Building on Complementary Assets in a Unified TCP/IP World

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"…the whole world had one language - one common speech for all people. The people of the earth became skilled in construction and decided to build a city with a tower that would reach to heaven. By building the tower they wanted to make a name for themselves and also prevent their city from being scattered. God came to see their city and the tower they were building. He perceived their intentions, and in His infinite wisdom, He knew this "stairway to heaven" would only lead the people away from God. He noted the powerful force within their unity of purpose. As a result, God confused their language, causing them to speak different languages so they would not understand each other. By doing this, God thwarted their plans. He also scattered the people of the city all over the face of the earth…"

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Abstract

The contemporary competition in the smartphone industry is an ideal setting for studying Schumpeterian creative destruction, the role of the complementary assets, and the strategic use of technology platforms. This current creative destruction is particularly interesting because the current convergence from previously separate industries is pitting firms with differing business models from the old telecommunications world against the operating system winners of the old personal computer, and competitors from the new internet world. This paper utilizes insights from the literature on complementary assets and technology platforms to understand the completion in smartphones. This paper contributes a broadened understanding of the contemporary industry convergence occurring with Internet and cloud computing at its unifying center, and with intelligent communications devices at its edges. Furthermore, this paper extends the current academic discussion of the changes in the mobile telecommunications industry to consider the possibility that cloud computing will integrate a plethora of new devices that will include personal computers, smartphones, the internet-enabled television, and a nearly infinite number of other devices that will provide data to the cloud.

Introduction

The long discussed digital convergence appears to be finally occurring with the Internet and cloud computing at its unifying center, and with intelligent communications devices at its edges (Zysman and Murray, 2011).[1] Convergences are particularly interesting periods; these are moments when incumbents and their ecosystems are threatened with becoming irrelevant. Theory suggests that complementary assets can be used by incumbents to deflect attacks by new entrants (Teece, 1986) intent upon overcoming the incumbent's competences (Tushman and Anderson, 1996). As these firms come into competition with each other to navigate the convergence, firms must understand and/or build their

[1] For a useful description of what cloud computing is, see, for example, Armbrust et al. (2009).

advantages. The current convergence is driven by the mobile phone becoming a smart phone, which is essentially a hand-held computer. This is a fascinating setting for exploring firm strategy, not only for its own sake, but because the smartphone and tablets are becoming the key edge devices for the entire ICT industry.

For firms In emerging new industries or those being transformed by new technologies, firms must identify the correct business model and occupy the key strategic position to ensure survival and an ability to capture out-size rents. Much of the recent analysis in the ICT industry has focused upon the position that Microsoft, Intel, Cisco, Qualcomm and others have achieved by controlling key technologies that would become industrial platforms (see Cusumano and Gawer, 2002; Gawer and Cusumano, 2002; Gawer and Henderson, 2007; Gawer and Cusumano, 2008; Gawer, 2009; Cusumano, 2010). In the PC industry, Intel and Microsoft occupied the key positions and their duopoly was termed Wintel (Borrus and Zysman, 1997). The general gist of the platform literature has been to suggest firms can occupy a favorable business position by encouraging the growth of a third-party provider ecosystem on their platform. To illustrate, in an examination of handheld computing operating systems Boudreau (2010) found that "granting access to complementors accelerated the introduction of new devices by a factor of roughly five," while giving up control over the platform completely only increased the introduction rate by roughly 20%"[2] Thus, the general advice in the platform literature is to develop a platform, allow its use by complementors, but retain control over the platform.

The mobile Internet is particularly interesting, because the current convergence is pitting firms and paradigms from the old telecommunications world against the operating system winners of the old PC world and entrants from the new Internet world. This strategic competition is a complicated, many-sided struggle, not only because these are multiple-sided markets (Hagiu and Wright 2011), but also

[2] One oddity about this study was that many of the entrants had no complementary assets, while those granting access like Microsoft had enormous existing power, so the playing field was hardly level.

because of the significant variety of business models, a variety of technologies and the layered nature of the computer-telephony industry. This article sheds light on the usefulness of these complementary assets in a case within which the macro-level innovation, or in Schumpeter's terms a "new economic space," is opening and there can be many innovations, but the firms entering are incumbents from adjacent industries and so by definition have assets in terms of legal protections, scale and scope, and complementary assets.

This convergence and business model competition can best be seen in the current rivalry in the emerging mobile internet ecosystem. Three competitors, each with their own strategy, technology, platforms, and complements are trying to define the new space even as they continue to eye personal computers and televisions. Their decisions, strategies, and success are likely to frame the ecosystem for all of the other ICT constituents, not only of the mobile communications industry, but for the entire information and telecommunications sector. To illustrate, Apple, which has a small personal computing business (when compared to Wintel), is using the iPhone platform-based iPad to threaten the personal computing industry. It is further extending its control with iCloud and considering entry into the television industry. Google's strategy could be similarly disruptive but would operate through quite different mechanisms. Finally, Microsoft's strategy is, in many respects, the least disruptive as its goal appears to be only to extend its control of the PC to the mobile phone and tablets. In this paper, we examine the competitive weapons that each of the firms is deploying to extend their business model into the newly opening business spaces.

The Internet as a Technology Platform

Competition in the ICT industries has very often been used to understand the creation, adoption and exploitation of technical standards (for an introduction to this literature, see Shapiro and Varian,

1999). In the ICT space new technological standards can become "platforms," though platforms need not be based on standards. The key point is that third parties can build their products and services upon the platform. Conversely, a platform has relatively little value without complementary products and services, thus platform providers are motivated to find the third-party complementors (Teece, 1986; Cusumano, 2010). In cases in which there are multiple firms proffering different platforms, market success is often determined by which platform can recruit the greatest number of complementors. The stakes in such contests are enormous, because in ICT, where interoperability is predicated upon complete interface standardization, owning and controlling the platform upon which other firms build their businesses provides enormous power and can be a lever for capturing value from the entire ecosystem. This was the core of the Microsoft business model in the PC and is now driving Apple's success.

Most discussions of platforms assume ownership by a single firm, but this need not be the case. To illustrate, the Internet protocols are not owned and yet they are a platform. This is one reason that the Internet ecosystem differs markedly from that of the PC ecosystem where Microsoft's ownership of the operating system allowed it to become the dominant force and capture outsize profits. Microsoft accomplished this by creating a mutually reinforcing linkage between the operating system and personal productivity software. These mutually reinforcing positions enabled it to become, with Intel, the dominant firm in the PC ecosystem. This position was challenged when the Internet emerged in the 1990s, and the browser, a new PC application, was introduced by Netscape. Netscape had hoped to use the browser to dislodge Microsoft's dominant position. However, Microsoft, though late in understanding the implications of the Internet,[3] used its control of the operating system and office application parts of the PC platform to directly embed Explorer into the MS Office package. With the

[3] Microsoft's official and fundamental recognition of the importance came on May 26, 1995 with Bill Gates' release of his "Internet Tidal Wave" memorandum.

widespread adoption of Microsoft's Internet Explorer browser application, the competitive environment fundamentally shifted against Netscape (Cusumano and Yoffie, 1998). The most important browser competition, until Google's recent release of Chrome, was the open source Mozilla Firefox.

