



Wireless Carterfone

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Over the next decade, regulators will spend increasing time on conflicts between the private interests of the wireless industry and the public's interest in the best uses of its spectrum. This report examines the practices of the wireless industry with an eye toward understanding their influence on innovation and consumer welfare.

In many respects, the mobile wireless market is and remains a wonder. Thanks to both policy and technological innovations, devices that were science fiction 30 years ago are now widely available. Over the last decade, wireless mobile has been an "infant industry," attempting to achieve economies of scale. That period is over: Today, in the United States, there are more than 200 million mobile subscribers, and mobile revenues are over \$100 billion. As the industry and platform mature, the wireless industry warrants a new look.

This report finds a mixed picture. The American wireless industry, over the last decade, has succeeded in bringing wireless telephony at competitive prices to the public. Yet at the same time, we also find the wireless carriers in the United States aggressively controlling product design and innovation in the equipment and application markets, to the detriment of consumers. In the wired world, their policies would, in some cases, be considered simply misguided, and in other cases be considered outrageous and illegal.

Four areas warrant particular attention:

1. **Network Attachments** – Carriers exercise strong control over what devices may be used on the public's wireless spectrum. The carriers place strong controls over "foreign attachments," like the AT&T of the 1950s. The FCC's *Carterfone* rules, which allow consumers to attach devices of their choice to the wired telephone networks, have not been applied to wireless networks. These controls continue to affect innovation and the development of new devices and applications for wireless networks.
2. **Product Design and Feature Crippling** – By controlling entry, carriers are in a position to exercise strong control over the design of mobile equipment. They have used that power to force equipment developers to omit or cripple many consumer-friendly features. Carriers have also forced manufacturers to include technologies, like "walled garden" Internet access, that neither equipment

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developers nor consumers want. Finally, through under-disclosed "phone-locking," the U.S. carriers disable the ability of phones to work on more than one network. A list of features that carriers have blocked, crippled, modified or made difficult to use, at one time or another, include:

- Call timers on telephones,
- WiFi technology,
- Bluetooth technology,
- GPS services,
- Advanced SMS services,
- Internet browsers,
- Easy photo file transfer capabilities,
- Easy sound file transfer capabilities,
- E-mail clients, and
- SIM Card mobility.

3. ***Discriminatory Broadband Services*** – In recent years, under the banner of "3G" services, carriers have begun to offer wireless broadband services that compete with WiFi services and may compete with cable and DSL broadband services. However, the services are offered pursuant to undisclosed bandwidth limits and usage restrictions that violate basic network neutrality rules.

Most striking is Verizon Wireless, which prominently advertises "unlimited" data services. However, it and other carriers offer broadband service pursuant both to bandwidth limits, and to contractual limits that bar routine uses of the Internet, including downloading music from legitimate sites like iTunes, the use of Voice over IP, and the use of sites like YouTube.

4. ***Application Stall*** – Mobile application development is by nature technically challenging. However, the carriers have not helped in fostering a robust applications market. In fact, they have imposed excessive burdens and conditions on application entry in the wireless application market, stalling what might otherwise be a powerful input into the U.S. economy. In the words of one developer, "there is really no way to write applications for these things." The mobile application environment is today, in the words of one developer, "a tarpit of misery, pain and destruction."²

Most of the carriers exhibit similar practices in the areas discussed in this paper. However, in each area, there are variations between the four largest carriers: AT&T, Verizon Wireless, Sprint-Nextel, and T-Mobile. Speaking generally, Verizon Wireless and AT&T have the most restrictive policies; Sprint is slightly less restrictive. The fourth and smallest competitor, T-Mobile, tends to be the least restrictive on consumers and application developers. The reliance on a fourth competitor for serious variation in industry practice must be kept in mind when considering any future consolidation.

² "Obstacles in the Mobile Platform: A Panel Discussion," IT Conversations, June 30, 2005, available at: <http://www.itconversations.com/shows/detail810.html>.

The paper makes four major recommendations:

1. **Wireless Carterfone** – The basic and highly successful *Carterfone* rules in the wired world and allows any consumer to attach any safe device to his or her phone line. The same rule for wireless networks could liberate device innovation in the wireless world, stimulate the development of new applications and free equipment designers to make the best phones possible.³ At a basic level, that would mean rules that:

- Bar the “locking” of devices to a single carrier; and
- Require carriers to allow, as some carriers do now, the attachment of any compatible and non-harmful network device.

2. **Basic Network Neutrality Rules** – Wireless carriers should be subject to the core network neutrality principles under which the cable and DSL industries currently operate. That would mean, most importantly

- A general ban on the blocking of internet content.

Consumers should have the basic right to use the applications of their choice and view the content of their choice, so long as it’s not dangerous to the network nor is it illegal. Wireless carriers who offer broadband services should respect the same basic freedoms. Carriers can tier or meter pricing for bandwidth without blocking or degrading consumer choice.

3. **Disclosure** – Consumer disclosure is a major problem in the wireless world. In addition to the disclosure of areas lacking coverage and rate-plan information, carriers should disclose—fully, prominently, and in plain English—any limits placed on devices, limits on bandwidth usage, or if devices are locked to a single network.

4. **Standardize Application Platforms** – The industry should re-evaluate its “walled garden” approach to application development, and work together to create clear and unified standards for developers. Application development for mobile devices is stalled, and it is in the carriers’ own interest to try and improve the development environment.

³ The first academic to suggest “Carterfone” for wireless was Eli Noam, in Eli M. Noam, “The Next Frontier for Openness: Wireless Communications,” Telecommunications Policy Research Conference, 2001.

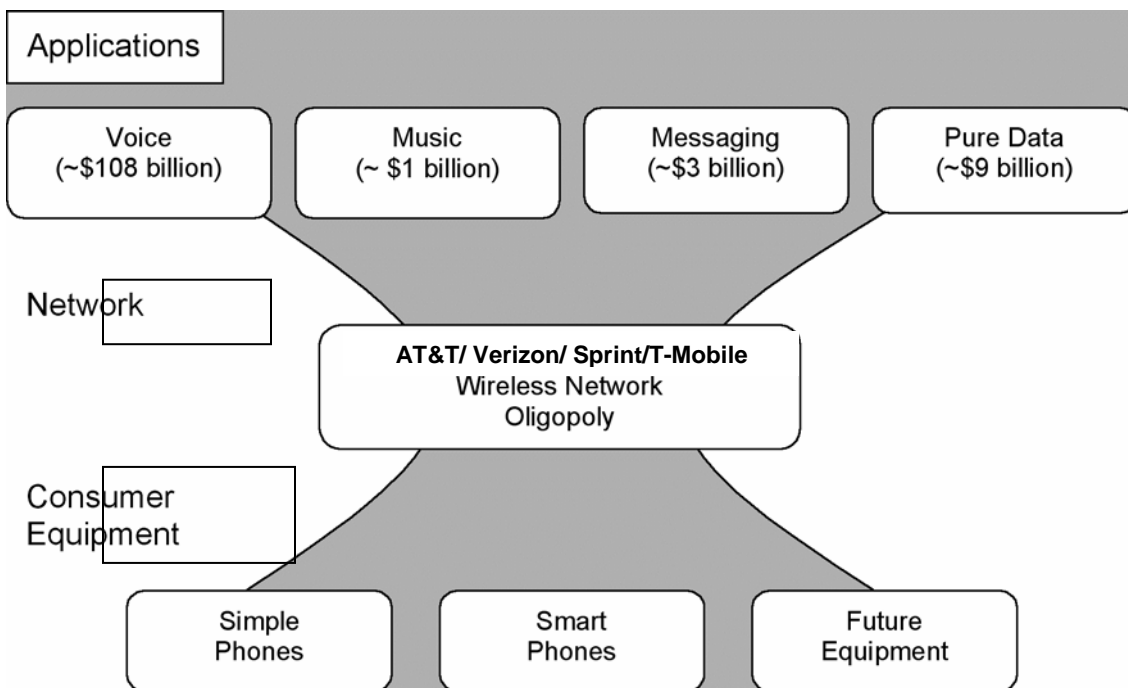
Part I: The State of Wireless

1. Introduction to the U.S. Wireless Industry

In Washington, D.C., the wireless world is sometimes described as a nirvana for consumers brought on by competition and enlightened government policy. Relative to its history, the state of the wireless industry is greatly improved.⁴ For years, the Federal Government placed severe limits on competition in wireless telephony. However, since the 1990s, when the Federal Communications Commission began to auction wireless spectrum suitable for telephones and other devices, wireless telephony has taken off. A decade later, the industry is no longer an infant. As mobile platforms mature, and as consumer markets reach saturation, the state of the wireless world warrants greater scrutiny.

The American wireless industry is a classic example of an information platform economy.

Figure 1. The Wireless Industry and Associated Industries⁵



⁴ See Jonathan Nuechterlein & Phil Weiser, *Digital Crossroads*, Ch. 8, 2005.

⁵ The sources of the revenues in the diagram are approximate, and come from multiple sources, including eMarketer, September 2006, and the CTIA-Wireless Association website (www.ctia.org).

Today, most discussion of the wireless industry is focused on the degree of competition *between* carriers—the horizontal competition within the carrier market, represented as the “Network” layer in

Figure 1. The FCC has done important work in this area since the 1990s. The rise of spectrum auctions, the initial imposition of spectrum caps (since repealed), and the number portability rules are important landmarks that have intensified intra-industry competition.⁶

Much less attention has been paid to a different issue: the impact of carrier practices on the vertical markets touched by the wireless industry and its spectrum-based oligopoly—in other words, the effects of the wireless oligopoly on the equipment and application markets, and consequently on consumers. This paper is primarily focused, therefore, on the impact of carrier market power not on inter-carrier competition, but on the markets affected by the carriers – the device and application markets.

But first a threshold question – if there exists oligopoly competition between the carriers at a horizontal layer, is there any room for concerns regarding vertical markets? Members of the incumbent industries argue, “no,” stating that the oligopoly structure of the wireless market makes scrutiny unnecessary, because any anti-competitive or anti-consumer behavior will be self-correcting. In the words of AT&T spokesman Mark Siegel, “this is a fiercely competitive industry” and any vertical concerns are a “red herring.” Since there is no single cell phone monopoly, the argument goes, attention to these issues is unwarranted.⁷

That the carriers make this argument is not surprising, but bald assertions that the industry is “competitive” cannot be the end of all scrutiny in this area. Most network industries, perhaps unavoidably, tend toward domination by a few firms, and the wireless industry is no exception. It is worth pointing out the obvious: that the industry is highly concentrated by any statistical measure. While there are numerous studies of mobile industry concentration, since consolidation in the mid-2000s few find HHIs of less than 2000, and some have reported mean HHIs as high as 6000, or higher levels of concentration than before regulation limited competition to two firms.⁸ As a reminder, the United States Justice Department considers any industry with an HHI over 1800 to be “highly concentrated.”

