worldwide smartphone market. Nokia continues to be the market leader but Apple and RIM have made strong gains. Interestingly, each of the vendors in the top 5 use a different software platform – Nokia phones are based on Symbian, Apple's are based on iPhone OS (or OS X iPhone), RIM's phones are based on RIM BlackBerry OS, Motorola's are primarily based on Linux variants, and HTC devices are either based on Windows Mobile or Google Android.

Table 4.2 shows the market shares for OS vendors in the worldwide smartphone market. Symbian

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[1]Canalys Press Release, "Global Smartphone shipments rise 28% ", 6 November 2008, `http://www.canalys.com/pr/2008/r2008112.htm`.

[2]Neil Mawston, "Global Smartphone Vendor Marketshare: Q2 2008", *Strategy Analytics*, 11 September 2008, `http://www.strategyanalytics.com/default.aspx?mod=ReportAbstractViewer&a0=4170`.

continues to be the leader of the pack though its wide lead from the past few years has started to disappear. Microsoft increased its share of the market as multiple device vendors (Motorola, HTC, Samsumg etc.) use Windows Mobile for their phones. The first phone based on Google's Android platform (T-Mobile's G1) came out in October 2008 and BlackBerry has introduced new models in November 2008; market shares are likely to dramatically change from quarter to quarter in the near term. This also indicates a market in a lot of flux where many different strategies are being tried out with no dominant design for the software platform in place yet.

Symbian

Symbian was a partnership founded by Ericsson, Nokia, Motorola, and Psion in 1998 to develop an OS for the "smart mobile device" market based on Psion's EPOC family of operating systems. Panasonic, Siemens, Samsung, and Sony Ericsson also held shares in the company.[3] In June 2008, Nokia acquired all the shares it did not own in the company and announced the Symbian Foundation to provide a "royalty-free open platform and accelerate innovation".[4, 5]

Symbian emerged as the early leader in the smartphone market based on the fact that Nokia, the leader in mobile devices, used Symbian exclusively for its smartphones. Other device vendors like Motorola and Samsung have also built smartphones based on Symbian contributing to the early popularity. Ericsson released the first Symbian smartphone in 2000 based on Symbian OS v5. NTT DoCoMo chose Symbian as the platform for its 3G handsets in 2004 and by 2006, 100 million Symbian smartphones were shipped.

The Symbian OS is based on microkernel architecture and supports preemptive multitasking and memory protection. The OS allowed each vendor to customize the User Interface – this means that an application vendor will have to rewrite portions of the UI if the application has to run on devices from different vendors. Popular software platforms for Symbian OS include S60 used on Nokia phones, UIQ used by Motorola, Sony Ericsson etc. The primary development environment for Symbian is a variant of C++ and the OS comes with a library of C++ classes that can be used to access the OS services.

The Symbian ecosystem is currently in a state of flux. Symbian has never been very popular in the US as Nokia was not particularly strong in the US. Despite going by the name of Symbian, each of the Symbian platforms were not compatible (particularly at the UI layer) with each other leading

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[3]Symbian Fast Facts, http://www.symbian.com/about/fast.asp.
[4]Cassell Bryan-Low, "Nokia Will Acquire Full Ownership of Symbian", *The Wall Street Journal*, 25 June, 2008, http://online.wsj.com/article/SB121429212225099409.html.
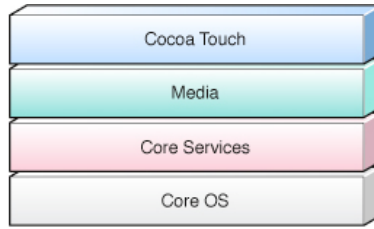[5]Symbian Foundation, http://www.symbian.org/index.php.

Figure 4-1: iPhone OS

to confusion in the marketplace. Nokia's moves in buying Symbian and making it open source may lead to some clarity but Symbian may be rapidly losing "mind share" in the face of challenges from iPhone OS and Android.

iPhone OS

iPhone OS, a derivative of Mac OS X, is Apple's operating system for iPhone and iPod Touch devices. The iPhone OS is organized into four technology layers – Core OS, Core Services, Media, and Cocoa Touch (Figure 4-1[6]). The kernel in iPhone OS is based on a variant of the Mach kernel in Mac OS X. The latest version of the operating system is v2.2.1. A developer only beta version 3.0 was announced in March 2009.[7]

The iPhone OS comes with a variety of applications preinstalled (ex: email, calendar, iTunes, App Store, Notes, Maps, YouTube etc.). iPhone OS also supports web applications delivered through Safari browser. iPhone can also sync with Microsoft Exchange servers out of the box enabling push email, contacts, calendar etc. iPhone OS comes with a SDK that allows third party developers to develop native applications for the platform. The Core OS and Core Services layers of the OS provide C API's for low-level data types, to access files, network sockets etc. The higher layers are a mix of C and Objective-C API's. They provide the frameworks for the fundamental infrastructure of a new application.[8]

The App Store is an application for iPhone OS that allows a device to access applications developed by third-party developers.[9] Developers can publish their applications through the App Store and are entitled to 70% of the revenue generated from their sales. Applications can also be made available through the iTunes music store. Within 9 months of launching the app store, more

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[6]Source: Apple, http://devimages.apple.com/iphone/gettingstarted/docs/images/overview_systemlayers.jpg.

[7]Apple Press Release, "Apple previews Developer Beta of iPhone OS 3.0", http://www.apple.com/pr/library/2009/03/17iphone.html.

[8]iPhone Dev Center, http://developer.apple.com/iphone/.

[9]iPhone - App Store and Applications for iPhone, http://www.apple.com/iphone/appstore/.

than 1 billion applications have been downloaded.[10] On average, each iPhone user is expected to have downloaded 27 applications.[11] Before an application can be run on the device, Apple has to approve the application and certify it. Apple has the right to reject applications that duplicate core iPhone functionality – for example a music player application can be and has been rejected. Apple has also removed applications that it finds objectionable: a baby shaker application that involves shaking an image of a baby until it dies has been removed from the app store after it was available for a few days.[12] iPhone OS also allows an organization to distribute applications to its employees through an enterprise deployment mechanism. The iPhone OS does not support Java applications.

BlackBerry OS

BlackBerry OS is a proprietary software platform made by Research In Motion for their BlackBerry devices. The latest version of the software is v4.5.[13] The OS supports email, ability to save and edit email attachments in Microsoft Word and Microsoft PowerPoint, SureType technology to help in fast typing, an Internet browser that supports streaming applications, maps, music and video applications, and calendar services. The OS supports synchronization with Microsoft Exchange servers (for email, calendar, notes, tasks) and push email.[14]

Third-party developers can develop applications for the BlackBerry OS using J2ME (Java 2 Micro Edition) and WAP. The OS supports MIDP 1.0 profile for J2ME applications. The OS also includes a proprietary API that allows for direct access to the OS services.

In October 2008, BlackBerry has announced that it will open an Application Storefront and Application Center in March 2009.[15] The storefront will be an online distribution mechanism whereas the application center will be an on-device app that will enable consumers to buy applications from the storefront. Application developers can set any price for their application and will retain 80% of the revenue generated from each sale. Similar to Apple, RIM can decide what applications to make available to the users through the Storefront.

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[10] Ben Charny, "App Store Increases In Importance For Apple", *The Wall Street Journal*, 23 April 2009, `http://online.wsj.com/article/BT-CO-20090423-723471.html`.

