Innovations at the edge:

The impact of mobile technologies on the character of the Internet

Harmeet Sawhney

Introduction

New communication networks typically start as complementary systems that extend the reach of an established network to areas it could not penetrate. For instance, people had to walk to a telegraph office to send a telegraph and conversely a delivery person had to deliver a telegraph to home of the recipient. The telephone extended the reach of the telegraph to the homes of individual customers and thereby eliminated the need for hand delivery of messages. Similarly, cellular networks extended the reach of wireline networks to the places they could not reach—moving vehicles. Today, we are witnessing the growth of mobile networks that extend the reach of the Internet to mobile environments. However, the similarity ends there in one very significant way.
In the past, the new technology came into play after the institutional arrangements for old technology had settled. The expansion of telegraph networks in the U.S. was chaotic until Western Union rationalized them. So, when Bell started developing telephone, he had to deal with an entrenched old network. Later, the cellular technology grew in the shadows of an entrenched Bell System, which by then was the dominant communications company. However, mobile technology has come into play while the Internet is still an unsettled technology.

The free wheeling character of the Internet has been under the assault of the rationalizing forces ever since advent of e-commerce. It remains to be seen whether the Internet we know is only a “democratic moment” or will the libertarian forces prevail in keeping the Internet relatively open. It is an unsettled matter. Within this context, the advent of mobile technologies has added another dimension to the interplay of forces shaping the character of the Internet. On the one hand, we see the carry over of the libertarian impulse onto the bottom-up WiFi networks. On the other hand, we see technologies such as 3G, iMode, and iPod serving as vehicles for the introduction of the top-down logic at the edges of the Internet.

“Chaos” and “order” have tended to be oppositional configurations. The Roman roads were emblematic of the imperial order. But at the outer edges of the Roman roads, the frontiers of the imperium, the barbarians lurked. For most of the Roman history, the advancing empire kept the barbarians on the run. But, when the empire started losing
energy, the barbarians overran Rome. The Chinese emperors built the Great Wall of China to keep the nettlesome barbarians out. Eventually, the barbarians overran the imperial order. In the realm of communications, for a period of time there was uneasy coexistence of radio amateurs, who developed broadcasting, and the radio corporations. Eventually, the corporate order prevailed and the amateurs were marginalized. Thus, we see that, on the one hand, “chaos” seeks to break down “order” and, on the other hand, “order” seeks to stamp out “chaos.” Both seek the elimination of the other.

Within this context, the interface between the chaotic Internet and its mobile extensions, which by and large are ordered configurations, begs attention. For the purposes of this particular paper, the focus will be on the following two questions: Will the chaos of the Internet spillover and open up the wireless arena? Or, will the order of the wireless arena march onto the Internet?

The recent developments with regard to iPhone highlight these tensions. In the run-up to the launch on iPhone, Steve Jobs said,

We define everything that is on the phone. You don’t want your phone to be like a PC. The last thing you want is to have loaded three apps on your phone and then you go to make a call and it doesn’t work anymore. These are more like iPods than they are like computers.
These are devices that need to work, and you can’t do that if you load any software on them. That doesn’t mean there’s not going to be software to buy that you can load on them coming from us. It doesn’t mean we have to write it all, but it means it has to be more of a controlled environment.¹

Coming from Steve Jobs, talk of a “controlled environment” is ironic because he was the upstart who disrupted the established hierarchical paradigm of mainframe based computing with the launch of Apple personal computers. His company’s stance was nicely captured in the still talked about “1984” commercial in which a runner throws a hammer and brings the big brother down, the former representing the personal computer and latter the mainframe. Perhaps, now as a corporate mogul, his perspective has changed.

A charitable view, from a radical point of view, is that right now Jobs has no choice but to present a controlled environment perspective because otherwise AT&T, the service provider that provides connectivity to iPhone, would not partner with Apple. According to this theory, later when iPhone becomes a major success and has market power, Apple will dictate terms to the carriers and open up the architecture of iPhone.² One supporter of this view thinks that,

if the iPhone becomes a hit over the next year or two, Apple will get more and more leverage over the Carriers and won’t be afraid to use it. While we wish OS X could be used to its full potential for us, and we wish OS X could be used as a
Trojan horse for the masses, maybe the iPhone is itself a Trojan horse for the whole mobile phone industry.iii

If that does happen, it would be ultimate subversion of order. More realistically, this is perhaps wishful thinking because Job is not only celebrating the closed environment of iPhone, which he had to according to this theory, but also that of iPod, which he did not have to.

