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Future of Mobile Software

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INTRODUCTION

Excitement about the mobile industry is beginning to mount. As the technology has improved, cell phones have become smaller, faster, and cheaper with more than 3 billion users today. For numerous reasons, the mobile industry has seen limited innovation over the past decade. With new initiatives, the industry is expected to go through a revolutionary change.

This paper begins with an overview of the history of the mobile industry, leading into the discussion of why software innovation in the mobile space was been so limited. Next, we examine current affairs in the industry, including Apple's iPhone, Google Android, and the 700 MHz spectrum war. In the following sections, we consider two of the most interesting issues affecting the state of the mobile software industry now: that of monetization through advertisement, and another of Location-Based Services. Our final section forecasts the changes in the ecosystem of hardware manufacturers, service providers, and mobile software companies.

HISTORY OF THE MOBILE INDUSTRY

The mobile industry has been evolving for the past three decades. Understanding this evolution is vital as it provides a context for the current events and future. This section provides a short history of the mobile industry.

The start of the cell phone industry began in 1945 when the first 0G network was launched. The network was not officially considered to be mobile because phones could not move from cell to cell. By the mid 1980s, though, Bell Labs successfully developed technology to handoff calls, allowing phones to move from one cell to another cell. Bell Labs also invented and developed cells for mobile phone base stations during the late 1940s into the 1960s.[1]

During the late 1970s and early 1980s, the first cellular networks were constructed. The first commercial network was available in Japan in 1979. This was followed by the first fully automatic network, the Nordic Mobile Telephone system, which was launched in Northern Europe in 1981. To transfer data over the air, analog radio signals, called 1G technology, were used.

Since this was nascent technology, cell phones during this time were considerably larger compared to those today. They were too large and cumbersome to carry in your pocket. As such, many people chose to have these devices installed in their cars. This technology was relatively new and expensive, so not everyone owned a car phone.

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1 Mobile phone. http://en.wikipedia.org/wiki/Mobile_phone.

In accord with Moore's Law which governs semiconductors, and hence most electronics, cell phones became smaller, faster, and cheaper over time. This enabled more people to own a cell phone and conveniently carry it around. In the United States, for example, phones are often subsidized by carriers, lowering the entry cost for consumers. In this short time period, cell phones have become prevalent with over 3 billion users as of 2007[2]. In several countries, for example the UK and Luxembourg, there are now more cell phones than people[3].

DIFFERENCES BETWEEN THE US AND ASIA

Since the creation of the mobile industry, Asian countries have consistently stayed in step or ahead of the United States in terms of technological advancements. It has even been reported that the US is about one and a half years behind Japan and other Asian countries. This trend can be primarily attributed to Asian companies investing heavily in technology for high bandwidth mobile networks, and the small infrastructure requirements necessary to service the whole nation. Over 50% of Japanese cell phone users have phones that run on these types of networks, while in the US it is only about 7%[4]. Cultural differences are another likely factor that explains these differences. In the US, people do not adore technology to the same extent as Japanese people. Also, consumers in the US have laptops, desktops, and car navigation systems in addition to their mobile phone, while in Japan, these additional devices are not as common.

WHY INNOVATIVE MOBILE SOFTWARE HAS BEEN LACKING

This section of the paper provides numerous reasons why mobile software innovation has been lacking. There are currently far too many OSs, each with their own API, which has caused considerable confusion for developers. Mobile network operators have considerable control that they have used to limit consumers' and developers' options. Mobile virtual network operators have struggled to gain any significant power in the United States. Finally, mobile networks still offer relatively limited bandwidth. These factors have all caused the innovation of mobile software to be restricted.

MOBILE OPERATING SYSTEMS

During this growth period, several technologies have emerged. For example, there are now several dozen mobile operating systems for smartphones, including Symbian, several variants of Linux, Windows Mobile, RIM BlackBerry, Palm OS, and Apple OS X. These operating systems captured market share through several different paths.

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2 Global cellphone penetration reaches 50 pct.
http://investing.reuters.co.uk/news/articleinvesting.aspx?type=media&storyID=nL29172095
[3] Informa Telecom & Media, Q1 2006 report on mobile penetration.
4 Why Is America 1.5 Years Behind Asia with Cellphones.
http://www.msnbc.msn.com/id/14702667/site/newsweek/

Symbian is a proprietary operating system that was originally started in the late 1990s by a consortium of cell phone manufacturers, including Nokia, Ericsson, Sony, Panasonic, Siemens AG, and Samsung. Symbian has been successful in many of the same markets as Nokia, its largest shareholder. One exception is in the Japanese market, where Symbian is primarily used, but only due to a relationship with NTT DoCoMo. Symbian has captured 72% of the smartphone worldwide market, yet lags behind other operating systems in North American markets[5].

Linux has been used heavily in China by Motorola and Japan by NTT DoCoMo, allowing it to capture 13% of the smartphone market. Unfortunately, Linux is not a platform since cell phone manufacturers and technology companies typically build on top of the operating system. This creates incompatibilities and interoperability issues. For example, an application may run on a Linux-based Motorola phone in China, but not on a Linux-based NTT DoCoMo phone in Japan.

The remaining operating systems have smaller market share. Windows Mobile, with 6% market share, has gained some traction in Asian and North American countries. RIM BlackBerry has captured 5% of the market. Initially designed for enterprise users, RIM has expanded its offering for consumers as well. Palm has lost market share and today only holds 1.6% of the market. Apple has seen success in the consumer market with its iPhone, which uses a stripped down version of OS X. Despite this initial success and large amounts of publicity, Apple still only has 1.3% of the market.

The main cause stifling cell phone innovation is severe platform fragmentation. Even within specific mobile operating systems, there are different incompatible variants. This highly fragmented market creates problems for mobile phone software developers that write applications. For example, if a developer decides to write a native application, he or she will need to either choose a specific set of phones to develop for, or spend a lot of effort to learn and develop for many different APIs and SDKs. This is not scalable and it becomes difficult to maintain different versions of code for each operating system. Developers can use Java to write applications once and deploy across different operating systems. Unfortunately, not all cell phones have Java installed, and those that do often conform to different Mobile Independent Device Profiles (subsets of Java functionality). Web-based applications can be created as well, but there are hundreds of different mobile browsers, of varying capability. In addition, only about 15% of mobile users access the web on their phone[6].

MOBILE NETWORK OPERATORS

Mobile network operators (MNOs) provide service for cell phones to users. To run a MNO, it is necessary to obtain a radio spectrum license from the government. In the United States, for example, there are four primary MNOs: AT&T, Verizon, Sprint, and T-Mobile. Since radio spectrum is limited and extremely expensive, and requires hundreds of millions of dollars in infrastructure investments to provide sufficient service coverage, it is difficult for new

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5 Canalys Report. http://www.symbian.com/about/fastfacts/fastfacts.htmlsfdkjafs
6 Nielsen Mobile Report. http://www.telephia.com/html/NielsenMobileRebrand.html

companies to enter the market. In addition, the MNOs in the United States have not been highly regulated to diminish their power. For these reasons, the four primary MNOs in the US command considerable control over the mobile industry.

MNOs have control over what phones are allowed to run on their networks. They leverage their market power to determine the functionality of these cell phones. Since nearly all US handsets are bought in their retail stores, most phones suffer from limited functionality. The MNOs determine which pre-installed applications are available to users when they first buy the phone as well. Software companies that want their application to be pre-installed must give up a considerable share of revenue, often making the business nearly unprofitable. MNOs also decide which applications a user can install on their phone. It can even take them up to six months to certify applications, and very few applications make it through the certification process. This closed system disincentives entrepreneurs and other software companies from making innovative mobile applications.