[11] Seth Weintraub, "With 27 apps per device, iPhone customers aren't likely to stray", *Computer World*, 25 April, 2009, `http://blogs.computerworld.com/with_27_apps_per_device_iphone_customers_arent_likely_to_stray`.

[12] Saul Hansell, "In Defense of Baby Shaking on the iPhone", *The New York Times*, 22 April, 2009, `http://bits.blogs.nytimes.com/2009/04/22/in-defense-of-baby-shaking-on-the-iphone/`.

[13] BlackBerry Device Software, `http://na.blackberry.com/eng/services/devices/#tab_tab_overview`.

[14] BlackBerry OS Features, `http://na.blackberry.com/eng/services/devices/#tab_tab_features`.

[15] RIM Press Release, "RIM to Launch BlackBerry Application Storefront and BlackBerry Application Center", `http://press.rim.com/release.jsp?id=1869`.

Windows Mobile

Windows Mobile is Microsoft's operating system for mobile devices whether they are Pocket PC's, Handheld PC's or Smartphones.[16] Windows Mobile is designed to be similar in use and behavior to the desktop Windows Operating System. The first version of Windows Mobile has appeared in 2000 as Pocket PC 2000 and the current version is called Windows Mobile Version 6.1. Windows Mobile is licensed by most traditional device vendors – Nokia, RIM, and Apple are the big exceptions.

The latest version of the OS includes features for communication (text messaging, E-mail, and IM), productivity tools (Microsoft Office Mobile, Outlook Mobile, IE for browsing), photo management (ability to send MMS messages), games (popular games such as Guitar Hero 3, Sudoku, Madden NFL etc.), and music/video support (with Windows Media Player Mobile).[17] Microsoft is also rumored to be building an app store similar to RIM, Google, and Apple called Windows Marketplace for a central location from which consumers can buy Windows Mobile applications. Latest reports indicate that this will be available in October 2009 with the launch of Windows Mobile version 6.5.[18]

Third-party developers can build applications for Windows Mobile platform writing code in Visual C++, .NET Compact Framework, or as Web applications delivered through a browser. As with the desktop version, Microsoft provides Software Development Kits (SDK) to work in the Visual Studio development environment.

Microsoft has attempted to replicate its success with desktop operating systems in the smartphone space by essentially following the same strategy. Microsoft established two separate but closely tied mass-market platforms (the operating system and Office franchise) on the desktop and by continuously evolving these platforms, was able to get users pay multiple times. The network effect from having the same productivity suite, for instance, has helped this strategy payoff. It is yet to be seen if Microsoft will be able to replicate the success in the mobile phone market where while similar network effects exist they may not be as stronger.

Android

Android is a complete set of software for mobile devices – an operating system, middleware, and key mobile applications.[19] It was originally developed by Google and is currently developed by the

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[16]Windows Mobile, http://www.microsoft.com/windowsmobile/en-us/default.mspx.

[17]Meet Windows Mobile, http://www.microsoft.com/windowsmobile/en-us/meet/default.mspx.

[18]Will Park, "Microsoft report hints at Windows Mobile 6.5 launch by October!", *Into Mobile*, 24 April 2009, http://www.intomobile.com/2009/04/24/microsoft-report-hints-at-windows-mobile-65-launch-by-october.html.

[19]Android Overview, http://www.openhandsetalliance.com/android_overview.html.

Open Handset Alliance, a consortium of 34 companies. Android is an open system built on the Linux kernel. All applications are created equal in Android – the system does not differentiate between core applications and third-party applications. Third-party developers can write applications for Android using Java running on an optimized virtual machine developed by Google. Android comes with a SDK and a set of development tools. Apps can access core device functionality through standard API's and can also publish capabilities for other apps to use (through a mechanism called intents). The core platform supports local storage through SQLite, connectivity (GSM/EDGE, CDMA, EV-DO, Wi-Fi etc.), SMS and MMS for messaging, a WebKit based browser, Java Virtual machine, and multimedia support.[20]

Android also includes Android Market, a distribution mechanism for developers to get their applications into user's hands. Developers need to pay a $25 registration fees. Developers get to retain 70% of the revenue generated through the sales of their applications. Users can rate application quality and anonymous usage statistics used to determine how apps are ranked and presented within the market.[21]

Others

Other smartphone platforms include various Linux variants used by Motorola in China and DoCoMo in Japan, BREW developed by Qualcomm, and Palm OS developed by Palm Source. Linux variants are reasonably popular with about 5% of the market in Q3 2008. Android itself is built on the Linux kernel, so the share of Linux based devices should grow in the coming years.

Competing for Platform Leadership

In their book, "Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation", Annabelle Gawer and Michael Cusumano lay out the Four Levers Framework for designing and implementing a successful platform strategy.[22] The four levers briefly are:

1. Determine the scope of the firm: Is it preferable to create product complements internally or let the "market" produce them?

2. Design product technology strategically: What degree of modularity is appropriate? Should

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[20]Android, http://www.android.com/.

[21]Android Market, http://www.android.com/market/.

[22]Annabelle Gawer and Michael A. Cusumano, *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation* (Boston: Harvard Business School Press, 2002).

product interfaces be open or closed? What information should leaders disclose to outside firms?

3. Shape relationships with external complementors: How can the company balance competition and collaboration with outside players?

4. Optimize internal organizational structures: What processes and systems will allow the company to manage internal and external conflicts of interests most effectively?

The goal of platform leadership is to drive innovation in the industry. The evolution of devices and software in the wireless ecosystem has been such that more and more vendors want their products to become the foundation on which other companies build their products or offer their services.

In the following sections, each of the above 5 platform wannabes (Symbian, iPhone OS, Black-Berry OS, Windows Mobile, and Android) is evaluated using the Four Levers Framework.

Lever 1: Scope of the firm

The first lever deals with what the firm develops in-house and what it encourages others to develop outside. A firm can develop all the complements itself or let the market produce the complements.

Each of the 5 platforms under consideration has decided to build a core operating system by themselves. This operating system is at the heart of the platform strategy. Each of the platforms also comes with a variety of applications built in – typical applications include email, instant messaging, text messaging, media players, calendar services etc. However, each of them also made different decisions on what complements should be built in addition to these core applications. These decisions seem to be largely based on the company's heritage more than anything else.

Apple has been very successful with the iPod line of music players and iTunes digital media store. Apple has decided that these applications will be core part of the iPhone OS. Apple does not allow applications that can potentially replace iTunes services on iPhone platforms.

BlackBerry's main claim to success is its push email application. While web applications that can provide email (for example: Google Mail) can be run on a BlackBerry OS, email remains at the heart of the system. BlackBerry's target customer base has been enterprises until now and as such email is at the core of BlackBerry's solution. BlackBerry OS is attempting to morph into a mainstream consumer platform and has recently added consumer applications such as media players as part of the core platform.

Google has had enormous success on the Internet based on its search application, its ability to organize information, and be a platform to deliver advertisements based on the context. Google

would like to see the mobile Internet be very similar to the regular Internet and if it does Google has the opportunity for its business model. Android is an attempt to accelerate the development of the mobile ecosystem. This is the primary reason why Google has pushed for an open platform.

Symbian has made the curious choice of not including the UI elements into its core offering. This may have been for political reasons – other members of the Symbian consortium did not want their phones to look like Nokia's from a user experience point of view. This had the damaging side effect that not all Symbian's are the same and application developers had to rewrite at least a portion of their apps if they wanted to support devices from different vendors. Nokia's 100% control of Symbian should avoid fragmentation in the future but it is increasingly likely that only Nokia will develop software on Symbian.