Notwithstanding what Steve Jobs says and does, there are other players for whom closed environments are an anathema. Within three weeks of the launch of iPhone on June 29, 2007, there were reports of a hacker, who goes by the name “Nightwatch,” having created and started an unauthorized program on iPhone. On August 18, 2007, there was the following post on mobile-society@googlegroups.com listserv:

The group iPhone Dev Wiki has discovered a way to partially unlock the device so that it can work with any AT&T or Cingular SIM card without the need for the exclusive new contract.....


If its good news, it needs to be spread!!
In the context of our discussion, the last line is notable. The hackers are particularly focused on decoupling iPhone from its sole authorized cellular service provider, AT&T.\textsuperscript{iv} Interestingly, this is reminiscent of hackers unlocking Apple’s original restriction that an iPod could share music with a single Mac and also it could not be used with a Windows PC.\textsuperscript{v} As Aviel D. Rubin of Independent Security Evaluators, a company that tests the security of its clients’ systems by hacking them, says “anything as complex as a computer—which is what this phone is—is going to have vulnerabilities”.\textsuperscript{vi}

The hackers smell blood.

It remains to be seen whether chaos or order will prevail.

This paper employs the “arena of innovations” framework developed by Sawhney and Lee\textsuperscript{vii} to analyze how the juxtaposition of chaos and order vis-à-vis Internet and its mobile extensions will play out. It uses iPhone as an example, among others, to draw insight and acuity. The next section provides an overview of the arena of innovation framework. The subsequent sections then employ this framework to study the development of the mobile extensions of the Internet.

**Arenas of Innovation**\textsuperscript{viii}

In Sawhney and Lee paper we first discussed the case of broadcasting to provide a vivid example of an arena of innovation in action. Thereafter we discussed the structural
characteristics of an “arena of innovation” that allows mass of loosely organized amateurs to generate insights that escape corporate laboratories. As we will later see, the arena of innovation framework is a useful heuristic for analyzing the intersections between mobile and Internet technologies.

In the early stages of radio's development it was framed as a wireless version of the existing telegraph technology. In fact the entire discourse was based on the telegraph metaphor. It was seen as a technology that extended the reach of the wire-based telegraph network into difficult-to-connect places such as ships in mid-sea. Even Guglielmo Marconi, the inventor of the radio, focused all his energies on molding radio into a technology for point-to-point communication. So much so, he saw the tendency of radio waves to scatter as a major nuisance.\textsuperscript{ix}

The influence of the telegraph metaphor persisted for a long time. At the time of GE - AT&T -Westinghouse agreement\textsuperscript{x}, the institutional forces guided by the telegraph analogy were clearly working towards casting radio as a point-to-point technology. In fact the very thought of broadcasting was not even within the realm of imagination.\textsuperscript{xi} It was the stubborn refusal of renegade amateurs to comply with the larger institutional framework that resulted in the identification of broadcasting as a new means of communication. Frank Conrad, in early 1920, started transmitting phonograph music as part of his ongoing experiments over a radio transmitter. His signal was picked up by amateur radio buffs and their enthusiastic response led Conrad to schedule regular concerts, which attracted much newspaper coverage and publicity.
Harry P. Davis, a Westinghouse vice-president, soon realized that "efforts then being directed to develop radiotelephony as a confidential means of communication were wrong, and that this field instead offered one of widespread collective publicity". He authorized the construction of a Westinghouse transmitter in East Pittsburgh and the transmission of programs on a regular basis. This transmitter which was assigned the historic call letters KDKA went on air on November 2, 1920, and it marked the birth of broadcasting.

The audiences grew at a phenomenal rate and broadcasting became a big business. People in the wireless industry could not help but wonder how come they did not see something as obvious as the potential for broadcasting. William C. White, a scientist at the General Electric research laboratory, later recalled, "(I was) amazed at our blindness . . . we had everything except the idea". The problem was with the conceptual templates that were brought to bear upon the phenomenon. The telegraph metaphor guided all the speculative activity along the point-to-point dimension and blinded people to any new configurational potentialities opened up by the new technology.

Such examples abound on the Internet, which is different from radio and other communication technologies in that it offers not one but many new configurational potentialities. On the one hand, amateurs have sought to subvert dominant institutions of the off-line world by replicating them on the Internet, e.g. Internet radio and telephony. On the other hand, they have developed new configurational capacities that
have forced established institutions to change, e.g. Napster and other peer-to-peer
systems and Web sites like YouTube and MySpace. It is perhaps because of the protean
type nature of the Internet that the rationalizing forces of commerce have not yet been able
to quash the libertarian culture on the Internet. It is also perhaps in the continual
development by amateurs of new and destabilizing configurational capabilities the
libertarian hope for the Internet’s future lies.

