December 5, 2012

Wireless Cloud Computing Strategy

COMMUNICATION AND CLOUD

SUMMARY

The advent of smartphones and cloud computing has more than doubled the overall market opportunity for traditional communication services companies from $400B to an estimated $800B. Much of the immediate opportunity is within wireless data. We are in the early stages of wireless growth, but the fourth wave of new technologies. While wireless data growth has been strong, up to this point profits have disproportionately gone to Apple's iOS and the Internet content providers. We expect some of the profitability to now shift back to the carriers from higher usage-based ARPUs and application revenue and most importantly lower handset prices. Specifically, Android-based phones are seeing major reductions in prices and market share gains. The combined profit potential for the carriers represents a $20B EBITDA opportunity over the next six years.

KEY POINTS

- If we are correct, we believe that the leaders in the wireless industry can grow revenues in the 6% area, EBITDA at 9% and FCF at 12% over the next five years. We examine three core areas for improved EBITDA growth throughout this report. These new revenue opportunities should help customer lock-in and churn, the major expense item for carriers. In addition, we evaluate the primary enablers of the wireless cloud computing strategy—cloud computing, LTE, and HTML5.
- We believe that the communications industry will undergo major structural change over the next five years with traffic shifting to wireless networks and applications to remote data centers. This in turn should drive more centralized computing storage and processing, which should significantly increase the competitiveness of simple low-cost devices. When cloud computing matures, consumers will be able to access their content over any screen/device.
- Cloud computing is still in its infancy, but it is evident that wireless access has become a core enabler in transforming computing into a utility sold over the Internet (Amazon is the current leader in this application); the ability to access content/computing power through dozens of new wireless and wireline devices has tremendous appeal to consumers as well as enterprises.
- We believe that there is a natural marriage between mobile connectivity and cloud computing, and that the carriers can take advantage of this to reshape the industry for their benefit. The carriers are positively adjusting their underlying pricing model with a complete shift from voice and text usage to data.
- Some of the major implications of this will be a huge proliferation of new end-user devices ("thin" devices), greater data usage, and more network-based computer storage and processing. The primary leverage that the carriers have is control of the wireless (spectrum) pipes that connect what is relatively commoditized hardware (end-user devices and data center-based servers), and partially commoditized content/applications.

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Executive Summary: Wireless Industry Disruption Set To Accelerate

The advent of smartphones and cloud computing has more than doubled the overall market opportunity for traditional communication services companies from $400 billion to an estimated $800 billion. Much of the immediate opportunity is within wireless data, an $80 billion business growing at 15% per year, representing a majority of the communication sector's growth. We are only in the first inning of cloud computing, but probably the third inning of wireless data. While wireless data growth has been strong, up to this point profits have disproportionately gone to Apple's iOS and the Internet content providers. We expect some of the profitability to now shift back to the carriers.

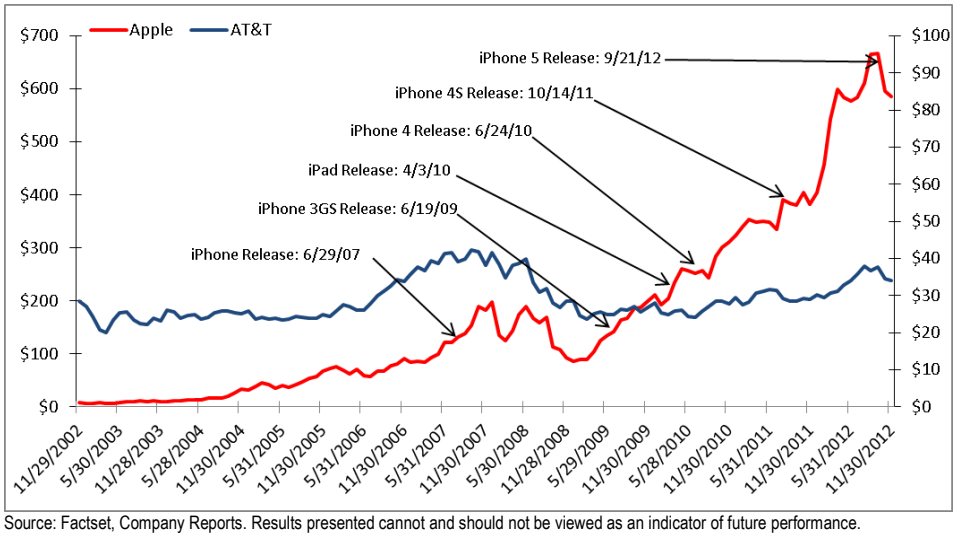
The specific opportunity is higher usage-based charges, lower handset and data device prices (declining at 30%-plus per year) and multiple new application revenues. The three primary areas of improved profit potential for the carriers represent a $20 billion EBITDA opportunity over the next six years, including:

1) More usage-based data revenue	$5 billion
2) Lower handset subsidies	$5 billion
3) Content providers paying for user data	$5 billion
4) New cloud-based value-added applications	$5 billion

The above cash flows are meaningful to a domestic wireless industry generating $70 billion of EBITDA and $30 billion of unlevered cash flow currently. The key for many of these new opportunities will be the LTE network build-out, which will enable some of the computing/application functionality to shift to the network away from the handset devices. In the US, T and VZ own the most valuable spectrum and consumers, and given limited supply and strong demand, we believe that they have pricing power. While T-Mobile and Sprint will likely improve their services, we still see them largely as subscale competitors with limited spectrum and limited ability to price compete, but believe they will ultimately merge.

It is fairly critical to the long-term value of the wireless carriers/telcos, though, to regain control over the customer and to have more network-based applications, more so to AT&T than Verizon as more than two-thirds of its smartphone customer base is on the high-subsidy Apple IOS versus less than a third for Verizon. Positively, the open based smartphone OS, Android, seems to have dominated the market, and prices for these devices are plummeting. The telcos do have several other advantages to accomplish this including their ownership of wireless spectrum and backhaul, and existing customer relationships. This influence can be seen in the growth of tablet/data devices that are seeing a huge decline in pricing and for which the carriers do not directly subsidize. However, they do need better application hosting and cloud services capabilities, and we would expect them to look to make acquisitions to improve these capabilities. In our coverage universe Rackspace is a likely target with Akamai more likely a strong partner but also somewhat of a target. Time is of the essence for the carriers as cloud business models are scale dependent and mostly winner take all, as can be seen by Apple's stock price and the fortunes created in Facebook and other cloud companies.

Exhibit 1: AT&T vs. Apple Stock Price



Source: Factset, Company Reports. Results presented cannot and should not be viewed as an indicator of future performance.

We believe the carriers have been willing to earn lower profits over the last few years to stimulate the wireless data food chain and to capture the high-end customers in family plans. They have also had to completely alter their business models (switching from metering for voice with unlimited data to metering for data with unlimited voice). This strategy has worked out so far, and will prove prescient if margins expand as we expect. If we are correct, the leaders in the wireless industry can grow revenues in the 6% area, EBITDA at 9% and FCF at 12% over the next five years. We go through the three areas for improved EBITDA growth throughout this report. These new revenue opportunities should help customer lock-in and churn, the major expense item for carriers. In addition, we evaluate the primary enablers of the wireless cloud computing strategy–cloud computing, LTE, and HTML5.

Essentially, we believe that the carriers will be able to leverage their control of the wireless pipes to favor the lower cost Android OS or others and to help create a third OS (lowering handset subsidies) and then encourage content providers to pay for customer data usage (having tiered data is a critical part of this strategy), and also create certain applications of their own (services which also may not count toward the data usage). Given Android's global adoption this could also force Apple to lower subsidies.

The biggest risk to our forecast is if:

1) Regulators provide stringent net neutrality rules to wireless (we are not concerned about this in the next few years)
2) The Android OS share gains reverse to Apple, unlikely in our opinion, but the Android OS does need to be managed
3) The carriers do not execute on the apps/content/cloud strategy

On the regulatory front, the carriers have negotiated much less stringent net neutrality rules on wireless versus wireline. They have successfully argued that spectrum is scarce and the nondiscrimination obligations on wireline should not apply to wireless. While we do not believe the carriers can outright block a voice/text or video application, they can have the content providers pay for the data transport or even for prioritization. We think even the current limited net neutrality rules have a good chance of being overturned. In this regard net neutrality rules on wireline have been appealed to the DC Circuit court and have a very good chance of being overturned (this court has already overturned a form of the rules based on the Comcast/Bit Torrent FCC rulings and overturned a majority of the FCC orders over the last two decades).

On points two and three above, Android has gone from 10% share to 68% of the smartphone market in the last three years. Subsidies for Android devices are usually 20%

to 50% below iOS and are declining and Android is open to application development and revenue sharing. We do expect that Microsoft 8 will become a viable niche OS provider with possibly 10% market share (particularly for customers looking for enterprise and personal usage devices on one tablet), which could also help the carriers with negotiations. The carriers have a huge vested interest in supporting Microsoft, and we believe Microsoft has almost no choice but to pour huge resources at 8. On the last point, this is a fairly large risk, and the carriers will need to partner and we believe make acquisitions. In this regard, Verizon and CTL have already done so with their cloud managed services acquisitions (Terremark and Savvis, respectively), which have leveraged their network and customer relationships. AT&T has grown more organically and through partnerships and has seen applications become almost a billion-dollar business from less than $100 million four years ago.

The Ten Implications of Wireless Broadband

1. New communication media always drive new content and new suppliers
2. Consumers demand a web experience for all content and apps
3. Innovation of Apps on LTE will balloon--mobility, low latency, high speeds
    - The next Google, Facebook is in a garage
4. Usage per device will be more than expected
5. Network CAPX will be high but revenues will be better
6. Android has won the OS war (lower subsidies, apps revenue for carriers)
    - Fourth wave of devices--Motorola, Nokia, Apple, Android
7. Handset prices heading to $100 and standardized
8. Content providers will start paying for an app cross platform
9. Customers will stop paying for voice and SMS
10. Positive for towers, data centers and fiber providers, and cloud service providers

Mobile Broadband Cloud Computing: The Next Step

Consumers and app providers want network-based applications that they can access over any device, and the LTE broadband will enable this. If we think back to the 1980s-90s and all the software disks (quicken, AOL, etc.) that were needed to download and then maintain applications on PCs, and how broadband has enabled the transition to network-based software, we can envision the transition from device-based apps to the network that this industry is about to make. Smartphones are geared toward mobility and accessibility, which is exactly what customers have come to expect from the web experience on PCs. Consumers want web browsing, e-mail, content, gaming, streaming video, voice, and text, and want it quickly and on the go.

We believe that as LTE becomes ubiquitous in the next few years, combined with Wi-Fi, consumers will be receptive to the idea of “thinner” mobile devices, especially if they come with lower up-front costs and improved functionality. This was also the case with wireline; as broadband has become ubiquitous and speeds approach 5 MBs, we have seen a huge uptake in Internet usage and cloud adoption. Consumer data costs will rise slightly, but will be aligned with usage, and we suspect subsidized by the content providers (a triple positive for the carriers). At this point, we believe the consumer could then elect to upgrade to a larger/better screen, longer battery life, and multiple other non-essential but value-added peripheries.

We see this as the fourth wave of wireless but the third wave of mobile data, with the first being relatively simple texting and email communications between 2002 and 2006 (Nokia’s phones did texting well), the second being Apple’s iPhone, which introduced consumers to mobile web surfing and smartphone apps over 3G wireless data networks, and now 4G (a five- to ten-fold increase in speeds to the 5 to 10 Megabit range) with an explosion of new data devices and applications dominated by the Android. This new medium will drive the industry in organic, unpredictable ways, but we believe that centralized computing storage and processing will become the dominant infrastructure. This in turn will enable simple, low-cost end-user devices. When cloud computing matures, consumers should be able to access their content over any screen/device; in fact, this is one of the advantages that Microsoft has in the process. Regardless, chances

are this new broadband wireless network will enable a new and difficult to predict OS and device food chain (in this regard, analysts were deeply skeptical about Apple's initial iPhone, which was made possible by the last wireless technology shift (from 2G to 3G).

Cloud computing is still in its infancy, but it is evident that wireless access has become a core enabler in transforming computing into a utility sold over the Internet (Amazon is the current leader in this application and will likely remain so); the ability to access content/computing power through dozens of new wireless and wireline devices has tremendous appeal to consumers as well as to enterprises. In fact, consumers are driving the process with their bring your own device (BYOD) craze, due we believe, to the desire for mobility. The appeal of mobility can be seen through wireless voice, which has gone from 10% market share ten years ago to 65% today. We talk at length about cloud services and network-centric computing in our *Cloud Services White Paper* (9/20/11), and *The Genie Is Out of the Bottle–Applications Separating from the Network* (6/11/09), so we won't belabor the subject here. Our focus on cloud computing for this report relates to how we envision the wireless industry given more recent trends in cloud services. For added convenience, we've included a review of consumer demand drivers as well as an overview of HTML5 in appendices 1 and 2, respectively.

We believe that there is a natural marriage between mobile connectivity and cloud computing, and that the carriers can take advantage of it to reshape the industry for their benefit. The carriers are positively adjusting their underlying pricing model with a complete shift from voice and text to data usage per contracted family. We view this as the correct pricing as the wireless industry shifts to a multipurpose all-IP network with applications becoming separated from the network. Among the major implications of this will be an explosion in innovation and usage, helped by lower cost end-user devices (thin devices) and computing (in the data center/Amazon). The primary leverage that the carriers have is control of the wireless (spectrum) pipes, customers locked in on family plans that connect what is relatively commoditized hardware (end-user devices and data center-based servers), and partially commoditized content/applications.