Second, the carrier market is not the open market it is optimistically described as. While entry is not impossible, all agree that under current conditions, it requires multi-billion dollar investments. The consequence is a spectrum-based oligopoly, not the “fiercely competitive” market that is sometimes portrayed. The wireless market may be competitive by the standards of the telecommunications industry

⁶ See Nuechterlein & Weiser, *supra* note 4, Ch. 8.

⁷ Mark Siegel quoted in Charles Babbington, “A Call to Let Your Phone Loose— Telecom’s New Battleground: Carriers’ Proprietary Controls,” *Washington Post*, February 9, 2007, available at: <http://www.washingtonpost.com/wp-dyn/content/article/2007/02/08/AR2007020802169.html>.

⁸ See, e.g., Marius Schwartz & Federico Mini, *Hanging Up on Carterfone: The Economic Case Against Access Regulation in Mobile Wireless*, Appendix A Paper released May 2, 2007 (HHI of 2716); Jeremy T. Fox, *Consolidation in the Wireless Phone Industry*, NET Institute Working Paper 05-13 (finding population weighted mean HHI of over 6000).

and regulated industries like energy generation. But the U.S. wireless market is nothing like the market for blue jeans or vodka, and it is a mistake to so pretend.⁹

Third, the behavior of the carriers is itself evidence of market power and refutes the argument that oligopoly competition is a cure-all. The carriers have the power, and exercise it, to decide what products enter the market and in what form. The fact that the carriers are able to control entry into vertical markets suggests that they wield market power. Variation in carrier practice is limited, and the practices documented in this paper are of manifest concern for consumers and for innovation in the markets adjacent to the carriers.

If it is accepted that the wireless industry warrants attention, several important justifications are usually raised for the industry's practices. It is often asserted that industry practices are made necessary by spectrum scarcity and the need to maintain network security. These arguments are important—no one wants a world of calls that never go through, or widespread identity theft practiced through cell networks. Yet these arguments cannot be accepted as blanket justification for any and all carrier practices.¹⁰ Just as the network security and quality claims made by AT&T for much of the 20th century were eventually questioned, the claims made by the mobile carriers today must be examined far more closely.

The historic parallel is instructive. Wired voice telephone networks had more or less reached their full potential under AT&T by the 1960s. To reach the next stage, the most important steps were not technological but what "deregulatory," in the language of the day—destroying impediments created by AT&T that restricted innovation and competition. As Eli Noam writes, "in almost all other fields of communications the U.S. is heavily dominant. Why not in mobile wireless? The one different variable is policy."¹¹ To reach the "next stage" in wireless communications, the most important step may be opening the networks to true competitive entry. This paper specifies how that could happen.

Part II: Carrier Practices

For various reasons, discussed in Part IV, the oligopoly of carriers, using their power over the public spectrum, are disabling features or paths of development that might be attractive to consumers. We now turn to a more detailed look at carrier practices. We examine four areas: (1) network attachments, (2) product design and feature crippling, (3) data-service discrimination, and (4) application development.

⁹ It is impossible to summarize the vast field of work on imperfect competition under conditions of oligopoly. For a recent work summarizing many of the main ideas, see: Xavier Vives, *Oligopoly Pricing: Old Ideas and New Tools*, MIT Press, 2000.

¹⁰ Jonathan Zittrain, *The Future of the Internet and How to Stop It*, forthcoming from Penguin and Yale University Press, 2007.

¹¹ Noam, *supra* note 3.



Figure 2.
Apple's iPhone

1. The Right to Attach – *Carterfone* Principles

In 2007, Apple launched the iPhone—its first foray into the world of wireless voice. The iPhone (Figure 2) is beautiful and innovative in design. But it also came with various limitations. Most importantly, to the surprise of many, the iPhone only works on the network of a single carrier, AT&T Wireless. The hundreds of millions of consumers who are not AT&T Wireless customers could not make use of the iPhone unless they become AT&T customers. The question is, why? Why can't you just buy a cell phone and use it on any network, like a normal phone?

One reason is the lack, in the wireless world, of basic network attachment rules. Thanks to FCC rules dating from the 1960s and 1970s, usually referred to as *Carterfone* rules, when it comes to wireline telephones, consumers have the right to attach whichever devices they want to their phone lines. That right is made possible by the standard "telephone jack." If Apple wanted to build a wireline telephone, it would build one that could plug into the standard household phone jack. It could sell the device directly to consumers—and it would work whether they bought their phone service from AT&T, Verizon or any of hundreds of smaller telcos.

The standardized telephone interface has proved essential to competition in the wireline space. To understand its importance, we must examine where it came from. For much of the 20th century until the 1970s, the AT&T monopoly barred consumers from attaching anything but a Bell telephone to their network. AT&T had a rule (a tariff¹²), which stated,

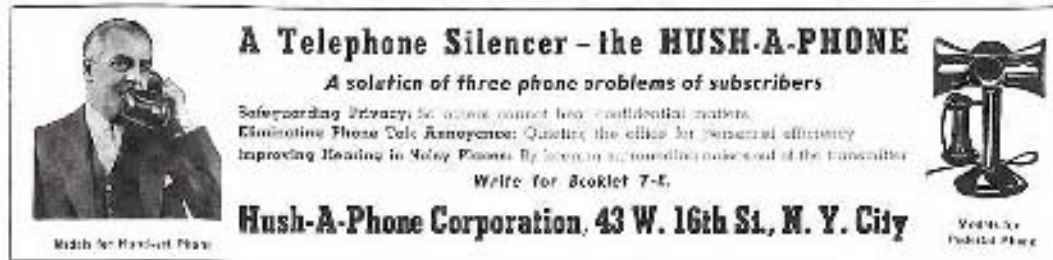
No equipment, apparatus, circuit, or device not furnished by the telephone company shall be attached to or connected with the facilities furnished by the telephone company, physically, by induction or otherwise.¹³

That rule, unsurprisingly, suppressed most competition and innovation in the making of telephones. A slow change began in 1948, when a company named "Hush-a-Phone" challenged AT&T's rule. AT&T had banned the use of a small device (shown in Figure 3) designed to keep phone calls quiet and private. Hush-a-Phone challenged the tariff at the FCC as "unreasonable."

¹² Pursuant to §203(a) of the 1934 Telecommunications Act, AT&T had the right to file tariffs showing charges for its phone service, and also "classifications, practices, and regulations affecting" its phone service.

¹³ See "Use of the Carterfone Device in Message Toll Tel. Serv.," 13 F.C.C.2d 420, 1968.

Figure 3. Hush-a-Phone Advertisement



In litigation, AT&T argued that:

It would be extremely difficult to furnish 'good' telephone service if telephone users were free to attach to the equipment, or use with it, all of the numerous kinds of foreign attachments that are marketed by persons who have no responsibility for the quality of telephone service but are primarily interested in exploiting their products.¹⁴



Figure 4. Carterfone

After eight years of litigation, the D.C. Circuit Court of Appeals ordered AT&T to allow consumers to attach the Hush-A-Phone to their handsets. The court said that the subscriber has the "right reasonably to use his telephone in ways which are privately beneficial without being publicly detrimental."¹⁵ Subsequent to this ruling, through the 1960s and 1970s, the FCC progressively deregulated network attachments—ordering the local phone companies to allow users to connect any devices that complied with a set of basic rules. These principles are often referred to as the *Carterfone* principles, after the 1968 case by that name.

¹⁴ See "In the Matter of Hush-A-Phone Corp. et al., Decision," 20 FCC 391, 415, 1955.

¹⁵ *Hush-a-Phone v. United States*, 238 F.2d 266, 1956.

In the *Carterfone* case, AT&T wanted to prohibit the use of the “Carterfone,” a device that facilitated communication between a mobile radio and a telephone. AT&T again argued that control over all equipment on the network was necessary for the telephone system to function properly. As AT&T described in an advertisement, “It takes a totally unified system to make it all work. One system. AT&T.”

Despite these arguments, the FCC in *Carterfone* struck down AT&T’s rule as “unduly discriminatory.” Importantly, the FCC rejected arguments made by AT&T that suggested control over all equipment on the network was necessary for the telephone system to function properly.¹⁶ Full realization of the modularity rule implicit in *Carterfone* took until the late-1970s, but few doubt the historic importance of the decision.¹⁷

The 1968 *Carterfone* right to attach devices to home networks is perhaps the fundamental consumer right in telecom, and indeed its consequences have been historic. The attachment right is broadly celebrated by policy analysts of every ideological persuasion, who recognize the *Carterfone* principle as a central tenet of a competitive telecommunications policy. However, as described below, AT&T’s wireless descendants have shown an interest in resurrecting, one way or another, the pre-*Carterfone* rule.

The *Carterfone* principle has had enormous consequences not only in telecommunications policy, but for the economic prosperity of the United States. The ability to build a device to a standardized network interface (best known to Americans by the standard U.S. phone plug, known as an RJ-11) gave birth to a new market in home and business telecommunications equipment. That led, predictably, to competition in the phone market. But it also led, unpredictably, to other innovations. Those have included mass consumer versions of the fax machine, the answering machine, and, perhaps most importantly, the modem. Arguably, the FCC’s rules on network attachments—now known as the Part 68 rules—have been the most successful in its history. In addition to fax and answering machine, openly available modems became the anchor of the mass popularization of the Internet in the 1990s. As one observer put it, without *Carterfone*, “the development and broad popularization of the Internet also would not have occurred as it did. The key point of *Carterfone* is that it eliminated an innovation bottleneck in the form of the phone company.”¹⁸

Carterfone is an important innovation policy. It drives decentralized innovation: any company or even individual can build to the standards of the phone system, without gaining the permission of the phone company.¹⁹ But in the wireless world, the *Carterfone* rule has not been applied. Instead, like in the

¹⁶ See “Use of the Carterfone Device in Message Toll Tel. Serv.,” 13 F.C.C.2d 420.

¹⁷ For more on the process from “Carterfone” to a full network attachment right, see Glen Robinson, “The Titanic Remembered: AT&T and The Changing World Of Telecommunications” 5 *Yale J. on Reg.* 517, 521-23, 1988.

¹⁸ Comments of the Center for Technology and Democracy, “In re: Joint Petition for Rulemaking to Resolve Various Outstanding Issues Concerning the Implementation of the Communications Assistance for Law Enforcement,” April 12, 2004.

¹⁹ See Mark Lemley & Lawrence Lessig, “The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era,” 48 *UCLA L. Rev.* 925, 2001.

pre-*Carterfone* world, innovative companies must seek the permission and cooperation of the carrier oligopoly.