With Microsoft's initial success and, as long as Internet access was limited to the PC, Microsoft could benefit even as the Internet grew and new corporate giants such as eBay, Amazon, Yahoo!, and Google emerged. Beginning in the decade of 2000, the Internet, through its "cloud" manifestation, threatened a fundamental reorganization of the entire ICT world. The technological changes encouraging the reorganization are the following: At the chip level, according to Moore's Law, increased computing and communication power became available in smaller and smaller devices, i.e., computers are becoming smaller and smaller, even while prices are decreasing. The current manifestation of this is that today's cell phone is an increasingly powerful computer. However, televisions and nearly every other electronic device are receiving increased computing power. For example, in televisions "set-top" boxes are superfluous as its functions and dedicated Wi-Fi are integrated at a trivial cost. Previously, the three main connectivity devices, telephones (wireless and wire line), televisions, and personal computers (desk top and notebook), were connected to central delivery backbones by not fully compatible networks. Today all are built with sufficient computational and communication capability to be connected through a single network, i.e., the Internet. Moreover, this "Big Three" is being joined by a myriad of other devices such as mobile computing "pads," and other computation and communication capability-endowed devices such as automobiles, refrigerators, appliances, cameras, sensors, and nearly every other electronic gadget.

While each of these computational and communication-enabled devices outwardly appears similar to their previous "dumb" manifestations, they now are being connected to a single network using Internet protocols. To illustrate, the smart phone will remain a small individual communication device,

the personal computer may remain in the office and be optimized for such activities, while the television with its large screen remains in the familial personal spaces. The interfaces with human actors are different, but they all will "speak" the same digital language. With this unification, what is at stake is the ability to provide services and capture value in this new network.

Fundamental in this struggle for control will be a strategy for developing, recruiting or controlling complementary assets in determining the outcome. Competition in this converged network world is likely to be asymmetric, because the three most salient competitors, Apple, Google, and Microsoft have differing business models, strategies, and potential complementary assets. While it is necessary to recruit actors with complementary assets into their ecosystem, the firm wielding platform may also threaten or attack firms providing complementary assets. In this paper, we examine the strategies of the three most powerful entrants and platform providers in the mobile Internet industry and examine what the implications of their platform models have for their key partners, the mobile phone operators – the firms that actually provide the connectivity. In the remainder of the paper we examine the interplay between firm missions, strategy and operating behaviors, their product and service platforms, and their efforts to strengthen their position in the converging sectors.

Industry Setting

The setting for this paper is the current digital information delivery system, which consists of mobile devices, personal computers, and televisions. The objective is to understand how different actors in an ecosystem react to the opportunities and threats presented when a technological discontinuity creates an industrial convergence. This is particularly interesting when considering the three most successful new entrants, Apple, Google, and Microsoft have not traditionally been significant in mobile phones as they come from the world of personal computers and, in the case of Google, the Internet. The

mobile Internet is changing the arena of competition, and complementary assets are one of the key weapons used by firms to shape the future.

The competition is played out across three layers: 1) the world of devices, their operating systems, and related complementary assets, e.g. applications and 2) the telecommunications systems and respective complementary assets, and 3) the world of operators. This is illustrated in Figure One, as the world of operating systems meets the telecom systems and operators for mobile internet.

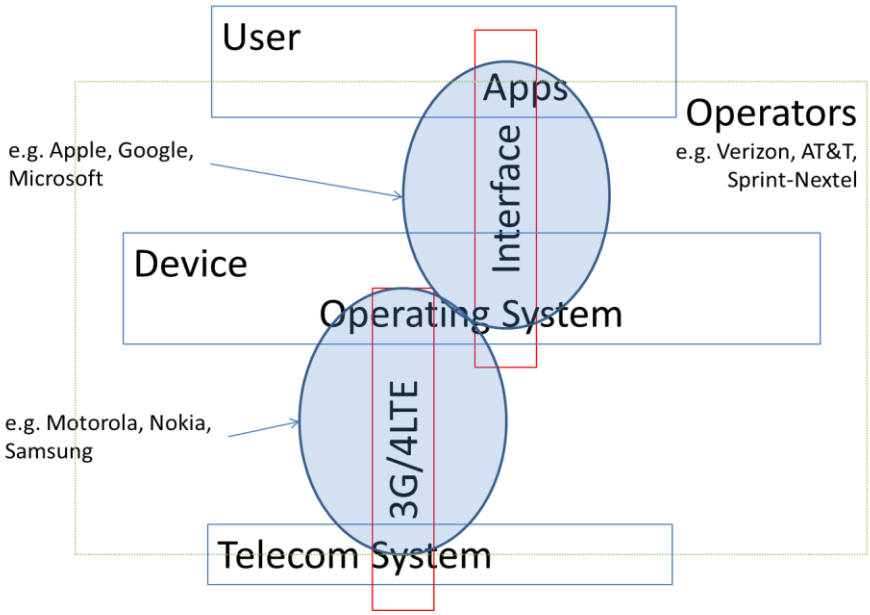

Figure 1: The Relationship between Smartphone User, Device Operating System, and Telecommunications System.

Previous Research

In this newly emerging ecosystem where it is likely that all activities will be united by the Internet, control of the mobile devices is increasingly viewed as vital for any firm seeking to become dominant in the information technology world. This particular moment is quite interesting, because during periods of convergence and turbulence it may be difficult for firms determine what the critical complementary assets necessary to achieve dominance are [on the interrelatedness of a major elements of the firms – strategy, organizational structure, employees, and technology, see the seminal work of Chandler (1962)

and Leavitt (1967); on complementary assets, the seminal work is Teece (1986; 1988)]. In another study, Rothaermel and Hill (2005) examined the effects of a technological discontinuity upon industry incumbents and found that an incumbent's financial strength had a stronger positive impact on firm performance after the discontinuity if the new technology could be commercialized through generic complementary assets, while R&D capability had a stronger positive impact on firm performance after the discontinuity if specialized complementary assets were required. Tushman and Anderson (1996) examined technological discontinuities from the perspective of whether they were competence enhancing or competence destroying. These studies concentrate upon industries that have relatively clear boundaries and recognizable trajectories. However, an increasing number of firms now operate in recombinant or converging industries where boundaries are uncertain or subject to redefinition. In information and communication industries, the underlying technologies are "stacked" upon each other and no firm controls the entire stack. Firms in different layers of the stack must cooperate sufficiently for the product to operate, but at times may also come into competition. These markets can be further complicated by the fact that firms may be involved in ecosystem or stack competitions, where groups of firms based on different platforms may be competing. In such markets, complementary assets and the implications of technology discontinuities may not be clear at the outset.

Previous research has focused on understanding the existing value creation and value capture mechanisms, and existing innovations, technology and service platforms in the current mobile telecommunications industry (see Funk, 2007; West and Mace, 2010; Ali-Yrkkö et. al., 2011; Kenney & Pon, 2011; Seppälä and Martikainen, 2011; Dedrick et.al., 2011; Funk, 2011; Seppälä and Kenney, 2012). Since the current mobile platform leaders and mobile internet ecosystems have different industrial trajectories, examining their strategies and operating behaviors can provide insight into how firms leverage complementary assets to extend their current business strategies and models.