Microsoft's strategy in the mobile domain is almost a duplicate of its strategy in the personal computing domain. Microsoft has included at its core the same set of applications that are part of the core PC offering – Office, Outlook, Media Player, browser etc. It seems that network effects are much small in some of the more modern applications such as browsers than in productivity apps like Office. Open standards have weakened the importance of everyone using the same application though enterprise integration is an area where Microsoft shines.

One recent change in the platform wars is the appearance of stores for users to buy applications. Apple started the trend with App Store, Google has quickly followed with Android Market, BlackBerry's store will go online in March 2009, and Microsoft is rumored to be working on its own storefront. All the platforms recognize that having a convenient distribution mechanism for 3rd party applications is key to building an ecosystem and as such are building this in to the core of the platform offering.

Lever 2 – Product Technology

The second lever deals with decisions platform wannabes need to make with regard to the architecture of the product – degree of modularity, openness of the interfaces to the platform, how much information about the platform should be disclosed to complementors and competitors.

All the five platform wannabes have published API's that provide a way for third-party developers to build applications on top of the platform. The scope of the API's is pretty similar: all the platforms provide API's access to the system at multiple levels. iPhone OS has an extra wrinkle that all applications have to be blessed by Apple before they can be distributed allowing them to block applications that compete with their core suite. All the platforms except for Android (and

possibly Symbian when Nokia published the code) have a very similar degree of openness.

Google has released the entire Android code base including the protocol and network stack under an open source license. This allows developers and partners to look at the entire platform and adapt it based on their needs. This again should be seen in the context of Google wanting to drive the adoption of mobile Internet. The theory is that availability of a robust software platform should reduce fragmentation and allow developers to concentrate on developing applications.

One aspect of the product technology that hasn't been discussed in this section is the approach of each of the platform wannabes in terms of hardware partners. Apple and BlackBerry do not license their OS to other hardware vendors whereas Symbian, Windows Mobile, and Android are available for any partner of the respective vendor. Microsoft's platform has a licensing cost whereas Symbian and Android are available for free. This difference in the way a platform is licensed can have a significant impact on the variety of devices that will be available in the market place. It is likely that there will be always be only a handful ($<$3-5) of iPhone OS and BlackBerry devices released each year. Symbian devices will also be fewer in number because only Nokia is likely to make them. Windows Mobile and Android have a potential advantage in this space – multiple vendors are likely to license the software and each year there could be a wide variety of devices using these platforms.

Lever 3 – Relations with external complementors

This lever deals with how collaborative or competitive the relationship should be between a platform wannabe and its complementors. Wannabes also have to decide how to arrive at consensus and deal with conflicts of interests.

All wannabes seem to be following a similar strategy when it comes to dealing with complementors – they have all built reasonably open API's and distribution mechanisms with revenue sharing (70% in Apple and Android case, 80% in BlackBerry).

Apple has already blocked applications that could potentially compete with iTunes from the iPhone distribution mechanism. This has caused some controversy but most application developers are unaffected by it at this point. It is possible that a new 3rd party developed app could become very popular and Apple decides it wants to build its own version of the app. This could become a potential source of conflict with its complementors. In this case, it is possible that Apple will pursue a strategy similar to Microsoft in the PC domain – make the application available as part of the core platform.

All of the other wannabes are behind Apple in terms of building a complementor ecosystem.

Microsoft has a strong developer ecosystem from its PC heritage but many of the developers have been drifting towards Apple and Android. Google's revenue model from Android is not based on anything that is in Android but on what services could be delivered over Android. For example, an Android user will have a choice of search engines (Google, Yahoo, Microsoft etc.) and Google believes it will be able to monetize the platform by delivering a superior search engine.

An important complementor for all the wannabes is the wireless network operator. The operators want to monetize the investments in their network by controlling the applications that run on the handsets. Traditionally, the operators have been able to dictate terms to handset vendors, 3rd party developers etc. Apple seems to have changed this equation by dictating terms to operators like AT&T Mobility. This is indicative of a shift in the platform value from the network to the software. BlackBerry, Symbian, and Windows Mobile have generally tried to align themselves with operators by building walls around the usage of platforms in a way the operators prefer. Apple has changed many of these rules and others seem to be following them.

As with everything else, Android is somewhat of an oddball here too. Operators have full control in customizing Android for their networks. This potentially means an operator could build a walled garden around its Android offering. Google hopes that there will be enough competition among operators and enough demand for Internet like applications from the consumers that the operators cannot afford to build walls around Android.

Lever 4 – Internal Organization

This level allows platform wannabes to use their organization structure to manage internal and external conflicts more effectively. From an external analysis point of view, this is one of the harder levers to understand, as organization structures are not published.

Apple, Microsoft, and RIM seem to be organized in a similar fashion – a core group to develop the platform and application specific groups. All 3 organizations will not hesitate to develop an application that is currently being developed by a 3rd party if they believe such an application is a necessary part of their portfolio. This could result in conflict of interest for the core platform group in some instances – if they make available to the internal application groups interfaces that are not available to others. Microsoft has successfully navigated this conflict in the PC domain often running roughshod over complementors whose applications it wanted to subsume. Apple, Microsoft, and RIM will probably try to follow a similar strategy.

Android is currently licensed through Open Handset Alliance and because of the open structure

of the platform, it is likely that there will be fewer conflicts of interests than with other platforms. There are some rumblings about not all parts of Android being not open and it is not clear how this would evolve. Google has progressively made the Android system open and this could result in fewer headaches.

Nokia is still figuring out how the new Symbian ecosystem would be structured, so it is hard to comment on how they will deal with potential sources of conflict of interest.

Looking Ahead

As shown by the Four Lever Framework above, each of the platform wannabes are adopting slightly different strategies as they attempt to win the market. In this section, we will evaluate if any of the wannabes can "core" or "tip" the marketplace in their favor.

Apple is probably the leader at this point based on a combination of innovative devices, a software platform focused on consumer needs, a strong complementor network, and a working distribution mechanism. Apple has been ahead of the curve in introducing innovative software and hardware and others have generally been playing catch up with them.

RIM is trying to evolve from its niche as an enterprise device to a mainstream consumer device – they are clearly behind Apple at this point and are in danger of losing their email advantage as push email is now supported by every platform. BlackBerry's biggest advantage is being the incumbent in the enterprise email space – organizations have made considerable investments on deploying and training employees in using their BlackBerry's. This provides them with some time to neutralize Apple's lead.

Symbian is a platform currently struggling for direction. When a consortium of companies with conflicting interests owned the platform, it was clearly foundering. Nokia made the right choice in owning the entire platform but it is not clear how Symbian will be positioned in the market and if Nokia can attract enough 3rd party developers to build applications for its platform.

Microsoft has been surprisingly passive in pushing the Windows Mobile platform. Microsoft is very dependent on its hardware vendors in coming up with innovative device designs and none of its partners are known for it. Microsoft based devices have often been of the "me too" variety and have definitely fallen behind in the "mind share" race.

Google's strategy with Android is a combination of strategies from everyone else. Like Microsoft, they deliver a software platform and depend on hardware partners to build devices. The first Android device from HTC, however, is much ahead of any Windows Mobile device though not as high quality

as the iPhone. Unlike Windows Mobile, Android is an open platform available for free. Google's Android Market is similar to Apple's App Store though smaller in size at this point.