Consequently, the market for consumer devices is unusual and distorted. As one developer put it, "You just can't sell in this market like you do in others. The carriers have ultimate control over what products reach the market. If they don't like what you're doing, that's too bad."²⁰

Current Barriers to Attachment and Marketing

American equipment manufacturers are used to Internet connections and telephone lines that are "plug and play." A firm can design equipment, create whatever features it thinks best, and sell to consumers directly.

In contrast, today, it is *de facto* necessary to obtain the permission of the carrier to market a wireless device in the United States. That fact creates an important bottleneck on innovation and product diversity. To make it to market, any device must "fit" with the business plans of the major carriers.

That has two main consequences. First, the cellular phones widely available in the United States are just a small fraction of the phones available in the world. As Marguerite Reardon of C-Net points out, "even though Nokia introduced roughly 50 new products into the market last year, only a handful were offered by operators in the U.S."²¹

Second, as discussed in subsequent sections, control over attachments has given carriers enormous power over equipment design and over application markets. First, we examine how the carriers control network attachment in the first place.

Retail Barriers

The major American carriers have strong lock on the retail of mobile wireless devices in the United States. According to analyst estimates, between 90% and 95% of cell phones in the United States are sold by the carriers. That is nearly the opposite of other markets: in some markets in Asia, for example, about 80% of cell phones are sold independently of a carrier.²²

The primary reason is well known, and even beloved by consumers: the practice of subsidizing equipment purchases with subscription fees. As Elliot Drucker writes in *Wireless Week*, "by far the biggest

²⁰ Many of the application and equipment developers interviewed for this report requested anonymity, for fear of retaliation. For that reason, some of the sources relied upon cannot be disclosed.

²¹ Marguerite Reardon, "Will 'unlocked cell phones' free consumers?" *CNET News.com*, January 24, 2007, available at: http://news.com.com/Will+unlocked+cell+phones+free+consumers/2100-1039_3-6152735.html?tag=st.prev.

²² *Ibid.*

impediment to commercialization of innovative wireless data products and services lies in the way mobile handsets are distributed in the U.S. market.²³

As the main carriers collect a monthly fee from consumers, they are in a unique position to collect the price of the telephone or smartphone over a long period. In effect, they can sell telephones on a “buy-now-pay-later” basis, like an installment plan, as opposed to a lump sum purchase. Typically, a provider like T-Mobile or AT&T will advertise and sell a phone for \$99-\$199 that retails without subsidies for \$300-\$600. They consequently collect the full cost of the telephone through higher monthly billing, spread over their entire customer base. The higher fees charged to recover the price of the telephone subsidy program are not indicated on phone bills. Since many consumers spend more than \$1,000 a year for mobile service, collecting the wholesale price of the telephones through subscription fees is practical.

As many sources we interviewed suggest, the subsidy makes trying to sell phones through non-affiliated retailers a losing proposition. As one equipment developer explained, “we always hated it, but if you want to move the needle, you have one choice, and that’s selling through the carriers.” It is possible to buy handsets from unaffiliated vendors in the United States, but they cost far more because of the lack of the subsidy.

This paper does not take a position on the interesting question of whether phone subsidies, long-term contracts and other retail practices are practices that mandates the attention of the antitrust law.²⁴ But the effect of retail practices on equipment markets and application markets is undeniable. As the only significant channel for the purchase of mobile devices, the carriers can and do reserve the power to decide what devices will “make it” to the U.S. market.

Technical Barriers

In the United States, carriers rely on two distinct main standards—GSM and CDMA.²⁵ The CDMA carriers (Verizon and Sprint) have different means of restricting network attachments than the GSM carriers (T-Mobile and AT&T). We shall examine each briefly.

Approved Phones Only. “We only allow devices on our network that have been approved,” said Jeffrey Nelson, a spokesman for Verizon Wireless.²⁶ As Nelson confirms, for Verizon Wireless, the largest CDMA carrier in the United States, only devices specifically approved by the company work on its networks. Technically, how is this accomplished? For CDMA carriers, every device that connects to the

²³ Elliott Drucker, “Handset Distribution: The Technology “Gatekeeper,” *Wireless Week*, July 15, 2005.

²⁴ Note that if the current low upfront prices made possible by subsidies are important to ensure the affordability of phones for consumers, telephones could be sold on an installment plan, with repayment processed automatically through billing.

²⁵ GSM stands for the Global System for Mobile Communications and is the world’s most popular standard. CDMA stands for Code Division Multiple Access and is used mainly in the United States, South America and Korea.

²⁶ Reardon, *supra* note 21.

network must have an approved ID number—an ESN (electronic serial number) or, more recently, an MEID (mobile equipment ID). The practice of Verizon Wireless is to block telephones that are not sold by Verizon itself.²⁷ As one Verizon customer representative put it, “all the phones that work are already in our system.”

The method of exclusion is a “whitelist” of Verizon phones which, by implication, prevents others from working. Without an approved ID number, telephones not sold by Verizon will not be recognized and cannot be used on the network. This effectively makes Verizon Wireless the gatekeeper of market entry for telephones on their network, like the AT&T of old.

The whitelist is not a matter of technological necessity. Sprint is also a CDMA carrier and its practice is slightly different. Sprint keeps a list of customer ESNs and bars the use of existing ESNs—which can be evidence of a “cloned” or stolen telephone. While Sprint “discourages” the use of non-Sprint phones on its network, and will not offer technical support for such phones, it does not block the use of phones on its network as Verizon does. In other words, a consumer who owns his own phone can call Sprint customer service and have his phone activated on the network.

Phone Locks. The GSM wireless providers (AT&T and T-Mobile) limit network attachments using a different means: “locking” cell phones, or making them incapable of operating on any network other than theirs. It would be strange to have a car that worked on some roads but not others. However, much of the mobile wireless equipment sold in the United States today, unless modified, will only work on one network, for reasons unrelated to technological necessity.



Figure 5. A SIM Card

Locking works as follows. The GSM standard envisions a standardized interface between the phone and wireless service. For that reason, GSM phones carry a Subscriber Identity Module, or SIM card, designed to make it easy for one phone to be used on various networks simply by plugging in new SIM cards. In addition, the SIM system allows consumers to easily switch telephones by moving the SIM card from one phone to another.

The mobile device itself, however, can be designed to recognize and reject certain types of SIM cards based on information carried on the SIM, creating a “lock.” There are several varieties of lock: a “service provider lock” simply prevents the phone from being used on anything but the SIM cards of one service provider. A “full lock” prevents the phone from being used with any other SIM card, period. Most, if not all, of the American GSM phones sold by carriers are locked, disabling the utility of the SIM system.

Just as it is possible to lock phones, it is possible to unlock them. Typically, unlocking a phone requires entering a series of codes, and there are companies that specialize in unlocking telephones and reselling them. The U.S. Copyright Office announced in 2006 that telephones may be unlocked without

²⁷ Verizon Customer Service, October 5, 2006.

violating the anti-circumvention provisions of the copyright laws, though of course the rule does not prevent carriers from locking phones to begin with.²⁸ The GSM carriers, T-Mobile and AT&T, have been careful not to go too far in absolutely preventing the unlocking of phones, perhaps for fear of regulation. Both firms appear to have a policy of agreeing to unlock telephones, on request, so long as the phone has been owned for three months.

What is important, however, is the status quo. Many or most consumers have no idea what a phone lock is, let alone know how to unlock a phone. New products, like the Apple iPhone, are sent to consumers locked to one network (AT&T, in Apple's case). Consequently—in contrast with much of the rest of the world—American devices are usually locked absent user expertise or knowledge.



Two sets of consequences flow from the control that carriers exert on the marketing and attaching of mobile devices in the United States. One is a loss of product diversity. As discussed above, of the many mobile devices sold even by major providers like Nokia and Motorola, only a fraction effectively make it to the U.S. market. The bottleneck also deters other potential market entrants.

The second set of consequences of the carrier bottleneck on the device market is in product design, an issue to which we now turn.

2. Coercive Product Design and Crippled Phones

As a condition of network access, American wireless carriers play an active role in controlling the design of mobile devices. "We were used to selling PDAs (personal digital assistants). But the wireless market was like night and day. Basically, the carriers have all the power," said the former wireless marketing director of a PDA manufacturer. While they accept that some level of cooperation is necessary, equipment developers complain about two problems: (1) being forced to disable services or features that might be useful to consumers, and (2) being forced to add elements to telephones that the designers do not think are what consumers want.

Call Timers. Developers report that carriers have often forced them to remove or limit "call timers" from their phones. Call timers can keep track of the length of individual phone calls, and can also keep track by month, year, or in total. The carriers, reportedly, are concerned that consumers might easily develop an independent and possibly different record of their mobile phone usage. While it is clear that destroying an independent record simplifies billing practices for carriers, it is less clear how that serves the interests of consumers.

Photo Sharing. As one developer said, "The first thing you want to do with a photo is get it off your phone [and] email it, right? But the carriers wouldn't let us make it that easy." In the early 2000s,

²⁸ Library of Congress, Copyright Office, "Exemption to Prohibition on Circumvention of Copyright Protection Systems for Access Control Technologies," 71 Federal Register 68472, November 27, 2006.

when camera capabilities began appearing in telephones, equipment developers and carriers came into conflict.

Developers wanted to make it relatively easy to send a photo to an existing e-mail account, as a product feature. Carriers, conversely, have wanted to channel consumers to paid "photo sharing" sites where, for a monthly fee, consumers could upload their photos and then download them to their computers. While results now depend on the device and carrier, many carriers successfully forced equipment developers to make photo-sharing services the only way to get photos off of a camera-equipped phone.

For example, Sprint's "Picture Mail," Verizon's "Pix Place" and AT&T's MediaNet/MMS services, for prices typically ranging from \$60-\$240 per year, allow consumers to get photos off of their phones and onto a Web "album." An AT&T customer, for example, who wants to get photos off of his/her phone must sign up for three packages: "MediaNet," "Text Messaging" and "Multi-Media Messaging," each of which has affiliated charges. On many phones, the carriers have made it difficult (or sometimes near-impossible) to get the pictures off of the phones otherwise. That has prompted numerous consumer complaints. As one consumer wrote about Sprint's offering:

so.. wtf i pay \$5/month just for the service
and i also the .2/.3 cents/kb for a data transfer?? for every single picture??
wtf kind of bull**** is this?²⁹

Consumers also report that Verizon has placed limits on the maximum size of photos that can be uploaded from its phones (300 KB), for reasons that are not always clear. In the words of a Verizon customer:

Verizon's greed hurts its customers...One phone call to Motorola's dedicated V3C support line (800-657-8909, for those who want that number) verified that the problem was Verizon's own limit of 300 Kb on MMS and email attachments — and led to the Motorola tech expressing extreme exasperation that his company was willing to put its products in the hands of customers via a middleman (Verizon) who crippled those products before passing them on...³⁰

Whatever the benefits of a photo-sharing service may be generally, it seems hard to see how consumer interests are served by making it harder for consumers to send photos to themselves.