Open Wins

The history of the computing industry shows that over time hardware becomes standardized and commoditized, although this can take a decade. It also shows that customers want open standards, multiple suppliers and to avoid lock-in. This drives the computing industry to a horizontal structure over time (as do most competitive industries), with the lion's share of profits in the computing industry accruing to those that control a relatively open operating system (the neutral connectivity point that connects software/applications with the hardware) or have unique applications and in our case infrastructure (spectrum, towers, etc.). This is largely why Microsoft dominated the PC industry despite Apple's enormous head start in the early 1980s, and Apple's relatively closed system looks at risk of some of the same disruption from Android. While Apple may be able to continue to innovate its way to industry dominance, 90% of innovation in cloud services has occurred in highly unpredictable ways.

As is typical in the early stages of a new technology, having a more vertically integrated platform enables initial growth, which Apple has done very well. However, consumers want a consistent ubiquitous experience, and with this fourth wave, we expect Android's open system to dominate due to having much lower costs and higher innovation. We also expect the carriers to try to create an overlay cross-platform OS that will enable most applications to work on any wireless device. We think that the carriers are well positioned to play a crucial role in what will effectively become the operating system of wireless cloud computing. Previously, the carriers only provided connectivity between separate devices or systems; however, as processing moves to the cloud, connectivity becomes the essential component of device operation in addition to device communication. The carriers' strength lies in unique infrastructure, and we do not believe that they can create a global application cross-platform, but they can individually encourage it.

In this regard, we believe the networks will help be an intermediary between the web browser and data center with a function analogous to that of a highway toll operator (or a PC bus in computing). As a prerequisite for wireless cloud computing, dozens of popular hardware devices have to be able to read and write to almost every piece of software or

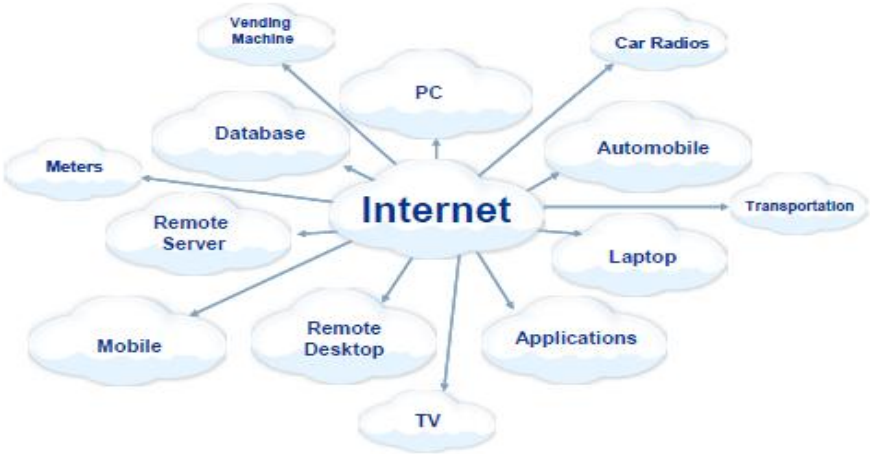
content imaginable, and the carriers (specifically AT&T and VZ) most likely with partners such as Akamai are the only ones with the neutral powers to enforce this, in our opinion. Indeed, setting global standards was one of AT&T's primary value adds for the first hundred years of its existence, and having a global standard for the Internet shows how powerful it can be. Please refer to our section on OS Standardization for additional information.

Having a global operating system that is neutral and open will be key to seeing lower cost hardware devices and innovation in applications and the Android appears to be becoming just this. Some early signs of lower cost devices driven by Android can be seen in the tablet market, with the Kindle Fire, Nexus and Nook, which is in turn driving down the price of the iPad mini and Microsoft's surface. If the Nexus retails for $300, we believe it will be selling close to cost, with Google hoping to benefit from unique application revenues that work better on its device than on others. The major problem for consumers and app developers with these devices is that each type of device has its own app format and app stores and they are not often interoperable, yet the various pieces of hardware and associated interface are rapidly converging to look very similar.

Having interoperable apps was a primary goal of Google's Nexus lineup of devices. The reason for this is that within the Android family of devices each of the major hardware manufacturers pre-installs its own software and "bloatware" to create differentiated services and customer lock-in. Google's answer to this is the "Nexus" family of devices which run a pure commoditized version of Android. We see the move to more standardized hardware and OS (app stores) as an outgrowth of the same problem, given that consumers want the same experience on wireless that they have on their PC computers, with applications working seamlessly on any device. Another, more open, smartphone is being developed by Firefox, the very successful open and standardized web operating system that has developed an open operating system for wireless devices utilizing HTML5. If history is any guide, the new 4G wireless wave will see a major surprise in the device lineup and a shift in dominance.

As a result, we believe that consumers will soon become agnostic about which device they want and, therefore, less attached to a particular brand. We believe network speed, cloud infrastructure, security, privacy and the ability to access any application or content (personal or professional) on any device will be critical to consumers. As attachment to specific devices wanes and devices become thinner and more standardized, we believe handset costs and subsidies will decline (as witnessed by tablets in recent years). Ultimately, we expect that in a couple of years, consumers will focus less on Apple, Android, or Windows and more on network speed, interface and seamlessness/openness of applications/content. We believe that having a more open global carrier-controlled OS will reduce costs across the board and make the experience better for consumers and enable more of the content and storage to be accessed from the cloud (or the Internet). In essence, this is the experience consumers now have on wireline and which we expect to migrate to wireless.

Exhibit 2: Cloud Services Universe

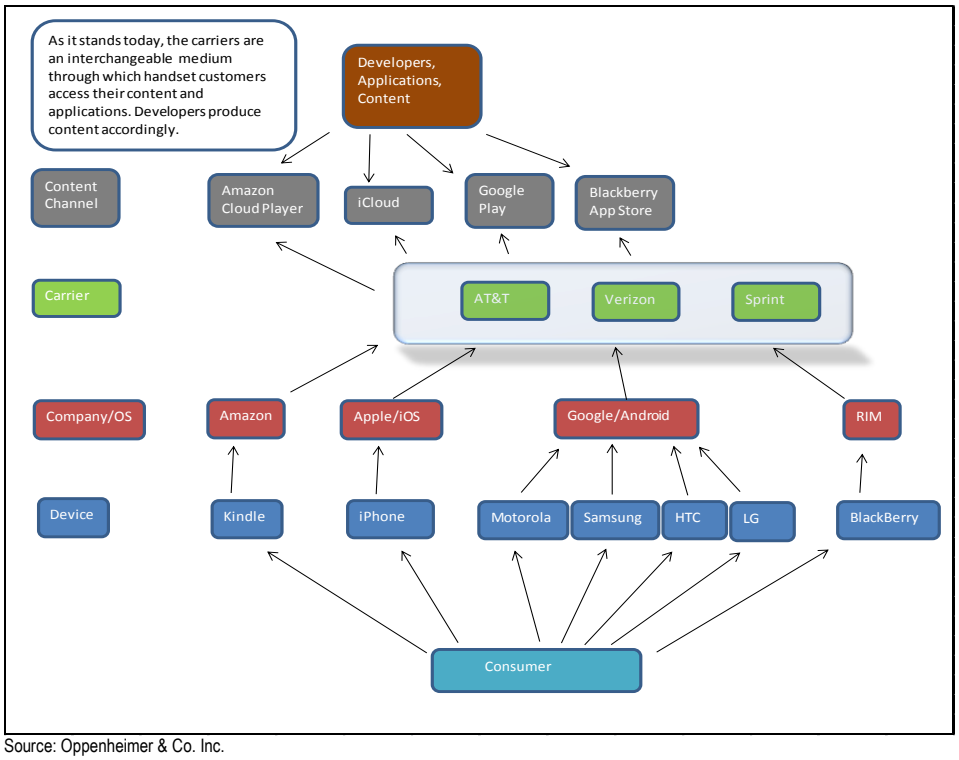


Source: Oppenheimer & Co, Inc.

LTE and Open Web Will Transform Wireless

It will take several years for the carriers' wireless strategy to play out, but the emergence of data-only devices is an early indicator of the improved balance of power and profitability for them. In the meantime, consumers remain focused on the phone's form function first (with the associated app store) and the network capabilities second, although there has been a very high correlation with network quality and share gains and hence margins. The carriers therefore end up heavily subsidizing the smartphones to attract subscribers. An added dilemma is that now a majority of smartphone sales are coming from current smartphone subscribers rather than from feature phone subs. This means that ARPU increases relatively less as a result of each sale while equipment costs remain elevated. We can see from Exhibit 3 how the carriers are currently in an unfavorable position to change these dynamics. That said, the Android ecosystem is gaining share (see Exhibit 13), and these subsidies have been declining and will continue to decline probably in the 5% area per year, which will put pressure on Apple to lower subsidies as its devices no longer have a significant advantage in functionality.

Exhibit 3: Current Competitive Landscape in Mobile



Source: Oppenheimer & Co. Inc.

The number of connected devices is growing at 20% per year, and wireless data has been doubling every year for the last five (see Appendix 1). The carriers have been growing data ARPU by over 20% per year, and it now represents a majority of revenues, but the definition is becoming meaningless as services are now bundled together (much the same has already happened in wireline). As we can see from Exhibit 4, average postpaid data ARPU for the three largest carriers has more than doubled from $9.67 in 2007 to $19.73 in 2011. Our CAGR estimate over a seven-year period is nearly 15%. Given AT&T and Verizon's success in moving customers to tiered data plans, our estimates are likely on the conservative side.

Exhibit 4: Postpaid Data ARPU

Carrier	2007	2008	2009	2010	2011	2012E	2013E	2014E	CAGR
Verizon	$ 9.87	$ 12.86	$ 15.19	$ 17.77	$ 20.57	$ 23.46	$ 25.80	$ 27.74	15.9%
AT&T	$ 9.00	$ 12.05	$14.71	$16.86	$18.52	$20.51	$22.56	$24.37	15.3%
Sprint	$ 10.14	$ 12.88	$ 15.89	$ 18.28	$ 20.10	$ 21.91	$ 23.56	$ 24.73	13.6%
Average	$ 9.67	$ 12.59	$ 15.26	$ 17.63	$ 19.73	$ 21.96	$ 23.97	$ 25.61	14.9%

Source: Company Reports, Oppenheimer & Co. Inc. estimates.

However, if we turn to Exhibit 5, we can see how the carriers' currently unfavorable industry position has affected their earnings potential. Wireless EBITDA margins have fallen from 32% to 29% on average for the industry, with a large bifurcation between VZ and T and the rest of the industry. If our thesis on carriers using the control of the network to lower expenses and grow new revenue streams is correct, we believe that the industry can grow margins by 500 basis points-plus in the next five years in total. We detail the network dynamics in the next section.

Exhibit 5: Wireless EBITDA Margins (As a % of Total Wireless Revenue)

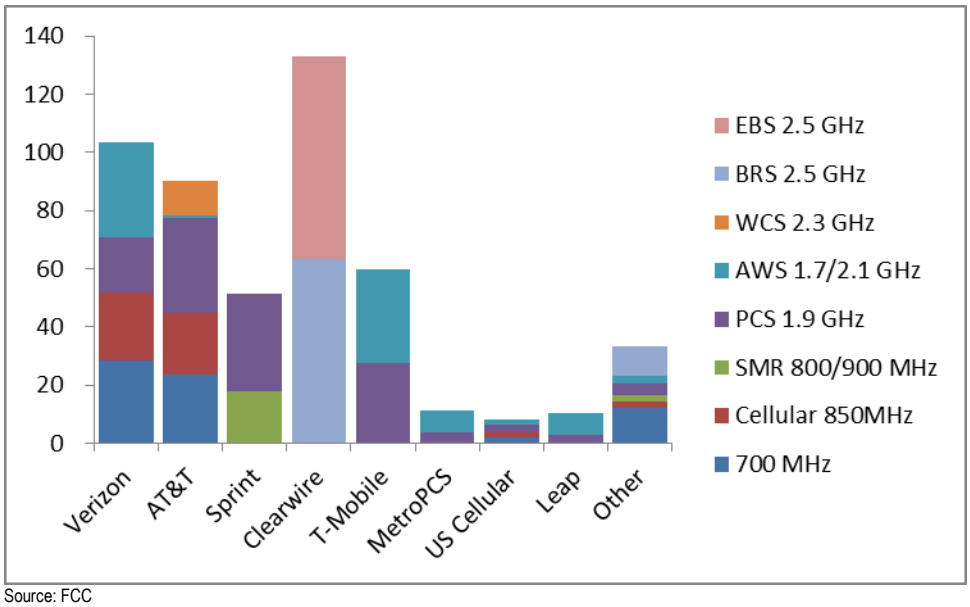
Carrier	2007	2008	2009	2010	2011	2012E	2013E	2014E	CAGR
Verizon	*38.6%*	*39.3%*	*39.5%*	*41.2%*	*37.8%*	*38.9%*	*39.6%*	*40.5%*	0.7%
AT&T	*34.8%*	*36.0%*	*37.1%*	*37.2%*	*34.2%*	*36.3%*	*38.5%*	*39.3%*	1.7%
Sprint	*28.6%*	*22.3%*	*18.7%*	*15.8%*	*14.1%*	*13.2%*	*15.1%*	*19.9%*	-5.0%
T Mobile	*27.7%*	*28.0%*	*27.5%*	*25.7%*	*25.8%*	*26.0%*	*25.2%*	*24.6%*	-1.7%
Average	*32.4%*	*31.4%*	*30.7%*	*30.0%*	*27.9%*	*28.6%*	*29.6%*	*31.1%*	-0.6%

Source: Company Reports, Oppenheimer & Co. Inc. estimates.