When using the Internet browser, users are kept within a "walled garden" by the MNOs. A walled garden is a set of closed content that is available only to an MNO's subscribers. It can be difficult for users to even navigate to the address bar, which is often hidden behind a menu. Users typically are unable to change the homepage of their browser as well. MNOs argue that this provides an overall better user experience, but critics claim their real motivation is to gain additional revenue from these closed services.

MNO determine which phones will be available over their networks. In the US, network interoperability is often not allowed. That is, someone cannot buy a cell phone through AT&T and then use it on Verizon. Before government regulation, users were also forced to change their phone numbers when switching networks. MNOs can charge users if they cancel their subscription early. The rationale for these policies is that it creates substantial switching costs for users so that they are less likely to switch networks.

It should be noted that the MNOs' closed systems are in direct contrast to the personal computer and Internet industries in many ways. Computer manufacturers are given much more leniency with regard to computers' functionality. All computers with a modem can use the Internet since it is an open service. While computer manufacturers determine which software is pre-installed, users are free to install and uninstall as many different programs as they wish. There is no certification process that slows down a software company from deploying their technology. And, users are allowed to customize their computers, including the browser's home page.

The differences between the mobile industry and personal computer and Internet industries are another reason why software developers have not created innovative applications. There are far too many limitations on what they can do. Even without these limitations, the MNOs are able to capture a considerable share of their revenue. Without change, users and developers will have to continue to wait for innovation.

MOBILE VIRTUAL NETWORK OPERATOR

Mobile virtual network operators (MVNO) provide service to cell phone users, similar to a MNO, but they do not own the radio spectrum or much of the necessary infrastructure. Instead, MVNOs lease access to MNOs' spectra. The first commercial MVNO was Virgin Mobile, which launched in the United Kingdom in 1999. While Virgin Mobile has been successful, most of the similar services in the United States have not been. A recent example is Amp'd, which went bankrupt in June, 2007 after burning through $360 million and with over $100 million in total debt[7].

MVNOs potentially could have played a very important role in the mobile industry. They would have likely given consumers more choice, better customer service, and generally more openness. Software companies may have been helped by MVNOs too as they could have developed killer applications for the devices on the networks. Unfortunately, at least for the MVNOs in the US, it has been difficult to find profitable business models.

MOBILE NETWORK TECHNOLOGY

As discussed earlier, initially 1G technology was used to transfer calls over the air. Nowadays, 2G is the primary technology. While 1G uses analog radio signals, 2G uses digital radio signals. In 2003, the first 3G services were launched in Europe. 3G networks offer higher bandwidth compared to 2G networks. 3G networks offer a maximum bandwidth of 2.4 megabits per second, but more typically a bandwidth of about 384 kilobits per second[8]. As of June 2007, less than 7% of all cell phone users are on 3G networks, with 2G still the most prevalent[9].

Since many people are on the slower 2G networks, software companies have had little incentive to develop innovative web-based applications. Even today, it is difficult for users to browse the web or retrieve content due to the high latency. This creates a poor user experience as most cell phone users are on-the-go when they are looking up information. As these networks increase in bandwidth, users will begin to access not only more content, but different types of content. Video, for example, consumes considerably more bandwidth than text or images and is beginning to be offered on 3G networks in the US and elsewhere. This additional bandwidth will lower the latency of web-based applications on mobile phones, providing users yet another information access point. Developers will then have the incentive to develop unique applications as will be discussed later.

SUMMARY OF HISTORY AND LACK OF MOBILE SOFTWARE INNOVATION

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7 Amp'd Mobile Implodes: Burns $360 million, Declares Bankruptcy.
http://www.techcrunch.com/2007/06/02/ampd-mobile-implodes-burns-360-million-declares-bankruptcy/
8 3G Speed – 3G Bandwidth. http://www.kriyayoga.com/love_blog/post.php/717
9 3G. http://en.wikipedia.org/wiki/3G

In conclusion, the mobile industry has been growing at an astounding pace over the past three decades. The history lesson provided a solid context for the current events and future prospects that will be discussed in the remaining sections. As one can notice, this market is very complicated with several different types of technologies, companies, and consumers. The complexity and power struggles often make it difficult for innovation to take place. Nonetheless, current affairs in the mobile industry are providing developers and consumers hope.

CURRENT STATE OF THE MOBILE MARKET

MOBILE AMERICA

Having once been at the forefront of mobile proliferation, adoption, and advancement, the United States of America has long since fallen behind with technological innovation in this high growth industry. While the US has trotted along offering primarily low bandwidth network connections, proprietary software and crippled hardware, mobile markets abroad have witnessed improved service technologies, the wide spread adoption of independently developed software, and mobile hardware that is comparatively much more open.

In recent history, the domestic mobile industry has followed a slow, linear growth pattern in which the dominant oligopoly players have controlled and defined the rate of the market's evolution. Due to corporate lobbies of government regulation and high financial barriers for new businesses entering the space, the domestic mobile industry has experienced only marginal entrepreneurially motivated progress. Instead, incumbents facing marginal competition have been forced to provide incremental innovations solely in order to remain competitive. Given the nature of oligopoly markets, though, this process has been painfully slow and inefficient.

In today's mobile market, however, the norms that have historically defined the industry are rapidly being redefined and the outcome of decisions made both by incumbents and new players over the next few months could potentially revamp the US mobile landscape. Companies that have previously been uninvolved in the mobile realm have made their first forays and succeeded wildly. As a result of the new competition, incumbents have been forced from resting on their laurels. Both carriers and handset manufacturers have had to rethink their strategies in the newly evolving market and have begun to enact policy modifications reflective of the potential changes that could occur over the next few months. Hence, we are experiencing significant period for America in mobile; the changes occurring now will very possibly redefine the way a majority of us interact with information on the web, with our geographic environs, and with each other.

UNDERSTANDING CHANGE

The US mobile industry has historically been a complicated and obfuscated aggregation of interrelated incumbent oligopolies. Whereas these oligopolies generally perform a variety of functions within the mobile space, in order to understand the significant current events driving market innovation it is best to deconstruct mobile into three topics: service, software, and hardware. When contemplating the different key players, their strategies, and how future changes will affect the market, pay particular attention to the effects of the change on each segment, and the effect of the change in that segment within the greater dynamic of the market.

MOBILE MARKET DYNAMICS

If the mobile industry were represented by a feudal caste system, service providers would be royalty, hardware manufacturers their noblemen, and independent software developers the serfs. There is little question about who controls the industry landscape – service providers have direct access to the customer base both for service subscriptions and as the primary hardware and software point-of-sales. As Richard Whitt, Google's chief telecom counsel, pointed out in a response to Verizon's illegitimate spectrum lobbying, ninety-five percent of mobile handsets are sold in retail stores owned and operated by the large service carriers[10]. Since the handset makers are forced to succumb to the will of the service providers and the service providers have the power to determine what software makes it onto the phones they provide, mobile software makers are forced to bow not just to the hardware companies and their platform restrictions, but also to the providers offering the (often irrelevant in this context) service.

SERVICE AND SERVICE PROVIDERS

The four largest mobile service providers in the US are AT&T (67.4 M), Verizon Wireless (63.7 M), Sprint-Nextel (53.96 M), and T-Mobile USA (27.7 M)[11]. While the network technologies they offer for phone service vary between GSM and CDMA by carrier, this differentiation is generally transparent to the end user. For smart-phone users, and potentially the average consumer of tomorrow, what is more relevant is the data transmission technology the companies have deployed, and the plans these companies have for improving data transmission rates into the future. AT&T serves data over two different networks: its slower EDGE network which is notorious for being the only network available to the iPhone, and the faster HSUPA 3G network only available in a limited number of metropolitan areas. Verizon's 3G high-speed data network is EV-DO based, the same as Sprint-Nextel's, although Sprint-Nextel is also currently rolling out a 4G technology WiMAX. Finally, T-Mobile currently supports EDGE and is moving on offering a 3G solution in spectrum space it acquired in September 2006.