Bluetooth. The disabling of Bluetooth functionality has been a major sticking point for many consumers and has even prompted a lawsuit. Bluetooth is a protocol designed for very short-range

²⁹ See post at <http://cellphoneforums.net/sprint-pcs/t235449-picture-messaging-wit-sprint.html>.

³⁰ See Q Daily News, "Verizon's Greed Hurts its Customers," April 20, 2006, available at: <http://q.queso.com/archives/001903>.

personal communications—to allow communications between devices such as PCs, printers, wireless headsets, etc.³¹ Obvious uses of the technology might include transferring photos off of camera-phones, printing information from a telephone, backing up address books, or using the mobile phone as a computer modem.

In 2004, Verizon Wireless released the Motorola V710 cell phone, advertising “full” Bluetooth capabilities. (See Figure 6.) However, most of the Bluetooth capabilities were, in fact, disabled. The phone was capable only of recognizing headsets and cooperating with a modem to make dialup calls. In statements and interviews, Verizon Wireless stated that the crippling was necessary for “security” reasons.³² It later defended the crippling as necessitated by its contracts with various content partners. In response, in 2005, subscribers filed a class action lawsuit in California. Verizon Wireless eventually settled the lawsuit.³³

Since then, while it hasn’t stopped crippling Bluetooth, Verizon and Motorola more clearly indicate the limits of the Bluetooth features on phones. For example, Motorola’s “Phone Tools” website states:

If you are a Verizon customer, all multimedia and internet connection features in this software will be disabled due to carrier request. Please contact your service provider for further information.³⁴

In addition to Verizon’s practices, which are notable, Sprint and AT&T have also, at various times, disabled various Bluetooth capabilities—particularly on smartphones like the *Treo* line.

It is important to understand the consequences of Bluetooth crippling. Generally speaking, the treatment of Bluetooth features by carriers is inconsistent and mixed, uncertainty which makes it difficult or impossible for developers to create secondary markets based on full Bluetooth capabilities. For example, it would be easy for mobile phones to communicate better with printers so that users can print phone numbers, addresses or photos. However, the unpredictability of Bluetooth capabilities has inhibited the growth of that or similar markets.

³¹ Bluetooth is specified in the IEEE 802.15.1 Personal Area Network Standard.

³² See “The Motorola v710: Verizon’s New Crippled Phone,” interview with Brenda Raney by Jonathan A. Zdziarski, reported at: <http://www.pencomputing.com/wireless/motorolav710.html>.

³³ *Opperman v. Cellco Partnership*, LOS ANGELES SUPERIOR COURT, Case No. BC 326764 NOTICE OF CLASS ACTION SETTLEMENT AND APPROVAL HEARING, Jan. 6, 2005, available at: <http://www.verizonwireless.com/pdfs/v710settlement/Second%20Notice%201-4-06%20FINAL.pdf>.

³⁴ www.hellomoto.com.

WiFi. Technologically, cellular phones can incorporate WiFi (802.11b) capabilities for a range of potential uses, from email, to web access, to VoIP, to communicating directly with other devices. While there strong signs of this behavior easing, over the last five years, American wireless carriers have strongly resisted the installation of WiFi capabilities in cellular phones. In some cases, they have forced equipment manufacturers to manufacture specialized American versions of telephones with all WiFi capabilities crippled.



The Nokia e62/e61 is one example. (See Figure 7.) The Nokia e61 phone is the company's flagship "smartphone"—widely known as its "Blackberry killer." It was released in Europe in the summer of 2006 to enthusiastic reviews. However, in the United States, AT&T is the exclusive vendor of the e62—a crippled version of the e61 that has WiFi and other features removed. In the words of MSN columnist

Gary Krakow: "What some carriers fear most is the e61's ability to handle VoIP calls when you're near a friendly wireless network. That's why we won't see WiFi on the e62."³⁵ The e61 was not made available.

Figure 7. Nokia U.S. e62 (e61 sans WiFi)

As of 2006, there are "pure" WiFi phones being sold in the United States, such as the Netgear SPH101. But these phones do not work on the cellular networks operated by the commercial wireless carriers. They are WiFi phones only—typically only allowing a user to make phone calls using Skype or other VoIP providers within range of a local area or public WiFi network.



**Figure 8.
Netgear SPH101**

In the United States, as stated, behavior in this area is beginning to change. T-Mobile has made available WiFi with notable exceptions including the Apple iPhone, it is uncommon today to find a WiFi capable cell phone. It is difficult to see how the practice of restricting the sale of WiFi capable phones has been helpful to the American consumer.

3. Discrimination in 3G Broadband Services

Under the general banner of 3G ("Third Generation") services, wireless carriers have begun offering various types of broadband data services using their wireless spectrum. These data services are designed to be used both for smart telephones and personal computers (presumably laptops) through a data-card (typically a modem card with an embedded antenna that plugs into the computer). GSM and CDMA telephones use different protocols for these data services (such as EVDO and HSDPA). While there are important technical differences, we shall refer to all as 3G wireless broadband services.

³⁵ Gary Krakow, "Nokia e62: The best smartphone ever?" *MSNBC.com*, August 24, 2006, available at: <http://www.msnbc.msn.com/id/14456766/>.

Verizon, Sprint-Nextel, AT&T and T-Mobile now all offer wireless broadband services of various kinds. These data services, based on licensed spectrum, compete with commercial and public WiFi providers, who offer services for free or for a fee in cafes, airports, and other public facilities, at designated hot spots or hot zones, and in some cases throughout cities.³⁶

WiFi is faster than 3G. Under current technologies, WiFi has a capacity between 11 Mbps to 54 Mbps, which means that WiFi usually operates at the maximum speed of the underlying Internet connection (often a home DSL or cable connection), minus whatever is lost through interference or sharing. As for 3G, Verizon and Sprint have claimed average downstream speeds between 500-600 kbps, though some in the industry contest these claims. One independent test of AT&T's broadband network found downstream speeds between 100-300 kbps, and upstream speeds under 100 kbps.³⁷

The major advantage of 3G broadband data services over WiFi is not speed but coverage—WiFi networks tend to be offered sporadically, by various providers (or neighbors), while cellular data services are available anywhere that the carrier's network reaches.

In a manner similar to early broadband services, Verizon and AT&T have offered their services pursuant to discriminatory conditions of various kinds.

Blocks and Bans



Figure 9. Verizon EVDO Advertisement

The practices of Verizon & AT&T with respect to their data services are most notable. Verizon widely advertises an "unlimited broadband access" offering (see Figure 9).³⁸

However, in practice, Verizon imposes limits on its "unlimited service"—namely by restricting bandwidth and designating certain applications as "forbidden.". AT&T and Verizon have virtually identical Terms of Service contracts. They ban their users from using their broadband connections for any purpose other than:

1. Internet browsing;
2. E-mail; and

³⁶ For a comparison of different approaches to using spectrum as implied by the 3G/WiFi comparison, see: Yochai Benkler, "Some Economics of Wireless Communications," 16 *Harvard Journal of Law & Technology* 25, 2002.

³⁷ http://telephonyonline.com/mag/telecom_speed_trials_umts_2/.

³⁸ Note that in other versions of the Verizon advertisement, it advises, in small type, that "unlimited" refers only to email and Web-surfing.

3. Corporate intranet access (including access to corporate email, customer relationship management, sales force automation, and field service automation applications).

Verizon limits its "unlimited" brand service as follows:

Unlimited NationalAccess/BroadbandAccess services cannot be used (1) for uploading, downloading or streaming of movies, music or games, (2) with server devices or with host computer applications, including, but not limited to, Web camera posts or broadcasts, automatic data feeds, Voice over IP (VoIP), automated machine-to-machine connections, or peer-to-peer (P2P) file sharing, or (3) as a substitute or backup for private lines or dedicated data connections.³⁹

AT&T takes its restrictions even further:

Prohibited uses include, but are not limited to, using Services: (i) with server devices or with host computer applications, including, without limitation, Web camera posts or broadcasts, continuous jpeg file transfers, automatic data feeds, telemetry applications, automated functions or any other machine-to-machine applications; (ii) as substitute or backup for private lines or dedicated data connections; (iii) for Voice over IP; (iv) in conjunction with WWAN or other applications or devices which aggregate usage from multiple sources prior to transmission; ... except for CONTENT formatted in accordance with AT&T's CONTENT standards, Unlimited plans cannot be used for uploading, downloading or streaming of video content (e.g. movies, TV), music or games. Furthermore, unlimited plans (except for DataConnect and Blackberry Tethered) cannot be used for any applications that tether the device (through use of, including without limitation, connection kits, other phone/PDA-to-computer accessories, Bluetooth® or any other wireless technology) to laptops, PCs, or other equipment for any purpose.⁴⁰

Under these contracts, a computer user who subscribes to Verizon's "unlimited broadband access" is contractually barred from many of the most popular uses of the Internet. The provisions ban, for example, a computer user from downloading episodes of the television show, *Lost*, or even music, from Apple iTunes. They also bar downloading user-created content on YouTube, or using VoIP providers like Skype or Vonage.

³⁹ Verizon Terms of Service, available at:

<http://www.verizonwireless.com/b2c/store/controller?item=planFirst&action=viewPlanDetail&catId=409>, accessed October 21, 2006.

⁴⁰ See AT&T Terms of Service, available at: http://onlinestorez.AT&T.com/cell-phone-service/wireless-phone-plans/cell-phone-plans.jsp?WT.svl=2206800007&q_catid=2206800007, accessed October 21, 2006.

How are these rules enforced? First, while this is not possible to verify, Verizon or AT&T may be blocking or degrading applications that fall outside its list of "permitted" uses. The limits of this study preclude monitoring any active blocking or degrading.

Second, over the last two years, Verizon has shut down the accounts of people who use banned applications or too much bandwidth. Numerous people have complained about being shut down by Verizon for such reasons.⁴¹ Victims identify two patterns of termination. In the first, users are notified through a letter that they are using too much bandwidth and asked to call a number. When they call, they are asked whether they are downloading games or songs. If the answer is "yes," the user is terminated, and charged a \$175 termination fee. In a second reported pattern, the appeal stage is skipped: Customers who, according to Verizon, use too much bandwidth are terminated and charged the termination fee.

An excerpt from a termination letter is below:

As you know, the terms and conditions that govern your NationalAccess and/or BroadbandAccess account, which were provided to you at the time of service activation and which are posted on VerizonWireless.com, only permit Internet browsing, email and intranet access. All other activities, such as streaming and/or downloading movies and video, are expressly prohibited by the terms and conditions. A copy of the terms and conditions is enclosed.