After studying the above-discussed cases, we then identified the following defining
characteristics of an arena of innovation:

**Physical substructure**

1. It is constituted by a multitude of people.

   By its very nature, an arena of innovation requires the participation of a very large
   number of people. It cannot be created by a handful of people, no matter how
determined. Why is size important? The power of a mindful multitude is very
nicely captured by Eric Raymond, who when explaining the success of open
source movement, states, “given enough eyeballs, all bugs are shallow”.\(^{xv}\)

2. The participants are dispersed across space.

   In the case of arenas of innovation, the geographical dispersion of the participants
is critical. For example, if all the radio amateurs were collected together in one place, they would not form an arena of innovation. The radio amateurs could spot the potential of broadcasting because they were dispersed across space. Since the new configurational potentiality of a communication technology by its very nature is a new modality of communication across space, geographical dispersion of participants is essential for its identification.

3. The object of play of the participants is the very medium that interconnects them.

The size provides numerous “eyeballs,” each differently oriented, and the geographical dispersion creates the arena within which a new configurational potentiality is spotted. These two factors define the overall arrangement of the arena. The third physical element is related to the phenomenon that is observed. The participants play around with the same communication technology that ties them into a geographically dispersed community. It is in the course of this fun and play that a new configurational potentiality is identified.

Social substructure

1. The experimentation by the participants is driven by fun rather than commercial gain.

The fun is primarily in the act of experimentation itself and not the results it may or may not produce. While leisure activities often generate learning, it is basically
a happy byproduct of a fun activity. The clever but goal-less activity in this milieu energizes greatly enhances the chance that one of the mindful “eyeballs” among the thousands that come together to create the arena of innovation will spot a new configurational potentiality. Corporate research teams, on the other hand, are boxed in by goals. Furthermore, there is constant pressure to show results. These factors retard the possibility of out of the box thinking.

2. The barriers to entry for joining the community are low.

The low barriers to entry allow all kinds of individuals to entry the arena and do their own thing and thereby enhance the possibility of a breakthrough observation or idea.

3. There is camaraderie and openness that facilitates cross-fertilization of ideas within the community.

In leisure groups communication is much freer than in commercial settings because the ties between members are based on the “principle of reciprocity” or “the gift relationship.” While members compete with each other and seek to establish reputations, they also help each other and freely share their knowledge. Each time a member helps another member he or she can be quite confident that somewhere down the line somebody else will provide assistance when it is needed. This free flow of information greatly enriches the overall environment.
Mobile Extensions of the Internet

With the arena of innovation as the backdrop, we will now look at the mobile extensions of the Internet. We will focus on MP3 players and cellular phones because they seem to be evolving towards open interconnected networks, potential technological underpinnings of an arena of innovation, from two opposite directions. The MP3 players, stand alone devices, are starting to get connected. Cell phones, connectivity technologies, could be moving out of a closed system architecture to an open one.

I have been watching the spread of MP3 players with great interest ever since the publication of the arenas of innovation paper. I anticipated that soon they will start getting interconnected and we may see the emergence of a new arena of innovation. My expectation that the MP3 players will start getting interconnected was based on a model I had earlier developed, based on research on clocks and computers, that delineates stages in the decentralization of a technology—over time there is a reduction in the size of a technology, multiplication in its numbers, and diffusion into the social fabric and eventually interconnection. The MP3 players were in the diffusion stage and the model suggested some kind of interconnection down the line.

Eventually, my anticipation did pan out in the form of Microsoft’s Zune, which offers connectivity with other Zune’s within 30 feet. The connecting Zunes can transfer audio
files, playlists, and pictures. But there is a “three-plays-in-three-days” limitation, i.e. a transferred music file can only be played thrice within three days. Also, recipients cannot transfer files to others and not all Zune Marketplace downloads are distributable.

Microsoft celebrates the social nature of Zune. Its tagline for Zune is “the social.” The package proclaims “welcome to the social” and the product logo is a network mnemonic. According to Microsoft,

> Under the Zune brand, Microsoft will build a community for connecting with others to discover new music and entertainment . . . We see a great opportunity to bring together technology and community to allow consumers to explore and discover music together^{xix}.