SPEAKING OF SPECTRUM – THE 700 MHZ SPECTRUM

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[10] Google Accuses Verizon of Violating FCC Lobbying Rules EWeek.com October 4, 2007 Thursday 7:35 PM EST
[11] http://en.wikipedia.org/wiki/List_of_United_States_mobile_phone_companies

One of the reasons high-speed data proliferation has not occurred at a faster rate is because of the limitations on spectrum space available for network deployment. Most useful spectrum is already bought up and either in use or controlled and crippled by the carrier that purchased it. Enter the 700 MHz spectrum bidding, one the three key factors helping shift today's American mobile market.

The 700 MHz spectrum is the last available chunk of high-quality airwave space with a particular affinity for mobile use, unless the US government decides to release portions of its military band. The spectrum previously served for television broadcast but since television networks must be fully digitized by 2009, the spectrum has become available for auction. This spectrum is of particular interest to carriers because it offers nationwide reach, has high penetration rates through dense materials, and can serve exceptionally well for high bandwidth data transmission. Hence, it is a very appropriate band on which to build and deploy the next generation data transmission network. The spectrum is subdivided into 3 blocks: the A/B blocks of two 6MHz chunks each, and the C block, two additional chunks of 11 MHz, each. Wholesalers looking to buy chunks of spectrum for licensing are entitled for a purchase discount, as are SMB group and private partnerships.

While plenty of bidding speculation has been flooding the news in anticipation of the January 2008 auction, one particular lobby by a key player ended up significantly changing the face of the offerings, and as a result, potentially of the mobile market as whole. In 2007, Google, a company that had previously shown minimal interest in the mobile space, decided to promise a minimum bid of $4.6B on a chunk of the C block if certain of its criteria were met. Among these criteria the most significant was an open access restriction that forced the winner of that network to allow third party devices and software to operate on it without the traditional barriers to entry that mobile carriers had previously erected. In a unprecedented move, the FCC accepted that term of Google's offer and implemented it into the bidding structure: if a minimum bid of $4.6B is received on that chunk, it will have the open access requirement[12]. If that reserve price is not met, the bidding on the C block will reopen at a lower price point and without the open access restriction.

Needless to say, this announcement led to a flurry of press releases, lobbyist deployments, and acquisition activities by some of the major players trying to accommodate for this potential change in the market. AT&T, the only of the big four to initially support the open access covenant addressed its spectrum needs by acquiring a company called Aloha for $2.5B. With this acquisition, AT&T gained control of Aloha's 12MHz of already auctioned 700 MHz spectrum. Immediately following the announcement, Verizon began lobbying for removing the open access restriction. Soon after realizing little progress and being publicly berated for improper lobbying procedures, Verizon pulled back and reversed course; they followed up the criticism with an announcement that they were opening up their current mobile networks to all devices as a shift towards openness before other carriers.

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[12] Potential bidders await details of 700 MHz auction RCR Wireless News August 27, 2007

THE HARDWARE FRONT

On the hardware end, a few key players dominate the handset market: namely Nokia, Motorola, and Samsung. Since cellular carriers have historically exerted so much dominance over handset manufacturers to deliver to specificity, only large handset manufacturers with established carrier relationships and the resources to develop-to-order have historically been able to succeed. Until now.

THE APPLE IPHONE

As the second key factor helping shift today's mobile market, the Apple iPhone showed the world that a consumer products company with sufficient resources could organize a team capable of developing and selling a world-class, market-changing mobile handset. Equally important was that rather than design a product to meet the specifications of the mobile carriers or deploy the phone across a variety of different networks, Apple showed that it could leverage its weight to enact innovative and differentiating change within its single carrier partner. This shift from top down carrier, hardware, to software development to a lateral interplay between independent service and hardware companies signaled the first steps in the direction of carrier hardware openness. Ironically, a closed phone on a single network, by being developed independently by a third party, signaled the first notion that a carrier was willing to trust hardware manufacturers to work independently. Hence, in the near future, it is reasonable to expect that carriers will be much more willing to hedge on the successful development of innovate new products from third parties handset makers and that barriers to hardware entry will fall.

THE SOFTWARE FRONT

As mentioned previously, the mobile phone software market is heavily regulated by a variety of players. Hardware manufacturers choose which software platforms to deploy on their phones and how much functionality to make available to third party applications running on them. Service providers decide what software makes it into phones they ship to market and what functionality and features they want to cripple. Even beyond all these barriers to entry, such a vast number of different software platforms for phones exist that software developers have to be willing to port their application to dozens upon dozens of different configurations. This process, in itself, can be forbiddingly tedious. As such, the current mobile software development space is small and relatively under-rewarding.

GOOGLE/OPEN HANDSET ALLIANCE ANDROID

In response to the problems of closed platforms and proprietary systems, Google has spearheaded its Android initiative – an open source, community driven, flexible, and customizable operating platform for tomorrow's mobile devices. As the last of the three key

factors shifting today's mobile market, Android presents the missing link that will allow for the proliferation of software development in the mobile space. By opening up devices themselves with an open source API, any individual will be able to develop and deploy applications without hindrance from network operators. Developers will be able to launch and test iterative versions of their software product for measuring customer response and adjusting accordingly. All in all, it will open up mobile devices in a way that can only foster innovation in mobile software development.

Best of all, there are a host of hardware companies and service providers committed to the *Open Handset Alliance* that will be producing, selling, and supporting Android phones. Whereas Android may not end up being the dominant platform that redefines mobile use in the future, it is definitely the open platform that's cutting the bleeding edge and generating buzz today.

MONETIZATION IN THE MOBILE ENVIRONMENT

Few users currently use mobile phones to access the Internet – 9% according to the Yankee Group. IDC research firm suggests however that one in five phones sold in 2011 will be smartphones. The world has now circa 3 billion mobile phones and, based on the infrastructure investment pace, users will certainly have faster access to Internet on mobile devices in the coming years. Providing content to those users while finding creative ways to monetize mobile services will be critical to support this market shift. The worldwide market for mobile content reached $21.3 billion in 2005 and is expected to reach $42.3 billion in 2010[13]. Already in 2005, mobile content represented the second largest revenue source after voice in mature markets. Currently, operators make money through subscriptions to their services. For instance, some companies charge for email service, ringtone downloads, or voting on television game shows. The research firm eMarketer believes that $16 billion will be spent on mobile advertisement in 2011, which is 10 times more than today. The research firm Jupiter has a much more conservative forecast for mobile advertisement though, predicting that SMS and display worldwide advertisement may reach only $2.1 billion by 2011, up 50% from today.

COUPONS

Coupons can be used as part of a marketing campaign in the mobile space. Coupons are sent and forwarded to other users. Third-party sponsored discounts are expected to play a major role in mobile advertisement, especially when used together with location-based services. Like coupons available in a newspaper, virtual coupons enable businesses to target consumers with interest in their local geographic area, and track the "conversion" rate, i.e. headcount of the users acting upon ads. Google is the first major company to offer web coupons to its Google Maps users. In 2007, Google Maps has had average audience of 25 million visitors per month. Users may generate coupons online, print, and render them at the stores nearby. There is no

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[13] Informa Telecoms & Media, Mobile Entertainment report 2006

need for a store to have its own web presence. In fact, according to Google, an estimated 50% of local businesses do not have sites. Google also is expected to use its acquisition of Zingku in September 2007 to provide services in which merchants create interactive "mobile flyers" and publish or e-mail the so-called zing-code to their customers (who choose to pull the flyer to their mobile phone).