We recently reviewed your Verizon Wireless NationalAccess and/or Broadband Access account and found that your usage over the past 30 days exceeded 10 Gigabytes. Your usage was more than 40 times that of a typical user. This level of usage is so extraordinarily high that it could only have been attained by activities, such as streaming and/or downloading movies and video, prohibited by the terms and conditions. Based on these facts, your extraordinarily high levels of usage conclusively demonstrate a violation of the terms and conditions, and your account will be terminated on 9/20/2006.⁴²

One anonymous user who was terminated documented his complaint as follows:

I would not object to being billed monthly per gigabyte, or even to being billed at a usurious rate for usage over a prespecified threshold. But in their advertising, 'unlimited' is the big selling point. Nowhere do they reveal the daily usage quota—which with great difficulty I finally discovered to be 166M [Megabits] per day—or any limit of any kind. They kick anyone off who uses more than that and pretend it's because they caught you streaming kiddie porn or something.⁴³

⁴¹ See, e.g., Glenn Fleishman, "Why 3G Isn't WiFi: Bandwidth Limits," available at: <http://www.WiFinetnews.com/archives/006562.html>.

⁴² Ed Foster, "Verizon Sneakwrap Tactics Channel the Ghost of @Home," *Infoworld*, October 17, 2006.

⁴³ *Ibid.*

In the summer of 2006, the group Consumer Affairs ran tests of the 3G limits and were terminated for using too much bandwidth, despite the fact that they did not violate any contractual limitations.⁴⁴ When contacted by Consumer Affairs, a Verizon spokesman, Jeffrey Nelson, maintained that advertising the service as “unlimited” is not misleading to consumers. “[The limits are] very clear,” he insisted, “in all the legal materials we put out.”⁴⁵

4. Application Stall

In the words of Michael Mace, an observer of the mobile application world:

There's a collision coming between the wireless world and the Web, and I think it won't be pretty... The river is the torrent of innovation happening in Web apps right now. The dam is the carriers who won't allow that innovation to run freely on their networks. They haven't figured out how to set up spillways and generators, let alone operate them, so the pressure of the water keeps growing as Web innovation gets further and further in front of what you can do on the wireless networks.⁴⁶

In the words of another commentator:

Developing any kind of mobile application is a tarpit. A tarpit of misery, pain and destruction.⁴⁷

Software Development on the Web and PC

The hallmarks of the software development environment for personal computers and Web applications are (1) permissionless market entry, (2) relatively low costs of market entry, and (3) open development standards that make it possible to write to many platforms. It is important to examine how these features work together. Today, a Web or PC developer can develop a new application without seeking the permission of any carrier, the World Wide Web, or any operating system owner. A new Web-based firm can be launched without “clearance” from anyone. Similarly, applications for the major operating systems—Linux, Apple, UNIX and Microsoft Windows—can be written without the permissions of the companies or authors of those systems.

The costs of developing software for these markets, while not zero, have been relatively low. Obviously, a developer needs a degree of computer expertise and computer equipment to write a new application. However, that has not prevented hobbies from becoming multi-national corporations. eBay, for example, was run as a hobby site before becoming a multi-billion dollar concern. The amount of

⁴⁴ Joseph S. Enoch, “Verizon Limits its Unlimited Broadband Service,” *ConsumerAffairs.com*, July 25, 2006, available at: http://www.consumeraffairs.com/news04/2006/07/verizon_unlimited.html.

⁴⁵ *Ibid.*

⁴⁶ Michael Mace, “The River and the Dam: CTIA and the Future of Web Apps,” *Mobile Opportunity*, available at: <http://mobileopportunity.blogspot.com/2006/09/river-and-dam-ctia-and-future-of-web.html>.

⁴⁷ IT Conversations, *supra* note 2.

start-up capital required was sufficiently low that the business could be launched as a part-time job. eBay is an extreme example, but the history of the personal computer and the Internet is full of examples of low-cost market entry. Microsoft was a tiny concern when it began to market MS-DOS. Yahoo! was a graduate student project. Similar examples are legion.

The importance of these facts for software development cannot be overstated. They allow developers to discover, or try to discover, entirely new markets at very low cost, and they give consumers more choice and value. Few in the 1980s would have ever predicted the existence of large markets for search engines, auction goods, online media, and other markets that have been discovered in the software/Web development environment. Not every market that people thought might exist has worked out—consider, for example, the “push” application craze of the mid-1990s. But through trial and error, many new markets have been discovered. In addition, cheap entry for developers creates iterative product development—rapid advances and improvements on products, based on what works and what does not. As it becomes more expensive to roll out a software product, the rate of improvement slows.

Difficulties for Developers

Many application developers believe that the mobile applications market is stalled, or much less active than it might be. Developers describe many reasons, though three are dominant: (1) access to phone capabilities, (2) extensive qualification and approval procedures, and (3) pervasive lack of standards in many areas.

Access to Phone Capabilities. Says one developer, “the bleeding from the neck problem is this: you cannot do anything if you cannot access the power of the hardware. Right now, you just can’t get at the phone’s capabilities, so you really can’t do much.” Today, in the mobile device world there are a limited number of development platforms: Java, BREW and Symbian count as the major ones. Both Java and BREW create a virtual machine that runs on top of the telephone’s capabilities. Neither offers application developers full access to the technological capabilities of the telephone.

Developers complain that carriers and even equipment makers do not make available many of the most useful application programming interfaces (APIs), or reserve them for some developers over others. In the words of one developer, “If you are a J2ME [Java] developer you’d be shocked at the number of capabilities that get locked down for no reason. Serial port access, Bluetooth access, location, Internet access with encryption, the list goes on...”

Simple evidence of this problem can be clearly verified by anyone who owns a cell phone. Available applications, if they need processing power, tend to perform very badly. On the Motorola Razr, even simple computer games run at a snail’s pace, and can take a long time simply to render graphics on the screen.⁴⁸ As one developer explained, “the guys who work at Verizon or Motorola aren’t software developers, so they’re just struggling to make things work. And thanks to lack of access for everyone else, the applications on phones are mostly a joke.”

⁴⁸ For example, Iomo’s “Gold Club” title takes between 20–22 seconds to render a screen on a Motorola Razr mobile phone.

Screening Developers. A second problem is the carriers' qualification and approval requirements. Each of the carriers has extensive qualification procedures to become a developer for their cell phone platforms. Becoming a registered developer is expensive, which can obviously impede development by very small or hobbyist developers. While hobbyist developers may not sound important, the history of the computer industry shows how important small developers can be. The work of economists like MIT's Eric von Hippel show how important user-driven innovation can be in fields as diverse as software through surfing. Qualification procedures that make user-driven improvements impossible, sacrifice that potential.⁴⁹

For example, most of Verizon Wireless's telephones run the BREW development environment, one of two used commonly for mobile telephones. BREW, as implemented, requires an extensive and expensive three-stage process to develop applications. It requires (1) pre-qualification of individual developers, (2) a rigorous process of testing for all applications, and (3) individual submission of each application to Verizon for approval and a potential contract. In taking this approach, BREW is notable for its apparent rejection of the value of an open development environment. As BREW's promotional materials, directed to carriers, state:

BREW equals REVENUE... With BREW, your needs come first: You own the relationship with your subscribers, you decide which apps to offer, and you determine the level of interaction you want with publishers and developers.⁵⁰

The consequence of this level of control is much less development of applications for BREW telephones. As David Passmore writes,

"Software can't be installed in Verizon BREW phones without permission of the operator, who gets to determine whether the resulting services are compatible with its walled garden business model, and then insist on collecting a percentage of the revenues."⁵¹

Lack of Standards. A third major problem is the costs created by the sheer number of mobile platforms—the variety of cell phones, each with varying operating systems and different implementations of Java and BREW, the main development environments. The lack of standards raises development costs, as developers need to spend considerable resources making sure that even a simple wireless application works on a reasonable portion of the cell phone platforms.

The following diagram (Figure 10), based on the work of Henry Holtzman of the MIT Media Lab, highlights some of the differences between the PC and mobile phone environment:

⁴⁹ Eric von Hippel, *Democratizing Innovation*, MIT Press, 2005.

⁵⁰ BREW website, <http://brew.qualcomm.com/brew/en/operator/operator.html>.

⁵¹ David Passmore, "(Un)acceptable Use," *Business Communications Review*, August 1, 2006, available at: http://www.bcr.com/opinion/next_generation_networks/unacceptable_use_200608011134.htm.

Figure 10. Differences Between PC and Mobile Phone Development Environments

	PC	Mobile Phone
Service	Google, Yahoo, AOL, Windows Live, YouTube	
Apps	Web browser. All kinds of vertical niche applications.	No Solution
GUI	Common "desktop" paradigm	
Input	Generic: usually keyboard, mouse, and monitor	Specialized: keypad, buttons, and inconsistent (and often limited) screen space
HW	x86 (Intel, AMD, VIA)	Lots of different platforms

As this diagram shows, while developers would like to write software for phones and smartphones, both the variety of standards in some cases, and the lack of a standard in other cases, can be a major impediment.⁵² Some large developers overcome these difficulties, but not without cost. As one developer commented, "yes you can download Google Maps for your Blackberry. But that's because at Google they have a huge team who spends all their time just trying to get a weak version of Google Maps working on all those different platforms. That's about the best they can do, and that's Google we're talking about."

We now consider several specific areas that, despite great potential, have experienced delayed development, for some of the reasons discussed above.

SMS Crippling

SMS, or short message service, is available on most American mobile phones, and is usually used for sending messages between friends. However, developers point out that SMS could be adopted to a far broader range of innovative and interesting uses. For example, many firms have been interested in using SMS as a means of payment, or, for example, as a means for charities to raise funds. Unfortunately, the

⁵² This is not to completely discount the existing efforts to provide a uniform development platform. Sun Microsystems' Java Micro Edition is probably the best-known effort to standardize development across mobile platforms, though developers report that it remains inconsistent across platforms and underpowered.

carriers have imposed complex controls on the usage of the SMS system that have all but crippled many uses other than the most basic ones.

The following anonymous testimony from a developer describes vividly the challenges in developing an SMS application:

Almost all cell phones sold in the developed world have the ability to send and receive SMS (short message service) text messages. SMS is gaining popularity in the US, but only as a way to send quick messages to friends. So why aren't there a wealth of amazing and interactive services available for mobile devices? Why is there no MySpace, Craigslist, Amazon, Flickr, or eBay accessible through this network? Why are cell phone payment systems and email systems nearly nonexistent? Why haven't charities raised money or awareness of their causes through this system?