“Community” has lately become a sexy word in the business world, as in other spheres.^{xx} User communities, when nurtured properly, offer the prospects of harvesting free user inputs with regard to product design and marketing at minimal cost. From a business point of view, “the community is best described, as an organization where consumers participate in costless assets formation by playing with a product”.^{xxi} The spectacular successes of various social networking systems on the Internet seem to have fueled this appetite. In this vein, Microsoft wants a community but with the various limitations noted above. In effect, it wants a controlled community, controlled in various ways that keep its assets secure and maximize profit potential.
We know what Microsoft wants. The question is can Microsoft have what it wants.

Carolyn Marvin points to the difficulties inherent in such wishes,

New media embody the possibility that accustomed orders are in jeopardy, since communication is a particular kind of interaction that actively seeks variety. No matter how firmly custom or instrumentality may appear to organize or contain it, it carries the seeds of its own subversion. xxii

These two pithy and sagacious sentences are worthy of elaboration into an essay, something this author hopes to do down the line. For our current purposes, we will focus on the elements most relevant for our present discussion. In the case of Zune, Microsoft is trying to maintain control by “instrumentality” or design that “organizes” and “contains” interactions. In effect, it is trying to impose limitations on types of interactions by channeling behavior along desired paths. But then, as Marvin tells us, once a medium opens up new ways of communication, people are almost certainly going to experiment endlessly or “actively seek variety” and generate surprising discoveries and innovations. Sooner or later they are likely to breakout of the imposed limitations and subvert the establish order. The chances are particularly high for a device like Zune, which invites play and that too on a continual basis since people carry it around during large part of their waking hours.
Already people have been hacking away at iPod, the market leader Zune is trying to overtake. On the one hand, the hackers have sought to remove those features of the iPod they find annoying. For example, Engadget helps people replace the “No” symbol that appears when syncing iPods, which many people find annoying, with a more amiable substitute. On the other hand, hackers have sought to add new capabilities to iPods. For example, iPodMAME allows people to play Pac-Man game on their iPods. The main thrust of the hackers has been to run Linux on iPods, which provides the platform for myriad applications.

In many ways, Microsoft has conceded inability to control users by agreeing to pay Universal Music $1 for every $250 Zune. This arrangement is unprecedented because in the past music companies have been paid per song and not a slice of the cost of hardware. The royalty Microsoft pays Universal Music per piece of hardware has been dubbed the “piracy tax” because it is based on the assumption that the buyers will inevitably use the device for acquiring, storing, and playing unauthorized music. According to Hollywood mogul David Geffen,

…each of these devices is used to store unpaid-for material. This way, on top of the material people do pay for, the record companies are getting paid on the devices storing the copied music.

Similarly, The New York Times reported that Universal Music characterized royalty per device as “only fair” because they were likely to be “repositories for stolen music.”
This stance is not unreasonable considering the fact that a recent study estimated that Apple sold only about 20 songs per iPod, a small fraction of the device’s carrying capacity. The great bulk of the music files on iPods are acquired from ripped CDs, personally owned disks, and the Internet.\textsuperscript{xxvi}

Software piracy has been a longstanding issue. The decreasing costs of computer peripherals have facilitated increasing levels of piracy.\textsuperscript{xxvii} Another contributing factor has been easy access to Internet bandwidth.\textsuperscript{xxviii} What would have earlier taken days to download via dial-up connection, now takes only minutes over broadband networks. Connectivity, especially broadband, increases opportunities and temptations for piracy.\textsuperscript{xxix}

In the cell phone world, where connectivity is central, we have the hackers trying to open up the architecture of the cell phone service, which thus far has been very closed or highly integrated. The service providers dictate the parameters within which cell phone network is used and also the end user device itself. We now have a Homebrew Mobile Phone Club, modeled on the original Steve Jobs’ and Steve Wozniak’s Homebrew Computer Club, busy exploring the possibilities of opening up the cell phone. The Homebrew Mobile Phone Club’s Web site describes itself as “a physical and virtual club to do to mobile phones what Jobs and Woz did to computers.” There is also a Tuxphone Project, named after the penguin mascot (Tux) of the Linux movement, which states that its objective is to create an open (in every sense of the word) cellphone platform that is convenient for creating novel applications.” Other projects include OpenCell, started by students of Florida Institute of Technology.
For open cell phone enthusiasts, present day cell phones are like mainframes. The users have little flexibility. They have to function pretty much within the tight parameters set by the system design. The open cell phone enthusiasts hope to do to this paradigm what the Jobs and Woz generation did to the mainframes. In effect, they want to make the cell phones as flexible as the personal computers.