It is unlikely that any of the platform wannabes can win the platform war by making themselves the "core" of the emerging mobile software platform. Generic mobile applications such as text messaging, email, Internet browsing, dialing, media streaming etc. will be available on all the platforms. More importantly, a majority of the applications that will be delivered on the mobile devices are likely to be web applications. In this arena, standards play a key role and this makes a coring strategy unlikely to succeed. The competition is probably more at the application level where each of the wannabes has different strengths – Apple in media, Microsoft in productivity, RIM in email, Google in search.

BlackBerry's technology strength is not inimitable and is only moderately difficult to replicate though existing deployments will give them a base from which they can compete. Some variants of Microsoft's productivity suites are likely to be available on all platforms eroding the need for a Windows Mobile platform. Apple's strength in media could potentially be challenged but the iTunes system is so well entrenched that it is likely to be a lasting strength for some time even though other platforms will provide options like Amazon's MP3 marketplace.

Google's strategy with Android can essentially be thought of as a "tipping" strategy. Google is attempting to provide an infrastructure that will be the basis of an open standards mobile Internet. Google's advocacy for open access to the spectrum, "white spaces" etc. is an extension of its strategy with Android. Google believes they will be able to execute on their business model if they can minimize the strength of competitors at each layer by pushing for open access. Open access at the spectrum level weakens the strength of network operators; open access at the software platform level weakens the strength of proprietary applications leaving the field open for Google to deliver its services based on its search platform.

It is likely that the iPhone OS and Android will be the dominant platforms in the next few years. iPhone OS will probably be ahead of everyone else based on its superior design and focus on customer centric innovation. Android will probably be the platform of choice for most handset makers because of its open source nature and zero cost. Most of the handset makers compete on cost by trying to optimize their supply chain and Android would be an effective complement for them. BlackBerry OS and Windows Mobile will compete from their base in the enterprise space but probably will see their market shares shrink.

It appears that the network effects in the mobile marketplace are much weaker than in the PC platform or productivity suite domains. Hence, it is unlikely that this will be a "winner-take-all"

market. It is more likely that there will be multiple platforms in the market – a few iPhone OS devices that are ahead of everyone else and a plethora of Android devices following in iPhone OS footsteps.

Chapter 5

Network Operators

The companies that operate the mobile telephone networks are some of the most important players in the wireless ecosystem. These companies are often referred to as 'mobile operators' or simply 'operators'. The operators have traditionally owned the customer relationship and this gave them the predominant influence in this market. Operators subsidized the price of the mobile devices and recouped their investment by requiring customers to sign one or two year plans. Operators dictated to the device vendors what the phones should look like and decided what software features would be available on these phones.

Most governments around the world recognized that they owned the valuable spectrum space that is required for mobile telephony services to be deployed. This space was auctioned to the highest bidder and typical auction rules required that at least two operators be available in each region where the definition of the region varied from country to country. Spectrum auctions have generally netted the governments billions of dollars and this meant there were only a few major mobile operators in each country. For example, the United States has four major operators (Verizon Wireless, AT&T Mobility, Sprint Nextel, and T-Mobile), the United Kingdom has five (Vodafone, O2, T-Mobile, Orange, and Three), France has three (Orange, SFR, and Bouygues Telecom), Germany has four (T-Mobil, Vodafone, E-Plus, and O2), Japan has three (NTT DoCoMo, KDDI, and SoftBank), and China has three (China Mobile, China Unicom, and China Telecom).

Strategies of mobile operators around the world have been pretty similar. Operators competed among themselves for subscribers. Devices are subsidized in return for subscription plans and other services that the consumers purchase. If a consumer wants to switch from one operator to another, typically they lost their phone number. They also had to purchase a new phone along with a new

subscription plan from the operator. Number portability has been introduced in many countries to allow consumers to switch operators without having to lose their telephone number. Operators around the world have been rolling out 3G networks improving data speeds on their networks. This has enabled many new data applications providing operators with new opportunities for monetizing the network. At the same time, each operator is facing competition not only from other operators in their market but also from companies in the mobile telephony value chain – device vendors, software platforms etc.

In this chapter, we will discuss some of the key operators in the mobile ecosystem. The discussion will primarily be focused on the operators in the United States. One operator in Japan (NTT DoCoMo) will also be discussed, as they have been generally ahead of most other operators in introducing innovative services and business models.

Verizon Wireless

Verizon Wireless is the largest wireless telecommunications company in the United States with over 80 million subscribers.[1] Verizon Wireless also has the largest revenue of all wireless companies in the United States with annual revenue of 49.3 billion dollars in 2007. Headquartered in Basking Ridge, N.J., Verizon Wireless is a joint venture of Verizon Communications and Vodafone.

Verizon Wireless operates a CDMA (Code Division Multiple Access) network and supports the 2G (IS-95/cdmaOne), 2.5G (1xRTT), and 3G (EV-DO) generations of the standard. Verizon Wireless claims to have the nation's most reliable voice and data network and has invested over 50 billion dollars since inception in building out the networks.[2] Verizon rolled out the first nation-wide network in January 2004. Verizon has completed deploying EV-DO Rev. A technology throughout its network by June 2007 making it the largest 3G network in the United States. Users can obtain download speeds of up to 600 Kbps to 1.4 Mbps and upload speeds of 500-800 Kbps on this network. Verizon has also announced that it will transition its network to the 4G standard LTE (Long-Term Evolution). Verizon expects to have LTE available by the end of 2009 in a few cities with nation-wide rollout following it. As discussed in Chapter 2, this will constitute a move away from the CDMA technology bringing potential interoperability with carriers across the world.

As a network operator using CDMA technology, devices on Verizon Wireless network are based on Qualcomm's BREW technology. 'Get It Now' is Verizon's implementation of BREW and allows users to download applications, ring tones, games etc. Only applications approved by Verizon Wireless

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[1] About Us Overview, http://aboutus.vzw.com/aboutusoverview.html.

[2] Verizon Wireless Network, http://aboutus.vzw.com/bestnetwork/overview.html.

can be installed on these devices though not necessarily legal 3rd party hacking systems exist that allow users to run any application of their choice. Verizon Wireless strictly controls the applications that are available through its download center by consciously picking only a handful of applications for each category. For each application downloaded by the user, Verizon Wireless gets a share of the revenue.

A few of the popular services on the Verizon network are as follows: VZ Navigator is a GPS application for Verizon Wireless phones.[3] Like other GPS navigation systems, VZ Navigator can provide turn-by-turn directions, locate points of interest etc. Users typically pay a monthly fee of $9.99 to use the service. V CAST is an application used by Verizon Wireless to deliver audio, video, and entertainment content.[4] With V CAST Music, customers can buy and download music tracks individually or subscribe to get unlimited access to music. V CAST video is a video on demand service that includes entertainment clips, sports highlights, breaking news, weather etc. V CAST Mobile TV provides live TV services including full-length broadband quality shows.

Verizon Wireless runs one of the most closed networks in the United States. Verizon's network comes closest to the "walled garden" approach to delivering services. Verizon prefers using BREW technology over Java so that it can control applications customers get on their devices. Verizon also is accused of disabling functionality in some devices so that the customers can use only approved applications – for instance, Verizon is accused in a class action lawsuit for wrongful advertising that it has disabled the GPS functionality on some BlackBerry devices in such a way that it can only be enabled by VZ Navigator software and not the built-in BlackBerry Maps application. At the end of 2007, Verizon Wireless has announced that it will let users with any compatible device to use their network. This was in response to AT&T Mobility's success with iPhone and the availability of thousands of applications for that platform.