It's simple. Because the cell phone carriers control what services are allowed to use their networks. There is no net neutrality on the cell phone network.

Imagine you want to create a user-moderated news service like digg.com that operates on SMS. On the neutral Internet, you rent a Web server (\$7-\$100 per month to start), register your name, and start programming. Total time required: less than two hours in most cases. But getting a service on the non-neutral US cell phone network would be a little different:

The first step would be to contact a company known as an aggregator. This company manages your relationships with the cell phone carriers -- and that's carriers, plural, because making an agreement with just one carrier ensures that your service will fail because it cannot effectively spread via word of mouth. The first requirement from an aggregator is a service charge, which starts at \$1,000 per month. Then, you must buy a shortcode (which kind of serves as your website name) for an additional \$500-\$1,000 per month. But you're not done.

The next step is satisfying the requirements of the cell phone companies. Many of these steps, such as requiring affirmative opt-in before a subscription can start, are not burdensome, and serve to protect the carriers' customers. Others, however, border on ludicrous. Requirements vary by carrier, but some prohibit operators from offering games or sweepstakes, or require that subscription periods can only be monthly—not daily, weekly, or yearly. Others require that content, such as ringtones, be locked so users can't forward them from their phones to their friends' phones.

Other requirements are outright offensive: as of this writing, Cingular, Sprint/Nextel, T-Mobile and Verizon all prohibit charities from raising money through their Premium SMS services. Too bad for the United Way, Greenpeace, and the Red Cross.

Some carriers also have "decency" restrictions that are so silly and restrictive that they make the production code that governed movies between 1934 and 1967 seem quaint. Verizon is the worst offender in this case: It prohibits dating services, images that are suggestive (the same images would be

acceptable if aired on prime-time network TV), and any use of "crude" words, including such shockers as "fornicate" and "genital."

After you make your application compliant to the carriers' requirements, you wait weeks or months for the carriers to approve it, and jump through more hoops if they reject your application, which they can do for any or no reason.

In practical terms, you'd never get approval for your brand new peer-mediated news service. Even if you were able to set up filters to block images and bad words, you'd still be sunk: Verizon prohibits "un-moderated chatting, flirting and/or peer-to-peer communication services."

Even if you could slip your service past the censors, you would already have been set back eight weeks and many thousands of dollars -- and this is just the beginning. Next, the carrier will charge you a fee (a few cents, typically) for every message you send to your users, and charge your users to receive your messages -- and charge them to send you messages. Just imagine where craigslist.org would be if it had to pay a few cents every time someone browsed an ad, and you had to pay as well. It's no wonder SMS services are overpriced and haven't grown beyond a niche market for ringtones and horoscopes.⁵³

As the anecdote suggests, the challenges surrounding the development of an ikjkkSMS-based application are formidable.

Geolocation & Mobile Social Software (MoSoSo)

Thanks to the government's "Enhanced 911" (e911) mandate, all American mobile phones are required to have basic geolocation capabilities, while some have more advanced, full GPS capabilities. This feature can be utilized along with tools like SMS, to create innovative location-based applications—from finding friends to locating lost items or restaurants. So far, such applications have not been developed, to any significant degree, in the U.S.

An example is the effort to develop "Mobile Social Software," or MoSoSo, modeled on successful social networking sites like Friendster and MySpace. The concept behind mobile social networking software is the ability to use your mobile device to find out where your friends are, and to tell them where you are. For example, you might use the software to figure out whether any of your friends are at the café or bar to which you are headed.

Unfortunately, despite the promise of MoSoSo, it has yet to become a widespread phenomenon. It may be that the services simply aren't popular, or haven't yet reached a critical mass of people. But the development challenges just described have certainly held things back. As commentator danah boyd explains:

⁵³ "Today's cell phone system argues for retaining network neutrality," *News Forge*, July 21, 2006, available at: <http://business.newsforge.com/business/06/07/19/206209.shtml?tid=138&tid=3>.

The next step in social technologies is mobile... Yet, a set of factors have made innovation in this space near impossible. First, carriers want to control everything. They control what goes on a handset, how much you pay for it and who else you can communicate with. Next, you have hella diverse handsets. Even if you can put an application on a phone, there's no standard. Developers have to make a bazillion different versions of an app. To make matters worse, installing [outside applications] on a phone sucks and most users don't want to do it... All around, it's a terrible experience for innovators, designers and users.⁵⁴

Boyd's concerns reflect general problems in this area. Other developers discuss the difficulty of accessing the GPS capabilities of phones. It stands to reason that, without the power to harness the relevant hardware capabilities, the development of useful GPS applications will continue to be delayed.

The OpenMoko Model

There are a few models trying to solve many of these application development problems is something called the "OpenMoko" model. The OpenMoko is a project, backed by various firms and developers, to produce mobile platforms that are as open to development as the Web and major operating systems.

In early 2007, a Taiwanese firm, FIC, Inc., announced the release of a phone called the OpenMoko Neo1973. The phone works on GSM networks, and its distinctive feature is that it runs a standard operating system (Linux) and is completely open to installation of third-party applications. In other words, the OpenMoko telephone comes with basic voice services, and allows a user to install any application she is interested in, downloadable from the Internet.



Figure 11. FIC's Neo1973

The theory is interesting—it is to create a phone that increases in value as it is used, rather than decreasing. As Sean Moss-Pultz, who works for FIC, Inc. and is a leader of the OpenMoko project, explains, "we want to build the first product that actually gets better the longer you own it." According to Moss-Pultz, the essence of OpenMoko is giving developers full access to the capabilities of the telephone. "If you don't have access to the hardware, you really can't do anything."

Whether the OpenMoko model will take off is far too soon to tell. The model depends both on the willingness of consumers to buy an unsubsidized phone and the willingness of third-party developers to write software for a telephone that will, at first, have a small user base. But what the OpenMoko model shows is that the current model of cell phone development is not the only way. Most industry observers bemoan the stagnant nature of mobile phone application development, but there are solutions.

⁵⁴ danah boyd, "Innovating Mobile Social Technologies (damn you Helio)," *Apophenia*, May 3, 2006, available at: http://www.zephorie.org/thoughts/archives/2006/05/03/innovating_mobi.html.



It is interesting to contrast the present mobile development environment with that of early computer platforms, such as the Apple II. The Apple II of the late 1970s was, like today's mobile phone, a platform with some serious technical limits. However, in many ways, the Apple was better for development than today's mobile devices. It gave its users a native development environment (BASIC and Assembler) that had full access to the (albeit limited) power of the underlying hardware. The Apple II, furthermore, had no particular pre-qualification or approval rules for developers.

It seems strange that today's mobile phones should be a more closed and limited development platform than a computer released in 1977. We might put things this way: if mobile devices are to become a major platform for software innovation, like the personal computer and web, they must become at least as hospitable to innovation as the humble Apple II.

Part III: Analysis & Recommendations

Recommendations

Recommendation 1: Wireless *Carterfone*

As described above, *Carterfone* was and still is among the most fundamental rules in telecommunications policy—the *Magna Carta* of telecommunications competition. Of the various potential actions, adapting *Carterfone* to the mobile world is likely to have the greatest positive consequences and the minimum negative side effects.

In light of existing practices, what *Carterfone* means for the mobile industry is fairly clear. It means, first, that two existing carrier practices must stop:

- on CDMA networks, blocking the registration of non-carrier-affiliated telephones; and
- on GSM networks, the locking of equipment to single networks.

A second reform is more ambitious yet more important. The industry or the FCC should, as in the Part 68 rules, define a basic interface to which any equipment manufacturer could build a mobile device and sell to consumers. As Eli Noam put it, "while the carrier could still offer and market its preferred equipment, it could not exclude other equipment, as long as it conforms to certain technical specifications pertaining to the RF transceiving function and non-discriminatory industry specifications for air interfaces standards. These specifications could not close equipment third-party applications or access to other network protocols offered by other types of providers, as long as it conforms to the FCC's software defined radio rules."⁵⁵

Some may argue that a standard interface for mobile networks would be highly complex or impossible. This report, obviously, cannot address the full set of technical issues involved. However, there

⁵⁵ See Noam, *supra* note 3.

are reasons to think that impossibility is an over-statement. The wireless world already has standardized interfaces—for example, the GSM standard contains the standardized SIM card (though its function is usually crippled by U.S. carriers). A standardized interface would work like any other in the phone or electric industry. Spectrum bandwidth is a commodity, and the interface would provide the user with a fixed maximum bandwidth and, like an electric meter, bill the consumer for the amount of bandwidth actually used.

The ramifications of such a rule are extremely important. Today, the mobile world is fixated on telephones, and to a lesser extent, messaging. However, given a standard interface, and the ingenuity of the electronics industry, we might innovation in some of the following areas:

- **Mobile video.** Right now, large-scale deployment of mobile TV or video services, especially independent of the cell phone model, is perpetually stalled in “carrier trials.” Companies in this sector are completely subject to the carrier’s plans for mobile TV. To take one example, Crown Castle International’s *Modeo* product has been thrown into jeopardy for want of carrier cooperation with its plans.⁵⁶ A consumer’s ability to buy a hybrid device, or even a “pure” IP device, that could simultaneously access other services on other frequencies could drive further innovation and development—and not just for video.

- **Mobile geolocation tools.** Presently, the technical possibilities of geo-location are highly underutilized. For example, an electronics company could sell a small device, using a tiny amount of wireless bandwidth, which could broadcast its location, making it possible and cheap to keep track of pets, vehicles and other highly mobile entities on a global scale. The limits on developing both devices and software that might inter-operate with wireless networks have so far made such products scarce in the market.

- **Mobile functions built into more devices.** There are telephones with cameras, yet it is hard to find a camera with mobile functions—that is, a camera that can download location-specific information, or upload photos it has taken. Cameras are one example, but given a standardized mobile interface, wireless communications might be built into cameras, refrigerators, e-Books, and other devices. In the 1990s, many spoke of the refrigerator that might call the grocery store to order more milk. Access to even tiny amounts of low-frequency wireless spectrum could make that a possibility, yet the ability of devices to inter-connect between these applications and commercial networks is a critical limiting factor.

- **Phone variety.** While the carriers do carry a wide variety of telephones, if phones were generally unlocked, we could expect see even greater product diversity. As detailed above, major companies introduce dozens of cell phones each year, only a handful of which are sold in U.S. markets. Devices like the Danger “Sidekick” barely made it to market under current conditions—and are sold by one carrier only (T-Mobile). We know that a better variety of phones is available outside of the United States. But we have no idea how many devices are dying on the drawing board for want of carrier approval in the United States.

⁵⁶ Junko Yoshida, “Modeo’s CEO quits as mobile TV struggles in U.S.,” *EE Times*, December 11, 2006.

