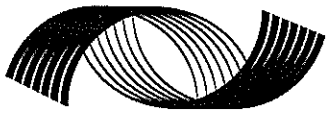
ATTACHMENT E



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The Economics of "Wireless Net Neutrality"

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THE ECONOMICS OF "WIRELESS NET NEUTRALITY"

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Network neutrality issues have been vigorously debated worldwide over the past few years. One major aim of network neutrality proponents is to prevent high-speed Internet service providers from charging content providers for priority delivery. Recently, proponents have turned their attention to the regulation of wireless networks, such as those for cellular phones, which provide increasing numbers of consumers access to Internet services. Some application providers have relied on a recent academic paper to support greater regulation of wireless operators. Although the proposals to regulate these networks use the phrase "net neutrality," the regulations they seek to impose on wireless operators have little in common with those being sought for other Internet service providers. In this article, we provide a framework for determining whether certain kinds of regulations should be imposed on the owners of wireless networks. We also consider the benefits and costs of specific proposals for the regulation of these networks. Our principal conclusion is that the costs of most of these proposals are likely to exceed the benefits.

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I. INTRODUCTION

"Network neutrality" has become a shorthand description of a policy that would regulate how network providers design, manage, and price the use of their networks. Depending upon the industry in which it is applied, however, the net neutrality concept has taken different forms. In the wireline context, net neutrality regulation primarily seeks to prevent a high-speed Internet service provider, such as cable modem provider or a DSL provider, from charging a fee for enhanced quality of service to content providers. By contrast, requests for "wireless net neutrality" regulation primarily seek to prevent a wireless operator

from imposing certain limitations on equipment manufacturers and application providers. They also seek to prevent wireless operators from imposing usage limits on end-users.

Net neutrality regulation is important from a policy perspective because it is likely to have a significant effect on the development and use of future wireline and wireless broadband networks. In particular, broadband operators face capacity problems as the demand for bandwidth-intensive applications, such as streaming videos and online games, accelerates. Network operators have limited options for addressing this demand, including rationing existing capacity in the short term, and building more capacity and more intelligent networks over the long term. If network neutrality regulations are implemented, it could have a dramatic effect on the future of the Internet, which may help to explain why the issue has received a great deal of attention from scholars and the broader policy community.

Scholars have offered up a diverse range of views on the subject of net neutrality, with some supporting regulation[1] and some opposing it.[2] Most scholarship until now has focused on the merits of different approaches for regulating wireline broadband operators. In this paper, we address recent regulatory efforts to subject U.S. wireless operators to net neutrality regulation. We provide an economic framework for analyzing whether specific practices identified by proponents of wireless net neutrality should be regulated. We identify and estimate the likely costs and benefits of preventing wireless operators from imposing certain limitations on suppliers and end-users that are alleged to be anticompetitive.

1. Jon M. Peha, The Benefits and Risks of Mandating Network Neutrality, and the Quest for a Balanced Policy, Carnegie Mellon University Working Paper, Sept, 2006; Rob Frieden, Network Neutrality or Bias? Handicapping the Odds for a Tiered and Branded Internet, Pennsylvania State University Working Paper, Sept. 2006; Barbara van Schewick, *Towards an Economic Framework for Network Neutrality Regulation,* Journal of Telecommunications and High Tech Law (forthcoming 2007).