AT&T Mobility

AT&T Mobility, a wholly owned subsidiary of AT&T, is the second largest wireless operator in the United States with 77 million subscribers at the end of 2008 and $43B in revenues in 2007.[5] SBC Communications and Bell South started a joint venture called Cingular Wireless in 2000. In 2004, Cingular purchased AT&T Wireless for $41 billion and after acquisitions of AT&T and Bell South by SBC, Cingular was rebranded as AT&T Mobility.

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[3]VZ Navigator, `http://www.verizonwireless.com/b2c/splash/turnbyturn.jsp`.

[4]V CAST, `http://products.vzw.com/index.aspx?id=video`.

[5]AT&T - Investor Relations, `http://www.att.com/gen/investor-relations?pid=5711`.

AT&T Mobility operates a GSM based network and supports the 2G, 2.5G, and 3G variants of the standard. The network includes a GPRS/EDGE network that is available all over the United States and a 3G network that is available in 350 major metropolitan areas. The 3G network based on UMTS and HSDPA was rolled out in 2005 in response to Verizon Wireless' rollout of EV-DO based 3G network. This network is currently being upgraded to use HSUPA technology. Similar to other operators, AT&T Mobility has announced its intention of rolling out a 4G network based on LTE. However, the company has not announced any dates for when the network deployments would start.

AT&T Mobility has the distinction of being the first wireless carrier to introduce Apple's iPhone. It still is the sole carrier of the device in the United States. AT&T Mobility offers a rollover plan that is unique among carriers in the United States – unused minutes from a user's plan in any given month are available for use in subsequent months for a typical maximum of 1 year. Unlike Verizon Wireless, in general, AT&T has allowed users to download and deploy applications of their choice to their devices. Like most other GSM operators, AT&T mobility handsets supported Java and users have the ability to download and run any Java applications of their choice. With the iPhone, users can purchase and download applications from Apple's store.

AT&T has developed some of its own applications for its customers to use. MEdia Net is AT&T's portal for Internet access.[6] The portal can be used for access to email, websites, games etc. AT&T Mobile Music provides access to full song downloads from Napster and eMusic, streaming music from XM Radio, music videos and other music applications.[7] AT&T offers video on demand through its CV service (Cellular Video) with access to entertainment, music, sports, cartoons, and shows.[8] Other applications include mobile banking, mobile backup ring tones, games etc. It has also introduced a new video sharing service called AT&T Video Share that allows customers to share live audio and video with other users.[9] Typically, most of these services are available by purchasing an unlimited data and messaging service as part of the subscriber's regular monthly plan.

In contrast to Verizon Wireless, AT&T offers a relatively open network when it comes to applications. Similar to Verizon, AT&T subsidizes handsets and requires users to sign one or two year contracts in return. AT&T has generally been behind Verizon in terms of technology and coverage – this will probably continue into the near future with Verizon moving actively towards rolling out

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[6]MEdia Net FAQs, http://www.wireless.att.com/learn/messaging-internet/media-entertainment/faq.jsp#what.

[7]AT&T Mobile Music, http://www.wireless.att.com/source/music/mobilemusic/.

[8]CV | Video On Your Cell Phone, http://www.wireless.att.com/learn/messaging-internet/media-entertainment/video.jsp.

[9]AT&T Video Share, http://www.att.com/gen/press-room?pid=9199.

LTE. AT&T had the advantage of being on a GSM network that allowed its customers the most mobility when they travelled outside the United States (as GSM is the primary technology used around the world), but that advantage is likely to erode when LTE deployments become commonplace.

Sprint Nextel

Sprint Nextel is the 3rd largest wireless provider in the United States nearing 51 million subscribers by the end of 2008.[10] Sprint Nextel was created by the acquisition of Nextel Communications by Sprint in 2005. At the time of acquisition, Nextel was the 5th largest wireless operator in the United States and was mostly known for its push-to-talk feature.

Sprint offers wireless services primarily through its PCS (Personal Communications Service) brand. The network is based on CDMA and is a mix of 2G and 3G technologies. Sprint's 3G network based on EV-DO is also known by the name of Power Vision and is expected to be available to 260 million users.

In the past few years, Sprint has had significant problems holding on to its customer base. It has one of the highest churn rates (2% and 2.15% in 2nd and 3rd quarters of 2008)[11] in the industry and is perceived to have a significant problem with customer service. In 2008, Sprint wrote off losses of $29.7 billion. Sprint also had significant problems integrating Nextel customers and network into the Sprint network. Very few executives from Nextel remained at the combined company making it harder for Sprint to make the acquisition work.

Sprint has taken a different path towards deploying 4G technologies in contrast to Verizon Wireless and AT&T. It has decided to invest in WiMAX instead of LTE. This 4G WiMAX service is known by the brand name Xohm. However, Sprint couldn't afford to build a 4G network on its own because of the failed acquisition of Nextel. Instead, Sprint has decided to merge Xohm with Clearwire's pre-WiMAX broadband network. The combined company is still known as Clearwire and as part of the agreement, Sprint owns 51% of Clearwire and the previous owners of Clearwire retained a 27% stake. Cable operators such as Comcast, Time Warner Cable, Bright House Networks and technology companies such as Intel and Google have invested a combined $3.2 billion into the company for the remaining share. Sprint and cable companies will become Mobile Virtual Network Operators (MVNO) for the 4G services by using the network being built by Clearwire.[12]

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[10] About Sprint Nextel, `http://www2.sprint.com/mr/aboutsprint.do`.

[11] Judy Mottl, "Sprint Struggles to Keep Pace with Rivals", *InternetNews.com*, 7 November, 2008, `http://www.internetnews.com/bus-news/article.php/3783646/Sprint+Struggles+to+Keep+Pace+With+Rivals.htm`.

[12] Marguerite Reardon, "Sprint Nextel and Clearwire detail 4G plans", *CNET News*, 7 May 2008, `http://news.cnet.com/8301-10784_3-9938068-7.html`.

In addition, the cable companies are expected to become MVNO's for 3G services using Sprint's 3G network.

Sprint became the first wireless operator to roll out a 4G service when it announced the availability of WiMAX network in Baltimore in September 2008. Both Sprint and Clearwire offer a 4G service in Portland, Oregon. Sprint claims to provide peak download speeds of 12 Mbps and average upload speeds of 2-4 Mbps on the Baltimore network.[13] Both Sprint and Clearwire have announced the availability of the service in 10 other cities in 2009 and 4-5 other cities in 2010.[14] The product is branded as "Clear".

Sprint Nextel and Clearwire are not financially strong and combined with a challenging financial environment, all the investors have had to take write-downs in the 4th quarter of 2008 on their investments. Clearwire had only $20 million in revenues and lost $118 million in the 4th quarter of 2008.[15] With a financially strong Verizon Wireless building its LTE network rapidly, Sprint-Clearwire's miniscule early start advantage is eroding rapidly. The combined Sprint and Clearwire network and the MVNO's using the network face many hurdles as they strive to reach a critical mass of adoption that includes developing sales channels, improving network coverage, marketing, availability of devices, rolling out innovative services etc.