The full implementation of *Carterfone*, would, over time, transform the wireless industry. Rule 68 is arguably the most successful rule created by the FCC. Its success should be exported, for it could create the same explosion of innovation that the wireline industries experienced in the 1970s and 1980s.

Recommendation 2: *Network Neutrality*

Wireless carriers should be subject to the same core network neutrality principles under which the cable and DSL industries currently operate.

In the early 2000s, the use of discriminatory terms of service and blocking of applications were strongly condemned by Chairman Michael Powell and the Federal Communications Commission. In a 2003 speech, Powell outlined the following "four network freedoms":

1. ***Freedom to Access Content.*** First, consumers should have access to their choice of legal content.
2. ***Freedom to Use Applications.*** Second, consumers should be able to run applications of their choice.
3. ***Freedom to Attach Personal Devices.*** Third, consumers should be permitted to attach any devices they choose to the connection in their homes.
4. ***Freedom to Obtain Service Plan Information.*** Fourth, consumers should receive meaningful information regarding their service plans.⁵⁷

These principles have since been adopted as FCC policy, and have operated as *de facto* rules for the broadband industry.

Regulators should use the same basic general scrutiny for the broadband services of wireless carriers. At issue, in particular, are the contractual bans on the use of wireless connections for perfectly legitimate purposes, such as buying music from iTunes or downloading videos from YouTube. Such restrictions, even if enforced unevenly, risk warping application development by discouraging the use of some applications over others. If the carriers' true goal is managing bandwidth, they should make that goal explicit. Metering of bandwidth is far more conducive to innovation, competition and consumer choice than is blocking.

Recommendation 3: *More Disclosure Rules*

Competition depends on information to work. Consumers cannot make wise decisions unless they know, for example, the daily or monthly bandwidth limits on wireless broadband services.

⁵⁷ See Michael K. Powell, "Preserving Internet Freedom: Guiding Principles for The Industry," 3 *J. ON TELECOMM. & HIGH TECH L.* 5, 2004.

Advertising “unlimited bandwidth” while maintaining secret limits is not acceptable. Consumers must receive truthful and meaningful information about their service plan.

Today, under agreements with states, the carriers have agreed to disclose information relevant to billing and coverage. However, much relevant information remains missing or buried. Wireless carriers should be required to disclose the following limits placed on devices and services:

- Locks placed on devices, and how to remove them, if possible;
- The disabling of standardized protocols, such as Bluetooth; and,
- If Internet access is provided, accurate and prominent information on bandwidth limits, if any; and prominent disclosure of any limits placed on Internet services.

Recommendation 4: *Changes to the Development Environment*

It is clear that the mobile application environment is not what it could be. Calling it “a tarpit of misery, pain and destruction” may be a little strong, but it captures the sentiments of many developers.

The problems include failure to give developers access to phone resources, over-demanding developer qualification requirements, too much inconsistency among platforms, inconsistent operating systems, and overly restrictive controls on developers. The combination of these factors has made what might be a flourishing jungle of mobile applications much more of a desert.

It is highly doubtful that government can play a useful role in this area. Instead, this report recommends that mobile carriers and equipment manufacturers should fundamentally rethink their approach to the development of software and applications for mobile platforms. Working with developers to liberate and standardize mobile application development may well yield great dividends for all parties involved, including both carriers and consumers.

In addition to the OpenMoko model already discussed, there are many existing models for better industry cooperation in this area. They include the Internet Engineering Task Force and IEEE for major Internet and communications protocols, and the CableLabs initiatives for cable Internet standardization. The emphasis must be on giving developers access to the power of mobile platforms in a standardized way. Given tools, the potential for new and innovative applications for mobile platforms is hard to estimate.

Part IV: Economic Analysis

This final section briefly addresses several difficult economic questions that are implicated by this paper. First, given many instances of product crippling, we must ask what motivates such behavior and whether crippling products might, in fact, ultimately serve consumer interests. Second, many may argue that the competitive nature of the wireless industry makes the scrutiny of the industry in this paper unnecessary. Third, some of the recommendations in this paper, particularly the *Carterfone*

recommendation, will yield important objections based on scarcity and network security. We address each issue in turn.

1. Why Cripple Products?

Some of the behavior described in this report presents a paradox. Why would carriers disable functions, or block development, that might be useful for consumers? Does crippling ultimately serve consumer interests?

A familiar framework for understanding the behavior discussed in this paper is to view it as an *infrastructure* problem, or as a problem of *vertical integration*.⁵⁸ The carrier oligopoly controls an important part of the national infrastructure, namely the public's licensed spectrum that carries digital wireless signals. The relevant question is how the spectrum caretakers interact with related vertical markets: namely, the equipment and application markets that depend on the wireless spectrum.

Given these premises, the wireless carriers have an obvious interest in exercising control over vertical markets: maximization of revenue. Usually, but not always, maximizing revenue is a useful motive, for it suggests making the wireless networks and wireless services as useful to consumers as possible. Vertical integration or controls placed on the equipment and applications markets may represent efforts to maximize the utility of the overall platform for consumers. For example, in some instances, careful "hand-in-glove" cooperation between the carrier and equipment may yield a better product or service. That's arguably the case, for example, for the voice services that are the carriers' main offering. Each carrier works carefully with handset manufacturers to make sure its voice service is carried efficiently on the spectrum it controls.

In other instances, however, what the carriers want can be at odds with what is good for consumers. As we have seen in this report, the carriers often control or cripple product features that might be useful for consumers. At various times, different carriers have, as detailed above, blocked, delayed or conditioned the following features on mobile platforms:

- WiFi technology,
- Bluetooth technology,
- Call timers on telephones,
- Photo transfer capabilities,
- Sound transfer capabilities,
- Email clients, and
- Internet Browsers.

⁵⁸ See generally, Joseph Farrell & Phillip Weiser, "Modularity, Vertical Integration, and Open Access Policies: Towards a Convergence of Antitrust and Regulation in the Internet Age," 17 *Harvard J. of L & Tech.* 85, 2003; Christopher S. Yoo, "Vertical Integration and Media Regulation in the New Economy," 19 *Yale. J. Reg.* 171, 2002; Tim Wu, "Why Have a Telecommunications Law?" 5 *J. Telecommunication & High Tech. L.* 15, 2006.

Why do so, if, for example, easy photo transfer capabilities might make a phone more useful? Logically, a more useful platform, if better for consumers and developers, should ultimately be good for the carrier too. Here we develop three explanations for this behavior—one that suggests that crippling serves consumer interests, and two suggesting it does not.

Price Discrimination. Crippled products can sometimes form part of a price discrimination (or market segmentation) strategy that in some instances can, on the whole, be socially beneficial. Companies will sometimes disable a product so as to sell it at a lower price to those with less money. Industries routinely segment markets, by quality and by price, a practice that generally enhances overall consumer welfare. For example, the IBM Series E Laser Printer was a fast printer that was deliberately slowed down and sold for less to home users. Similarly, Microsoft in 2004 released a crippled version of Windows, named “Windows Starter XP,” that was substantially less capable than Windows XP—for example, capable of only running three applications at any time.⁵⁹ The idea was to produce a weaker version of Windows to sell in developing countries and sell it for less, thereby serving consumers who cannot afford the full Windows XP.

Some of the behavior described in this paper looks like a partially implemented price discrimination strategy. For example, if AT&T prevents Nokia from marketing the WiFi capable e61 Smartphone in the United States, a primary interest may be in selling the cheaper product.⁶⁰ Similarly, if 3G broadband services are limited to web browsing only, it may represent an effort to offer less capable products for poorer consumers.

Whether price discrimination in high-tech markets is on balance socially beneficial remains an open question. But the oddity of the facts discussed here is that while the disabled product is made available, no full-featured and higher priced version of the product is made available. Verizon will sell a Bluetooth-crippled phone, but not a Bluetooth-capable phone. Historically, carriers would not sell a WiFi phone at any price. In other words, the other half of the price discrimination strategy is missing. Out of Superman is made Clark Kent, but without retaining Superman. That fact seems to raise doubts as to whether what the carriers are engaged in what can properly be called a price discrimination strategy.

Protecting Revenue Sources. A more plausible explanation for the behavior seen here is this: carriers believe it makes sense to block a feature to protect an existing revenue source, or to keep their own costs low, even if that behavior is bad for actors in the equipment and application markets and hurts innovation. For example, again, many carriers block Bluetooth’s media transfer capabilities. Bluetooth makes it easy to communicate between a computer and cell phone, so blocking helps preserve an existing revenue source—the prices the companies can charge for songs, ringtones, wallpapers, and other content. In other words, with a more open system, a consumer could get what she wanted without passing the carrier’s “tollbooth.” Unfortunately, protecting such tollbooths come at a price.

⁵⁹ “Microsoft Announces Windows XP Starter Edition Pilot Program,” August 11, 2004, available at: <http://www.microsoft.com/presspass/press/2004/aug04/08-11WinXPStarterPilotPR.msp>.

⁶⁰ This issue was discussed by Randy Picker at http://uchicagolaw.typepad.com/faculty/2006/08/the_Wi-Fi_cell_p.html.

Here is the dilemma presented. A more capable phone might be worth \$30 more to the consumer, but cost \$10 to the carrier in existing revenue streams. In a perfect world, the carrier would give the consumer the more capable phone, and raise its prices to reflect the benefit to the consumer. However, in the world of real pricing, it is sometimes difficult for a carrier to raise its prices or rates to reflect consumer surplus of this kind. Instead, the carrier may block the \$30 surplus to preserve the \$10 revenue stream. Since the industry finds it difficult to price for a more capable phone in general, as oppose to a specific feature or plan that comes with a price tag. Hence the interest in resisting features that do not come with a clearly identifiable revenue stream.

Cultural Explanations— the Bell Model. A different explanation for the behavior seen here is that the carriers are simply acting to maximize their control and power over their networks. They have adopted a strategy that prevents the development of business models or revenue streams that depend on their network, yet over which they would lack significant control. We can call this the Bell model, after the same patterns of behavior exhibited by the pre-breakup Bell Company.⁶¹

Such strategies may simply be a mistake. The carriers may, in some cases, block the development of services that might make the cell phone platform more valuable, and therefore are ultimately good for the carrier. The industry sometimes appears to prefer that a new service or application not exist at all rather than develop into a lucrative industry whose pricing and conduct it might not be able to control.

The major example of this kind of behavior is the strategy adopted in the area of mobile software development. Given standardization and more openness, software developers might develop a range of applications at the rate seen in Web development. But the carriers seem hesitant to allow such development to occur, possibly out of the idea that if any new services come into existence, the services should be "theirs." Analyst Andrei Jezierski describes the carriers' behavior as follows: "It's not clear if the carriers will make money from these value-added services. So if the economic model is still unclear, why give away more control earlier than you have to?"