2. *See, e.g.*, Christopher S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 GEORGETOWN LAW J. 1847 (2006); Bruce Owen, The Net Neutrality Debate: Twenty Five Years after United States v. AT&T and 120 Years after the Act to Regulate Commerce, AEI Brookings Joint Center Working Paper 07-03, Feb. 2007; Alfred E. Kahn, Network Neutrality, AEI Brookings Joint Center Related Publication 07-05, Mar 2007; J. Gregory Sidak, *A Consumer-Welfare Approach to Network Neutrality Regulation of the Internet*, 2 JOURNAL OF COMPETITION LAW & ECONOMICS (2006); Robert W. Hahn & Robert E. Litan, *The Myth of Network Neutrality and What We Should Do About It*, AEI-Brookings Joint Center Working Paper No. RP06-33 (Nov. 2006); Robert E. Litan & Hal J. Singer, *The Unintended Consequences of Net Neutrality,* 5 JOURNAL ON TELECOMMUNICATIONS AND HIGH TECH LAW (forthcoming 2007); Hal J. Singer, *Net Neutrality: A Radical Form of Non-Discrimination,* REGULATION (forthcoming 2007); William J. Baumol, Martin E. Cave, Peter Cramton, Robert W. Hahn, Thomas W. Hazlett, Paul L. Joskow, Alfred E. Kahn, Robert E. Litan, John W. Mayo, Patrick A. Messerlin, Bruce Owen, Robert S. Pindyck, Vernon Smith, Scott J. Wallsten, Leonard Waverman & Lawrence J. White, *Economists' Statement on Network Neutrality Policy*, AEI-Brookings Joint Center Working Paper No. RP07-08, Mar. 28, 2007.

To make matters concrete, consider the following practice of one wireless operator, Verizon Wireless, as of March 2007. If a Verizon Wireless subscriber commits to a two-year contract, then the price of her LG Strawberry Chocolate handset is $99.99; if she commits to a one-year contract only, then the price of the same handset increases to $199.99; if she does not commit to a contract, then the price increases to $269.99.[3] According to proponents of wireless net neutrality, this practice "distorts" the market for wireless handsets.[4] Using an economic framework, we can examine whether such a strategy is likely to lead to higher prices of handsets for end-users in the long-run, or whether there is some efficiency justification that explains the practice.

The intellectual support for wireless net neutrality regulation is provided in a provocative paper by Professor Tim Wu.[5] Wu's paper seeks to identify carrier practices that may be harmful to consumers. Wu cites several restrictions that wireless operators have imposed on their customers or suppliers, including a requirement that all handsets be sold by the wireless operator. Economists refer to such restrictions as "vertical restraints." There is a large literature on the economic impacts of such restraints. In some cases such restraints can reduce economic welfare, while in others they increase economic welfare.[6] Most, but not all, of the allegedly anticompetitive conduct identified by Wu can be characterized as a vertical restraint.[7]

To appreciate the controversy raised by proponents of wireless net neutrality, one needs a basic understanding of the structure of the wireless market. Consider, for example, the relationship between an applications provider and a wireless customer. Because the transaction between those two entities flows over the

3. *Id.*

4. In the Matter of Skype Communications S.A.R.L. Petition to Confirm A Consumer's Right to Use Internet Communications Software and Attach Devices to Wireless Networks, Dkt. No. RM-11361, Feb. 20, 2007, at 13 [hereinafter *Skype Petition*] ("For the vast majority of U.S. wireless consumers, carriers sell phones that are highly subsidized and mask the true cost of the device. Consequently, the market for wireless devices is unusual and distorted. This market distortion is of increasing concern as handsets become more versatile and are used to access a broader array of functions and services.") (citation omitted).

5. *See* Tim Wu, Wireless Net Neutrality: Cellular Carterfone on Mobile Networks, New America Foundation Wireless Future Program Working Paper No. 17, Feb. 2007, *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=962027&high=%20net%20neutrality. By March 11, 2006, a little over one month after its initial posting, Wu's paper had been downloaded over 1,700 times, making it the second most popular paper among all SSRN postings between January 10, 2007 and March 11, 2007. By April 2, 2007, the paper had been downloaded 1,961 times. *See Skype Petition* at 12 n.21, 13 n.22 (citing Wu).

6. We define economic welfare as the sum of producer surplus and consumer surplus. Profits are a good proxy for producer surplus. Consumer welfare is equal to the difference between a consumer's willingness to pay for a good and the price summed across all consumers. Economists may disagree on whether regulatory policy should focus on consumer surplus only. We focus on consumer surplus here because that seems to be a concern of Wu.

7. Wu identifies some other practices that he also finds objectionable, such as failing to disclose key information to consumers. These other practices are considered here as well.

network of a wireless operator, the operator can be thought of as the "downstream" provider—that is, the entity that interfaces with the customer. The applications provider is referred to as the "upstream" provider because it is removed from the end-user. The wireless operator may have the ability to impose certain restraints on the behavior of upstream suppliers as a condition for gaining access to the operator's customers.