Setting the Scene

In the pre-Cloud computing era, each of the currently converging industries had a relatively clear industry structure. In mobile phones, personal computers, and televisions, there were firms that produced the gadget, which were connected by various operators to sources of content. Initially, mobile phones were "dumb" handsets, but gradually other services normally provided by the mobile operator were incorporated into the device. And yet, the operator's control gradually loosened. Similarly, personal computers initially had limited connection to networks. This began to change most significantly with the introduction of email. However, the creation of the World Wide Web made the Internet an increasingly important personal computer application and gradually came to rival the Microsoft Office application's monopoly. Televisions were one-way content "push" devices (and, in some cases, gaming monitors) with content delivered by cable TV firms. The final set of competitors were the Internet-only firms, such as Amazon, Yahoo!, Salesforce.com, and slightly later Google, that began life in what came to be known as the Cloud.

In this world, the operators controlled the voice and data "pipelines" to the consumer, while Microsoft controlled the personal computer. The operators were treated and regulated as utilities, with the benefit of guaranteed rates of returns and significant barriers to entry, but also had to make large capital investments to stay abreast of the increasing volume of voice and data flows. The operators aimed to increase their returns by controlling the content provided to their "captive" customers. These arrangements were termed "walled gardens" within which the owner would be able to extract the bulk of the profits – effectively, these were invitation-only platforms (for a vigorous praise of these operator controlled environments, see Hazlett et al., 2010; for a discussion of the case of Japan, see Funk, 2001, 2007; Kushida, 2008).

The access device makers, operators, and content providers in the earlier model had a rough symbiosis within which each of them could capture a return. The move to the smartphone threatened the operators, but, at least initially, it appeared as though there would be another walled garden promoted and controlled by the device makers, as Apple migrated its music-downloading iTunes Store from the iPod to the iPhone and renamed it as the "Apps Store." Nokia and other mobile handset access device makers responded with their own much less successful stores. The tremendous market power that Apple demonstrated in their negotiations with the operator broke their power to control the smart phone as a platform.

Despite the success of the Apple App Store with applications such as Rovio's Angry Birds, the true killer application was direct access to the Internet (West and Mace, 2010). This can be proven by the latest survey results that found that smart phone users spent 128 minutes per day on their smart phones of which 19 percent was surfing the Internet, 14 percent checking social networks, 11 percent listening to music, 12 percent playing games, 9 percent making phone calls, 10 percent text messaging, 7 percent using email, 7 percent watching TV/films, 7 percent reading books, and 3 taking photographs (O2, 2012).

Internet access destroyed the operator strategy of confining customers within their network's boundaries. The new smartphone device/operating system makers were repositioned to be able to provide a semi-walled garden. While the device must provide access to the Internet, the operating system provider could create a "store" where users could purchase applications made either by the owner of the operating system or third-party vendors. For the operators this was an unwelcome development as they were threatened with relegation to utility service providers even as they were forced to invest more to keep up with traffic growth.

With any platform or ecosystem, the issue is which firm(s) can capture the greatest profits as that is likely to indicate where the locus of power resides. While admittedly crude indicators, growth in revenues and profits are one substantial indicator of relative success. During the recent years the operating revenues and the profit and loss before taxes of the mobile internet ecosystem operating system providers seems to have increased hand in hand, but the profit before taxes has declined in what appears to be an accelerating pace. This can be seen in Figure 2, which presents operating revenue data for a selected peer group of firms, Apple, Google, Microsoft, AT&T, Sprint Nextel, Verizon, Comcast and Time Warner from 2000 through 2011. Clearly, since entering the mobile space in 2007, Apple has had remarkable success. Google, whose main revenue source is advertising, has continued to grow and appears to be gaining success in the mobile space. Microsoft is still in the middle of its attempted extension from computer to mobile internet and the vast preponderance of its revenues is derived from its personal computer monopoly. The operators, whether they are the mobile carriers, such as Verizon, AT&T and Sprint/Nextel,[4] or the cable carriers for the landline have experienced operating revenue increases, but profitability remains weak.

[4] Three biggest mobile carriers in US based on number of subscribers (source Pyramid Research, 2011).

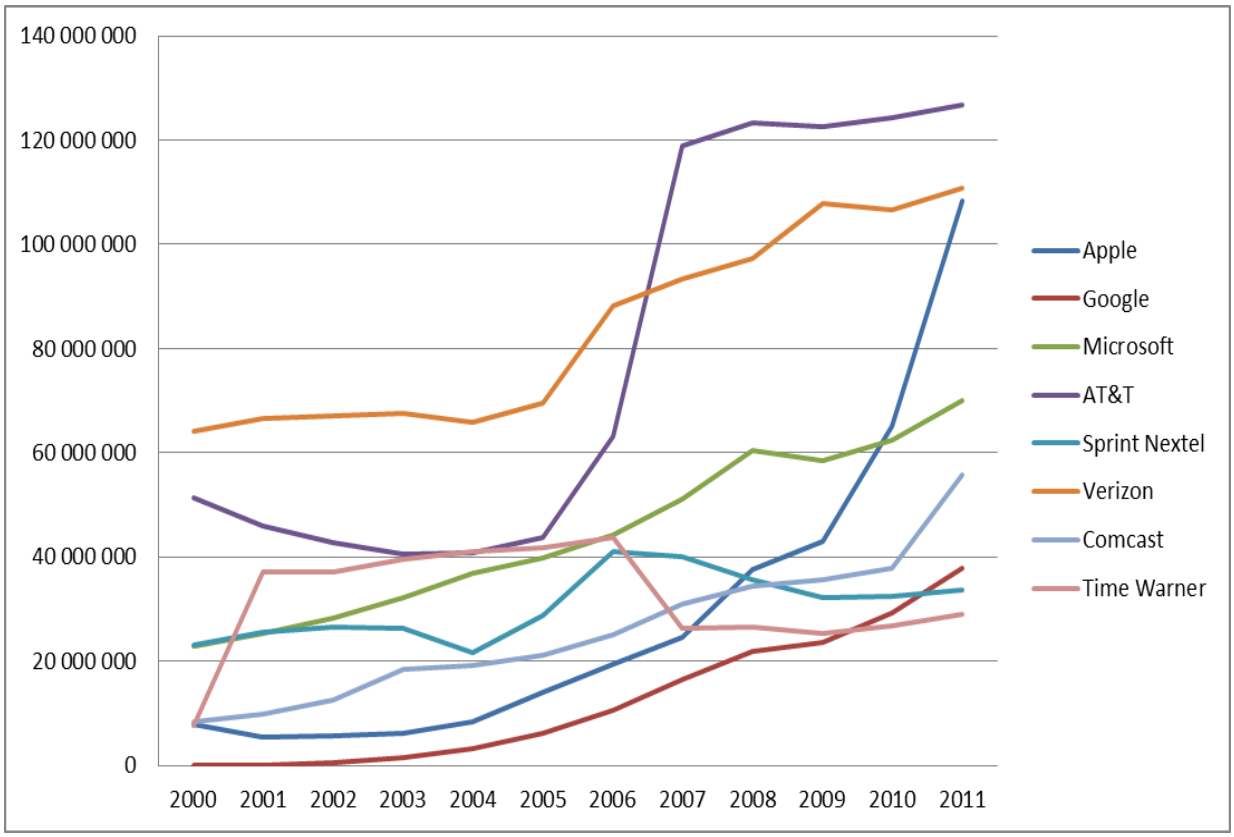

Figure 2: Operating Revenue Data 2000-2011 (Various sources)

In long term the mobile carriers may face difficulties in maintaining the current operating revenue levels due to fierce price competition in data products. However, the operating revenue levels seem not to be the main problem of mobile carriers in the short term, but rather the problem is to fulfill the increasing data carriage demand while coping with weak profitability. According to industry estimates the capacity requirement for mobile data has been doubling annually.[5] In Figure 3 we examine how profit and loss before taxes has evolved for the same peer group of firms from 2000 to 2011. What this indicates is that the OS providers, in particular Apple, are capturing the preponderance of the industry profits.