While this strategy makes a certain amount of intuitive sense, it may represent an error. The industry, or parts of it, appears strongly concerned that they will become "just a pipe" or a firm that sells "a commodity," and thereby giving up control over what happens on their network. But that fear may be irrational, and lead, in some instances, to outcomes contrary to the interests of the carrier.

⁶¹ More speculation on the "mental models" and their influence over decisions in telecommunications can be found in the work of Jeffrey Funk, particularly in his comparison of Japanese and U.S. developments. See, e.g., Jeffrey L. Funk, "Solving the Startup Problem in Western mobile Internet markets," *Telecommunications Policy*, 2006 doi:10.1016/j.telpol.2006.11.003.

2. Regulating Under Conditions of Oligopoly?

Some of the recommendations in this report, particularly the *Carterfone* recommendation, have led to the response that the wireless industry is generally unsuited for *Carterfone*-style scrutiny.⁶² There are two main reasons. The first is based on the argument that the wireless industry is competitive, unlike AT&T in the 1950s.

The AT&T monopoly in the 20th century was accepted and even maintained by government action. By contrast, it is often said that the wireless mobile market is “fiercely competitive,” suggesting that a competitive cell phone provider might be as easy to start as a hot dog stand. That claim, oft repeated, does not stand up to closer examination.

First, by any statistical measure, the wireless industry, like most network industries, is highly concentrated. While studies vary, various groups report HHIs of between 2500 and over 6000, depending on the method used. That fact in and of itself suggests that attention to this industry is warranted.

Structurally, as in many telecommunications markets, the mobile wireless industry has a natural and major barrier to entry—acquisition of sufficient spectrum. Under today’s conditions, that means spending hundred of millions at a minimum—and more likely billions or perhaps even tens of billions of dollars—to acquire sufficient spectrum to enter the market. For example, T-Mobile announced in 2006 that it would enter the 3G broadband wireless market. It also announced it would use \$4.2 billion of spectrum to do so. The oldest fact in broadcast, spectrum scarcity, is a physical fact that cannot help but affect the conditions of competition in the wireless world.

It is important to point out that, in one respect, the justifications for regulating AT&T were, to some degree, on weaker theoretical ground than in today’s wireless environment. The basis was a theory of natural monopoly in the local loop, which has subsequently undergone much criticism.⁶³ On the contrary, there is less doubt that, using today’s technologies and the federal government’s outdated spectrum allocation policies, spectrum suitable to support a wireless mobile phone company is scarce. That scarcity, in turn, has obvious market effects.

The future of the industry, of course, is hard to predict. Ongoing spectrum auctions may lead to greater market entry. Smaller firms, like Clearwire Communications, which offers wireless broadband services in some markets, may attempt to provide services that compete with the major carriers. Yet the current trend is in the opposite direction. The industry is a textbook oligopoly—premised on a bottleneck resource—with four major players. While no one should discount the possibility of new entrants, we must

⁶² See, e.g., Marius Schwartz & Federico Mini, *Hanging Up on Carterfone: The Economic Case Against Access Regulation in Mobile Wireless*, Paper released May 2, 2007.

⁶³ See, e.g., Gerald R. Faulhaber, “Bottlenecks and Bandwagons: Access Policy In The New Telecommunications,” *Handbook of Telecommunications Economics*, Vogelsang and Cave, eds., 2004 (criticizing natural monopoly assumptions and noting that multiple local loops existed in the 1890s).

also look at the facts as they are, not as how we might imagine them to be. The theoretical possibility of market entry cannot be a reason to immunize this or other industries from any scrutiny.

Whatever we might expect from oligopoly competition, there are also some reasons to believe that even competition between the carriers may not eliminate certain anticompetitive practices. Many of the practices described in this report are beneficial for an individual company to pursue, yet may not be good for society.⁶⁴ Those practices will not necessarily be eliminated by oligopolistic competition.

That may particularly be the case where the feature in question is not well understood by consumers, and not often a relevant decisional factor. For example, say a wireless firm can narrowly make more profit by disabling the phone to protect ringtone revenue. Unless consumers are aware of the crippling and its implications, it will be difficult for a firm to differentially compete by *not* crippling Bluetooth. It is relatively easy for consumers to compare firms by metrics like price and network coverage. But taking the time to do comparisons on the basis of whether the carrier cripples technological feature sets is something only a select group of consumers have the time or expertise to do.

That leads to a final reason that the existence of competition cannot be a reason not to examine carrier practices. As just described, for competition to work, consumers must know what is going on. To say that competition can then be a reason not to examine industry practices and mandate as much disclosure as possible is exactly backward. For it is such information that is necessary to make competition work in the first place.

3. Spectrum Scarcity, Network Security and Other Arguments

A different objection to *Carterfone* rules is the argument that the scarcity of wireless spectrum and network security make any such rules infeasible.

Spectrum Scarcity. While spectrum scarcity affects market structure, it also may affect the kind of rules that can be effectively maintained in the wireless space. To take *Carterfone*, for instance, how can carriers allow devices they have not approved on a network of scarce spectrum?

The problem with this argument is that scarcity is an economic feature of not just wireless networks, but wireline networks as well. Both wireless and the local loop are last-mile networks of limited available bandwidth, and, in fact, the bandwidth available on a copper local loop is considerably less than on some of today's wireless networks. For both products, it can be claimed that third parties cannot be trusted to make products that respect the shared needs of the network. In the *Hush-a-Phone* case, for example, AT&T claimed that third parties would bear "no responsibility for the quality of telephone service, but [be] primarily interested in exploiting their products." Similarly, local carriers for years complained that modems abused the scarce resources of the phone network (by maintaining long connections). But as Judge Robert Bork argued in another context: "All economic goods are scarce... since scarcity is a

⁶⁴ See Brett M. Frischmann & Mark A. Lemley, "Spillovers," 107 *Columbia L. Rev.* 257, 2007.

universal fact, it can hardly explain regulation in one context and not another. The attempt to use a universal fact as a distinguishing principle necessarily leads to analytical confusion."⁶⁵

Does the fact that the local loop is reserved bandwidth (about 64 kbps), while wireless users share a far larger pool of bandwidth, make a difference? Yes, to a degree. You can leave your phone off the hook all day with little effect on the telephone network as a whole. However, a wireless connection left open would affect other customers.

The fact of shared bandwidth is important and true of wireless mobile networks. However, that is also true of most networks, including all Ethernet networks, the cable broadband networks, WiFi networks, and other network designs. One advance over the last forty years of telecommunications technology and policy is a better understanding of what is possible using shared-bandwidth networks, and in fact many of the pieces of handling shared spectrum are already very well understood.

What is needed are private and sometimes government standards that allow a network to be shared. That's how, for example, Ethernet and DOCSIS cable networks work. That is also, crucially, how many of the cell phone networks *already* work, through the GSM and CDMA standards. These standards already control and standardize how individual devices make use of scarce spectrum—making strange the argument that scarcity is unmanageable as a technological issue. The second necessary element for addressing scarcity is pricing that reflects the scarcity of the resource, which is also already partially implemented by current cell phone pricing.

One thing should be clear from this. The answer to scarcity that has been rejected is the insistence that one party need to have total control over all aspects of the network to make possible usage of shared and scarce bandwidth. The issue of scarcity is not, by first principles, as completely different on wireless and wireline networks as is often maintained. For that reason, the thinking on network attachments from the wireline world is properly considered here.

Network Security. Customer representatives for the various companies defended practices as varied as phone locking, whitelisting, Bluetooth crippling, and other practices as necessitated by the demands of scarcity or to protect network security. For example, Verizon Wireless originally justified crippling Bluetooth on its telephones as a means of preventing "fraud" and virus infections. AT&T made similar claims in opposing the *Carterfone* principles.

There are valid and important security concerns on wireless networks.⁶⁶ The point here is similar to the point just made about bandwidth scarcity. The question that must be asked is whether the issues of network security on wireless networks are fundamentally different from similar concerns on other

⁶⁵ Telecommunication Research & Action Ctr. v. FCC, District of Columbia Circuit Court of Appeals, 801 F.2d 501, 5081986.

⁶⁶ Tom Lookabaugh & Douglas Sicker, "Multimedia Quality of Service and Net Neutrality on Wireless Networks," Presentation to International Advanced Symposium on Radio Technologies (ISART), 2006, available at: http://www.its.bldrdoc.gov/isart/art06/slides06/sic_d/sic_d_slides.pdf.

networks. Jonathan Zittrain's work is the starting place for the debate over network security and what it should and should not justify.⁶⁷ As he points out, any allowance of open entry and competition is likely to lead to greater abuses. Yet it is also essential to remember that the abuses are a cost that comes with a benefit: innovation, flexibility and diverse social function.

Spam, viruses, junk mail and telemarketing are different names for problems that every information network faces. What this suggests is that network security must be taken seriously, but also cannot become a blanket answer to any scrutiny of carrier practices.

All Regulation of Access is Doomed. A final argument is that any public effort and perhaps any private effort to promote greater access to wireless networks is a bad idea. Drawing a comparison with UNE-P line sharing, Scott Wallsten of the Progress and Freedom Foundation writes that "regulating how wireless carriers allow their networks to be used would represent another version of regulating network access, and the history of such regulation does not bode well for its impact."⁶⁸ Many, however, believe that the *Carterfone* rules, which "regulate network access," are among the successful in the history the FCC. Before *Carterfone*, the interconnection requirements of the early 20th century, critical to the growth of a national phone network, were also the "regulation of network access." In fact, nearly all telecommunications regulation is some version of regulating network access. The important question is not whether access is regulated, but whether it is done well. Whether unbundling "worked" is a disputed question—some point to Europe as evidence of how unbundling can work, while others suggest such rules were doomed in the United States from the outset. But certainly bald assertion that any rule that can be called "regulating network access" is doomed to fail ought not be taken seriously. In the end, the comparison of the Wireless *Carterfone* proposal with the line-sharing rules of the 1990s is the wrong one. The rules urged here are, as the name suggests, a version of *Carterfone* rules. They were never an effort to provide a price-fixed access to the Bells' phone lines. Instead, they center on a consumer's right to attach the devices of his choosing to the Bell network, and their time has come in the wireless world.

Conclusion

In many respects, the mobile market is and remains a wonder. But the infancy of the wireless market is now passing, making greater public scrutiny of industry practices more appropriate and important. In the words of analyst David Passmore, "At some point, I think Americans are going to put their foot down and say, 'We won't tolerate this anymore.'"

⁶⁷ See Zittrain, *supra* note 10.

⁶⁸ Scott Wallsten, "Wireless Net Neutrality?" *PFF Blog*, February 11, 2007, available at: http://blog.pff.org/archives/2007/02/wireless_net_ne.html.

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