Unlike “homebrew” personal computers, the ambitions of “homebrew” cell phone projects are not limited to the device itself but go beyond to the connectivity between them. The “homebrew” mobiles are vehicles for opening up the cellular network. As Suraj Patel, the force behind the Tuxphone Project says, "I want the phone to be much more open. The world's best research and development lab is all the hackers there. Enable them, and they'll do it." Patel notes that five years ago it would not have been possible to build a cellphone without a “million-dollar” lab. Even today, it is quite a taxing affair to put together a “homebrew” cell phone. Yet, the final product is clunky and the battery’s charge lasts less than half an hour. “So what's the motive? For many, it is the urge to play around with devices that are an integral part of all our lives.” Patel goes on to say, “the real reason you should be interested in this technology is the applications you can’t predict.” Similarly, Casey Halverson, a Seattle-based open phones enthusiast, thinks as more people use mobile devices, “they will be running into more and more limits with closed systems.”
The hacking activities will go beyond the geeks to the general public and the result could be an open platform.xxxii

All this sounds so much like the arena of innovation discussed earlier. Imagine an arena of innovation based on portable devices that are handily available most hours of the day and invite play. It could unleash tremendous amount of creativity.

On the other hand, we need to also keep an eye on corporate efforts to harness open source energy for their own benefit. For instance, Nokia released the source code of its mobile phone Web browser to spur the industry to move towards a single standardized Web browser. Opera Software ASA’s CTO does not think that Nokia’s move will have much impact because Nokia released only a small portion of the code and kept the rest proprietary. Also, the innovations in the released code are not likely to be of use to programmers working on mobile platforms other than Nokia’s own S60 phones. According to him, “What I’m seeing is they’re flirting with open source and trying to get the open source community interested in their platform, but it’s more of a marketing thing rather than a real technical contribution.”xxxiii Other such corporate efforts, among many others, include France Telecom’s support of GPE Palmtop Environmentxxxiv and Funambol’s initiative to develop applications for Google Android with the help of open source community.xxxv de Laat, after a comprehensive study of the different ways by which corporations have tried to leverage open source efforts, concluded “that over time the open source-inspired networks developed by these companies gradually came to resemble classical corporate networks”.xxxvi I cannot see anything special in mobile
technology that will change this dynamic. Actually, as described above, we see this same tendency in Nokia’s Web browser project. Therefore, to this observer, it seems that if something dramatic comes about in the open source arena, it will at the amateur and not the corporate end.

**Migration between Arenas**

If an arena of innovation supported by handheld devices were indeed to emerge, what would be its relationship to the arena of innovation supported by the Internet? Would it be an extension of the Internet or would be different? What innovations will arise? Which way will they flow?

Currently, there seems to be more migration from the Internet to mobile, which should not be surprising since the Internet has been a hotbed innovation for quite some time. Some of the innovation migration from the Internet to the mobiles include: efforts to build gateways between cell phones and Skype, linking of mobile’s address book with social applications like LinkedIn or MySpace, enhanced mobile address books that work like IM, use of avatars on mobiles. This point need not be belabored.

We are also beginning to see the possibility of migrations the other way around. Unlike the Internet where the written word dominates the Internet, the mobile phone environment is speech oriented. This difference in orientation is showing up in the development of avatars for mobile phones. The developers of avatars for mobile phones
are working to create increasing sophisticated avatars that use voice, as opposed to speech bubbles and text on the Internet. We are likely to soon see mobile phones avatars whose lip movements and facial expressions are synchronized with real-time speech inputs. And, more importantly for our analysis, “these developments will in turn flow back into virtual worlds.”

Speaking avatars could be fun. But then, there could also be migrations of the type that strengthen the forces of order on the Internet. For instance, the concept of micro-payments employed with considerable success by DoCoMo in i-Mode has now been appropriated by many national broadband development projects. This is the scary part if one is of libertarian persuasion, at least on the Internet. Interestingly, in a very insightful article, Gerard Goggin and Christina Spurgeon examine how the premium rate culture (paid information services) is transferring from traditional telephony to the mobile environment and potentially limiting the scope of mobile interactivity. According to them, “the mobile Internet is being redesigned most effectively and pervasively not in the open and interoperable spaces of the fixed internet . . . but in the proprietary premium rate spaces of digital, and increasingly mobile, telecommunications.” Here we have a scenario where the order of the mobile environment is further reinforced by the transfer of elements from traditional telephony, which has been a bastion of order for over a century.
Only time will tell which scenario will prevail. But the possibility of a new mobile-based arena of innovation should not be discounted as fancy imagination. Surprise usually springs out of chaos and not order.
Notes


ii Internet posting by Andy Warwick on January 11th, 2007 at 11:25

iii Internet posting by Jack (last name not provided) on January 11th, 2007 at 23:52


vi quoted in Schwartz, C4.