We believe that other major online hubs like MSN and Yahoo! will soon announce their strategy for coupons and integrate them into their mobile platform. We envision in the near future paperless coupons and mobile payment, by leveraging most of the services that are already available.

MULTIPLE PRICING OPTIONS FOR CONTENT

There is a myriad of pricing policies that can be explored by providers of rich mobile content. The subscription model (pre- and postpaid subscribers) is one which users are already familiar with – since this is the model carriers typically use. Most of these models will be explored by mobile media providers like music and video subscription services. This model is, however, not insulated from advertisement-based monetization and will certainly be used in many situations in conjunction with the latter in order to subsidize costs.

ADVERTISEMENT-BASED MONETIZATION

Most service providers targeting mobile consumers should at least evaluate the possibility of supporting their monetization strategies by advertisement. We believe that all forms of mass-media available today are essentially financed by advertisement and that market transition to mobile is inevitable.

Mobile advertisement may however hit cultural barriers in different parts of the world. Mobile devices are very personal and usually not shared. Tapping on the valuable source of personal information users have in their phones may represent a gold mine for targeted advertisement. We believe however that different strategies will probably be pursued in different regions. Europeans for instance are typically more sensitive to privacy issues, which may hinder certain behavior-based mobile advertisement initiatives.

The market penetration of mobile devices in the developing world is much larger than that of personal computers, which may also mean that most of the content accessed in those countries will be from phones. The online advertising market in those countries is still in its early stage and the possibility to use mobile advertisement to provide free content and empower local businesses may represent a major business opportunity.

SHORT-MESSAGE (SMS) BASED ADVERTISING

The early days of SMS advertising is similar to the advent of e-mail advertising, which initially had very high conversion rates. In Europe, where SMS advertising is more prevalent than in the US, as many as three quarters of subscribers received an SMS advertisement in July 2007[14]. Nearly 73% of respondents said that their mobile service providers had sent them SMS ads and more than 17% of mobile users received opt-in SMS ads. On the other hand, only 17.2% of US mobile users received SMS ads. A study conducted in 2007 by M:Metrics found that SMS ad responses are around 12% in the US. The country with the highest rate of receiving SMS advertising is Spain, but also has one of the lowest levels of conversion.

Text-Based (SMS) Mobile Advertisements Received and Responded to by Mobile Subscribers in the US and Select Countries in Western Europe, July 2007 (thousands and % of mobile subscribers receiving and responding)

	Received	% receiving	% responding
France (n=12,728)	27,743.9	62.3%	7.6%
Germany (n=16,127)	15,089.8	32.5%	5.7%
Italy (n=13,696)	25,567.9	56.8%	8.0%
Spain (n=12,921)	24,122.6	75.4%	6.1%
UK (n=15,834)	18,648.8	41.4%	9.2%
US (n=32,824)	36,671.8	17.2%	12.0%

Note: based on three-month moving average for the period ending July 31, 2007
Source: M:Metrics, Inc. as cited in press release, September 18, 2007

087566   www.**eMarketer**.com

Figure 1 – SMS Ads Received and Responded to by US and European consumers

Despite the high response rate, we believe that SMS advertising is similar in nature to e-mail advertising. That is, in the long-run it will experience very limited success. In fact, we believe the percentage of users responding to SMS advertisement will dramatically decrease as the number of ads increases and more users ignore this form of advertising.

SEARCH-BASED MOBILE ADVERTISING

This market is still in its infancy but companies like Google already offer text ads on search result pages on mobile phones in the US, UK, and Germany. According to the company's reports, early results were very promising, although no click-through rates have been disclosed. The possibility to offer search results and advertisement based on a user's geographical location will certainly generate new avenues to monetize and track customer leads.

Google Mobile AdWords contain two lines of text, with a limit of 18 characters per line, and a third line for the destination URL. Customers may directly connect to a business phone by clicking on a "Call" icon, which appears next to the destination URL. Microsoft has also recently begun offering mobile display advertisement on its MSN Mobile portal. Users see banner and text ads that are conformant to the guidelines provided by the Mobile Advertisement Association. Paramount Pictures and Jaguar Cars North America are among the first companies to use the service to promote their products.

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[14] M:Metrics

Figure 2 – Example of Google's Mobile AdWords and Call link

Studies have shown that consumers search on their mobile phones for different reasons than on their personal computer. Due to screen size constraints, marketers have learned that mobile ads need to be much more targeted to be effective. The limited screen size has increased the rate of accidental clicks, which still charges advertisers. Since the price per click is higher for mobile ads than normal ads, this can become costly for advertisers. For example, Google typically charges advertisers $2 per click.

Nokia claims that click through rates (CTRs) for mobile phones are usually 10 times higher than on the web. That was also found by ABI Research, which found that CTRs for Internet banner ads lie around 0.2%, while mobile banner ads have CTRs of 2% to 3%. The main reason for this is that mobile phones have much smaller screens, which inherently limits the number of ads displayed and makes them easier to notice.

Figure 3 – Example of an ads on a Nokia mobile phone

In this space, we believe Google is strategically well positioned to reap benefits of search-based advertising. Google may use the new platform Android to provide services beyond search and integrate location-based services with maps into a search engine tailored for future mobile users. Google may also leverage several of its products, such as Product Search, Coupons, and Checkout, in the mobile space to provide an end-to-end solution. For example, a user could

search for a product in a store, find a relevant coupon, and pay with a mobile version of Checkout.

MOBILE SOCIAL NETWORKS

The average user checks his or her favorite social networking site roughly 10 times a day. Currently, most users access the social networking site from their personal computer. We believe, however, that social networks will become a major destination for mobile web users and a potential strategy to monetize mobile services. In fact, a research conducted by Jupiter Research showed that 48% of marketers plan to use social marketing tactics in 2008, as compared to 38% in 2006. Another research firm, eMarketer, predicts advertising on social networking sites will reach $865 million in 2007 and nearly $2.2 billion in 2010.

Virgin Mobile US, a MVNO, has almost 5 million customers. An internal survey from the company showed that 63% of their customers under the age of 35 have posted a profile to at least one social networking site. Furthermore, 92% check those sites at least once per day.

In fact, social networks with a strong web presence, such as Facebook, MySpace and Bebo, are offering mobile portals. These mobile versions allow users to check for new messages and the current status of their social graph. By merging social networks with location information, new types of services and targeted advertisements will be possible. For example, it will be possible to find where your friends currently are located. A business could then advertise a special sale or an event to promote you and your friends to get together.

In this space, communication-focused social networks have the most to gain in the short term. Since they limit the amount of media embedded into user profiles, they are easier to port to mobile phones due to the bandwidth constraints that most users will face. Media-focused social networks like MySpace may profit in the long run, when more powerful devices and high bandwidth networks become pervasive. In 2004, Cyworld was launched by South Korea Telecom. Since then, it has become the most successful mobile social networking site, with almost two million unique mobile visitors per month (out of 19 million registered users). Cyworld has generated over $14 million in revenues from advertising.

Thus far, monetization of mobile social networks has been primarily limited to revenue generated for carriers due to data traffic. Tole Hart, Research Director for Mobile Devices and Consumer Services for Gartner, believes that revenue sharing agreements will be in place in the future. These agreements will enable carriers to receive a share of mobile advertising revenue.