Some upstream applications suppliers have relied on the Wu paper to support an agenda of greater regulation of wireless operators. Shortly after Wu's initial paper was released, Skype, a voice over Internet protocol (VoIP) provider that generally relies on wireline broadband networks, filed a petition at the Federal Communications Commission (FCC) asking the agency to "confirm a consumer's right to use Internet communications software and attach devices to wireless networks."[8] The petition alleges that wireless operators are engaging in restrictive practices at both the "device layer"—at the point of handset purchase—and the "application layer"—at the point of installing applications on their chosen handset—that are harming consumers. The petition requests that the FCC should apply a *Carterfone*-style rule to wireless networks[9]—a rule imposed by the FCC in 1968 that required AT&T to allow devices to be connected directly to the AT&T wireline network so long as they did not cause damage to the network. Skype also asks the FCC to "initiate a proceeding to evaluate wireless carrier practices in light of *Carterfone*, and to create an industry-led mechanism to ensure the openness of wireless networks."[10] In this paper, we also provide an economic analysis of the Skype petition.

The paper is organized as follows. In Part II, we provide an analytical framework for determining whether government intervention, both generally and of the particular kind sought here, is warranted in the U.S. wireless industry. We lay out four general principles for regulatory intervention:

(1) There should be clear evidence of a significant market failure;
(2) There should be clear evidence that the proposed intervention is likely to be better than the status quo;
(3) The intervention should take into account all important benefits and costs; and
(4) The proposal should draw constructive lessons from earlier attempts at regulation.

In the absence of direct or indirect evidence of a market failure, it is generally not prudent to interfere with a well-functioning market.[11] We demonstrate here that there is a high degree of competition in the wireless industry, and thus little reason to believe that there is a significant market failure. According to the FCC, the price of a wireless call, as measured by the revenue per minute for the operator or cost per minute from the end-user, declined from $0.43 in 1995 to $0.07 in 2005.[12]

8. *Skype Petition* at 1.
9. *Id.* at 25-28.
10. *Id.* at 28-30.
11. *See, e.g.*, Kenneth J. Arrow et al, *Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?*, 272 SCIENCE 221-222 (1996)
12. FCC, Eleventh Annual Report to Congress on the State of Competition in the Commercial Mobile Radio Services (CMRS) Industry, WT Dkt. No. 06-17, released

We also demonstrate that the proponents of wireless net neutrality have failed to specify a clear benchmark (or counterfactual) from which to judge success. Notwithstanding Wu's assertion to the contrary, we demonstrate that U.S. wireless customers enjoy great diversity in their wireless telephones. Moreover, innovation at the application level is thriving. A survey of FCC competition reports and the operators' websites reveals that there have been more than 50 significant innovations in wireless applications since 1999. A separate review of the operators' websites reveals that there are more than 150 unique models of handsets directly available from the five largest operators. It is incumbent on proponents of regulation to explain why that seemingly high level of product diversity is not adequate.

Next, we specifically examine the costs and benefits of Wu's proposal to prevent wireless operators from imposing certain restraints on upstream suppliers.[13] We demonstrate that banning these restraints would not likely generate significant benefits for consumers. The reason is that the market structure of the U.S. wireless industry is simply not conducive to engaging in anticompetitive strategies aimed at weakening upstream equipment or applications providers. Moreover, the wireless market is constantly evolving, which makes regulation even less likely to achieve its objective. We also explain why allowing wireless operators to impose certain limitations on both suppliers and end-users would preserve significant efficiencies that redound to the benefit of wireless consumers. Common limitations imposed by wireless carriers include offering discounts on handsets in exchange for term commitments, using exclusive distribution agreements between operators and handset makers, and imposing limits on foreign attachments or the type of content downloaded. We demonstrate clear efficiency justifications for each of these limitations. In particular, these strategies can be shown to (1) encourage wireless operators to promote handsets aggressively, (2) permit the wireless operator to discount the price of the handset, (3) ensure a high quality of service for wireless customers, or (4) enable the wireless operator to manage a scarce resource. Regarding other practices identified by Wu, such as requiring that a handset be sold by the operator or disabling certain features of the handset, we find that those strategies are *generally not employed by wireless operators*. Where a network operator vigorously polices usage by its customers, the quality of service and thus customer satisfaction tend to be higher. We find that the network that engages in the "worst practices" identified by Wu ranks highest according to customer satisfaction surveys. Given the high level of competition in the wireless industry, an individual operator should be entitled to experiment with different business models, especially where there is unlikely to be any anticompetitive effect.