[5] http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html (accessed July 3, 2012).

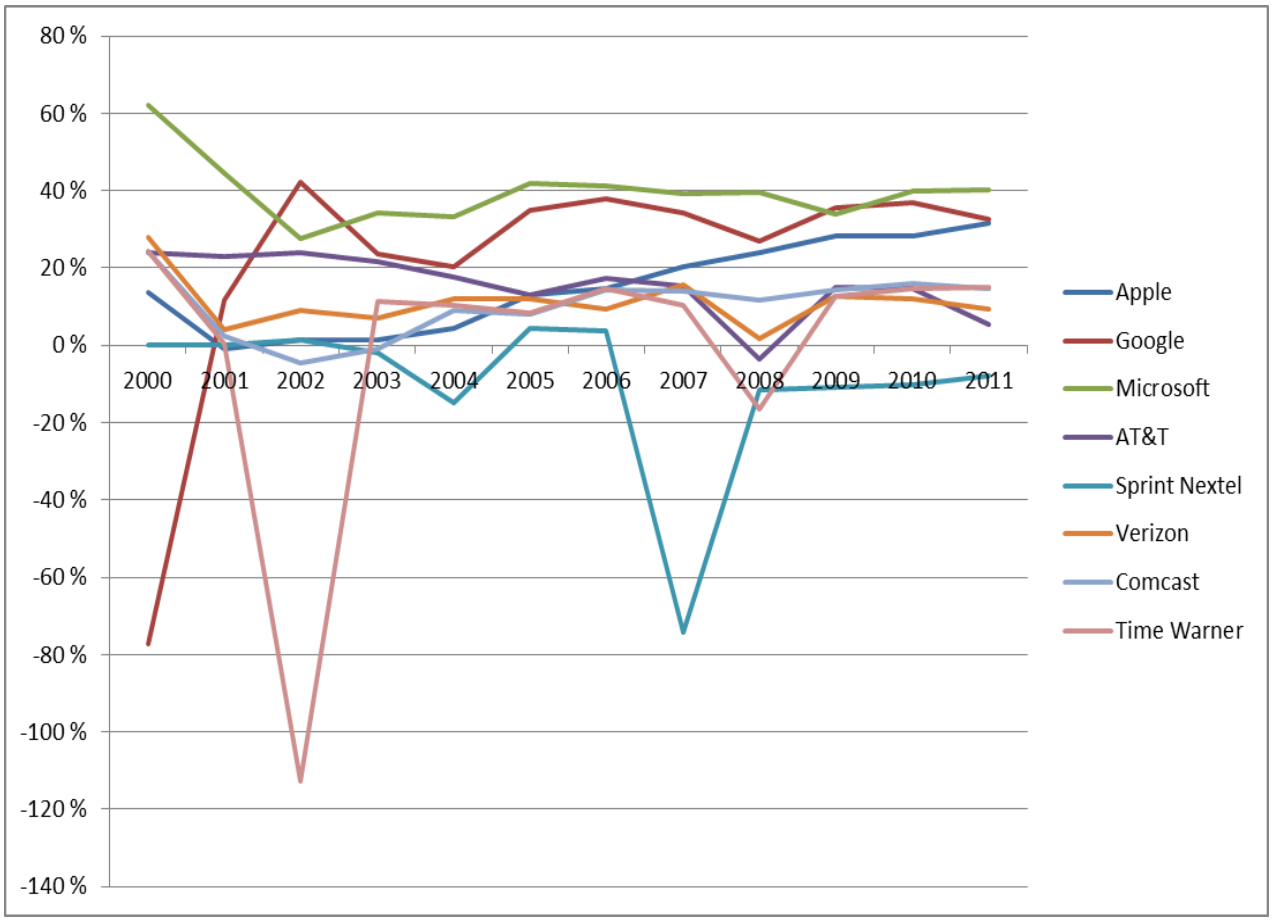

Figure 3: Profit & Loss before Taxes (Various sources).

For the mobile operators, the situation is difficult, but the cable operators that do not have the benefit of subscriber and carriage growth appear even more stressed as they have low profit margins. Moreover, they are threatened by the mobile carriers that also have land pipelines to the home. However, in the US market thus far the carriers have been able to maintain their profit margins due to their relative monopoly. As long as this monopoly is protected, their positions do not become untenable. However, particularly for Google, lowering the cost of access to the Internet, which ultimately is its platform, would be a desirable development.

For the carriers, it is the strategies of new entrant operating system providers that are of critical importance because the operators stand in the way of their direct access to their customers. To illustrate,

Apple is considering adding a software subscriber identity module (Software SIM) to all of its next generation devices.[6] The change from current SIM-card to software SIM would be a direct attack on the mobile operators, as it would enable Apple to directly interface with its access device owners through their Apps store. This would mean that a consumer accessing the Apps store chooses its carrier via an App Store download i.e. the connectivity in devices becomes an application instead of a SIM-card as today.

In contrast to Apple's investment in applications to disintermediate the operator's SIM-card dominance, Google has invested heavily in long-distance fiber capacity. More recently, it has been experimenting with various last-mile technologies to achieve access to the user's devices. For example, in Kansas City, Google is experimenting with extending optical fiber to the home. It also invested $500 million in a failed Wi-max project – again, to achieve access to the home. In 2012, Google is one of the largest data carriers in the world. Interestingly, Microsoft has not announced any significant technologies and investments that could be interpreted as a threat to mobile operators. In this respect, Microsoft's initiative appears to preserve the current roles of the ecosystem members and this may explain why Nokia, the leading cell phone incumbent, which was under severe threat from both Apple and Google's Android OS, agreed to join with Microsoft.

The common denominator for all three mobile internet ecosystems is the Internet cloud as the technology platform. The Internet cloud as a technology platform, together with new technology innovations such as software SIM, threatens to displace or subordinate the current mobile operator infrastructure with new technologies, infrastructure, and data centers. These new Internet cloud based technology platform enables mobile internet ecosystems to provide global access for an infinite variety of devices, services, and applications. These could be provided without roaming fees and the other

[6] http://www.bloomberg.com/news/2010-11-18/gsma-explores-software-based-replacement-for-mobile-sim-cards.html (accessed 6.3.2012)

charges that make the carriers greatly disliked by consumers. For the cloud providers location is largely irrelevant from a cost of service perspective. For the mobile operators this extremely profitable part of their business could decline driving their profitability even lower.

The Entrants in the New Ecosystem – Positioning for Value Capture

Prior to the emergence of mobile internet, the mobile value chain was relatively stable for many years. The mobile carriers in each country delivered service to the consumer at a standard price, the media providers supplied the content, and network equipment and handset manufacturers interacted with the mobile carriers to provide new phones (Sabat, 2002; see West and Mace 2010 on initial efforts to create mobile internet). West and Mace (2010) explain how after June 2007 the introduction of the Apple iPhone revolutionized the mobile telecommunications industry. Figure 4 illustrates the change from the perspective of the increase in wireless penetration in the United States from 75.5% in 2006 to 103.5% in 2011. Furthermore Figure 1 explains the shares of feature phones and smartphones of total wireless penetration during the same period of time. While the total wireless penetration has grown 30.0%, smartphones represent 116.5% of total wireless penetration growth and respective feature phones represent -16.5% in comparison. That said, the growing share of smartphones from 4.4% in 2006 to 39.3% in 2011 has not significantly decreased the share of the feature phones. However the feature phone penetration has continued to stay almost at the same level in 2011 as in 2006. Moreover, it is important to recognize that wireless penetration is calculated from the total number of all wireless subscriber connections.