Demand for Wireless Broadband Equals Pricing Power

The carriers, which control the quantity and quality of spectrum necessary to utilize LTE, have effectively become the gatekeepers of wireless broadband. With supply unable to keep pace with demand, securing an attractive price for bandwidth and data usage will become a primary consideration in consumer spending habits. The FCC has historically been very slow to issue new spectrum, and this is unlikely to change. Verizon and AT&T currently have the best-quality spectrum by a wide margin, owning almost all the beachfront spectrum below 1GHz. The limited supply of spectrum can be offset by higher CAPX spending (more cell splitting), but this is extremely expensive for the subscale carriers which would need direct increases in revenue to remain solvent.

Exhibit 6: Population Weighted Spectrum Holdings by Carrier (in MHz)



Source: FCC
Note: Reflects Spectrum Holdings as of 2Q12

By placing caps on data usage the carriers can now acquire more control over what is not billed under these caps, influencing hardware and content choices. Recent pricing moves include:

- July, 2011: AT&T and Verizon move to tiered data plans; previously offered unlimited plans.
- May, 2012: VZ will allow grandfathered customers to keep existing unlimited data plans, but only if they keep their existing device or buy a new one without subsidies.
- July 2012: VZ rollout of the shared data plan, a critical move to increase data devices on the network and lock customers in. AT&T follows suit in September.
- July, 2012: T and VZ abandon promotion of 50GB of free storage space from Dropbox for the Samsung Galaxy Smartphone.
- August, 2012: AT&T restricts use of Apple's Facetime app to shared data plan members only. We note that AT&T voluntarily lifted the restriction in November, but believe this demonstrates the potential control carriers can wield over their respective networks.

The most important of the pricing moves is the shared data plans, which can have up to ten devices per data plan. These bundled device plans with tiered data buckets have multiple benefits.

1) They limit the cannibalization potential of voice and texting applications with unlimited usage per smartphone device,
2) They encourage consumers to use more data devices on cellular networks, driving longer term data usage and ARPU and locking customers in with devices that are not subsidized;
3) They shift carrier lock-in away from the two-year handset upgrade cycle to the number of devices on the shared data plan and the stored content in the carrier's cloud services offering; and
4) They limit the attractiveness of unlimited data offerings per device that Sprint and T-Mobile promote (despite their protestations).

The risks to the pricing power are competitive and regulatory. On the regulatory side we are optimistic. One of the reasons is a 2011 Supreme Court decision, in AT&T vs. Concepcion, that consumers no longer have the right to file class action lawsuits against wireless carriers. This means that the FCC is the only means by which net neutrality can be enforced. This gives the large carriers flexibility in terms of how they can utilize their unique wireless and wireline assets. In addition, from a consumer perspective, wireless quality and utility will continue to explode to the upside, creating limited anger against the industry.

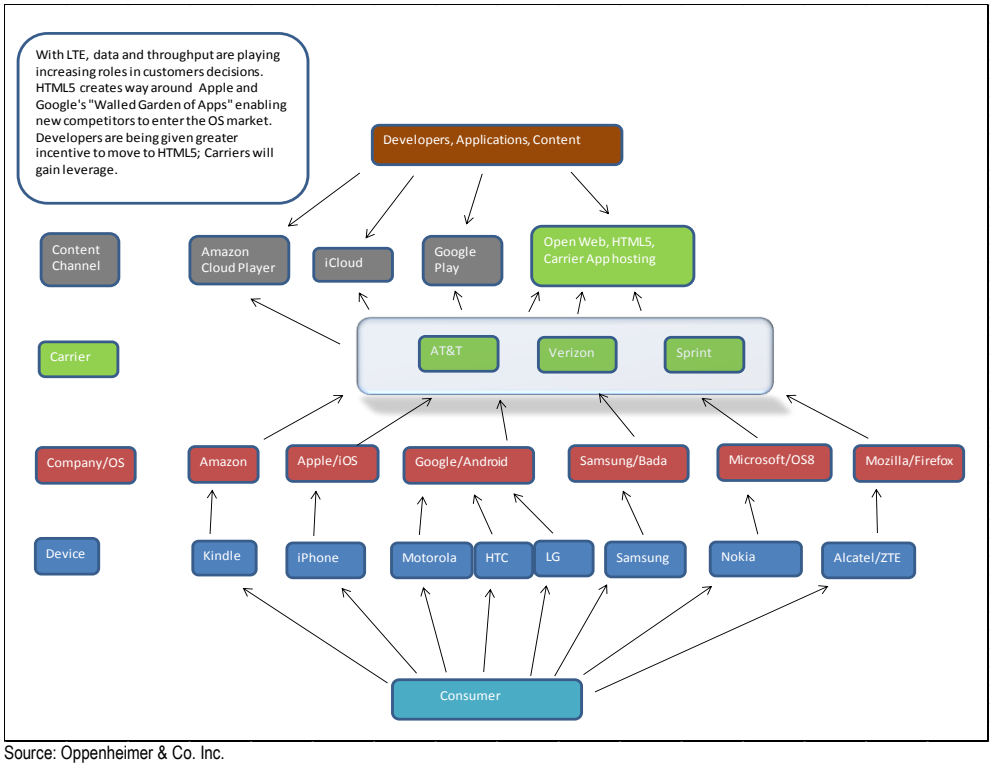
Carriers Look to Reduce Power of iOS App Store

The carriers and AT&T in particular are looking to enable apps to be more open and easily accessible on any device. The content providers also want this because they do not want the expense to support dozens of different device Oss, not to mention browsers. The carriers would like to host the apps directly on their networks and convert them to each operating system OS. They would also like to have more of the apps reside in the network, which will require a more robust HTML5 standard. HTML5 is an improvement over the standard Internet markup language and will enable applications and content to be provisioned over the web and not be device-specific (native OS-specific apps).

We expect HTML5 to also enable increased native app capability as well as better open web applications (network provisioned). There are multiple benefits of this upgrade, including lower development and maintenance costs for the app developers and seamless usage of applications across devices (wireline and wireless) for consumers. Furthermore, HTML5 will allow web applications to substitute a range of operating system functions. Perhaps more importantly, this will lead to the "thinning of smartphones" a trend we discuss in greater detail in the following section of this report. Ultimately, we believe that LTE, along with mobile open web, are two major developments that will give the carriers the ability to reduce the power of the current operating system app stores.

As mentioned and shown in Exhibit 7, we expect the carriers (or more likely another independent startup global company, as Amazon has done with computing) to create an app hosting overlay infrastructure that can seamlessly convert any app to work on any computer/mobile device. We think the carriers will be able to draw developers and consumers toward their proprietary app hosting platform which will help lock-in carrier customers and app providers. This in fact is already done in the video arena. App providers would encourage this development as they will not have to share 30% of revenues with Apple, and they will have lower upgrade costs. The carriers will also seek to piggyback basic cloud infrastructure onto their platform and offer this to customers (storing a customer's complete digital archive and computing software). With more processing power and data storage accessed over high-quality LTE networks, the carriers will potentially be able to offer prioritization of cloud services as an additional incentive to attract developers to their hosting platform.

Exhibit 7: "Walled Garden" Erodes, Open Web Increases Handset Competition



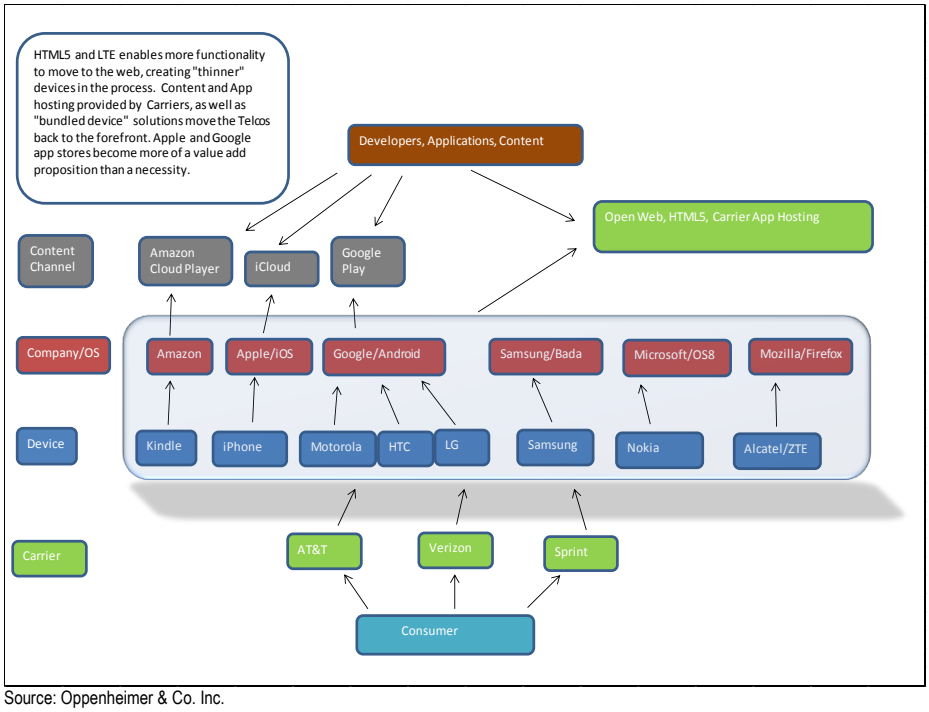
Source: Oppenheimer & Co. Inc.

Carrier Profitability Should Improve in This Fourth Wave

As more services are provided from data centers in the cloud, customer hardware can be made thinner and more standardized, and hence lower priced. Additional device manufacturers will be better able to compete, which will drive down costs for carriers. Driving subsidies down by $100 a year on the 100 million high-end smartphones sold per year in the US is a $10 billion annual saving. The telcos will integrate their network with cloud computing services/applications/content through their own data centers. These customized services can have different degrees of quality (prioritization) and data usage charges (with the provider paying for some of the usage). As a result, the network will resume its role as the primary differentiator vs. the device, which was the case between 1984 and 2006, before the phone lineup became a major differentiator. To consider, the smartphone and spectrum are both a means to an end, easily accessible and portable applications/content. While both inputs can be substituted, a major difference is that smartphones can be replaced, while spectrum (as well as towers, fiber, data centers and other major infrastructure) cannot.

Specifically, we view the recent partnership of Amazon and AT&T to be a great example of this new landscape. Amazon's 4G LTE-enabled Kindle Fire tablet will include 250 MB a month of data services for only $50 a year, and will have alternative apps to Apple and Google. AT&T is charging a low annual fee (current AT&T plans can charge $15 per month for that amount of data), but is betting on monthly data overages to drive revenue. Furthermore, the consumer is being offered a lower cost device, which is positive for industry growth. According to CEO Jeff Bezos, Amazon is focusing on making money when people use their devices, not when they buy them, which appears to be Google's strategy with Nexus. Amazon has also been at the forefront of paying for users' data usage with its book sales (similar to 800 voice services), and is an example of how we expect the industry to evolve. This is only an initial development in a sequence of events we see unfolding, whereby the carriers will benefit from seeing additional devices, channels, and services running on their network.

Exhibit 8: Open Wireless Web Differentiates Carriers, Standardizes Handsets



Source: Oppenheimer & Co. Inc.

Wireless OS Standardization and Thin Devices Mechanics

In the next two sections, we focus on how we expect end-user data devices to evolve to become relatively dumb terminals, at a much lower price. From a bigger picture perspective, each company in the entire food chain is both trying to dominate its horizontal segment as well as cannibalize all the other segments. Apple has been winning at this game so far, but it is also constantly negotiating with other app providers as well as the carriers and each has negotiating leverage. We illustrated earlier how these companies are locked in a battle over ownership of the consumer and that the tech companies have thus far been successful in using their proprietary app stores to align customers with their devices. Small screens, slow networks, and anti-competitive interests have created an environment more conducive to native-based apps with more data storage and processing in the device. As a result, companies such as Apple and Google have been able to leverage their operating system to funnel application development into their own app stores.

Currently, an average of $20 per month of an iPhone subscriber's bill goes toward the subsidy that the carriers pay for the $600 or so high-end smartphone devices. The carriers would like ultimately to drive this below $10 a month (but not do away with it entirely). The subsidy of the iPhone boils down to its ability to streamline the consumption of content using the mobile phone. The iPhone changed the way consumers could access movies, TV, and music. Web browsing was complemented by the usage of native applications. Instead of having to re-design entire web pages for mobile devices, developers could instead pick and choose the most important aspects of their webpage and create apps so that these phones could access small portions of a site at a time. This, combined with mobility, is why we've seen smartphone apps take off despite their limitations compared to the open web. The full range of the web and the depth of its content have to this point been reserved for the PC.

Functionality Set to Shift to the Network

By moving device functionality to the cloud, the carriers can create thin devices, thus decreasing the potential for differentiation among smartphones. If the purpose of a mobile device is to possess a portable array of quickly accessible functions, or end uses, this suggests that smartphones need be only as complex as necessary to do this. Further, whether the user is accessing an application through a PC, tablet, or smartphone, the experience should be similar.