T-Mobile USA

T-Mobile USA is the 4th largest wireless operator in the United States and is a fully owned subsidiary of T-Mobile International based in Germany. T-Mobile USA has over 32 million subscribers and is based in Bellevue, Washington.[16]

Like its parent company, T-Mobile USA offers a GSM based network. It announced the rollout of its first 3G (UMTS) network in November 2006. T-Mobile partnered with Google in announcing the Open Handset Alliance and offered the first Android based platform in the United States. It has recently received approval from the FCC to make available an Android based 3G device.[17] T-Mobile USA has not announced any plans to deploy a 4G network. The parent company has recently finished a trial of 4G technologies, so an announcement can be expected to follow soon. T-Mobile

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[13]Shane McGlaun, "Sprint Announces 4G for More Cities in 2009", *Daily Tech*, 26 March 2009, http://www.dailytech.com/Sprint+Announces+4G+for+More+Cities+in+2009/article14682.htm.

[14]Samantha Rose Hunt, "Sprint unveils cities to receive 4G WiMAX in 2009 and 2010", *TG Daily*, 26 March, 2009, http://www.tgdaily.com/content/view/41861/103/.

[15]Marguerite Reardon, "Clearwire stays the course despite losses", *CNET News*, 5 March 2009, http://news.cnet.com/8301-1035_3-10190068-94.html.

[16]T-Mobile USA 3rd Quarter 2008 Results, http://www.t-mobile.com/Cms/Files/Published/0000BDF20016F5DD010312E2BDE4AE9B/0000BDF20016F5DE011D72EF4D15895F/file/TMUSQ3PressReleaseFINAL.pdf.

[17]T-Mobile using Android in Tablet; G2 confirmed, *electronista*, 6 April 2009, http://www.electronista.com/articles/09/04/06/android.tablet.and.t.mo.g2/.

also offers Unlicensed Mobile Access (UMA) service that enables a user to use their home broadband network when they are at home instead of using the wireless network.

NTT DoCoMo[18]

NTT DoCoMo is the largest wireless operator in Japan and has over 50 million subscribers in 2008 (over 50% of Japan's cellular market). NTT DoCoMo is a subsidiary of NTT, which is Japan's national telephone operator (partially owned by the Janapese Government). DoCoMo launched the world's first 3G mobile service and was known by the brand name FOMA (Freedom of Mobile multimedia Access). FOMA was not initially compatible with the UMTS standard for 3G but by 2004, DoCoMo upgraded its network to make it fully compatible.

DoCoMo introduced an innovative wireless service called i-mode that serves as a good example of an operator that understood how the emerging data services could impact the bottom line and how they should adapt their business model. i-mode is a distributed software platform; parts of the platform are located on the handset and the rest of it is distributed across various servers in the backbone of the network. i-mode provided its customers access to a variety of content including news, entertainment, email, sports, weather, financial services etc. through servers deployed in the backbone by the operator. This enabled DoCoMo to monitor usage (packet counts, bit counts) and bill users based on their usage.

Before i-mode was launched, DoCoMo handpicked 67 content providers as preferred partners. Mobile banking was perceived to be the most important application and had 21 providers. i-mode also included the FeliCa chip that allowed customers to use their mobile phones in lieu of credit cards. This was very popular in a country like Japan where the penetration rates of credit cards was very low. i-Mode was based on cHTML standard (compact HTML) instead of WAP which was pushed by many powerful interests in the wireless industry (Vodafone, Nokia etc.). cHTML enabled content providers to migrate their existing content at a much lower cost than WAP. DoCoMo also pioneered the use of external content providers instead of providing all the content itself. A prominent counter example around this time was the Vizzavi service offered by Vodafone in UK, which was based on WAP, and content provided by Vodafone. Because of its relatively open nature, i-mode attracted far more content providers than Vizzavi ever did.

i-mode was a relatively open platform – a content provider did not need DoCoMo's approval to be available through the service. However, i-mode labeled some providers as "official", which

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[18]David S. Evans, Andrei Hagiu, and Richard Schmalensee, *Invisible Engines: How Software Platforms Drive Innovation and Transform Industries* (Cambridge: MIT Press, Second Edition, 2004), 202-209.

improved the providers' desirability in the eyes of the consumer. In addition to billing the customers based on usage, i-mode made its billing system available to its content providers. In return, i-mode charged 9% of the gross billings as fee.

i-mode was rolled out in other countries in Europe and Asia through NTT's partners, but it could not repeat the success it had in Japan. The penetration rate of personal computers was pretty low in Japan and mobile devices were the primary way to access Internet – this contributed a lot to i-mode's success.

Looking Ahead

While i-mode was a great success in Japan it has not fared very well everywhere else. Despite this, it is a good example of an operator trying an approach that was relatively unorthodox. i-mode has many of the trappings of an open platform and some attributes of a walled garden. DoCoMo dictated the standards for the platform and expected the handset makers to implement the parts of the standard that it wanted them to implement. While DoCoMo did not prevent content providers from being able to provide services on its network, it retained the ability to call some of these providers "official". This enabled them to leverage their power in the ecosystem to drive better bargains with content providers.

The most interesting aspect of DoCoMo's strategy that could provide a way out for operators in the United States is its billing plan based on usage. This has been relatively uncommon in the US even for home broadband usage. Most, if not all, billing plans in the US for domestic broadband access, are based on a flat monthly rate and not on usage. Some providers charge different flat rates based on speed tiers, but it is still essentially a flat rate model. Usage based pricing model is pretty common in many countries outside the US for broadband access. Many wireline operators in the US are claiming congestion in the network and want to impose usage based pricing and are meeting considerable resistance.[19] With the increasing threat from online video services such as Netflix and Hulu, cable companies are suggesting that they would take such a route.

As can be seen from the subscriber numbers of the 4 major wireless carriers in the US, there is very little room to grow. Operators can poach customers from other operators but this would essentially lead to a price war. Operators have the potential to increase their revenues dramatically with data services as can be seen by the increase in data usage of iPhone customers. However, this essentially has put Apple in the driver's seat at the expense of AT&T Mobility. Fear of losing control

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[19]Time Warner Cable Charts a New Course on Consumption Based Billing, 16 April 2009, `http://www.timewarnercable.com/corporate/announcements/cbb.html`.

has made many operators, including Verizon Wireless, build walled gardens. Verizon's strategy of choosing what applications are available on its network severely limits the choice of applications to the user. It is highly likely that the more innovative applications will be available on iPhone and Android. Verizon will be more likely to be left behind in delivering applications and will probably be scrambling to deliver similar applications through its content provider network.

It appears that, in the long run, the operators have no choice but be relatively open if they want to be competitive. In order to avoid becoming bit pipes, wireless providers in the US can try to move their customers to usage based plans. As a matter of fact, the operators already get users to pay based on usage for text messaging. In addition, the operators can adopt the DoCoMo strategy of bundling some applications along with their basic plan and have application providers compete with each other. This can allow them to monetize some of the power they hold in the ecosystem.

In conclusion, the nature of the competition in the wireless space between the operators is changing. Instead of competing on price plans, voice and network quality, they need to compete on providing the best platform for running data based applications. It is unlikely that an operator with a closed system will win this battle and by adopting innovative pricing models, the operators can attempt to leverage their central position in the ecosystem.

Chapter 6

Platform Wars

Until recently, the interactions between various players in the wireless ecosystem were relatively easy to understand. The operators chose what technology they would use for their networks (GPS vs. CDMA) and negotiated with handset vendors on the devices they would carry on their network. They dictated the feature set on the handsets in return for their distribution channel. The operators provided to the customers handsets at a discounted price in return for agreeing to subscribe to the service for a fixed amount of time.