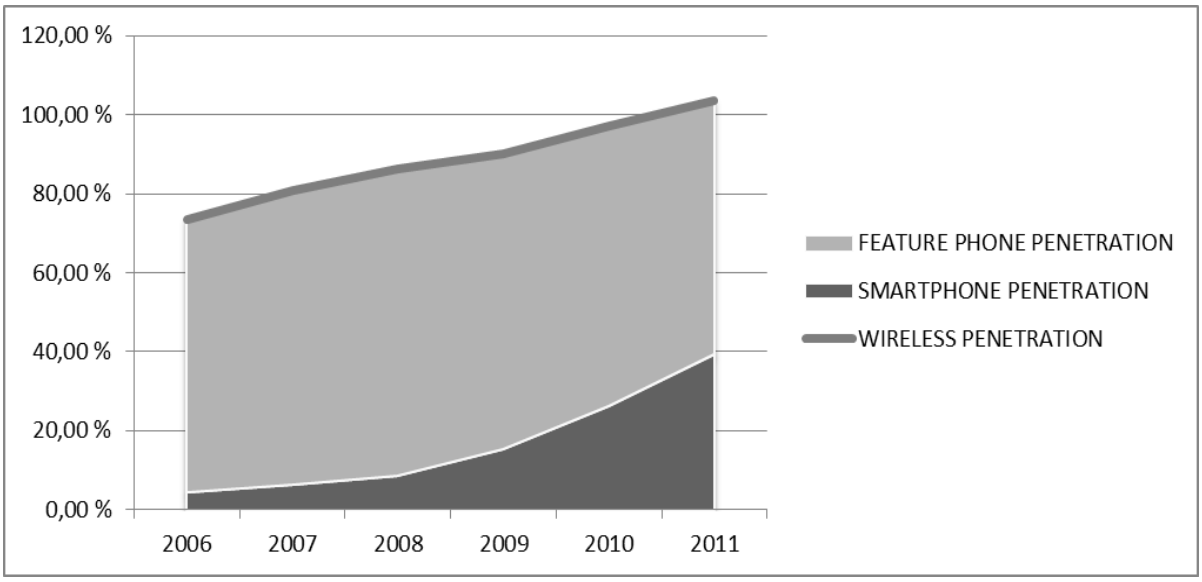

Figure 4: Wireless Market Penetration in United States versus Feature Phone and Smartphone Penetration

The iPhone was the outcome of a trajectory that drew upon the enormous success with the iPod and its experience and skill at integrating operating systems and hardware. However, the overwhelming advantage was the iPhone's ease of use for surfing the Internet. This introduction was further strengthened because Apple already had its iTunes store for downloading music which became a powerful complementary asset for the iPhone and soon evolved into the App Store, which was opened to third-party application developers (West and Mace, 2010).

The key to the iPhone was its introduction of a rich user experience, but it was also protected from other competitors by a strong technology patent portfolio (Seppälä and Martikainen, 2011). This allowed Apple to leverage the touch-based screen of the iPod and continued a migration away from the keyboard-based systems that the other vendors had introduced from the PC world. While the App Store and music downloads were significant complementary assets and are usually cited as the key to Apple's success, the application that catalyzed the transformation of that smartphone into the mobile internet was the provision of an excellent web surfing experience, which became possible due to the touch-based

screen. With this, Apple shifted the competition from "feature phones to "smart phones" and further to the "mobile Internet" and catalyzed the integration of the cell phone into the Internet. With this transformation, the most used internet access device was destined to become the mobile phone. Parenthetically, with the later introduction of the iPad, the PC itself, or, at least some of its functions, were threatened, and by extension the personal computing industry platform owner, Microsoft.[7]
The significance of the iPhone can be seen in the US market by the impact it had on AT&T, on whose network it was first introduced. AT&T's exclusive US distribution rights were limited to 3 years and 7 months, until Verizon received the iPhone 4 in February 2011.

The operators had always feared becoming utility-like access providers, as had been the case with their landline operation. Already prior to the emergence of the smartphone, operators particularly in Japan and Korea, but also globally were trying to provide value-added services to their customers. The problem for consumers is that the operator made the choices and there were no alternatives. Walled gardens, by virtue of being within one operator's purview and optimized for cell phones, were, by definition, small business ecosystems, especially when compared to the World Wide Web. The strategy was adequate as long as the device was the cell phone with limited Internet capability. However, technology was evolving.

When Apple introduced the iPhone with its excellent web surfing capabilities, the immediate result was that the worldwide web became the new ecosystem. The iPhone allowed customers to escape the walled garden and they proceeded to do just that. The benefit for the initial operator, AT&T, was an enormous increase in the profitable download traffic, but in return it had to handsomely pay Apple for the privilege and it lost the ability to monetize its customers with value-added services. In fact, with Skype and other Internet-based voice services, voice traffic itself was threatened.

[7] Interestingly, though Microsoft's partner, Intel, was not as directly threatened, its weakness in mobile integrated circuits may prove to be a long-run threat.

With Apple providing a single operator, AT&T, an exclusive opportunity to sell the iPhone its enormous success placed the other operators at a serious disadvantage. The other operators needed a phone with mobile internet access and similar user experience. Nokia was not an answer with the Symbian operating system, and Meego, another operating system platform offered by Nokia, was still on the drawing board. To meet this demand, different operators, software companies, commercialization companies, semiconductor companies, and phone manufactures established an Open Handset Alliance (OHA) in 2007. At the heart of OHA was Google's Android operating system as a free, relatively Open Source offering, fully integrated with a specific hardware, i.e. Qualcomm hardware platform. For both the operators and various mobile phone producers that could see they had to transition from feature phone to smartphone, this was an attractive platform. With Google's brand, the relatively high-quality of the software, and the fact that it was free, adoption soared (see Figure 5). Google's strategy was to attract mobile phone users to Android so other potential competitors such as Apple, Microsoft, or others could not prevent or shunt users to other search services. For the operators, however Android also permitted their customers to leave the walled garden – it also destroyed the operators hold on customers.