Now that wireless devices have access to broadband speeds, we believe this should enable the network to substitute much of the processing function in place of the phone's operating system. In this sense, web browsers will take some of the share from iOS and Android and enable other device development (Kindle Fire being a good example); devices will be able to seamlessly "connect" to a separate operating system rather than having to house one of their own. This process has started somewhat on the wireline front (Google Docs, Gmail, Netflix, etc.). We think HTML5 will enable a similar revolution on the wireless application front and also help wireline. Just as the web is open for desktop consumers regardless of the platform used for access, we believe mobile web will follow suit. HTML5 provides mobile browsers the ability to integrate audio and video into web pages without having to utilize a plug-in (such as Above Flash), as well as the ability to mimic features of native apps (such as web page optimization for screen size). Therefore, the need for OS and app integration is greatly reduced.

With these technological hurdles cleared, we expect to see a number of open-source mobile operating systems spring to life. App development for mobile devices will move to the open web as it currently is for the Internet/PC. Both developments will break the OEM/platform app store stranglehold. The value of content will increase, as will the value of limited network latency. The smartphone will eventually transform into a "dumb" collection of hardware (think keyboard, a screen, processor, and a mobile browser). As mentioned, Firefox has an open mobile-based phone operating system, and we expect others to follow.

We view the move by enterprises to outsource software (SaaS) as a leading indicator for a similar move by the consumer

For businesses, the major value-added proposition of moving IT to the data center has been to lower costs and improve flexibility. Thus, higher upfront costs by service providers are enabling better sharing of resources by enterprises and eliminating their upfront CAPX internally and lowering operating costs (OPEX) by 20%-plus. With mobile phones, we believe that a similar trend will unfold. The desktop will maintain its role as the consumer's "critical device" because of its faster processor, larger hard drive, screen, keyboard, and security. Consumers will continue to rely on desktops to store and process personal documents, select content, and other critical files, and use the cloud for backup. But they will use new mobile devices for instant and easy connectivity.

With Mobile Broadband in Place, Open Web Will Follow

With faster broadband speeds and more computing and content being created for the cloud, less functionality is going to reside on the device. Not surprisingly, companies have divided into two camps regarding their support of this trend: those with established mobile platforms and those without. We see room for a new unexpected start-up to create the service that customers want, supported by the carriers.

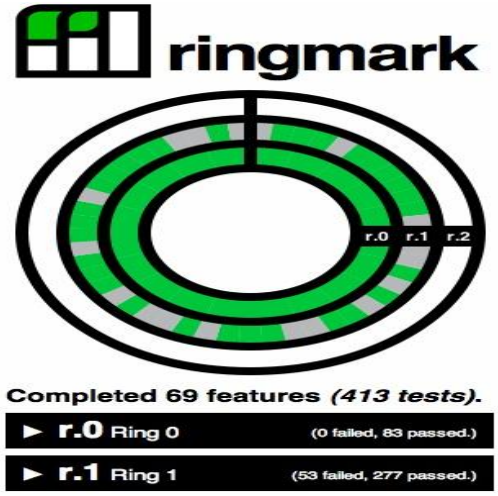
Apple and to a much lesser degree Google realize that open web on mobile would limit their mechanism for locking in customers (the App store) and have impeded their mobile browsers' ability to use open web applications. For instance, Google refuses to allow Windows Phones to access YouTube metadata in the same way that Droid and iPhones do. As a result, Microsoft's YouTube "app" on Windows Phones is basically just a browser displaying YouTube's web site, without the rich functionality offered on competing phones. Apple and Google's mobile browsers also don't support photo uploads or high-performance animation for Facebook's HTML5-based app. In this regard, Google's Chrome Browser is much slower on Apple's iOS than other devices. Carriers and more importantly consumers will demand seamless functionality, in our opinion.

Facebook had been one of the companies most vocal in support of HTML5, but its apps suffered, and it has adopted native apps as a result. But as seen with online radio (and exemplified in Pandora's stock price), if Apple and Google want to make a big move into social networking, they could use their app stores and wireless operating system as a competitive weapon (much as Microsoft did with Office in entering the browser market with Explorer). In Facebook's case, we believe it will continue to favor open web-based standards and apps, but its business model is predicated on the open web. Growth in the use of Facebook solely through native apps would be limiting in the long term for Facebook, as it would become "just another app" on mobile exposed to having sharing revenues/data with the OS providers.

Facebook's HTML5 Testing Suite, Ringmark

Facebook's Ringmark measuring tool is helping to drive the movement toward open web because it raises awareness of mobile browser compatibility with HTML5 apps and identifies the missing components on each browser in order for developers to build their apps. Levels of functionality are divided into "rings" as a means of determining which types of apps can and can't work on each browser. So far, only Mobotap's Dolphin browser has passed rings zero and one.

Exhibit 9: Ringmark



Source: Facebook

Ring 0: Apps that can be built with this ring include content apps like the New York Times, Washington Post Social Reader, and Flixster; games that have a low amount of animating sprites like Words with Friends, Skyscraper City, Poker; music apps like AudioVroom and SoundCloud; and e-commerce apps like Amazon.

Ring 1: By enabling Ring 1, Facebook believes it could enable web developers to build eight or nine out of every ten of the most popular apps that are created today. The major categories of apps that developers are building and that are included in Ring 1 are 2D games, audio and video apps, and camera apps. Examples of each include 2D games like Angry Birds and Where's My Water?; audio and video apps like Netflix, Hulu, Spotify, and Turntable; and camera apps like Twitter, Facebook, Instagram, and Foodspotting.

Ring 2: While Ring 1 is primarily focused on enabling mobile apps that are already being built today, Ring 2 is organized to unlock the rest of the most popular apps, as well as new functionality that will enable developers to build entirely new types of apps for mobile. The concepts in Ring 2 are very new and are expected to change substantially over the next year. This class of features will enable the final portion of market share for apps being built today, including 3D games. It will also unlock new possibilities for rich apps like augmented reality, real-time multiplayer games, and more nascent categories.

Safari and Chrome could become Ring 1-complete if Apple and Google were to make it a strategic priority, but we doubt that they will unless forced to. Better HTML5 support would also mean developers could port their current iOS and Android apps to HTML5, giving users options beyond the App store where Apple and Google can't monetize payments.

Mozilla Firefox OS—A Prototype for Thin Devices

Firefox OS is more than another mobile OS competitor to Android, iOS, and Microsoft 8.0. The project represents the realization of network-centric computing for the mobile phone; it is tangible proof that thin devices for mobile cloud can be built and are not just a concept, whether Firefox is the organization that drives it or not. The OS uses a Linux kernel and boots into a Gecko-based runtime engine, which will let users run applications

developed entirely using HTML, JavaScript and other open web APIs. (Gecko is the engine behind Mozilla's Firefox web browser.) The key takeaway from this is that a product has been developed that can utilize its mobile browser as an operating system through a web-based engine that is housed in a separate data center.

We see this as a disruptive product that is dismissed by incumbent handset suppliers given its current low quality, but this is how all disruptive products start (see the *The Innovator's Dilemma*) and is how Apple and Android started in the last wave of wireless. For Firefox the Internet/HTML5 becomes the OS. Practically speaking, though, we expect some software to reside at the device level, much as the current browsers operate now, and HTML5 does incorporate some of this. The Firefox phone will be manufactured by Alcatel and ZTE, and utilize Qualcomm's Snapdragon processor. Firefox OS will be released in Brazil in early 2013 through mobile carrier Telefonica and is expected to cost $100-$150.The US version is expected shortly thereafter.

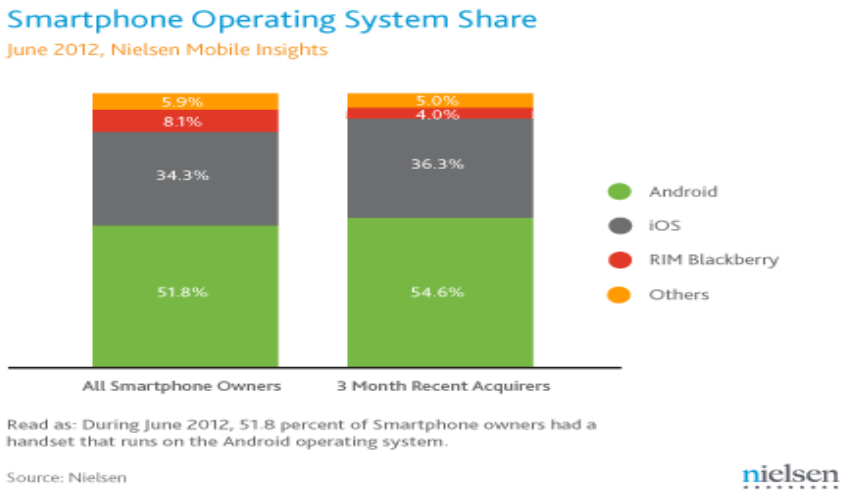
Since the phone provides a completely independent alternative to the proprietary mobile market, Google and Apple will be unable to hinder HTML5's development. If consumers see that HTML5 works on Firefox OS, there will be no excuse for it not to work with iOS6 and Android. Therefore, this phone not only serves as a low-cost competitor, but will also keep open a path for HTML5 to proliferate. We expect that the carriers will be very supportive.

The move to thin devices won't happen overnight, but as with most disruptive technologies, momentum could suddenly accelerate. The process is very well discussed in the classic book *The Innovator's Dilemma*. While the process is several years away from maturing, we see it as inevitable. The implications to earnings are compelling for the carriers, and can provide long-term capital gains to their attractive dividend payments. Currently, subsidies cost the major carriers ~15% of wireless revenues. We estimate the 2012 cost of smartphone subsidies for Verizon to be $11.1 billion and for AT&T to be $9.6 billion, or close to $30 billion for the entire US wireless industry. Outside the US, many consumers pay full retail price for devices and have even more near-term incentive for lower device prices. While having another one to two smartphone handset suppliers would accelerate the process, data-only devices are also driving us to the same endpoint.

Increased Handset Diversity

There is currently a wide variety of handset manufacturers competing within the smartphone space, but only a couple of primary operating platforms. Just as AT&T and Verizon have a virtual duopoly on wireless transport, with about a 65% market share, Apple and Android have an even greater duopoly on the operating system with about a 90% flow share, with Android growing share dramatically close to 70% now on its own, and growing. We believe that Android has been gaining share with its more flexible open OS that enables hardware suppliers to customize it, in turn driving up elasticity with lower priced services to the emerging market.

Exhibit 10: Smartphone OS Market Share



As we've alluded to earlier, in many ways the carriers compete against the handset suppliers as much as they do each other and with the content providers. In fact, all three are locked in a mutually beneficial competitive/cooperative dance, with the balance of power constantly shifting from the three segments which are crucial to each other's survival. Currently, the iPhone costs the carriers $400 to subsidize each device, and a high-end Android device $300. For a company such as AT&T, for which iPhones comprise 75% of subs, the average subsidy per smartphone is $375. The carriers get stuck with paying the subsidies because having the best smartphone has thus far been critical to growing/maintaining post-paid subs.

In our view, the success of smartphone devices has been driven by fashionable designs and a reliance on third-party developers for innovation and the ease of integration between all three components (network, device, software). Apple and Android have developed simple-to-use APIs for any application developer, which has opened the device to the developer community. Apple and Google have made great strides in serving the customer directly and can command premium prices for their OS-based phones because there are not enough legitimate substitutes.

Microsoft OS8

As we can see from Exhibit 11, there is now a third entrant into the smartphone OS marketplace. The recent introduction of Microsoft's mobile operating system (OS8) will alter industry dynamics by providing more choice to consumers and could help drive subsidies down somewhat. We believe the operating system will appeal to enterprises and customers who wish to integrate work and leisure functions onto one phone (Xbox and office); we expect Microsoft to capture a portion of Blackberry's former users as bring your own device to work (BYOD) should be a strong selling point. It usually does take MSFT a few years to get the product momentum going, and the weak launch of the current 8 is not a surprise.

Microsoft 8 offers multiple screen resolutions, and near field communication (NFC) support will allow a fully integrated wallet system (something the carriers have been arguing with Apple over with no resolution). Open native code access to third-party developers will allow very fast cross-platform development such as iOS and Android ports. More importantly, OS8 will allow for simultaneous development of Windows Phone 8 and Windows 8 applications. It is a step toward the more seamless usage of the web that customers want, but still a far cry from the endgame, in our opinion.