The operators essentially ran a two-sided business bringing together handset vendors and customers. They followed the standard pricing maxim of a two-sided business – *subsidize the side that is sensitive to price and charge the side whose demand increased in response to growth on the other side.*[1] Customers were sensitive to the prices of handsets that typically ran into hundreds of dollars. Handset vendors were sensitive to the number of customers an operator had. The operators subsidized customers and the more customers they can attract to their network, the more discount they could extract from the hardware makers.

The operators primarily competed against each other. The competition initially was over technology – CDMA is better than GSM and vice versa. Later, the competition evolved into one over network capabilities – whose network is more reliable; whose network had more coverage etc. As long as voice was the primary service delivered over the network, the nature of competition and interaction has remained pretty much unchanged.

As described in the previous chapters, the capabilities of the wireless devices are increasing and they play a much larger role in day-to-day life. Wireless devices are the window through which many

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[1] Thomas Eisenmann, Geoffrey Parker, and Marshall W. Van Alstyne, "Strategies for Two-Sided Markets", *Harvard Business Review* 84, no. 10 (October 2006).

people access email, news, weather, sports, and increasingly multimedia content. A new brand of platforms is now moving into the drivers' seat – the software platforms. These platforms could be entirely located on the device or could be distributed between the device and the network. Just like the operators' platform, the software platform is a multi-sided business. It brings together hardware makers, customers, application vendors, and a host of other complementors such as content owners to the table.

The nature of competition in the wireless ecosystem is evolving from one between operators networks to a battle between two different kinds of platforms. If the operators win this battle, they will continue to maintain their role as the key arbiters in the ecosystem. Their business will evolve to having software vendors as one of the sides in their multi-sided business. If the software platforms win out, the operators will become one side in the software platform vendors' multi-sided business, a complementor. Operators could essentially become 'bit pipes' carrying data over their networks between end users and the content providers.

This chapter will take a look at how the conflict between these two systems could potentially be resolved. The main approach will be to draw some lessons from two ecosystems that can be seen as predecessors to the wireless ecosystem – the personal computing industry and the Internet.

Internet and Walled Gardens

Many commentators have described the Internet as having fundamentally changing the way in which humans communicate with each other leaving very few areas of life unaffected.[2] The impact of Internet can be seen everywhere in our day-to-day life – from emails to browsing, how we purchase music, how we watch movies and shows, how we consume news etc. The Internet imposes different ways of doing the same things – often in a much more efficient manner. This has led to new opportunities and new business models in many of the industries considered to be the bedrock of the economy. The Internet has caused a lot of disruption and a lot of pain breaking many of the existing business models.

Every industry that has been impacted by the Internet has tried to cope with the problem in fundamentally similar ways. New businesses using the Internet have appeared at different rates in different industries depending on how much efficiency the current state of technology can provide. One of the earliest industries to feel the impact of the Internet are small and medium-sized brick and mortar firms selling books, electronics etc. The Internet has fundamentally improved the efficiency

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[2]Peter Magnusson, "The Internet Revolution: History and Significance", `http://www.sics.se/~psm/ar97/sld003.htm`.

of this industry by eliminating the middleman between the publishers and consumers as well as by providing the opportunity to serve long tail markets.

Starting in the late nineties and early parts of this decade, the music industry started being impacted by the Internet. Initially it was due to file sharing services like Napster that allowed users to exchange music without having to purchase it. The music industry was highly profitable because of the heavy price charged for each CD and file sharing started impacting the music business. The music industry did not realize the value of Internet as an efficient and new distribution mechanism that it should invest in and develop technologies for. Instead, it started waging a battle against companies like Napster and users that were exchanging files. Until Apple showed up on the scene with iTunes service, the music industry did not recognize that users would buy music online if there were good ways of purchasing them. Apple now is the largest music retailer in the US and dictates to the labels many of the parameters that the labels are used to dictating.

We see essentially the same pattern repeated in other industries. As the technologies for delivering video have improved, the movie and television industry are facing similar challenges to the music industry. The patterns of television viewing in the US have changed dramatically in the past few years and over 5% of the video watched in 2007 was what is called "over the top" video.[3] Services like YouTube have become the primary vehicles for the young people to watch video. The television industry has learned some lessons from the music industry and is trying to provide television over the Internet in ways that would leverage the efficiencies of distributing content over the Internet. One good example of this is Hulu service that has become recently operational.

Another pertinent example is the newspaper industry. In the last couple of years many newspapers across the United States have shut down. Most large newspaper organizations like The New York Times have been losing money. The news organizations face a stiff challenge from two sources: news aggregators like Google News and portals like Huffington Post. The news organizations would like Google to pay them for letting their articles show up in Google News but they are also dependent on Google to direct a large percentage of their traffic (over a third in many cases).[4] Portals like Huffington Post do some original reporting but also bring together content from many different providers essentially simplifying users' lives by organizing news. In addition, most of the revenue newspapers made in the print medium were through advertising and advertisers have found the Internet to be a better way of reaching their audience. Free services like Craigslist have pretty much

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[3]Jeff Evenson, Jeremy David, and Jonathan Cofsky, "U.S. Data Networking: Where Are We Now? A Progress Update on IP Video Adoption", *Bernstein Research*, 21 May 2008.

[4]Eric Schonfeld, "Does Google Really Control The News?", *TechCrunch*, 11 April 2009, `http://www.techcrunch.com/2009/04/11/does-google-really-control-the-news/`.

taken over the lucrative classifieds business away.[5]

One common theme in the attempts by all existing businesses to deal with the Internet is to try and build a walled garden around their service. Essentially, this model boils down to erecting boundaries around their service and letting users access the service only through some form of payment. New York Times experimented with a failed service called 'TimesSelect' that walled off some content from users that did not subscribe to the service. NYT disbanded the service after realizing that the revenue they are losing in advertising because of the walled garden far outpaced the subscription revenue.[6]

America Online (AOL) was a prominent success, at least for some time, using the walled garden model in the Internet era. AOL started out by offering an online communication and game playing service for Commodore users in 1985. This service provided chat rooms, environments for playing games etc. that was later supported for DOS and Windows users. When the Internet started becoming mainstream in the early 1990's, AOL positioned itself as the online service for new computer users. AOL borrowed the chat room concept from its earlier Commodore service that enabled its popularity to skyrocket. AOL, initially, did not allow access to the regular Internet through its service. AOL also introduced the concept of keywords that allowed users to access portions of the Internet – AOL could sell the keywords to content providers. However, as the popularity of Internet skyrocketed, the services on the AOL network couldn't keep up with the services on the open Internet. AOL finally opened access to complete Internet but by then no one needed AOL to get on the Internet.[7]

AOL is a good example of why walled gardens do not work well on the Internet. A walled garden needs to compete with the entire, open Internet to keep up its value proposition. An organization that essentially has limited resources has to compete with everyone from professional organizations to bored hackers around the world. It is almost always the case that the more creative and innovative applications and content comes from the place where there is the most opportunity to create it. The Internet fundamentally has this advantage over any walled garden.[8] The AOL example also provides a good model for when walled gardens can succeed on the Internet. Success is possible in industries that are just being impacted by the Internet and where it is not clear what the eventual business

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[5]Ken Wheaton, "Craigslist Killed Newspaper Classifieds. You're Next.", *Ad Age*, 24 April 2009, `http://adage.com/adages/post?article_id=136256`.