Jumbuck is the largest mobile social networking in the US and is exploring a similar revenue sharing model, which may create a blueprint for monetization in this space. According to Jumbuck's CEO, Brian Milton, the company has experienced 20% to 30% growth[15] every month.

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[15] Telecom carriers seek ways to monetize social networking, Billing & OSS World, http://www.billingworld.com/articles/feature/Telecom-Carriers-Seek-Ways-to-Monetize.html

AT&T and Vodafone currently support their service. Jumbuck provides the content and users are billed by the carrier. This setup allows Jumbuck to avoid setting up billing and customer service infrastructure, while carriers are able to increase their revenue per customer.

With the introduction of the Google's Android platform, we believe tensions will begin to increase in the mobile space. Carriers could still struggle to get a share of the large advertising market that mobile services and social networks may capture. As Google spearheads the Open Handset Alliance, it will have to work closer with carriers, while concurrently defending an open platform. Google may be able to mitigate carriers' concerns by guarantee a portion of their mobile advertising revenue.

MICROBLOGS

Microblogs have become one of the latest sources of excitement over the past few months. Sites like Twitter, Jaiku and Pownce have become discussion topics in major blogs and newspapers. Microblogging is a service well tailored for mobile users. Twitter users submitted updates from their cell phones during the wildfires in Southern California in October 2007. This service provided more usefulness since it reported breaking news quicker than most mainstream media outlets. Nonetheless, effective monetization strategies for these services are still unproven. Twitter has recently been testing mobile advertising potential by inserting advertisements at the bottom of the personal messages, the so-called "tweets". Twitter is also considering developing branded channels, which will allow companies to connect with users via their own corporate Twitter page. We believe that placing advertising at the bottom of the tweets will be a potentially effective way for Twitter, and other similar Microblogs, to monetize their service. Advertisers would have the opportunity to create excitement about new products, services, or deals.

LOCATION-BASED SERVICES

THEORY, TECHNOLOGY, AND APPLICATIONS OF LOCATION-BASED SERVICES

Frequent mobility of the user is the salient difference between portable handheld devices and the desktop platforms. Therefore, software which provides location-based services is essential to the success of mobile devices as a platform.

Location-based services can be broadly classified along two methods for estimating location: proximity and positioning. Proximity measures the distance between the mobile device and a reference object, which may be a stationary transceiver, or another mobile device. Position measurement estimates the absolute coordinates of a mobile device within a geographical frame of reference, usually relative to stationary beacon emitters such as cellular service towers, or geosynchronous satellites with known revolution periods and regular spacing.

Proximity-based services usually rely on a low-power radio with a bounded transmission range, typically in the dozens of meters around the handheld device. It is notoriously difficult to accurately measure the distance between a transmitter and a receiver using signal strength, which, in theory, should fade off with the square of the distance, but in practice suffers from multipath interference and reflections from walls and other obstacles[16]. Therefore, methods for estimating proximity typically do not provide continuous measurements of the distance. Instead, they provide discrete, Boolean indicators of the reference transmitter object being either "within reception range" or "out of range."

The key technology currently employed by many handheld devices is Bluetooth radio[17], although other short-range radios such as ZigBee[18] offer viable alternatives. Bluetooth has many desirable features (such as authentication and encryption) and is designed to create short-range personal wireless networks of peripheral devices which connect to the mobile handhelds, such as wearable telephone headsets and full-size wireless keyboards. The ranges for Bluetooth radios are binned to multiples of 10 meters, according to the radio's "class." Class 2 and Class 1 Bluetooth devices can transmit over 10 and 100 meters, respectively. However, the majority of the devices are Class 3, transmitting within the range of 1 meter. Using a shorter-range Bluetooth transmitter drastically reduces power consumption, and conserves the battery power of the mobile devices. Bluetooth is capable of establishing connections in "ad hoc" mode, where a device can discover a nearby peer to communicate with and exchange data within seconds of coming into radio range. Discovery and successful wireless communication with another Bluetooth device signifies proximity. In fact, most of the applications of proximity-based services simply imply short-range communication between a mobile device and a peer, which may be a stationary computer equipped with a compatible short-range radio (which we refer to as a "station").

Device-to-device proximity applications usually imply personal contact, and involve a symmetric exchange of user information. For example, users mingling at a social gathering may have their phones exchange virtual business cards based on how closely they have come to one another. Proximity-based dating is a similar idea, whereby users with similar interests get alerted of the mutual closeness.

Device-to-station proximity applications connect end-users to organizations, and are usually mostly unidirectional in the flow of information. For example, the station of a movie theater may transmit the latest film schedules to the handhelds of the passer-bys. Alternatively, mobile phone applications may be used to transmit an individual user's beverage preferences to the café's station even as the user walks through its door. Another example device-to-station

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[16] "Taming the Underlying Challenges of Reliable Multihop Routing in Sensor Networks." Alec Woo, Terence Tong, and David Culler. In Proceedings of ACM SenSys 2003.
[17] Bluetooth Special Interest Group. http://www.bluetooth.com
[18] ZigBee Alliance. http://www.zigbee.org/

application, proximity-based payment, may help the customer pay for the coffee by securely transmitting the customer's coffee shop account number to the shop's station on the way out.

Positioning applications are fundamentally different from proximity-based applications. While proximity methods allow for transmission of supplementary information, positioning methods do not carry meta-information describing the location. Therefore, applications must reference position estimates against a database of geographical information, such as a map, in order to obtain the type of information that is meaningful to the user. Unfortunately, handheld devices are usually severely limited in storage and processing resources, which are typically devoted to other functions. This, in turn, limits the size and the level of detail of the database. However, if the device is equipped with a high-speed wireless network connection, the task of referencing the database may be deferred to the powerful and capacious servers of the company providing the mobile application. This approach has the additional benefit of allowing the maps to be updated and annotated with the latest events and other location-specific information.

The technologies used to determine the position of a mobile device include forms of radiolocation used by the service providers or devices, the use of Global Positioning System (GPS) by the mobile handheld device, and a hybrid approach called Assisted GPS.

Radiolocation usually relies on the time difference of arrival of a signal from the mobile device to multiple cellular network towers. Typically, multiple service towers cover the same area for redundancy as well as assistance with the handoff of cellular connections from one tower to another as users move through an area. A signal transmitted from a mobile phone will reach multiple towers at different times due to the difference in the distance of travel. It is possible to triangulate the location of the transmitting phone from the difference in times of the arrival of a specific signal from a phone to different cellular towers (closest one first). This approach requires line-of-sight to towers for precise localization; otherwise, radio reflections (echoes) may confuse the matching of phone signals by similarity.

Another method for radiolocation is fingerprinting, whereby the towers know how a mobile phone's signal will be distorted and reflected depending on the location. The unique features used for location fingerprinting are provided by the radio signal reflections off of the obstacles such as the terrain and the tall buildings obstructing the line-of-sight of the signal.
The technology for estimating phone locations is currently in place for most cellular service providers. It was installed to satisfy a federal requirement[19] in order to supplement emergency calls (i.e. Enhanced 911) with location information. Until recently, few network providers (almost none in North America) "closed the loop" on the location information, allowing mobile phones to learn their location from the information calculated by the providers' radiolocation servers. Closing the loop was difficult to justify economically, because feedback to the phones requires a large-scale infrastructure investment: data servers, wireless bandwidth, and the data connections to feed this data back to mobile devices. However, achieving a return on

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[19] "Wireless 911 Services." Federal Communication Commission.
http://www.fcc.gov/cgb/consumerfacts/wireless911srvc.html

investment for installing Enhanced 911 systems motivates the cellular network providers to provide location-based services to end-users and monetize them.