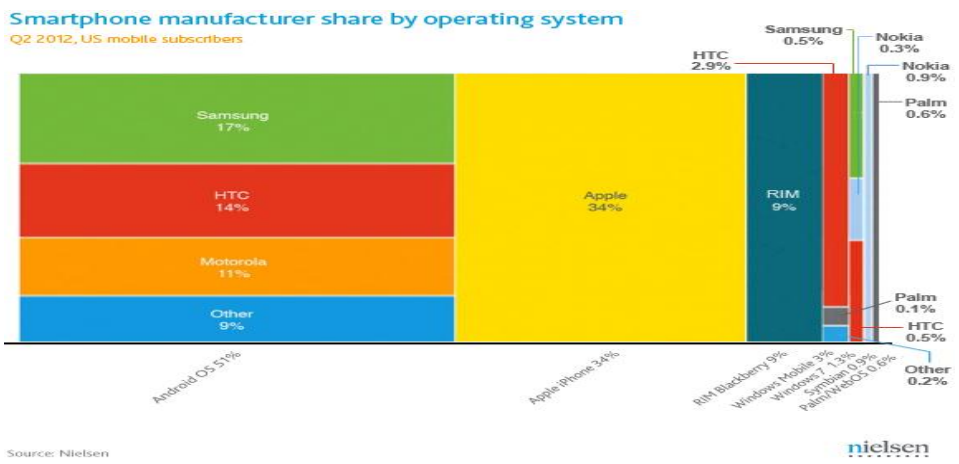
Exhibit 11: Recent & Upcoming Smartphone Releases

Carrier	Make	Device	Platform	Release	Contract Price
Verizon	Motorola	RAZR M	Android	Now	$99
AT&T	Motorola	Atrix HD	Android	Now	$99
Sprint	Motorola	Photon Q	Android	Now	$199
Verizon	Motorola	RAZR HD MAXX	Android	Now	$299
Verizon	Motorola	RAZR HD	Android	Now	$199
Verizon	Samsung	Galaxy Stellar	Android	Now	$49
T-Mobile	Samsung	Galaxy S Relay 4G	Android	Now	$149
Sprint	Samsung	Galaxy Victory	Android	Now	$99
T/VZ/TM/S	Samsung	Galaxy S III	Android	Now	$199
T/TM/S	Samsung	Galaxy Note II	Android	Now	$299
Verizon	Samsung	Stratosphere 2	Android	4Q12	$129
T/TM	HTC	One X+	Android	Now	$99
Verizon	HTC	One X5	Android	4Q12	$199
AT&T	Sony	Xperia TL	Android	Now	$99
Verizon	LG	Intuition	Android	Now	$199
AT&T	LG	Escape	Android	Now	$49
T/S	LG	Optimus G	Android	Now	$199
Sprint	LG	Cayenne	Android	4Q12	NA
Verizon	LG	Spectrum 2	Android	1Q13	NA
AT&T	Panetech	Flex	Android	Now	$49
VZ/T/S	Apple	iPhone5 (16GB)	iOS6	Now	$199
T/VZ/TM	Nokia	Lumia 920 (32GB)	OS8	Now	$99
T/VZ/TM	Nokia	Lumia 820	OS8	Now	$49
T-Mobile	Samsung	Marco	OS8	4Q12	$99
T-Mobile	Samsung	Odyssey	OS8	4Q12	$199
T/VZ/TM	HTC	8X (16GB)	OS8	Now	$199

Source: Company Reports, Oppenheimer & Co. Inc.

Several major manufacturers (Samsung, HTC, Nokia) are already set to produce handsets on the platform, and we wouldn't rule out LG coming on board at a later date.

Exhibit 12: Smartphone Market Share by Device Manufacturer



When compared to Windows Phone 7.5, OS8 will offer superior web browser performance with Internet explorer 10. The new OS will be 4x faster running JavaScript and support twice the number of HTML5 features compared to Windows Phone 7.5. Just as Microsoft's second-generation gaming console (Xbox360) ultimately succeeded where the original did not, we believe the Windows phone should perform markedly better over the next two years.

Exhibit 13: Windows 7 Phone Global Shipments

Global smart phone market
Shipments into the channel, split by platform, Q2 2012, Q2 2011

Platform	Q2 2012 shipments (million)	% share	Q2 2011 shipments (million)	% share	Growth Q2'12/Q2'11
Total	158.3	100.0%	107.7	100.0%	46.9%
Android	107.8	68.1%	51.2	47.6%	110.4%
iOS	26.0	16.4%	20.3	18.9%	28.0%
BlackBerry	8.5	5.4%	12.5	11.6%	-32.1%
Symbian	6.4	4.1%	18.1	16.8%	-64.6%
Windows Phone	5.1	3.2%	1.3	1.2%	277.3%
bada	3.3	2.1%	3.1	2.9%	5.1%
Others	1.2	0.8%	1.1	1.0%	15.2%

Source: Canalys estimates, © Canalys 2012

If OS8 can become a competitive mobile platform, it will allow the carriers to exert pressure on Apple and Google in future subsidy negotiations. Since VZ and T have the best LTE networks and the largest subscriber bases, the threat of losing access to either of these networks would resonate strongly. An additional OS will lead to more handsets, which will in turn lead to a more staggered deployment of new phones. This will make phones more ubiquitous, as the best device will remain on top for only a short period before a better model comes along. However, we still see this as a short-term fix toward consumers' ultimate goal of a thin dumb device that access all their applications and content on the network.

Carrier Profitability Improvement Efforts

The two major factors we have discussed so far, thin devices and handset diversity, are gradually driving down subsidy per device, with a majority of the improvements from Android. The carriers have other initiatives on profitability, including:

Charge a $30 upgrade fee for any device: AT&T, Verizon, and Sprint now charge $30-$36 for each device upgraded. This helps delay customer decisions on upgrades and lowers the subsidies. We expect these fees to increase to the $50 area next year.

Extend the upgrade cycle from 12 to 20 months: All three carriers have also extended the wait period for subsidy eligibility on upgrades. For AT&T, this period was extended by about eight months. Further, the early upgraded discount was lowered to $150 from $200. The carriers also charge steep early termination fees.

AT&T ETF: $325 less $10 for each full month
Verizon ETF: $350 less $10 for each full month
Sprint ETF: $20 times the remaining months on contract up to $350

Charge for data usage: The carriers have both a usage per device charge of $10 per gigabit or so above the 2 gig normal cap and are also selling bucket plans for up to ten devices.

Charge content providers for data transport: While it's early, the carriers would like to start this revenue stream as consumers can afford only so much spending per month.

We believe these upgrade disincentives were one of the major reasons the carriers managed the release of the iPhone5 better than was expected. Until the carriers can renegotiate with Apple and Google, these initiatives serve as the best defense against dilutive smartphone to smartphone upgrades.

Cross Platform for Applications

The carriers believe that they can bridge the divide between web app developers and the consumer through the creation of their own app hosting platform/gateway. For instance, AT&T Foundry gives app developers access to a location both to store their apps and to test their usage on real-life networks. Verizon has similar initiatives, while Akamai is already largely embedded in enabling this. We believe that the app providers and the carriers have great incentives to promote this gateway. In a perfect world, the app provider would give one version to a particular carrier, which would then host, convert, and optimize it for the different hardware devices. Verizon, AT&T and others already do this for many applications such as video. We think this will help facilitate the emergence of universal app stores which would list sites in HTML5.

By creating an App store gateway, the carriers would have the ability to leverage the thousands of apps already developed to work on any device. Having an app superstore would have many benefits

1) It would make it possible to create competitors to Apple and Google;
2) The carriers would grow their own hosting revenues from the app providers;
3) The carriers could create their own apps more easily as well as gain advertising and M2M revenue;
4) It could ultimately lead to a new, more open, handset supplier;
5) The carriers could create different classes of service and charge different data prices and plans.

Ultimately, it could enable the carriers to re-take possession of the consumer. In order to establish a legitimate gateway, the carriers will need open web apps to work well on any smartphone. This requires the ability to convert the apps for both iOS usage and make them compatible with HTML5 so that developers can feel confident that when they develop web-based apps, they will get a return. In addition, the developers would want a new means by which users could find and utilize their apps. Web apps could be listed in a manner similar to the way that bookmarks for a mobile browser are listed today.

Exhibit 14: App Store Overview

App Store	Device Affiliation	Carrier Affiliation	Developer Economics	Launch Date	OS Compatibility	Apps Offered	Billing System
Apple App Store	Apple	Exclusive	70%	July 10, 2008	Apple OS	650,000	iTunes
The OVI Store	Nokia	No	70%	May 26, 2009	SymbianOS	30000	cr. card, carrier
Palm App Catalog	Palm	No	50%	June 5, 2009	WebOS	5000	TBA
Android Market	No	No	70%	October 22, 2008	Android (Linux)	600,000	Google Checkout
Windows Phone Store	No	No	70%	October 21, 2010	Windows Mobile	125,000	cr. card, carrier
BlackBerry App World	RIM	No	80%	April 1, 2009	BlackBerry OS	105,000	PayPal
Samsung Mobile Applications	Samsung	No	NA	March 19, 2009	multiple	10,000	cr. card
Facebook App Center	No	No	NA	June 7, 2012	multiple	600	Bango/Carrier
T-Mobile	No	T-Mobile	variable	November 20, 2008	multiple	NA	T-Mobile
AT&T App Center*	No	AT&T	70%	1Q2012	multiple	925	AT&T
Verizon Apps	No	Verizon	70%	April 2, 2009	multiple	3000	Verizon

* Evolved from AT&T Media Mall (2008-2010)

Source: Company Reports

Carriers Well Positioned to Bring HTML5 to Market

1. They can bundle services with high-quality network transport in all its forms, including guaranteed throughput, security, redundancy, and privacy.

2. They have minimal channel conflict in that they do not tie customers to particular hardware or software. In essence, they can promote a more horizontally segmented business model while controlling the critical infrastructure and hopefully customer relationships through bundling.

3. The telcos can overcome many of the shortcomings of HTML5 versus apps stores. Carriers can help HTML5 app providers with sales, marketing, customer care, and most importantly payments (fraud and bad debt are major factors for most applications providers). In addition, they can also help develop and maintain specific applications for enterprise customers.

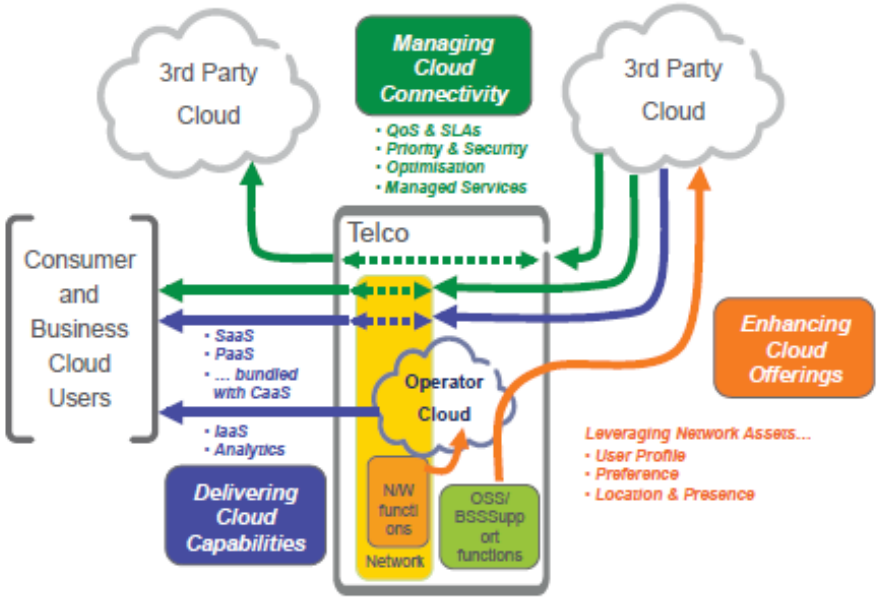
Incentives for App Developers to Migrate to the Open Web

The app providers now pay a 30% fee to Apple and Google for revenues through their app store. Having carriers host apps delivered through browsers would be a much smaller bill. This would become particularly important in emerging countries, and could help drive the process. The carriers will also seek to improve services by having more location-based applications (on which they control the data) through cloud storage and processing. For example, a consumer can take a picture and the wireless carrier can store the picture on the device with the location but back it up in its data center to be accessed at any time with any device (wireless or wireline). By building out an app gateway, developers will need to build only one version of the app and then convert it on a continuous basis to the other wireless app stores. Customers of Apple and Google are not going to want them to have all their customer information and data. We believe consumers will want the same application to work on all their computing devices (laptops, desktops, etc.), and HTML5 is better suited for this. The carriers and app providers strengthen their relationships with their customers in the process.

Data Centers and Managed Services Capabilities Required

The carriers already have in place the network and managed services capacity for the app store gateway. In addition, they have considerable experience serving enterprise customers. Their purpose with this is to leverage their strong networking capability with data hosting in order to provide unique solutions to consumer and enterprise customers. Verizon and CenturyLink recently expanded their respective global data center reach through their acquisitions of Terremark ($1.4 billion) and Savvis ($2.5 billion), respectively. AT&T, on the other hand, has focused on growing its cloud offerings in-house, and earlier this year announced plans to construct a 900,000 square foot data center near Cleveland, OH. The company said the facility will begin with a $200 million investment in a 470,000 square foot building, part of an anticipated 14-year, $851 million project that would be the first phase of potentially four computer-room phases at the complex. The AT&T data center is expected to be operational by second quarter 2014. We believe that the carriers will leverage their experience in enterprise as they work with developers to enhance their mobile cloud platform. In our view, the carriers will seek to integrate wireless and wireline networks and applications, enabling unique solutions that should appeal to developers.

Exhibit 15: Evolving Role of the Telecom Operator



Source Ericsson Discussion Paper

Centralized Cloud Services Will Lower Customer Churn

We believe that the ability of carriers to provide a centralized platform from which consumers can manage all of their connected devices has tremendous lock-in potential. One example of this would be Isis, the mobile payment joint venture backed by Verizon, T-Mobile, and AT&T. Users will be able to store payment information, as well as transit passes, and loyalty cards and use their phone's NFC capability to make payments. Isis will be installed in-stores and potentially have dozens of other applications, and will involve integrating an Isis chip within the phone's SIM card. By aggregating different functions and their associated costs into one platform, the carriers can offer consumers an added convenience they cannot get anywhere else. Billing, customer information, apps, and device/data plans can all be centralized in this manner.