In Part III, we address specific problems in Wu's analysis and Skype's proposal to apply *Carterfone* rules to the wireless industry. We explain that, for

Sept. 29, 2006, Appendix A Table 10 [hereinafter *Eleventh CMRS Report*]. The numerator in the average price per minute is average revenue per subscriber, which is collected by CTIA. These values are given in nominal terms rather than real terms. The FCC shows that the "Cellular CPI," as recorded by the Bureau of Labor Statistics, declined by 35 percent from December 1997 to December 2005. *See id.* at Appendix A Table 9. Thus, cellular prices have declined in real terms.

13. Skype basically proposes Wu's policies in its FCC petition. Thus, our analysis of Skype's proposal would be no different from our analysis of Wu's proposal.

at least four reasons, the market and regulatory conditions that potentially justified *Carterfone* regulation in the late 1960s do not exist in the current U.S. wireless industry. First, unlike AT&T's control of the supply of wireline voice services nearly forty years ago, U.S. wireless operators today lack monopoly power in the downstream market for wireless services. Second, unlike wireline voice services in the 1960s, U.S. wireless operators have not integrated into the upstream applications or equipment markets. Third, a wireless operator lacks the ability to exercise buying power over an upstream handset supplier like Apple, which wields significant countervailing seller power. Fourth, wireless operators are not subject to price regulation in the market in which they are alleged to have market power, which might encourage them to seek profits in complementary markets.

Wu asserts that several "obvious" wireless applications seem to be missing, such as uploading photos or printing address labels. Wu cannot, however, reject the hypothesis that certain applications are not offered by wireless operators because they are not in sufficient demand. The power of well-functioning markets ensures that consumer needs that are not currently met will likely soon be addressed. As of 2007, a Blackberry could do many things a laptop could not and vice versa. If a laptop maker could shrink its device to the size of a Blackberry, it would. Likewise, if a Blackberry could perform all of the applications of a laptop, it would. The fact that a Blackberry cannot perform a certain function today is not evidence of a conspiracy among wireless operators. If that function is demanded by a sufficient number of wireless subscribers, it is likely to be available on the next generation of wireless handsets.

Next, we explain why exclusive contracts between wireless operators and content providers are unlikely to harm consumers in the wireless market. In particular, the type of content that has become exclusive to a particular wireless operator, such as an online music library, is generally interchangeable with a music library carried by a rival operator. This stands in sharp contrast to certain exclusive contracts used by video distributors—for example, an exclusive agreement to carry National Football League games. Such exclusive content cannot be replicated by a rival distributor, which means that the end-user may be forced in the case of video service (but not wireless services) to purchase multiple subscriptions to access exclusive, *non-replicable* content on two different systems.

In Part IV, we explain why Wu's proposed remedies do not flow from his theory of competitive harm. In particular, Wu makes four major policy recommendations:

(1) Wireless operators should be compelled to allow customers to attach any safe device to their wireless handsets;
(2) Wireless operators should be compelled to allow customers to use the applications of their choice and view the content of their choice;
(3) Wireless operators should be compelled to disclose any limits placed on devices and on bandwidth usage;
(4) The wireless industry should work together to create clear and unified standards for developers.

We assess each of these recommendations in turn. We conclude that the best policy for the U.S. wireless industry is maintaining the current light-handed

approach to regulation, which generated by our estimates roughly $50 billion in consumer welfare in 2005 alone.[14] Additional government regulation of the wireless market could put these substantial consumer benefits at risk.