Google recently released its "My Location" positioning services[20] for the cell phones, which flips the fingerprinting approach around. In this scheme, it is the signals of towers, together with their signal strengths and reflection signatures, are recorded for many locations in big cities. Then, a cell phone receiving signals from multiple towers needs only to consult Google's database to determine which location its signature matches more closely. Since there are infinitely many locations between any two which measured by Google scouts, Google's servers interpolate the distortion of the radio signals between the known locations. In recent tests, Google positioning services proved to be accurate to within 300m in densely covered cellular service areas such as highways and city centers, and around 5000m in the areas scouts have not yet visited. While relatively precise, Google's approach requires the smallest commitment of resources aside from the human power of "measurement scouts" and servers which determine the closest location signature match.

The Global Positioning System relies on the microwave signals sent from a subset of the 24 medium Earth orbit satellites, enabling the receiver to estimate its location, direction, and time. GPS is typically accurate to within 15 meters, with the best achievable accuracy of 3 meters[21]. Despite very precise location estimation, GPS devices suffer from a variety of drawbacks. First, they are power-intensive. The popular SiRF III GPS chipset by SiRF Technology[22] can drain a standard Nokia phone battery in about 3-4 hours of continuous operation, even without having to share power with cell phone circuitry. Second, their accuracy deteriorates drastically as the reception quality decreases. In particular, under trees shrouds, indoors, and especially in tunnels the readings become so unreliable that even the most sensitive GPS receivers refuse to provide a definite location estimate.

A recent approach called Assisted GPS (A-GPS) combines the triangulation methods based on cellular towers with GPS reception to help mobile devices improve their location estimates indoors. A-GPS chipsets have been recently introduced by mainstream mobile chipset manufacturers such as Qualcomm. However, A-GPS inherits the drawbacks of tower-based positioning approaches because it requires a feedback data connection to help the mobile devices determine their location.

According to the iSuppli Corp report[23] titled "GPS in Mobile Devices," 11.1% of all mobile phones shipped in 2006 had GPS capability, and the research firm estimates that 29.6% phones shipped in 2011 will be GPS-capable. Unfortunately, this is a misleadingly optimistic figure,

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[20] "Google Announces Launch of Google Maps for Mobile with "My Location" Technology."
http://www.google.com/intl/en/press/annc/20071128_maps_mobile_my_location.html
[21] "GPS Errors & Estimating Your Receiver's Accuracy." Sam Wormley.
http://edu-observatory.org/gps/gps_accuracy.html
[22] Sirf III GPS Chipset Technical Specifications. http://www.sirf.com/products/gps_chip3e.html
[23] "GPS-Enabled Mobile Handsets." iSuppli Coroporation. Summary:
http://www.isuppli.com/marketwatch/default.asp?id=420

because in this report, "GPS-capable" is defined as "able to recognize a standalone GPS receiver attached via Bluetooth, and provide the internal on-device software with an API to control it," and is lumped together with tower-based positioning. In reality, the high cost of the GPS receiver, its size, power requirements, and the need for the geographical database to make the location information meaningful to the user of the device, result in less than 1% of all the phones currently produced being equipped with a built-in GPS receiver (according to our own survey of industry reports). However, external GPS receiver devices are expensive (because they must incorporate their own battery, a Bluetooth transceiver and the GPS receiver) and inconvenient (yet another device to carry around).

Applications involving GPS are navigation, tracking, and proximity search. Navigation refers to calculation of a route between the user's current location and the target destination. Tracking may refer to self-tracking (transmitting your own location for someone else to see, such as your boss or a pizza delivery van), or tracking other people (such as parents tracking their children). Proximity search helps with finding nearby businesses and destinations based on a provided name or type of business. The main hurdle in adoption and use of the GPS applications is the need for the coordinates map onto sections of a large cartographical database. Such databases are offered by geographical information firms such as Navteq and Intergraph, and are rather expensive. For example, depending on the geographical area, map "packs" from Navteq which include the roads and points of interest may cost between $59 and $199 per device[24], in volume licensing. This is a significant quantity, comparable to the parts and labor costs of manufacturing a high-end mobile device. The map databases also require significant storage, processing, and power to reference, access, and render graphically, which suits dedicated GPS navigation devices from Garmin and TomTom, but requires too much real estate inside of a multi-purpose handheld device. That is why solutions like Google Maps, which use offsite servers to store the map database and render it graphically, may be more economical from the point-of-view of the hardware manufacturers and mobile application developers.

Mobile device location applications have long been the target of ire from privacy advocates. Their argument is that cellular service providers, and networked location-based service providers should not be aware of the precise location of their customers. If applications expose adequate controls over when location-based services are enabled and the level of precision of the location estimate shared with the network, it is possible to address the privacy issues to a sufficient degree.

THE STATE OF THE LOCATION-BASED SOFTWARE BUSINESS MARKET

According to the comprehensive 2005 Juniper Research report on Mobile Location-Based Services[25], the market size for MLBS was US $1 billion in 2006, and was slated to grow to US $8.5 billion by 2010. The report predicted the largest geographic markets to be Asia/Pacific, followed by Europe and the United Stated. The report cites the rollout of 2.5G and 3G networks

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[24] Cost of NavTeq licensing for embedded devices. Private conversation, Nokia researcher, 2005.
[25] "Mobile Location-Based Services." Juniper Research, June 2005

as the major facilitator of MLBS, which, as was previously described, includes radiolocation methodologies, and provides the high-speed data connections to communicate with the radiolocation servers.

However, the September 2006 report on location-based services from Jupiter Research[26] laments the failure of pay-based location-based applications, noting that free services such as Google Maps are the only ones in use, and that interest in in-vehicle navigation dominates over demand for this service on handhelds. They identify a few key services that people considered valuable enough to pay for: child-tracking services, in-vehicle emergency services (e.g. automatic 911 calls if airbags deploy), local news and weather, and local 411 directory listings. In the follow-up July 2007 study[27], Jupiter reconfirmed these findings with better research. The more recent report additionally explored desirable applications, and suggested that the ability to see where friends are on a map is appealing to 26% of phone users between 18 and 24 (vs. 11% over all segments), and the ability to send messages to friends who are nearby is a major selling point for 16% of users between 18 and 24 (vs. 8% over all).

One of the earliest LBS software businesses providing such services is Loopt. In addition to locating friends, the current version of Loopt's software also allows tagging locations with photos and sharing them with friends. In addition, users can create events for particular locations. Loopt launched in 2005, and served as a key differentiator feature for the BoostMobile prepaid phone service. Recently, it made a deal to offer its services to Sprint customers for $2.99 a month, attracting over 100,000 users[28]. In May 2007, Loopt was funded by Sequoia Capital with $5 million in venture backing.

Another early adopter was a firm called Dodgeball, now owned by Google. Dodgeball allows you to broadcast an SMS message annotated by your location to multiple friends – it is a "multicasting" communication mechanism useful in group collaboration, but also for telling your friends your current location.

Cellular service carriers have reacted very quickly to the demand for child tracking. Chaperone from Verizon Wireless allows a parent to not only track the child's whereabouts, but to set up a "child zone" which would generate an SMS alert to your phone if the child goes outside its boundaries. Sprint offers a similar "Family Locator" service. An entire mobile network operator called Disney Mobile was established in 2006 around the child tracking concept, but failed to generate sufficient revenue and will be shutting down at the end of 2007[29]. Subscription numbers for any of these services were not available, but failure of Disney Mobile despite heavy promotion in parent-oriented sites and magazines suggests lack of popularity.