Exhibit 16: Cloud Strategy Notes

Segment	Company	Cloud Strategy Notes	Advantage
Consumer	Apple	Apple's recently launched iCloud service stores user content in the cloud and in newly built datacenters, allowing synchronization across all iOS devices. Apple plans to leverage its large iTunes customer base in the consumer adoption of iCloud services, focusing on local storage for iTunes songs (avoiding upload of millions of copies of the same file). iCloud's ability to synch content across all of Apple's iOS devices (over 200 million iOS devices sold), simplifies users' responsibilities of managing content. Apple users can use up to 5GB of iCloud service for free, allowing them to adjust to the new service before devoting to a plan (yearly plans cost $20 for 10GB, $40 for 20GB or $100 for 50GB).	Content, Devices, Scale, Customer Relationship via iTunes
	Facebook	With roughly 900 million users, Facebook is the leading cloud website, with all revenue generated from its cloud service (ads, app platforms, etc.) Facebook's cloud strategy is structured around providing a wide range of functional user applications (online music, video, photo storage, communications and other social apps). Facebook provides a PaaS for application developers and SaaS for application users.	Content, Large and Global User Base
	Google	Google's cloud strategy is to make network applications better and cheaper than PC ones. Google Docs allows users to access, edit and share Microsoft Office documents in real-time. Music Beta and Google Movies are two cloud services that allow Android users to playback content offline. Google also launched Chromebook, a web-based laptop that uses Chrome OS as its sole means of operability. Subscriptions for the Wi-Fi ready service cost $20 for consumers and $28 for businesses (3G plans cost extra). The device itself costs around $350. Google also hopes its Google Compute Engine can draw customers away from AWS.	Search, File Sharing App Design
SMB	Rackspace	Rackspace's cloud strategy relies on a hybrid hosting option that combines traditional dedicated hosting with cloud hosting services. Rackspace hopes this hybrid plan will help customers adjust to the relatively new concept of cloud hosting. In a partnership with NASA, Rackspace created "Openstack," a massively scalable cloud operating system, in hopes of creating industry-wide cloud standards.	Hosting, Customer Service, Leading Position in SMB/Enterprise
	Amazon	Amazon Web Service's EC2 provides customers with elastic, on-demand internet hosting and was designed to make web-scale computing easier for developers. EC2 pricing ranges from $0.085 - $1.60 per hour depending on the operating system and the type/size of instance used. Amazon also offers Simple Storage Service (S3), which allows customers to store music and files in an online locker. Amazon's Kindle provides e-books to customers, and will most likely offer additional applications in order to compete with Apple's iPad. Amazon customers can use the cloud drive to store up to 5GB of media for free. Security of its cloud was criticized earlier this year when a power outage knocked some customers offline for several hours.	Accessibility, Affordability, Large Cloud Infrastructure
	Microsoft	Microsoft's Windows Azure platform is a PaaS that allows customers to build, host, and scale web applications. Microsoft also offers its SaaS, Office 365, which provides access to Microsoft Office Web Apps. Microsoft targets enterprises and consumers alike as potential users of both services. All Windows 8 devices, as well as future versions of Windows Phones, will automatically connect users to a free SkyDrive account as soon as they log in. Users will be able to access to all their data and services, regardless of which device they are using, via the cloud.	Hosting, Large Legacy Customer Base
Large Business	Verizon	Verizon has had an ongoing cloud initiative, but given prior cannibalization concerns, we believe the company's push in that field had been moderate. Recent acquisitions (TMRK and CloudSwitch) are a clear indication that managed services and cloud offerings are now higher on the priority list. Verizon's key differentiator down the road will be its LTE build-out supported by its large spectrum portfolio.	Network, Scale in Enterprise, Security Expertise
	AT&T	AT&T embedded cloud capabilities directly into its IP based network, allowing them to provide cloud-based services to any device through a trusted, secure network. AT&T offers Synaptic Compute/Storage as a Service in a pay-as-you-go model. The 2006 acquisition of USInternetworking (software and e-business management services company) enhanced the company's enterprise service offerings.	Robust IP network, 12 Years of Hosting Experience
	CenturyLink	CenturyLink acquired global cloud computing company Savvis in July 2011, giving the combined company a total of 48 data centers worldwide. Savvis' "Symphony" service is a cloud-computing portfolio with dedicated hosting, virtual private data center (VPDC), public cloud infrastructure and database services available for bundling. CenturyLink's strategy revolves around leveraging Savvis' existing cloud expertise with the combined company's large enterprise client base.	VPDC, Savvis' Existing Customer Base
	HP	HP offers two public cloud computing services: HP Cloud Compute and HP Cloud Object Storage. These services are based in part on the open-source OpenStack code. HP hopes to market these services to a wide array of customers including developers, independent software vendors and enterprises. The services are currently in beta versions and are in test trials with select customers. Additionally, the discontinuation of webOS devices allows HP to focus more on its cloud service offerings.	Scale in Enterprise, OpenStack
	IBM	IBM's cloud strategy is aimed at communications service providers and offers a platform that enables the deployment of their own cloud services. Additionally, IBM's "SmartCloud," provides IaaS and SaaS to enterprise customers on an on-demand basis.	Large Customer Base
	Dell	Dell purchased Wyse for an undisclosed sum (estimates range from $400M-$600M) in April as a means to expand into thin clients and virtualization software. The acquisition will put Dell in competition with VMware and Citirx, as Dell attempts to differentiate themselves from established players in the cloud space (Amazon, Rackspace).	Inexpensive Hardware, History of Online Services
	Oracle	Oracle provides IaaS, SaaS and PaaS options to service providers and enterprise customers. The company aims to provide an extensive breadth of cloud services to compete with companies like IBM and HP. However, like Dell, Oracle's strategy lacks any central focus/differentiator.	Huge Installed Software Base with Enterprise Customers

Source: Oppenheimer & Co. Inc.

Revenue Growth

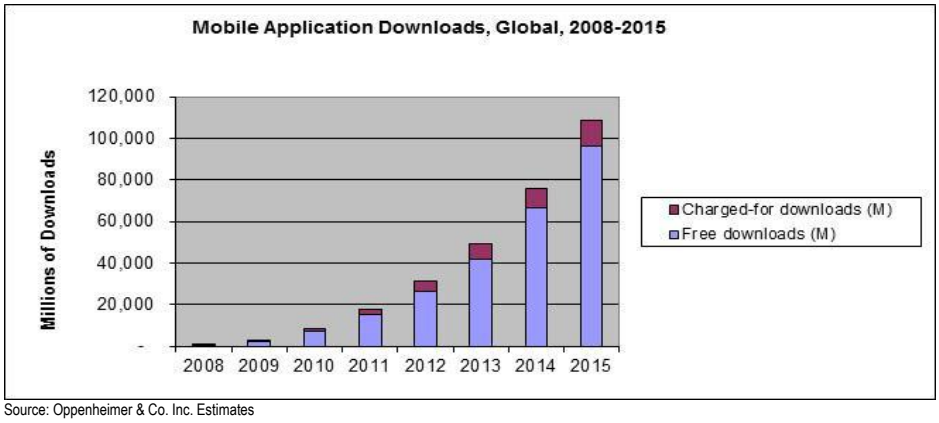
The carriers can expect to grow revenues by selling more data, devices, and apps to consumers. They can also source new revenues from developers by charging for app hosting services, advertisements, and app sales revenues. The carriers have already taken several key steps to move this along with the key step being the creation of an app store gateway. The carriers have already unveiled their shared data plan, which gives flexibility to both drive the industry structure and increase revenue streams. Both AT&T and Verizon have already experienced strong demand for these recent service offerings. However, we would expect the carriers to partner with a third party for much of these new hosting and application-based revenues. The carriers have particular core competencies with security, integration, and location-based productivity improvements.

Application-Based Revenues

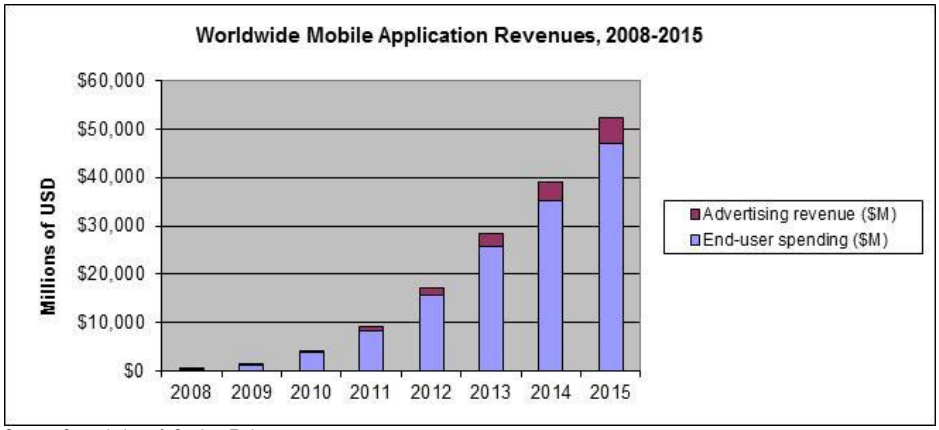
We think the carriers stand to generate new streams of revenue from application hosting, application revenue sharing, and in-app purchasing. Additionally, the carriers are likely to realize further revenues from security, sales, advertising, and customization services that they can provide through their unique infrastructure.

Earlier this year, AT&T announced a new app center that will be built in HTML5 and sell "unwrapped" HTML5 apps to Android devices. AT&T will receive a $99 access fee from each developing company and will receive 30% of the app revenue. The telcos are also producing apps in-house. For instance, AT&T's Toggle app enables smartphone users to set up separate profiles for personal or work use on the same device. The user simply toggles between profiles, and avoids cluttering work and personal files within the same phone. Verizon has a similar set of products.

Exhibits 17 & 18: Mobile Application Downloads and Revenues



Source: Oppenheimer & Co. Inc. Estimates

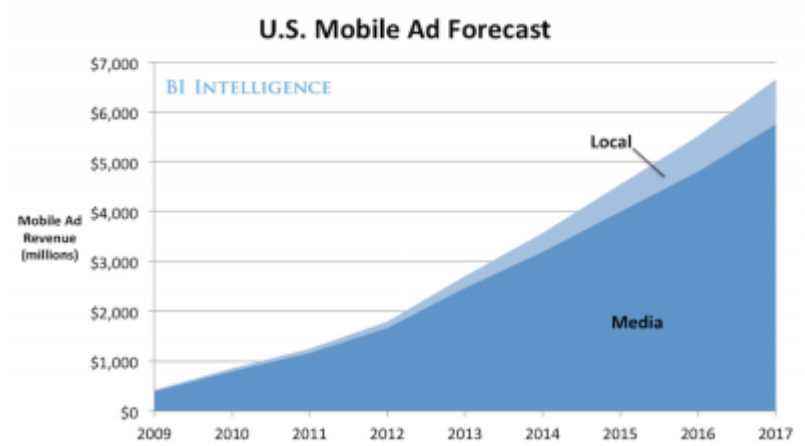


Source: Oppenheimer & Co. Inc. Estimates

Advertisement-Based Revenues

The carriers are going to see increased opportunities to generate advertisement revenue through closer customer relationships. For instance, in September, AT&T launched a service allowing marketers to target Internet advertising to consumers based on data collected from U-Verse TV and AT&T wireless users. The service tracks TV viewing data, as well as mobile content usage including downloaded apps, games, and videos. The company has already pre-signed two advertisers.

Exhibit 19: US Mobile Advertisement Revenue



Source: BI Intelligence

M2M Revenues

We believe M2M (machine-to-machine) will be one of the fastest growing segments in the cloud services industry. The problem for M2M is that the interface with corporate enterprise data has been difficult, and there have been competing wireless standards that have made it even more difficult to implement. As enterprises port more data to the cloud, it will be easier to set up and use data from M2M. We also see LTE as a 20-year broadband wireless technology upon which M2M can be standardized. The carriers are utilizing the power of network-centric computing to turn hardware (iPhones, tablets, laptops), as well as other products (automobiles, appliances) into interchangeable platforms.

We believe there is a large amount of service revenue and new connectivity revenue that will soon be coming off the smartphone base. Thus, the carriers will be exploring how best to layer these new sources of revenue on top of each smartphone subscription. In the next couple of years, we could see a significant change in how we think about the network provider, the app provider, and the device provider.

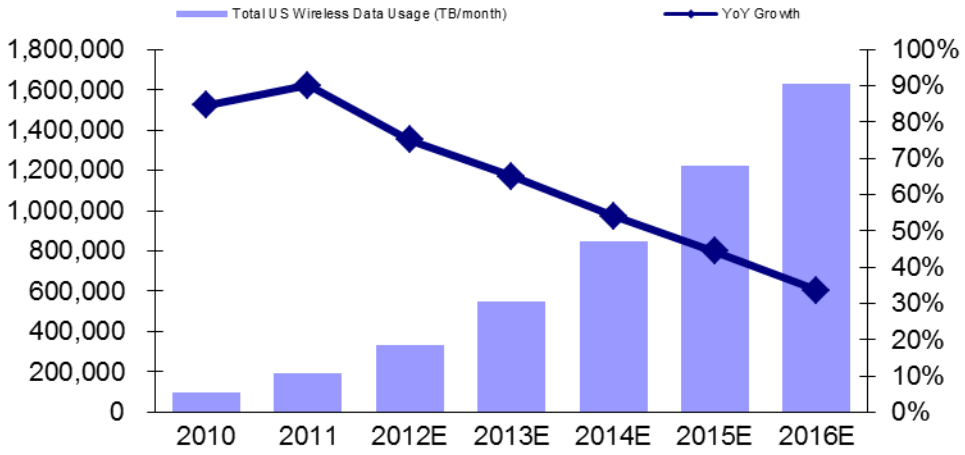
Over the next 12 months we expect to see dozens of other, mostly machine-to-machine, devices (laptops, cars, home appliances) operate as different platforms all within the same data subscription plan. Since the pricing is usage-sensitive, as utilization increases, revenues will follow. Similar to other data devices, there are no subsidies for M2M devices. In the appendix, we've outlined a sampling of the opportunities from which the carriers could capitalize in the next couple of years.