II. A FRAMEWORK FOR DETERMINING WHETHER GOVERNMENT INTERVENTION IS WARRANTED IN THE U.S. WIRELESS INDUSTRY

A dynamic market is one in which technology is constantly changing, where today's market leader can be upstaged by an unforeseen competitor or technology. In dynamically competitive markets, such as the U.S. wireless industry, the government should be very reluctant to regulate.[15] The problem for regulators is that dynamic incentives to invest are important to wireless operators. Inefficient regulation threatens to jeopardize the investment needed to upgrade the existing third generation (3G) wireless platform to support broadband services and to launch the fourth generation (4G) network to support real-time applications such as mobile video, remote monitoring, and mobile commerce. Indeed, regulation in network industries generally and in the wireless industry in particular does not have a very positive history.[16] In this section, we provide some general principles for regulatory intervention of any kind in the U.S. wireless industry. We demonstrate that the costs that would result from banning certain limitations currently imposed by wireless operators would likely exceed the benefits created by allowing those limitations.

A. General Principles for Regulatory Intervention in the U.S. Wireless Industry

When considering regulatory intervention of any kind, at least four overarching principles should be considered. We outline these principles below, and then apply each principle to the U.S. wireless industry. Our approach does not rule out all forms of regulation in the wireless industry. For example, it is conceivable that certain wireless applications with positive externalities or

14. Consumer welfare is equal to the area under the demand curve bounded from below by price. Assuming linear demand, that area is equal to one half the product of the quantity of wireless subscriptions and the difference between the average monthly price and the monthly "choke price" or price at which the demand for wireless service would be zero. For example, using an elasticity of demand of -1.2, an average monthly price of roughly $50, and 213 million wireless subscribers, the monthly choke price for wireless service is roughly $91. Thus, the monthly consumer welfare is roughly $4.4 billion and the annual consumer welfare is roughly $53.2 billion. For an estimate of the elasticity of demand for wireless service, see Allan T. Ingraham & J. Gregory Sidak, *Do States Tax Wireless Services Inefficiently? Evidence on the Price Elasticity of Demand*, 24 VIRG. TAX REV. 249, 257 (2004) (generating estimates of -1.12 and -1.29). For average monthly prices and total number of wireless subscribers, see *Eleventh CRMS Report*, *supra* note 12, ¶¶5, 155.

15. *See, e.g.*, Dennis Carlton, *Antitrust Policy Toward Mergers When Firms Innovate: Should Antitrust Recognize the Doctrine of Innovation Markets?*, Testimony before the Federal Trade Commission Hearings on Global and Innovation-based Competition (Oct. 1995).

16. *See, e.g.*, Bruce Owen, The Net Neutrality Debate: Twenty Five Years after United States v. AT&T and 120 Years after the Act to Regulate Commerce, AEI Brookings Joint Center Working Paper 07-03, Feb. 2007.

spillovers might be undersupplied by the market. The key issue here, however, is whether proposals to implement wireless net neutrality make good economic sense.

1. There Should Be Clear Evidence of a Significant Market Failure

Markets generally can be counted on to allocate resources efficiently and to ensure that goods and services are supplied at the lowest cost possible.[17] In the presence of externalities (benefits or costs that cannot be fully captured by the parties to a transaction), however, markets may fail by providing too much (in the case of negative externalities) or too little (in the case of positive externalities) of a good. There are externalities in network industries like communications services,[18] which implies that the market-determined size of a network might be less than the socially optimal level. The existence of positive externalities has been used to justify subsidies for customers living in high-cost areas, which increase the number of subscribers to the network and thereby generate benefits for existing subscribers. To the extent that these externalities are significant, they would not be addressed by any of the proposed remedies sought by proponents of wireless net neutrality.[19]

Proponents of any regulation must first demonstrate the existence of a significant failure in the wireless market. Direct evidence of a market failure could include proof that (1) prices are significantly above or below the relevant measure of costs, or (2) output is significantly above or below socially efficient levels. Economists often subscribe to a version of the Hippocratic oath—first, do no harm. In the absence of large positive externalities or high entry barriers, they believe that markets generally do a pretty good job in allocating resources.