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[26] "Location-Based Services: Leveraging Connection Ubiquity and Location to Build New Markets." Jupiter Research, September 29, 2006
[27] "Location-Based Services: Where Are You?" Jupiter Research, July 23, 2007
[28] "Loopt Creates New "Social Mapping" Services" Microsoft Startup Zone. http://www.microsoftstartupzone.com/files/storage/28/2044/Loopt_FINAL.pdf
[29] "Disney Mobile R.I.P.: 2006-2007" Engadget. http://www.engadget.com/2007/09/27/disney-mobile-r-i-p-2006-2007

Hyphen8, Aki-Aki, Imity and MobiLuck represent the current crop of proximity-based social networks, allowing the exchange of messages with other subscribers nearby. We were unable to obtain estimates of user base size for these startups, but our own informal survey suggests single thousands. ProxiDate, a popular European service, is an example of the contemporary proximity-based application, matching potential dates by profile compatibility as well as location. We estimate its membership to be in the dozens of thousands, mostly in large city hubs.

A number of firms develop fundamental technologies enabling other LBS-based applications. One of the more prominent, Geovector, has developed a geographical search for points of interest along the user's heading estimate (i.e. the estimated trajectory), and a "point and buy" method which detects if users are pointing at something, and intersects their vector of interest with the location of sale items whose coordinates are kept in a database.

Enterprise LBS applications improve the flow of location-based information to the workforce. For example, AppearIQ by Appear Networks Systems AB is a platform enabling mobile applications and services based on context, including location. It is used on the Dutch Rail to deliver targeted information to the Dutch Rail employees based on their location and job description. The system has reportedly[30] saved over €8 million per year since the installation. Another company, SmarterAgent, offers a service for real estate agents which shows all the houses sold within the three mile radius relative to their current location, and their prices.

TeleNav is the leading provider of navigation software for mobile phones. It offers a Java-based client which requires a GPS receiver and connects to TeleNav's servers to render its maps. The service costs $9.99 per month. However, its market share relative to Garmin (58% of US market), TomTom NV (24%) and Magellan (7% according to researcher NPD) is rather small. This is explained by the results of the GPS device survey by Jupiter Research[31], which estimates the desire for a stand-alone, in-vehicle device to be about three times the interest of navigation features on cell phones.

Now we will turn to Google, perhaps the most significant player in the market. According to the 2007 Yardstick report[32] by the mobile software retailer Handango, Google's free Mobile Maps is the top application used by Handango's customers. Google has broad licensing agreements with NavTeq and the providers of other cartography and point-of-interest datasets throughout the world. With the rollout of its client-based location services (which do not depend on an infrastructure investment or support by the cellular service providers), it is well-positioned to augment its free Mobile Maps software with revenue-generating, location-based advertisements.

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[30] Cisco Networker Awards, Best Mobility & Wireless Project of 2007.
http://www.cisconetworkersawards.com/pdf/appearnetv3.pdf
[31] "GPS: Focusing the Core Feature to Drive Sales" Jupiter Research, February 28, 2007
[32] Handango Yardstick.
http://corp.handango.com/Handango.jsp?siteId=1&CKey=CORP_YARDSTICK&option=pressroom

While the technological requirements of the proximity-based services market is lightweight in comparison to positioning, the usefulness of proximity-based applications is related to the likelihood of meeting other users of the same application, which is negligible in all but the most densely populated cities. We believe that, even in the largest cities with pedestrian traffic, the density of early adopters of the proximity-based social networks will be insufficient to support strong growth of the user base.   On the other hand, we note the convenience offered by some of the device-to-station applications connecting customer devices and the businesses they interact with, and consider this to be the promising area of future development.

The location-based services market requires considerable technological investment and the ability to overcome many challenges. Tower-based approaches place the burden on the service providers, including nearly all of the following: radiolocation equipment, servers for triangulation and sending location estimates to mobile handheld devices, bandwidth for the data connections to the devices, and support from the mobile device OS. GPS-based technology burdens the phone manufacturer, having to allocate space for the GPS receiver, include a higher-capacity battery cell, and inflating the costs of the device. So far, only Google's positioning methods are lightweight enough to be implemented entirely in software and require no special support except for a connection to the Internet.

Even if all the stars align properly and pervasive support for LBS does appear on a device (as it did for the GPS-equipped Blackberry 8800), what value can the users get? Navigation is needed mostly while driving and can be executed more elegantly with in-vehicle navigation units. The tracking of friends and family members, which is certainly a useful application, offers no inherent business model aside from being a value-added feature of a cellular plan.

In summary, the position-based application market still does not have an application in the consumer market that capable of generating significant revenue. Perhaps with the recent introduction of lightweight positioning methods offered by Google a new crop of ideas will materialize for the mobile devices.

Thus far, only the location-based information retrieval applications for workforce automation offered concrete value, but only in a context of a larger networked system supporting a specific business's processes. We can see a large market potential for LBS for many industries, such as mail and delivery services, construction, transportation, city planning, etc. From the research we have gathered so far, we project that enterprise software for workforce automation and tracking will be the most profitable area for LBS-based application.

THE FUTURE OF MOBILITY

November 29th 2007 was a special day in this business: global mobile penetration hit 50%, or 3.3 billion mobile subscriptions 26 years after the first cellular network was launched, research firm Informa said[33]. Mobile subscriptions and mobile subscribers aren't the same and more than 59 countries have mobile penetration rates of greater than 100% which means even a bigger white space for growth in emerging countries, but what is most relevant is that during this time the mobile industry has constantly outperformed even the most optimistic forecasts for subscriber growth and mobile phones have become the consumer electronics sector with the largest volume of sales in the world.

Somebody said that he could predict the past with certain accuracy; it is the future he had problems with. The road ahead looks to be anything but a rollercoaster, but we will do our best to expose the most important trends that underpin the industry at this point.

THE FUTURE OF AIRTIME

Wireless is fast becoming a cheaper and better way to do things. The introduction of more efficient technologies has provided wireless data rates that were unimagined of just a few years ago, but spectrum will be a scarce resource for years to come as broadband speed is there but broadband capacity is still an issue and turns into a competitive advantage for these carriers who own a bigger chunk of the spectrum. That puts the spotlight in initiatives like the Upper 700 MHz auction in US, participated by Google, which wants a national broadband wireless network that would be unimpeded by gatekeepers. Furthermore, the open access rules lobbied by Google to the FCC send a strong signal in the potential usage of this spectrum to de-intermediate the heavily protective wireless industry.

We envision that flat rates will be the dominant model for consumption of rich media in years to come. They will tiered and capped in quality or service due to the price per unit time of the spectrum with a range of basic and premium data plans at consumers' choice. Enterprise users will lead in this space due to their willingness to pay for solutions that increase the productivity, while rich consumer media will initially adopt a short area (Retail kiosk, Wi-Fi network) approach.

WI-FI

Nokia and other manufacturers have introduced new handsets capable of accessing both cellular and Wi-Fi networks (so-called "mixed-network" phones that can make calls over regular cellular networks and over VoIP when within range of a Wi-Fi hub). Following our example, T-Mobile has one of the largest Wi-Fi networks in the world and was the first to launch converged Wi-Fi/cell calling. The integration and seamless handover between networks will become better, but the coverage of free or pay-per-use Wi-Fi will grow steady in the next years but

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[33] "Global cellphone penetration reaches 50%" Reuters UK Online, Nov 29, 2007.
http://investing.reuters.co.uk/news/articleinvesting.aspx?type=media&storyID=nL29172095

lagging behind the predictions that the supporters of full Metropolitan networks anticipated some years ago. As such Wi-Fi is a great complementary solution in restricted environments (your home, your office, airports, hotels, etc.) but it cannot address the whole issue of pervasive mobile connectivity.