viii The second, third, and fourth paragraphs in this subsection have been extracted from Harmeet Sawhney, “Information superhighway: Metaphors as midwives”. Media, Culture & Society 18(2), 1996, 291-314.


x The intense rivalry between AT&T, General Electric, and Westinghouse led to a situation where none of them could commercialize radio because the patents for key
components were controlled by different corporations. The resulting impasse was resolved in 1920-21 via a patent sharing agreement between the three corporations. Each corporation had access to a pool of about 1,200 patents but their areas of operations were restricted to specific applications. Very broadly, AT&T could use any of these patents for applications related to the public telephone network while General Electric and Westinghouse could use them for private networks and amateur markets.

The interesting thing about this agreement is that it was based on the notion that radio is essentially a point-to-point technology. Therefore no provision whatsoever was made for the emergence of broadcasting. The agreement collapsed once broadcasting became a reality. Each rival claimed that broadcasting fell within the area earmarked for it. The agreement was eventually renegotiated in 1926. As a result of the second agreement, AT&T decided to quit broadcasting in lieu of financial compensation and guarantees safeguarding its monopoly over the public telephone network. On the other hand, General Electric and Westinghouse were allowed to dominate broadcasting. See Gerald W. Brock, *The Telecommunications Industry: The Dynamics of Market Structure* (Cambridge, MA: Harvard University Press, 1981).

xi Brock *The Telecommunications Industry*


xiii Davis “American Beginnings”.


xv Raymond, 41. In other words, when thousands of eager volunteers are involved in the development of a program, the bugs are more likely to be spotted than by a corporate
team specially assembled for that task. Open source movement’s success stems from the
fact that it is able to engage a huge number of “eyeballs” each of which “approaches the
task of bug characterization with a slightly different perceptual set and analytical toolkit,
a different angle on the problem” (Raymond 1999: 41). Eric S. Raymond, *The Cathedral
and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*
(Sebastopol, CA: O’Reilly, 1999).

xvi They are extensions of the Internet in that they plug into the Internet and download
music and other programming.

xvii Sawhney and Lee, “Arenas of innovation”

xviii Sawhney.

xis Marshall Kirkpatrick, On Universal Music Group’s Zune Tax TechCrunch, November
9, 2006, Available at:

April 11, 2007).

xx For an insightful overview and critique see: Nikolaos Tzokas and Michael Saren,
“Building relationship platforms in consumer markets: A value chain approach”, *Journal
of Strategic Marketing* 5, 1997, 105-120.

xxi Lars. B. Jeppesen, Organizing and Tapping Consumer Communities (Copenhagen:
Working Paper, Copenhagen School of Business, 2001), 23

xxii Carolyn Marvin, *When Old Technologies Were New* (New York: Oxford University

xxiii In addition to the royalty for each piece of hardware, Universal Music will also
receive a portion of the revenue per song downloaded (Leeds 2006). Jeff Leeds,
“Microsoft Strikes Deal for Music”. *The New York Times*, November 9, 2006, Available at:


**xxiv** Many countries have tried to levy an “iPod” tax to compensate music companies for losses due to piracy. In Canada, such a tax levied as much $25 per iPod but the courts ruled it to be invalid. What is different about the Microsoft-Universal Service agreement is that it is voluntary (Kirkpatrick 2006). Mashall Kirkpatrick, “On Universal Music Group’s Zune Tax”. *TechCrunch*, November 9, 2006, Available at:


**xxv** Kirkpatrick.

**xxvi** Leeds.


John Borland, “Build-it-yourself cell phones: Frustrated at limitations on mainstream mobile phones, "homebrew" enthusiasts are building their own”. *CNET News.com*, November 15, 2005, Available at:  

Borland “Build-it-yourself cell phones”.

Quoted in Borland 2005, online.

Nancy Gohring, “Nokia to open source its mobile browser code”. *IDG News Service*, May 24, 2006, Available at:  

Paul McDougall, “Open source mobile phone on the way”. *Dr. Dobb’s Portal*, February, 8, 2007, online at:  

Brad Reed, “Funambol to develop open source mobile messaging app for Android”. *Network World*, November 19, 2007, available at:


Cleland, 39.