Bottom line, we believe that the migration to network-centric computing, enhanced by mobile broadband speeds (LTE) and open web capability (HTML5), presents a tremendous opportunity for the carriers. We expect them to be able to lower subsidy costs, source new streams of revenue, and re-take control over the consumer.

Appendix 1: Review of Consumer Demand Drivers

As smartphones continue to replace cellphones, and with LTE rollouts under way, we are expecting to see massive overall growth in wireless data usage.

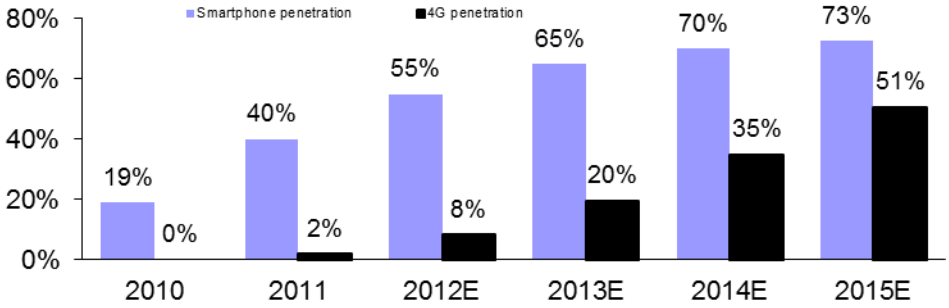
Exhibit 20: Wireless Data Growth in NA Poised to Grow at 2011-2016 CAGR of 75%



Source: Oppenheimer & Co. Inc. Estimates

Verizon's smartphones have been adopted by 50% of its subscriber base, with 16.5% of these on LTE. By 2015 we expect to see 75% smartphone penetration and 80% to be LTE-based. We expect that the LTE-enabled iPhone5, released on September 21st, could drive adoption acceleration even further. We expect the 4G penetration rate to more than double to 20% by the end of the year. LTE is currently using more than double the data of 3G, and we expect this to accelerate.

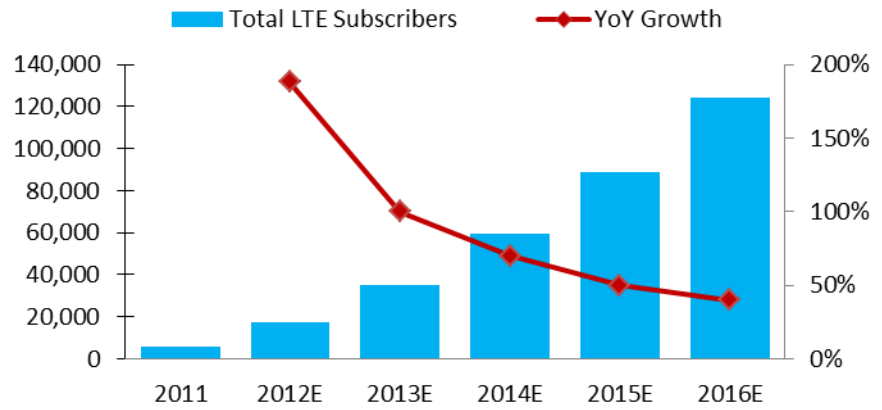
Exhibit 21: US Smartphone and 4G Penetration



Source: Oppenheimer & Co. Inc.

LTE is providing consumers with the ability to easily stream movies, television, videogames, and computing over any device using the cellular network. With a large lead in its LTE deployment, Verizon's very strong 3Q12 results (4.5M LTE devices sold, 14.9M LTE subs total) indicate that consumers recognize this value. The US currently leads the way in LTE subscribers and deployments, with US carrier subs comprising approximately half of the global total of 27M (as of 2Q12).

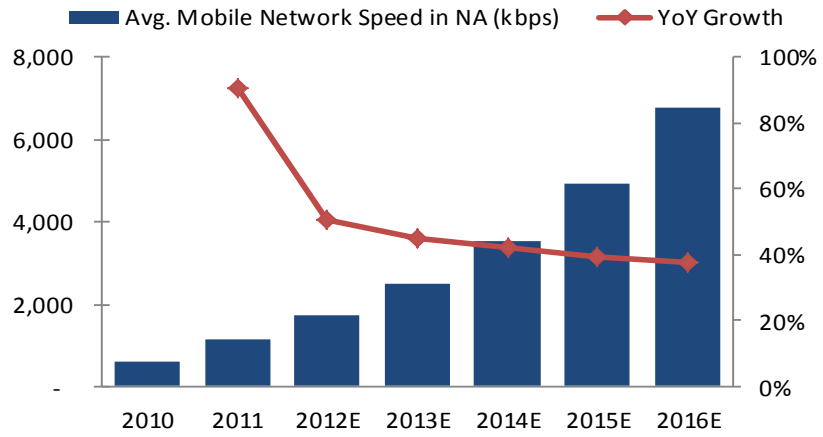
Exhibit 22: NA LTE Subscriber Growth (000s) 2011-2016 CAGR of 183%



Source: Oppenheimer & Co. Inc.

LTE roll-out in the US is going to push the average network speed well past the 3mbps threshold, and with pricing per usage keep it above that level. This is typically regarded as the point at which streaming video over IP goes from possible to practical and with the lower latency of LTE high-quality gaming and voice services. An April 2012 PC World's Coast to Coast 3G vs. 4G test was telling. AT&T download speeds rose from 2.62mbps over 3G to 9.12mbps over 4G; Verizon speeds rose from 1.05mbps to 7.35mbps.

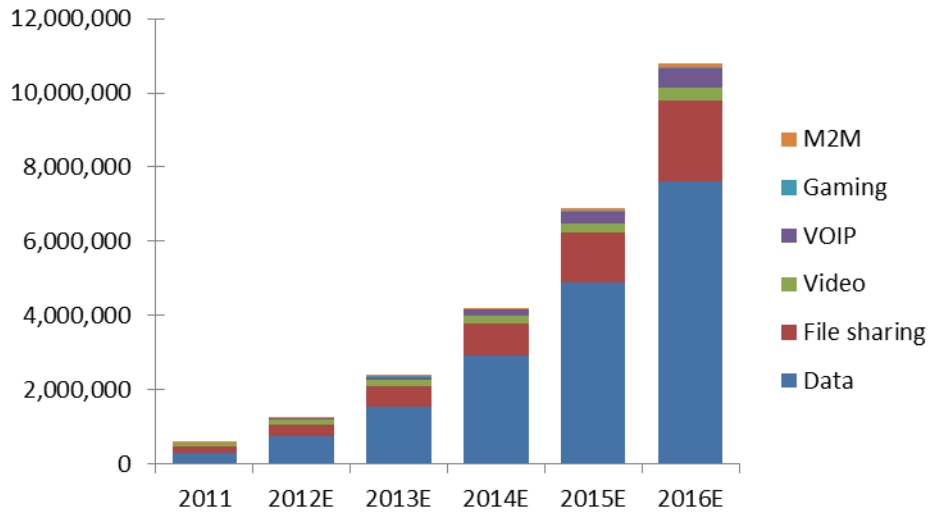
Exhibit 23: Mobile Network Speed Projected to grow at a 2011-2016 CAGR of 43%



Source: Oppenheimer & Co. Inc. Estimates

Speed drives application usage and variety, which in turn drives data usage. We believe 4G LTE is going to reshape the way the consumer thinks about bandwidth-heavy apps, such as video streaming and online gaming. This impact will be massive, as apps that were considered novelty items only a couple of years ago are now being heavily utilized.

Exhibit 24: Global Traffic Growth by Application (TB per Month)



Source: Oppenheimer & Co. Inc. Estimates, Cisco VNI Mobile 2012

The effect of LTE will be compounded by tablet and laptop mobile usage. Each tablet generates almost 3.5x the data that smartphones do; laptops can generate over 14x as much traffic. We also expect growth from 65 million households connected with broadband to closer to 200 million smartphones with at least another 50 million heavy data usage devices. Admittedly, the mobile devices will be using a quarter the amount of bandwidth as a fixed home line, but we will see 4x the number of devices in the next four years, or a doubling in capacity from this wireless growth on top of the secular 30% growth from wireline services.

Exhibit 25: Avg. Monthly Data Usage per Wireless Technology (Gigabytes)

3G Smartphone	400MB
4G Smartphone	1,400MB
Laptop with 3G data card	5,000MB
Laptop with 4G data card	14,500MB

Source: IDATE & UMTS Forum Report

From Exhibit 26, one can see that tablets generate almost 3.5x the data that smartphones do; laptops generate over 14x as much traffic.

Exhibit 26: Traffic Generation by Device Type

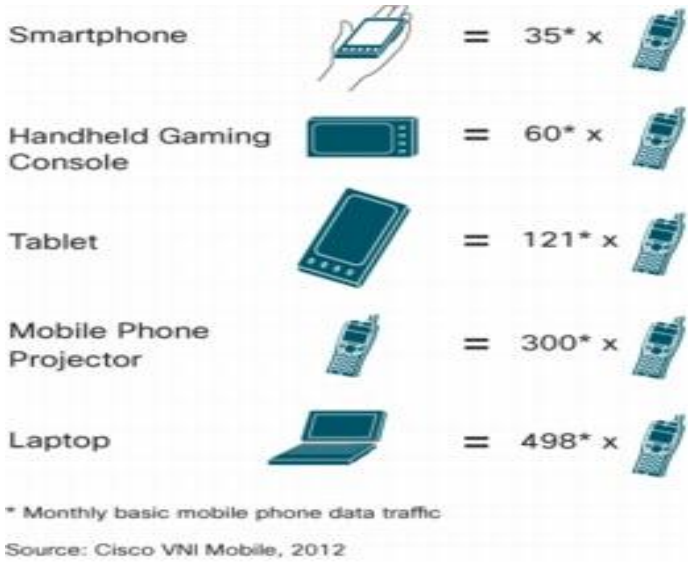


Exhibit 27: Cloud Applications Multiply Data Usage

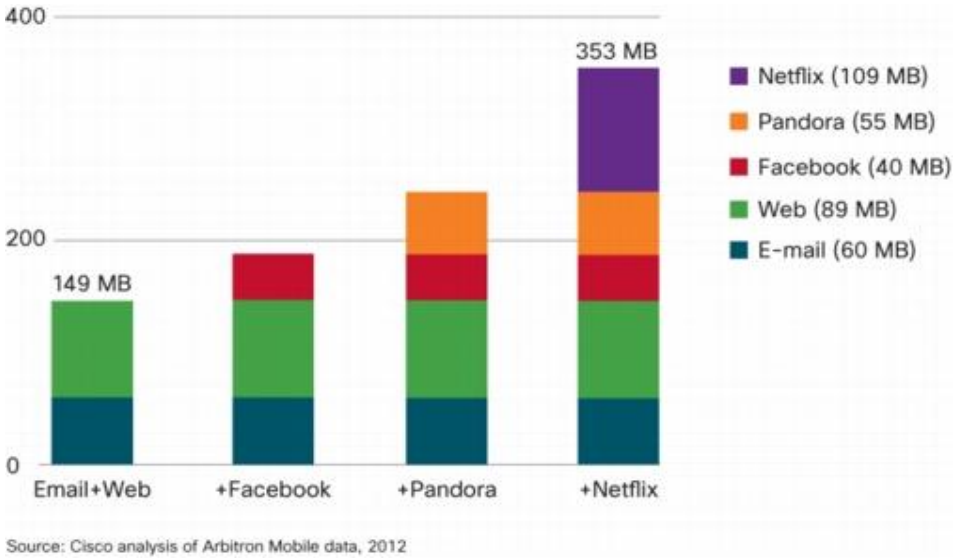
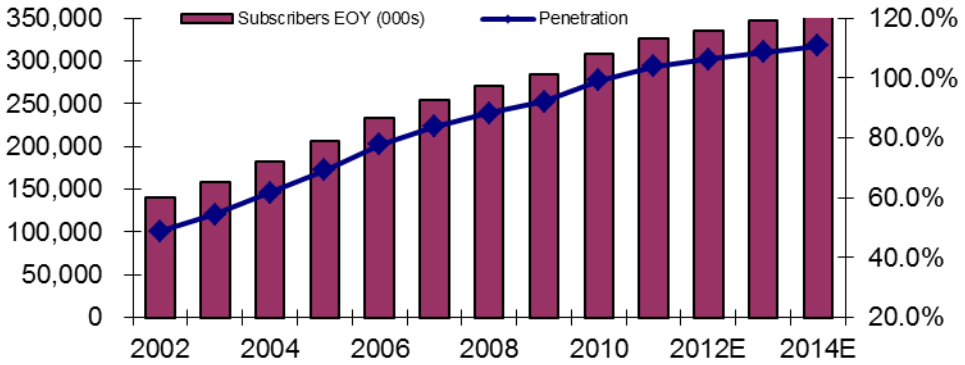


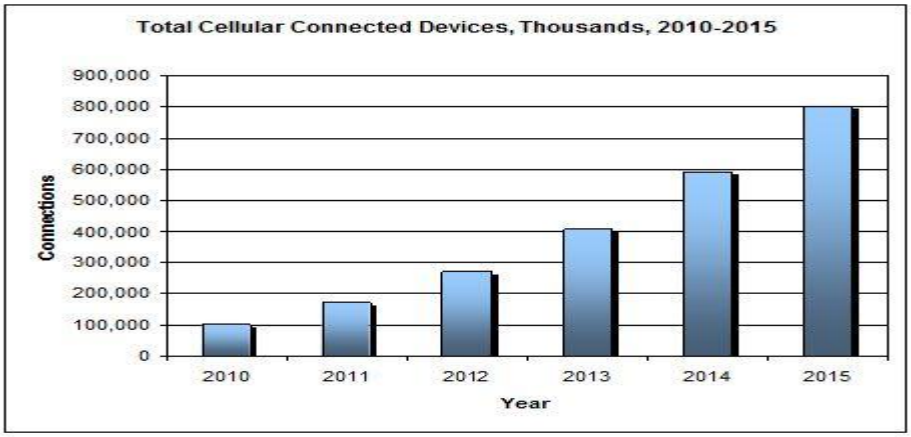
Exhibit 28: Total US Wireless Subscriptions



Source: Oppenheimer & Co. Inc. Estimates

Connected Devices/M2M: Connected devices is a broad category that includes handsets, eReaders, connected digital signs, smart meters, cameras, fleet tracking devices, and others. We expect that these devices will continue to proliferate, driven by the accelerating evolution of next-generation wireless networks, advances in wireless modules, and a rapidly expanding ecosystem of solution providers. The underlying foundation for these advances is network technology evolution, such as GSM, HSPA, and now LTE.