PERSONAL NETWORKS

Moving from the macro to the micro level, one increasingly important technology that is taking shape today and likely will be one of the most significant developments in wireless over the next decade is called personal area networks (PANs). Today, this technology makes extensive use of Bluetooth to connect wirelessly with keyboards, mice, printers, and ear buds.

The low-power ultra-wideband (UWB) technology, which is expected to supersede Bluetooth at some point over the next two or three years, will be capable of delivering data rates in excess of 100 Mbps as well as operate over existing communications channels without causing interference for other wireless signals using the same frequencies, opening a whole new space for ad-hoc personal networks in which individuals would be able to interact with very little previous training and zero cost.

THE FUTURE OF HANDSETS

The de-intermediation of the airwaves discussed above would lead to think that the power would be switching from the carriers to the global handsets manufacturers which have been strengthening their position through the years not only with respect to the carriers but also the IT vendors. Microsoft was expected to take over the market for mobile OS as early as 2003, but the reality was that Symbian emerged over Windows Mobile as the dominant force. The reason behind is partly that Microsoft's reputation lured the wireless top players into a defensive alliance but also partly because the mobile manufacturers learned the skills required to develop good quality software and brought their platforms to a competitive level, getting the edge by their intimate knowledge of the particularities of a mobile environment in which the PC paradigm doesn't translate very well.

It was puzzling for many that the Nokia S40 (proprietary) OS produced better phones than S60 (Symbian based) which was intended to create an ecosystem of 3rd party feature rich solutions, but when the underlying platforms and tools are not "good enough" proprietary, integrated, fast architectures win over componentized, flexible, feature-rich ones, such is the added cost of openness. What is different now? That thanks to advances and standardization in chips, memory, middleware, etc. it is not rocket science to develop a mobile OS. It is not only about Google's **Android** mentioned earlier; its future is uncertain and several vendors are commercializing an eRCP based Java platform on some phones that is architecturally very similar to Android. There's also the **iPhone Developer Platform** coming out early next year. Additionally, **OpenMoko** (http://www.openmoko.com) is maturing, Intel is working on their **Linux** platform and Sun is working on their **JavaFX** platform. Nokia is pushing its own Linux-based open OS called Maemo (http://maemo.org/) that is receiving good developer traction.

Not all of them will be successful but some of it likely will end up being successful and disruptive and it doesn't really matter who will be the winner; the trend for commoditization of both hardware and software in the mobile handset stack will increase quickly and gone are the days of the hefty operating margins. Some industry analysts expected in the market a "$100 Smartphone" in early 2009.

KEEP IT PERSONAL

Now, will the standardization and openness in hardware and software necessarily imply the demise of the handset manufacturers, as the PC wiped out the Mac? Not necessarily. We should not forget that no matter how many analogies are drawn between IT and wireless, mobile devices are only second to your underwear in terms of the amount of time that you spend with them, become an object of personal self expression that is used in social contexts to convey the style, stand and status of the owner. Design hence plays a very important role acting as an opposing force to commoditization and calls for the importance of the brand (e.g. the best selling mobile device in history, the Motorola Razr, was a horrible price per feature proposition). A plain vanilla Android phone, no matter how feature rich, does not have the appeal of a sexy iPhone. This dynamic can be best seen in the success of the iPhone, by no means an engineering feat (there were great mp3 players before) but a total marketing success). Now that the engineering barriers of entry have dropped dramatically it may also imply the entry of players associated with the fashion and media industry in partnerships with white label mobile manufacturers and carve niches out of the higher tranches of the mobile market.

RICH MEDIA AND ADVERTISING

Ray Ozzie, Microsoft's Chief Software Architect acknowledged it already in November 2005: "a new business model has emerged in the form of advertising-supported services and software. This model has the potential to fundamentally impact how we and other developers build, deliver, and monetize innovations"[34]. Symbian is in the same boat as Microsoft and Apple here because they are all expecting to profit from their products or the media that will be provided through them while they do not hold any important stakes in the advertising space. Google instead can sell mobile devices at break even or at loss by using advertising as a way to recoup the investments originated in the platform.

Being highly contextual and highly personal the mobile phone is an excellent channel for advertising. Analysts say that advertisers have spent $1.4 billion on mobile media during 2007 and envision that rising to $14.4 billion in 2011[35]. With wireless advertising is not about cannonballs but guided missiles: combining fine-grained profiling with location bases services

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[34] "The Internet Services Disruption," Ray Ozzie, Executive Staff Memo. October 28, 2005.
[35] "Mobile Advertising Reaches for the Sky", Wireless Week. Aug 15, 2007.
http://www.wirelessweek.com/Mobile-Advertising.aspx

would allow for. The importance of location based services will emerge as a key enabler that underpins the whole mobile industry and that is evidenced by Nokia acquiring Navteq and Google working with Tom Tom and Garmin.

SECURITY AND THE ENTERPRISE

Gartner expects that by 2010, 80% of key business processes will involve the exchange of real-time information involving mobile workers. 40-70% of employees are not co-located with supervisors, and the figure jumps to 90% if one considers these away from the corporate HQ.
The number of virtual workers increased of 800% in last 5 years and this trend will only accelerate, putting collaboration as a top CEO priority and widening opportunities in mobile email, VoIP, device management, mobile browsing, corporate middleware and on-line collaboration tools. Organizations using business processes as strategic differentiators can increase visibility into market changes and distribute critical intelligence to the field worker closest to customers by automating processes at the edge of the enterprise[36].

However before Smartphones become so cheap that they are considered a standard "prosumer" item, businesses will need to develop a corporate strategy that makes sure employees are well acquainted with their security features. There's a lot of risk for carriers with open platforms; they must design their networks to isolate bad actors rapidly in order to avoid spreading viruses or having phones that suddenly act up and take the network down. That's a real fear, and one that Steve Jobs cited in Apple's interest in delaying an SDK for the iPhone until security issues were well-characterized and covered.

These factors outline the enterprise segment as another substantive stronghold for the dominant wireless players that are able to provide turn-key solutions for these concerns, just as enterprises have provided the highest margins and customer loyalty in the IT space.

OUTLOOK

In summary, we envision that the future will bring de-intermediation in the wireless networks and commoditization as the ecosystem is infected through digital convergence and transformed by the trends that disrupted the IT industry. Several key differences remain, however: the high cost per unit of the spectrum, that will force to look for innovative ways of delivering low value added services or concentrate on the high added value segment, and also the personal aspects associated with mobile devices that would call for a substantial, though diminished in comparison with the past, importance of investing in brand, image and design.

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[36] "Mobile Enterprise: Turning Post-Sale Service Into Profits", Servigistics. Aug 16, 2007.
http://www.servigistics.com/news/articles/2007/08-16-2007_Mobile_Enterprise.html

Not only the hardware but also the software are quickly being commoditized, and it is quite unlikely that many players will profit from it unless they have the sufficient scale to produce at the lowest possible costs or they look for complementary sources of revenue. The recommendation for the both carriers and manufacturers would be to move upstream into services, on the one hand providing secure, turn-key enterprise and field force mobility solutions for corporations, and on the other diving into content and rich consumer media, looking for as many synergies as possible with their existing assets (e.g. integration of mp3 and contacts so that the wait tune that I hear when I call my buddy is the song he is listening to right now, creating a viral social effect, etc.) in order to strengthen their value proposition once they look for alliances in that space (film studios, music distributors, etc.) and apply business models that have long worked in the magazine industry, namely subscriptions and advertising.