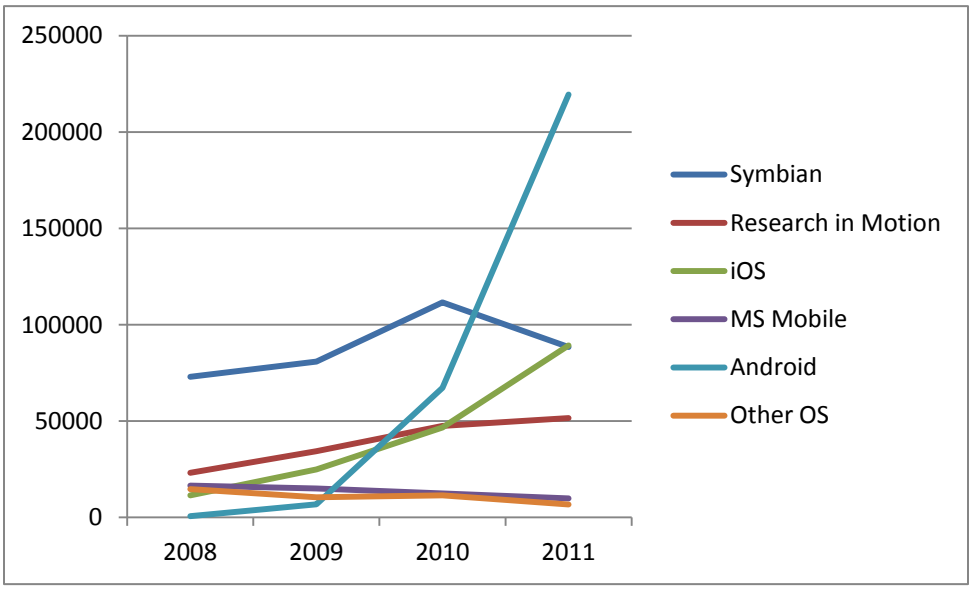

Figure 5: Global Smartphone Sales by Operating System 2008–2011 (Source Gartner Press)

While Apple was a device maker and did not directly threaten Microsoft, Google was different. Google was essentially a server of data, so it was interested in moving applications from the end-user device to its data center. More significant, was the other side of Google -- the enormous data centers (the Cloud) that could store and serve data to anywhere with cell phone access (increasingly, everywhere). With this, now applications such as those in the Office suite could be hosted in the cloud and used locally. For Microsoft, recognition of this trajectory meant that while its dominance on the desk top might be threatened, mobile phone operating systems, especially those on pad-like devices, could become a potent rival to the immensely profitable Windows franchise.[8] The arrival of the mobile Internet meant that Google, which had become the dominant Internet franchise, could possibly erode the Microsoft business. New classes of devices/users were arriving and this promised Google a tremendous opportunity to expand its market. Of course, with this opportunity came a threat, if the new users did not use Google instead adopting a different search engine on their mobile devices, it might lead to the replacement of their PC search engine and, of course, it was obvious that soon more people would be accessing the Internet from mobile devices than from PCs. The mobile Internet ecosystem could be a lever to penetrate Google's position as the dominant search engine for personal computer users. The owners of the mobile internet device operating system might be able use it in the same way as MS had used its Windows platform to disadvantage and eventually overwhelm its applications' competitors, as was the case with the Netscape browser (Cusumano and Yoffie, 1998).

While the incumbents of the PC world were discomfited, so were the leaders in mobile telephony. Apple demonstrated with the iPhone that there would be one Internet and that access was the

[8] Parenthetically, this would also threaten the Intel monopoly as ARM-based processors on mobile devices threatened the Intel franchise.

killer application for all devices. For Nokia, the dominant mobile phone firm, the competitive situation worsened dramatically. For all incumbents including Google, the threat was existential. The iPhone showed that the new economic space in the mobile world was the Internet. The mobile Internet also proved that all devices with a microprocessor/controller would ultimately and possibly quite soon, be connected to the Internet through a variety of networks. All of these devices would need an operating system and possibly one could unite them all. If all devices were to be connected to the Internet, then the heart of the convergence would be the cloud data center, where the data going to and coming from the plethora of different devices would be served from and stored at (Murray et al., 2011). This new configuration is displayed graphically in Figure 6. The Internet cloud would become the platform. This new Internet would serve multiple devices and thus a PC-centric perspective could not be sustained. It would take time for the implications of these changes to become manifest, however.

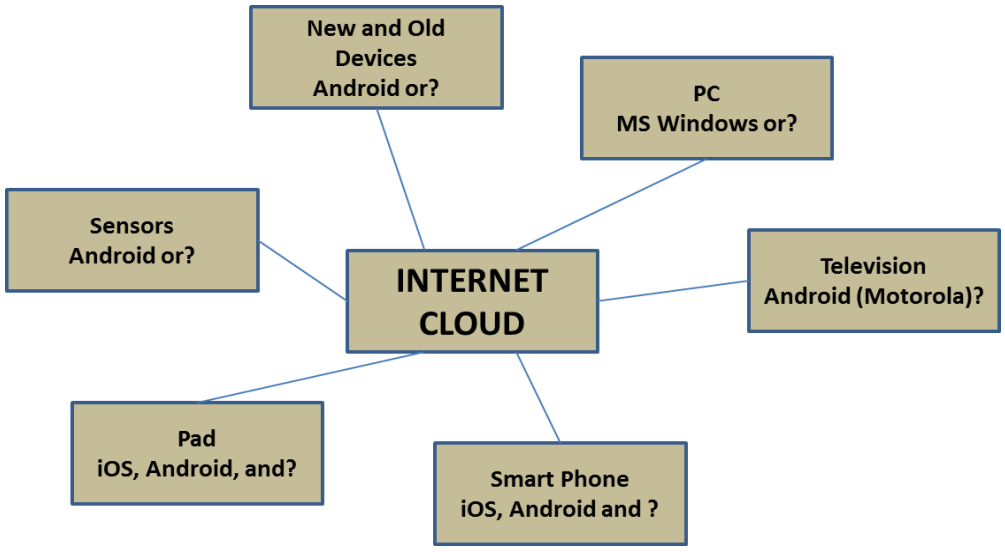

Figure 6: Internet cloud - The Heart of Industry Convergence Source: Authors.

Just as the operators are being thrust toward being commodity providers, the increasing centrality of the cloud required them to increase the capacity of their networks. The current capacity of the legacy telecommunications networks that had to be expanded to handle the increasing data consumption from the first Internet wave would once again be placed under strain from the new data communication wave. Moreover, while the dot.com bubble offered carriers the ability to raise enormous amounts of capital from the public markets, in the current environment public markets were unwilling to provide capital to operators. New radio frequencies were required to support the increased demand as cell phones became data-intensive end-use devices. As the locus of economic power shifted to content providers, the operators experienced profit declines, even as their networks experienced greater traffic (see Figure 2).

Industry Convergence, Architecture, and the Internet Value Chain/Stack

In a technology convergence, as is the case when an industry is formed, the industry architecture is uncertain. For example, when the personal computer industry was formed the industry architecture was uncertain and, in fact, two architectures emerged. The dominant one was the IBM-initiated personal computer whose core firms would be Microsoft, Intel, and the computer assemblers such as Dell and HP. The other architecture belonged to Apple, which controlled the brand and the operating system. These two architectures co-existed until the present time. Considering the industry architecture is important, because, as Pisano and Teece (2007) theorize, it shapes the distribution of returns from innovation. In the formative period, competitors experiment with creating the architecture. One of the vital strategic decisions firms must make is what portion of the entire value chain must be controlled. In the case of information and communication technology industries, this includes the stack. So, for example, Microsoft decided that it could secure its position by owning the operating systems and the major office productivity applications. With the advent of the Internet, Bill Gates, then CEO, recognized that it was vital to extend its competitive scope and it did so by introducing the Internet

browser (Internet Explorer), a portal (MSN), and purchasing an email firm (Hotmail). Later, it would introduce a search engine (Bing), a mapping application, and other applications in an effort to match Google.

There are two technological developments driving this industrial convergence. The first technological development is that the mobile phone is completing its evolution from a phone to a computer. In the process, it went from a phone with some other applications to a computer with the Internet being its most important application. The second development is that applications are increasingly moving to data centers serving data to the end user using any number of devices. The convergence is not in the user-interface device, but rather the network/data center that is serving the bits. The epicenter of this convergence is the mobile device, which requires an operating system. The number of mobile Internet devices globally will be a far larger market than the personal computer, and mobile devices such as pads may replace, at a minimum, notebook computers including those using the Microsoft operating system. For this reason, the stakes are enormous. For the incumbent mobile phone-makers the stakes are also enormous because any firm controlling the operating system will be able to determine the success of the phone maker.