Exhibit 29: Connected Devices Projections



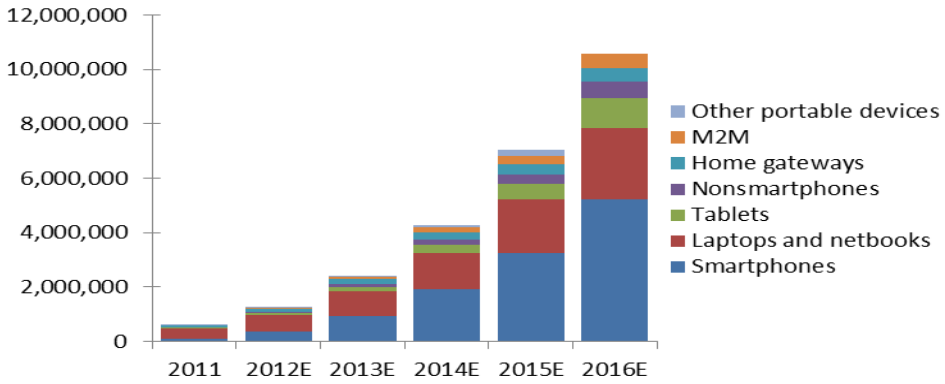
Source: Yankee Group, 2011

Exhibit 30: Connected Devices Universe

Source: OpenNet

Carriers such as AT&T and Verizon are working aggressively to let users apply their smartphone data subscription toward other devices. They are utilizing the power of network-centric computing to turn hardware (iPhones, tablets, laptops), as well as other products (automobiles, appliances), into interchangeable platforms with centralized processing and data storage. The carriers can also now use a shared data plan to make these devices affordable. The spread of mobile broadband networks, the emergence of new mobile device s, and the expansion of mobile service propositions is establishing an "Internet of things" (IOT). Some industry players, such as Ericsson and Intel, predict that the connected device segment will reach 20-50 billion connections by 2020.

Exhibit 31: Global Mobile Traffic Growth by Device Type (TB per Month)



Source: Oppenheimer & Co. Inc. Estimates, Cisco VNI Mobile 2012

Over the next 12 months we expect to see dozens of other mostly machine-to-machine devices (laptops, cars, home appliances) operate as different platforms all within the same data subscription plan. Since the pricing is usage-sensitive, as utilization increases, revenues should follow. Two examples include:

The Automobile: A terrific opportunity to leverage the smartphone base and generate additional utilization by connecting the car to the mobile network. Imagine having an entire iTunes library available to stream on demand or having TV shows and movies available for backseat passengers.

Mobile Banking: The smartphone is rapidly becoming a major platform for making payments and doing banking. The carriers' joint-venture ISIS platform will be launching this year and will be the basis for conducting commerce. There is a considerable service revenue opportunity off of financial payments and services.

Appendix 2: HTML5 Overview and Evolution

Differences Between Web-Provided Apps (HTML5) and Native Apps (we expect hybrid apps to be the most common)

1) Web-based apps are accessed over the Internet, over open standards that do not need to be accessed through a store.
2) Native apps work better for graphic-intensive uses such as gaming.
3) HTML5 app data is processed in the cloud, usually in remote data centers connected over the Internet.
4) Native apps are usually optimized for each device that they work on (although this is becoming less of an issue as web apps such as video are usually adjusted real-time for the device).
5) Native apps often work offline, whereas web apps are limited.
6) Customers do not have to download web apps or update them.
7) Security is better on native app stores, which have been vetted by carriers and users.

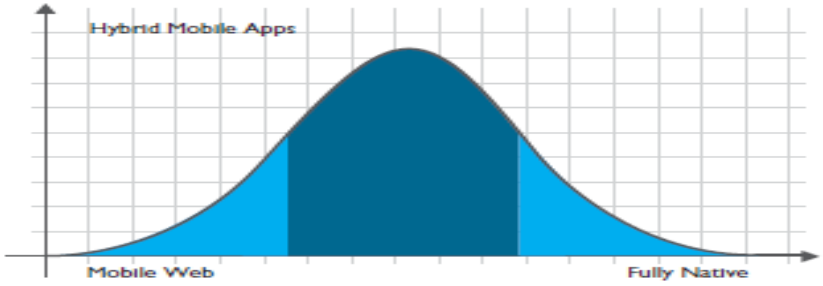
Exhibit 32: Native vs. Hybrid and Mobile Apps.

	Native App	Hybrid App	Mobile App
Definition	Native app code and data	Native code wrapped around HTML	Mobile browser access to HTML
Coding Language	Java. Objective-C, etc.	JavaScript (native) HTML5 (Webview)	HTML5
Pros	Native- UI, Full platform capabilities	Semi-native UI	Full code reuse, single app experience
Cons	Limited code reuse	limited native API access	Limited offline functionality, inferior UI

Source: Oppenheimer & Co. Inc.

Native apps not going away overnight, but hybrid apps likely a step toward their replacement. While we believe native apps are better suited today for numerous situations versus web apps, we expect a large proportion of native apps will eventually be replaced by hybrid apps. These hybrid apps take advantage of some of the best features of native apps (sold in app stores) combining them with some of the benefits of web apps (written in HTML).

Exhibit 33: Near Term, App Deployment Likely to Take the Form of a Bell Curve



Source: Wipro

We believe HTML5 is 18 months away from becoming a global standard. While it is still an immature technology, it already works in many instances and is improving. It allows wireless applications to be developed through the Internet over regular browsers (Firefox, Chrome, and others). There have been limited apps on HTML5 due to lack of support from browsers, wireless carriers, and app developers, but we believe this is set to change. These constituents have strong financial and strategic incentives to migrate their apps to the web. Most importantly, high-quality, consistent connectivity is critical to web-based wireless apps working, which is why we believe that LTE will be the real catalyst for HTML5 adoption

Exhibit 34: HTML 5 Developments Timeline

HTML5 Developments Timeline	
2004	Web Hypertext Application Technology Working Group "WHATWG" is formed by individuals from Apple, Mozilla, and Opera Software
Oct-06	World Wide Web Consortium "W3C" begins collaboration with "WHATWG" to evolve HTML as a technology
2008	First version of HTML5 is introduced
2008	Firefox 3 becomes compatible with HTML 5: Chrome, Safari, and IE will eventually follow suit
Jan-10	Youtube offers HTML 5 video Player
May-10	The online document sharing site, Scribd switches to HTML5
Dec-10	Chrome opens its web store in HTML 5: Non-Apple web apps now easy to buy on tablets
Mar-11	Disney Buys Rocket Pack, a HTML5 gaming engine start-up
Jul-11	Pandora begins the switch to HTML 5
Aug-11	Amazon creates Kindle Cloud Reader: Allows customers to access their content offline from their browser
Aug-11	Twitter rolls out HTML5 version for iPad
Sep-11	34% of top 100 trafficked websites are using HTML5
Nov-11	Adobe stops making flash for mobile devices in order to focus on HTML5 tool development
Apr-12	Flickr uses HTML5 for uploading files
Jun-12	Linkedin creates 95% HTML5 native iPad app
Jun-12	A million websites created on publishing platform Wix.com, just 90 days after releasing HTML5 website builder
2012	Research firm Kony estimates that 79% of mobile app developers plan to integrate HTML5 technology into products they plan to launch.
2013	Over 1 Billion HTML5 compatible smartphones are expected to be sold from 336M two years ago according to Strategy Analytics
Jul-14	The W3C (World Wide Web Consortium) plans to finalize the standard
2015	More than 80% of all mobile apps will be wholly or in-part based on the technology by 2015.

Source: Strategy Analytics, Oppenheimer & Co. Inc.

Companies mentioned that are not covered by Oppenheimer & Co. (priced as of 12/05/2012):

Adobe Systems (ADBE, $35.30, Not Covered)
Alcatel Lucent (ALU-US, $1.15, Not Covered)
Clearwire (CLWR, $2.47, Not Covered)
Walt Disney (DIS, $49.3, Not Covered)
Ericsson (ERIC: US, $9.55, Not Covered)
Hewlett Packard (HPQ, $13.53, Not Covered)
HTC Corp. (2498: TT, 278.5 TWD, Not Covered)
IBM (IBM, $189.36, Not Covered)
LG Electronics (066570: KS, 75,800 KRW, Not Covered)
Pandora (P, $9.45, Not Covered)
Samsung Electronics (005930: KS, 1,430,000 KRW, Not Covered)
Telefonica (TEF: US, $13.04, Not Covered)
T-Mobile, owned by Deutsche Telekom (DTEGY, $11.21, Not Covered)
ZTE Corp. (ZTCOY: US, $3.07, Not Covered)

Key Risks to Price Target
Stocks trading under $5 may be considered speculative and appropriate for risk-tolerant investors.

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Stock Prices as of December 5, 2012

Apple Inc. (AAPL - NASDAQ, 575.85, OUTPERFORM)
Akamai Technologies (AKAM - NASDAQ, 36.00, OUTPERFORM)
Amazon.Com, Inc. (AMZN - NASDAQ, 252.49, OUTPERFORM)
Comcast (CMCSA - NASDAQ, 37.20, OUTPERFORM)
Cisco Systems (CSCO - NASDAQ, 19.17, OUTPERFORM)
CenturyLink (CTL - NYSE, 39.28, PERFORM)
Facebook, Inc. (FB - NASDAQ, 27.46, OUTPERFORM)
Google, Inc. (GOOG - NASDAQ, 691.03, PERFORM)
Intel Corp. (INTC - NASDAQ, 19.97, PERFORM)
Leap Wireless International, Inc. (LEAP - NASDAQ, 6.45, OUTPERFORM)
Microsoft Corporation (MSFT - NASDAQ, 26.37, OUTPERFORM)
Nokia Corporation (NOK - NYSE, 3.44, PERFORM)
Oracle Corporation (ORCL - NASDAQ, 32.38, OUTPERFORM)
MetroPCS Communications Inc. (PCS - NYSE, 9.96, UNDERPERFORM)
QUALCOMM Incorporated (QCOM - NASDAQ, 63.47, OUTPERFORM)
Rackspace Hosting, Inc. (RAX - NYSE, 66.59, PERFORM)
Research In Motion Limited (RIMM - NASDAQ, 11.56, PERFORM)
Sprint Nextel (S - NYSE, 5.68, PERFORM)
AT&T, Inc. (T - NYSE, 33.92, OUTPERFORM)
Verizon (VZ - NYSE, 43.67, OUTPERFORM)

All price targets displayed in the chart above are for a 12- to- 18-month period. Prior to March 30, 2004, Oppenheimer & Co. Inc. used 6-, 12-, 12- to 18-, and 12- to 24-month price targets and ranges. For more information about target price histories, please write to Oppenheimer & Co. Inc., 85 Broad Street, New York, NY 10004, Attention: Equity Research Department, Business Manager.

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Buy - anticipates appreciation of 10% or more within the next 12 months, and/or a total return of 10% including dividend payments, and/or the ability of the shares to perform better than the leading stock market averages or stocks within its particular industry sector.

Neutral - anticipates that the shares will trade at or near their current price and generally in line with the leading market averages due to a perceived absence of strong dynamics that would cause volatility either to the upside or downside, and/or will perform less well than higher rated companies within its peer group. Our readers should be aware that when a rating change occurs to Neutral from Buy, aggressive trading accounts might decide to liquidate their positions to employ the funds elsewhere.

Sell - anticipates that the shares will depreciate 10% or more in price within the next 12 months, due to fundamental weakness perceived in the company or for valuation reasons, or are expected to perform significantly worse than equities within the peer group.

Distribution of Ratings/IB Services Firmwide

			IB Serv/Past 12 Mos.	
Rating	Count	Percent	Count	Percent
OUTPERFORM [O]	315	54.31	139	44.13
PERFORM [P]	260	44.83	89	34.23
UNDERPERFORM [U]	5	0.86	2	40.00

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