[6]Now, everyone is entitled to our opinions, *The New York Times*, `http://www.nytimes.com/marketing/ts/index.html`.

[7]AOL Breaks Down Walled Garden; Is It Too Late?, *Twilight in the Valley of the Nerds*, 2 August 2006, `http://nerdtwilight.wordpress.com/2006/08/02/aol-breaks-down-walled-garden-is-it-too-late/`.

[8]Jeff Atwood, "Avoiding Walled Gardens on the Internet", *Coding Horror*, 29 June 2007, `http://www.codinghorror.com/blog/archives/000898.html`.

model will be. The walled garden is a good quick in and out strategy for an organization already well known in that industry. There is a small window of time in which a walled garden can succeed but eventually the Internet will plow through those walls.

There is another class of walled gardens that have had some success on the Internet. These gardens are prized for attributes like authoritativeness, reliability, uniqueness etc. Financial Times has a walled garden that has been relatively successful because of their reputation for financial reporting but with the proliferation of financial blogs, their model is increasingly challenged. Despite the huge number of food blogs, Cook's Country has a relatively successful walled garden. This has mainly to do with the confidence that comes with using their recipes – that they are tested, would work, and that home cooks can produce results that match the description.[9]

As described in Chapter 5, the wireless operators face a similar conundrum. The Internet has started making an impact on the wireless business. Until now, the operators primarily carried voice and a few other things like text messages that were essentially cheap and easy add-ons for them. As the wireless devices become the primary mechanism through which the Internet is accessed, the open Internet will start pushing at the walls of the closed gardens. Customers are used to a certain kind of user experience on the wire line Internet and any attempts by the operators to put constraints on that behavior will meet with resistance. As with all the other industries that were impacted by the Internet, the resistance will also come from enlightened and opportunistic operators that embrace the qualities of open Internet. We are already seeing some of that in operators like T-Mobile that are tentatively dipping their foot into waters with the Open Handset Alliance. During the recent spectrum auction, the FCC has imposed open access requirements on part of the spectrum and that will provide opportunities for accessing the Internet in its unfiltered form.

The AOL example provides some guidance to the operators. Just as with AOL in the mid-nineties, these are early days for Internet on wireless devices. Only a small percentage of users have devices that are capable of accessing the Internet and not all of them use those devices to access the Internet. The operators can get away with a walled garden approach for some more time but the success of devices like iPhone is pushing the rate of Internet usage on the wireless networks dramatically. If the operators do not develop alternate strategies for the emerging future, they are likely to take the path that AOL has taken.

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[9]Minti Patel, interview by author, Burlington, MA, 10 April 2009.

Software Platforms and Transformation of Industries[10]

In their book "Invisible Engines:How Software Platforms Drive Innovation and Transform Industries", the authors describe software platforms as the invisible engines that have created, touched, or transformed nearly every major industry for the past quarter century. They also note that the platforms have been the source of enormous value to consumers and are likely to drive change that will dwarf the business and technology revolution seen to this point.

Software platforms are at the heart of many multisided businesses from personal computers to video game consoles to Internet applications. Microsoft is the dominant force in personal computing because of the success of its Windows platform. This is the same reason Apple is dominant in the digital music business, Google is successful with its Search platform, and Palm did so well in the PDA market. Each of these organizations executed a successful platform strategy by bringing together users, content providers, application developers, hardware makers and a host of other complementors with themselves at the center.

There are many reasons for the success of these platforms – killer applications built on a specific platform helped drive the adoption of the platform, evangelists persuaded developers to build applications for the platform, the platform vendors nurtured complementor relationships bringing the widest possible feature set to their platform etc. The platform vendors adopted different pricing strategies in different industries based on price sensitivities and interdependencies between the different sides in the multisided business – in personal computers the developers paid nothing and the users paid for everything, in the video game industry the users got subsidized consoles and the developers paid license fees for developing applications.

Software platforms have also reduced the value of hardware innovations. It is possible to come up with something innovative in the hardware and succeed in the short term, but without the right software that innovation is not likely to provide dividends in the long run. A good recent example is Nintendo Wii. Nintendo took a very different approach than Sony and Microsoft when designing its latest version of the console. While Sony and Microsoft focused on more power, more capabilities, Nintendo focused on simplicity. Nintendo built a simple to use console that expanded the market of game players – everyone from grandparents to little kids can play with the Wii in an intuitive manner. Nintendo, deservedly, reaped a lot of success on this hardware innovation. There was a lot of software that made the hardware work including the Wii Sports game, but the Wii was primarily known for its hardware innovation. For the first time since the Wii was introduced, Nintendo is

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[10]David S. Evans, Andrei Hagiu, and Richard Schmalensee, *Invisible Engines: How Software Platforms Drive Innovation and Transform Industries* (Cambridge: MIT Press, Second Edition, 2004).

seeing a weakness demand in Q1 of 2009.[11] Nintendo has diagnosed that the right solution to the problem is to reinvigorate its software platform – by revamping its successful Wii Sports franchise, Nintendo hopes to rekindle the sales of its consoles.

What this means for the future

The experience from many technology ecosystems in the past decades shows that it is more likely that software platforms eventually will outmaneuver all other platform-wannabes from the heart of an ecosystem. There will be a tremendous amount of competition between software platforms to be the winner in the wireless ecosystem. But as described in Chapter 4, it is unlikely that this will be a "winner-take-all" market. Multiple platforms are likely to coexist with no single platform being at the core of the entire ecosystem. If there is no one dominant software platform, some of the value in the ecosystem can move both up and down the stack. If the majority of applications that are delivered are Internet applications where open standards predominate, then application and content providers that provide services on multiple platforms can extract some value. Google search, Facebook etc. are good examples of applications from the traditional Internet. Also, because of the aesthetic and style related attributes of mobile devices (as outlined in Chapter 3), some of the value will always flow down to the hardware makers. A compelling hardware solution will always have the potential to capture value in the short term.

This is both good news and bad news for the wireless operators. The bad news is that they will not be in the driver's seat in the ecosystem. They will essentially be complementors to the software platforms. However, the good news is that, unlike the personal computing ecosystem it is unlikely that there will be a single, dominant software platform. The operators can actually help make this happen by encouraging multiple software platforms on their networks. By not tying themselves to a single platform, they could push devices from all software platforms. But at the same time, they should ensure that one software platform does not gain an upper hand. One way to do this is to push for open standards on the network by making it hard for a platform vendor to build their own walled gardens. Operators can also neutralize the power of the platform vendors by investing in application developers that can provide applications for the multiple platforms on their networks at the same time.

The operators have a bit of time before the software platforms and the Internet will start making them less important in the ecosystem. They would be wise to build out their networks in such a

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[11]Kiyoshi Takenaka and Sachi Izumi, "Nintendo Wii in doldrums in Japan, plans fight-back", *Reuters*, 9 April 2009, `http://www.reuters.com/article/rbssLeisureProducts/idUST26300020090409`.

way that they can still market the superiority of their network over the competitors' networks. This strategy will resonate for some time – there might never be enough bandwidth on wireless networks to meet the demands of mainstream customers though the importance of bandwidth will diminish over time. As network build outs continue, the operators will reach a point where the marginal value of bandwidth will start decreasing for the mainstream customers. By this point, the operators should prepare ground for having multiple platforms delivering comparable applications on their networks. Doing this will require a fundamental change in how the operators' think – it requires embracing open standards and giving up some of the control on their networks. If the operators are not willing to cede some of their own power, they are likely to lose most of it.