Industry architectures are also affected by the strategies used for monetizing the good or service provided. This "commoditization" of such technology platforms has enabled firms such as Google to enter the market space with new business models and value propositions or those that extend their current business model to new users. In the case of Google, this is the provision of free-of-charge technology platforms integrated to its existing advertising-based revenue model. The ability to shape the industry structure, as Apple and Google appear to be doing, may allow them to become leaders as their technology and service platforms become the core of the new ecosystems.

As compared to both Microsoft and Apple, as Cusumano (2005) recognized, the Google business model has no technical or market lock-in. If a better search, email, or mapping application appears, users can quickly migrate; though there may be a high switching cost to migration. This may be similar to other Internet technologies. For example, Mozilla Firefox has experienced a significant decline in browser market share, particularly in the face of competition from Chrome. Internet market share can drop extremely rapidly, i.e. the clock speed is extremely fast (on clock speed see Fine, 1988). This fundamental fact forces Google (and all firms within the Internet ecosystem) to constantly experiment, innovate, and find new ways of retaining existing users and attracting new ones. This is best illustrated by the difficulties Yahoo! is experiencing, as it also was unable to create a platform with lock-in. The strongest lock-ins may be for firms, such as eBay and Amazon that have created widely used marketplaces.

In contrast to traditional software firms that can and do introduce new features only quite slowly, Google does not have natural lock-ins, but it can constantly introduce new features and modify existing features. So their strategy, as was the case with Yahoo!, is to continually introduce new and upgrade old services for which it can introduce advertisements.

Google

Like so many Internet firms, the core of Google's activity search offers little lock-in. Gmail and Calendar offer stronger lock-in possibilities, but again their strength is debatable. In addition to the user-friendly interfaces Google has enormous amounts of organized data – that is what YouTube, Images, Maps, Street view, Earth, Scholar, News, Books, Patent, Translate, etc. are. For example, in 2008 Google processed 20 petabytes of data per day (Dean and Ghemawat, 2008). Hosting and organizing all of this data also provides Google with powerful economies of scope and scale.

Ultimately, it is access to data that attracts users and ensures that they use Google. As long as Google can remain best or near-best in class for all of these functions, it can retain users and leverage this advantage to new connectivity devices, of which mobile is the most important.

Google has demonstrated that they understand the two different levels of network effects by separating their value capture from value creation, i.e. separating advertising profits from technology platform investments makes it is possible for it to capture the benefits of network effects. In other words, the Google business model uses a commoditized technology platform, i.e. the Internet including carriers/networks and also commoditizes different types of hardware and software technology platforms while establishing an advertising-driven revenue model (Venkatraman and Henderson, 2008).

In contrast to earlier models where the stack layers are controlled by separate firms, Google appears to be integrating many layers. Figure 7 demonstrates the variety of initiatives Google uses in various stack layers. What is interesting is that normally an ecosystem or platform leader acts as a complementor in the industry value chain/stack, not a stack integrator (Gawer & Cusumano 2008). Such an end-to-end strategy would appear to violate the normal platform or ecosystem strategies, but, if Google does not believe it has a lock-in platform, then controlling increasing large portions of the stack could be an effective defensive strategy.

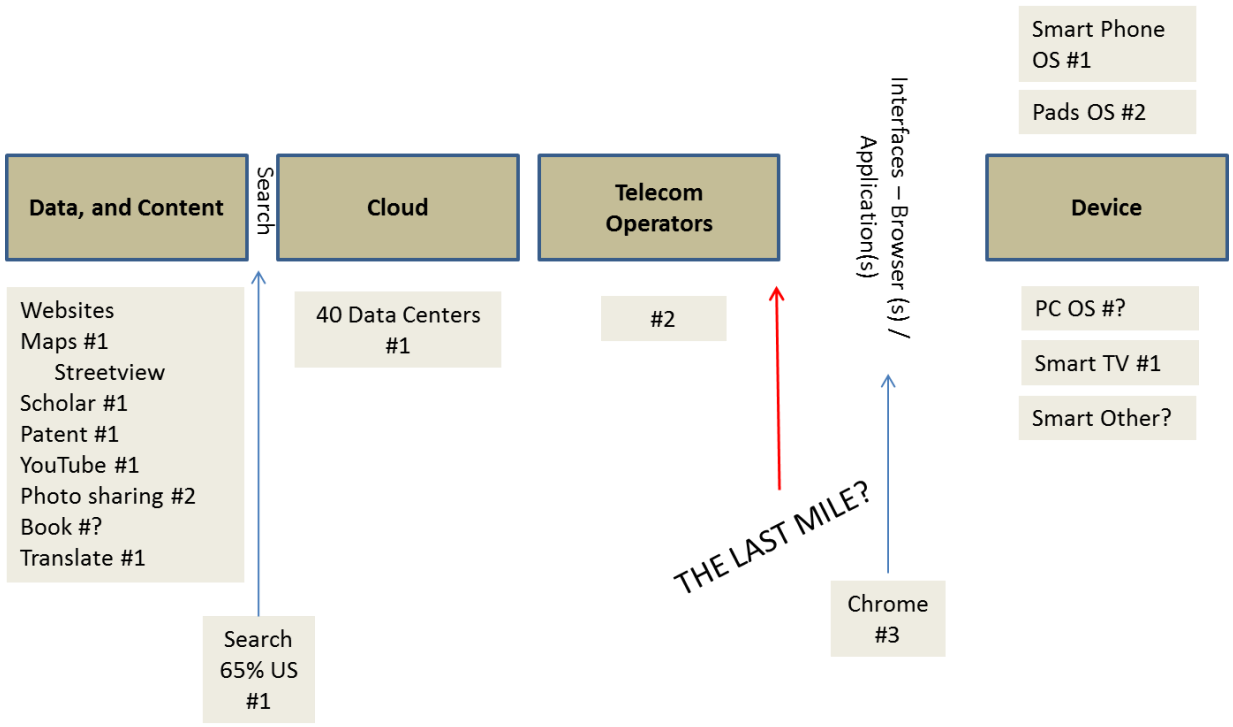

Figure 7: Google's Value Chain/Stack Integration Strategy Source: Authors.

Google's offerings do experience network effects, but they are not as tightly coupled as those of Microsoft or, those of the closed system provider, Apple. Google also captures some network effects, as it can tightly link its various offerings and follow users through the many services it offers.

In the US Google has already purchased sufficient long haul fiber access to make it the second largest data carrier in the world.[9] Because Google is estimated to generate 12% of the total US data traffic, having this capacity prevents other carriers from blocking or slowing its traffic. It also allows it to participate in decisions regarding data carriage where it inevitably argues for net-neutrality. The seriousness of its bandwidth initiative can be seen by the announcement that it was considering bringing fiber to Europe, though no concrete plans have been announced (Telecommunicator, 2011).

[9] Stu Feldman 7.2.2012 in Cloud Computing: Key questions for Economic Policy, and How to address Them, A Roundtable Workshop; The Berkeley Roundtable on the International Economy (BRIE), University of California, Berkeley

The Android operating system, in contrast to other Google products, could develop powerful network externalities if it enables the introduction of new devices, applications, and related services thereby expanding the market. Prior to the shift into the mobile Internet field, Google's business was based on the open and unowned Internet protocols - they were the platform. In certain respects, this changed when it released the Android operating system. Conceived as relatively open and free, Android threatened not only incumbent cell phone firms but also Microsoft, which was endeavoring to extend its operating system monopoly from PCs to mobile phones and Apple with its closed garden approach. As Google expanded from the relatively open and uncontrolled Internet world to other technology areas, such as operating systems, it entered domains within which intellectual property can be used to bar competition. While Google spends over 10% of revenue on R&D, it had not been active in patenting. Because in the mobile communications industry patents can be extremely important, Google has been forced to strengthen its patent portfolio.

While Android is a platform, its openness allows all vendors to build their own brand, and provides them with some protection against commodification. In this respect, the Samsung Galaxy brand is the most significant and most successful illustration.

Google's experimentation with various strategies for circumventing the operators' control of the last mile opens the potential to circumvent the operators completely. The strategic reasons for this are unclear, and could be merely the creation of a credible threat to prevent operators from creating environments excluding Google's search engine. Also, the experimentation may operate as an implicit threat to encourage the operators to upgrade their last-mile networks, as Google wants to encourage increasingly fast and cheaper access to the Internet so that it can deliver still more advertising. Finally,

securing direct access to users' homes would eliminate the ability of the cable and landline operators to block access to televisions and other devices in the home.[10]

Google's interest in securing access has taken a number of forms. For example, in 2008 Google invested $500 million in a 4G WiMAX scheme that was meant to develop a wireless last mile link to the home. This scheme failed and in 2012 it sold its stake at an enormous loss (Priyo, 2012). Google is also undertaking a project to provide high-speed fiber for television and other services to Kansas City homes. This would place it into direct competition with the landline telephone and cable firms for the last mile. Even if Google does not proceed with a large-scale last mile effort, the creation of a credible threat may be sufficient.

Another area within which Google appears to be making headway is in office productivity applications delivered from the Cloud – this will lead it into directly confronting Microsoft. The scale of adoption of Google Apps by enterprises is difficult to measure. For example, a 2011 estimate is that it generated approximately $400 million in revenues (or 1% of total Google revenue). Increasingly, enterprises appear to be accepting certain apps such as email, internal search, browsers and other communication applications. Further, an ecosystem may be forming around Google Apps (Walsh, 2011) that, if it continues to expand, will threaten the core of the Microsoft business, Office. The question for Microsoft is whether Apps adoption proceeds from the Internet-linked applications such as email and browsing to office productivity.

Google is intriguing because it constantly intrudes into the markets of other firms across the entire IT industry. With its huge cash flow from advertising, it can fund large-scale experiments, any one of which might provide new demand for data that can be served with those advertisements. Threatened firms cannot predict Google's intentions in advance, thereby making them vulnerable to

[10] In February Google announced that they were an Internet provider of "ultra-high-speed broadband" for up to 500,000 customers in a US city. http://www.google.com/appserve/fiberrfi/public/overview (information retrieved 26th September, 2011)

coercion. Its leverage is that it can offer, at least some, services for "free" because its monetization is through advertising – a situation that makes it even more vexing to conventional competitors that require direct compensation for products and services.

Currently, Google's threats are most salient in the mobile space where it has an opportunity to participate in the definition of a new ecosystem. In certain respects, this is similar to what Microsoft was able to do in the early days of the PC industry. An alternative explanation of Google's initiatives is that the emerging market is still unformed, and each initiative is simply exploratory. This may be explained by the fact that when Google was formed it was not initially obvious how it would monetize search. It only gradually came to understand that advertising was the proper business model. The emergent nature of Google's strategy is particularly obvious when compared to Apple and Microsoft. Apple progressed from iPod through iPhone and iPad to the iCloud. Microsoft's goal is to protect and extend the Windows-Office monopoly/synergy in the movement to the cloud. Google, in many respects, appears less consciously directed and, perhaps, like the Internet itself depends more upon the emergence of new opportunities.

Conclusions and Discussion

Google is disrupting the business models for many ICT firms as the Internet threatens devices, network equipment providers, and network operators with commoditization and using advertising to monetize providing data (in its myriad forms – images, sounds, maps, written content, etc.). Were Google's Android to become the operating system leader for the mobile internet, it would not directly compete with other industry participants, device makers or operators, as it offers Android as a complementary asset for its mobile internet ecosystem members that enables them to commercialize

their innovations, but for Google it would allow them to control the platform to sell more advertising. Other ecosystem members would have to differentiate themselves by product offering.

Google's technology and service platform is a complementary asset that takes into account all different forms of complementary assets: generic, specialized, and non-specialized. To illustrate Google provides technologies and service platforms such as Google Play, operating system Android, Internet cloud and other technology and service platforms freely to different stakeholders of its mobile internet ecosystem members, but also to consumers. It may impede, however, the other ecosystem members from capturing monopoly rents as they are constantly in competition with other firms using the platform. Finally, as we have shown, because of Google's weak lock-in it must protect itself by having positions in the largest number of spots in the value chain/stack.

Google's, as well as several other firms, mobile internet strategy aligns with the current network neutrality rules particularly for Internet delivery. The goal of network neutrality is to treat all content, sites, and platforms equally in the Internet. This is opposite to carriers' aspirations. The carriers' current strategy is to accept Internet-based neutrality for long-haul and possibly the wire into the home, but for the mobile Internet they would like to control and channel the data flow. Because this is a fundamental threat, Google is experimenting with building its own optical fiber networks with a last mile access.

According to network neutrality rules in mobile Internet the carriers have an opportunity to limit the network traffic, e.g. in the networks equipment there are several algorithms available to manage available bandwidth, in both ends of the networks, provided to individuals, both, firms and consumers. Furthermore, these algorithms can be used to manage the traffic between networks, e.g. from the Google network to the Verizon network and vice versa. In the Internet, and due to Internet neutrality rules, these limitations are not possible.

Carriers' future may be determined by the regulators if the network neutrality rules of the Internet are extended fully to the wireless world. The carriers will be relegated to being commodity service providers as even voice is carried through programs such as Skype (owned by Microsoft), which could significantly depress their income even while they must build out more bandwidth. If network neutrality rules are not extended to the mobile Internet, then it may be possible for the carriers to reestablish their control, though this is by no means certain because Microsoft, Google and Apple have sufficient financial resources to purchase the carriers.

It can be also argued that the competition in mobile Internet is becoming N-dimensional. N-dimensional refers to a space of competition rather than actually specifying a certain number of dimensions of competition, because any part of a business model can attract a competition. By analyzing the N-dimensional competition several areas can be considered: 1) Feature-by-feature; 2) Application-by-application; 3) Operating systems; 4) Device-by-device; 5) Intra- and/or inter-stack layer competition; 6) Data center management and 7) Ecosystem recruitment to mention a few of the most salient. Business model unification comes in the Internet cloud, which creates a common platform for data and content, while users access the data and content through multiple devices. The Internet may be becoming more than a platform for data and content -- it may be the technology platform upon which all new ICT business models and related services, device and application platforms are implemented. It is becoming the nervous system for a multi-device environment and as such a new digital tower of Babel is being rebuilt. The firm or firms that can achieve centrality in this new world will be in a position to extract value from the largest business ecosystem ever created.

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