Although Wu is concerned about innovation in the upstream applications market, he provides no quantitative evidence of a particular market failure in the U.S. wireless industry. In particular, he provides no direct evidence (for example, output being significantly below efficient levels) and no indirect evidence (for example, the existence of strong positive externalities or high entry barriers). We believe that such a demonstration is difficult precisely because of the robust competition among U.S. wireless operators.

By almost any measure, the U.S. wireless market is highly competitive. Consumer choices are expanding and prices are declining. In its series of annual *Commercial Mobile Radio Services (CMRS) Competition Reports*, the FCC has documented the concurrent increase in wireless usage and decrease in wireless prices over the past decade. Table 1 summarizes these statistics from 1993 through 2005.

17. Of course, there are other important concerns, such as equity. We do not consider such concerns in the interest of brevity, though they can be important in selected instances.

18. *See* Carl Shapiro & Hal R. Varian, INFORMATION RULES: A STRATEGIC GUIDE TO THE NETWORK ECONOMY, Harvard Business School Press (1999).

19. Even where positive externalities exist, it may be difficult to implement regulation or subsidies that improve on the status quo.

TABLE 1: WIRELESS TELEPHONY PRICES AND USAGE 1993-2005

	Average Monthly Wireless Bill (A)	*Average Minutes of Use Per Month (B)*	*Average Revenue Per Minute (A / B)*
1993	$61.49	140	$0.44
1994	$56.21	119	$0.47
1995	$51.00	119	$0.43
1996	$47.70	125	$0.38
1997	$42.78	117	$0.37
1998	$39.43	136	$0.29
1999	$41.24	185	$0.22
2000	$45.27	255	$0.18
2001	$47.37	380	$0.12
2002	$48.40	427	$0.11
2003	$49.91	507	$0.10
2004	$50.64	584	$0.09
2005	$49.98	740	$0.07

Source: FCC, Eleventh Annual Report to Congress on the State of Competition in the Commercial Mobile Radio Services (CMRS) Industry, WT Dkt. No. 06-17, released Sept. 29, 2006, at tbl. 10.

Table 1 shows that the price of a wireless call, as measured by the revenue per minute for the operator or cost per minute from the end-user, has declined from $0.43 in 1995 to $0.07 in 2005—a decline of roughly 84 percent in one decade. There are few services consumed in the United States that have experienced such a rapid decrease in prices. Table 1 also shows that wireless usage has exploded over the same period, from 119 to 740 minutes per month.

In addition to falling prices and higher usage, the quality of wireless service appears to have improved significantly. According to a J.D. Power and Associates survey released in March 2007, the overall rate of customers experiencing a wireless call quality problem declined for a third consecutive year.[20] One explanation for the higher satisfaction is the digitization of the wireless networks. Digital technology provides better sound quality than analog technology. According to the FCC, digital technology is now dominant in the mobile telephone sector, with approximately 97 percent of all wireless subscribers using digital service.[21] Digital technology also allows for more efficient use of the spectrum. By improving network performance, these upgrades improved the quality of service in terms of (1) better voice quality, (2) higher call-completion rates, (3) fewer dropped calls and deadzones, (4) additional calling features, (5) more rapid data transmission, and (6) advanced data applications.[22]

The most likely explanation for falling prices is an increase in the number of wireless operators, which generates more intense price competition. The FCC's *Eleventh Annual CMRS Report* reports that, as of 2006, roughly 94 percent of the

20. J.D. Power and Associates Reports: Wireless Call Quality Problems Continue to Decline as the Transition to 3G Networks Takes Hold, Mar. 15, 2007, *available at* http://www.newscom.com/cgi-bin/prnh/20050527/LAF028LOGO-a.

21. *Eleventh CMRS Report*, *supra* note 12, ¶105.

22. *Id.* ¶131.

U.S. population had a choice of at least four wireless operators.[23] That represents an increase from the roughly 80 percent of the population that had a choice of four or more operators in 2000.[24] The fact that 14 percent of the population (equal to 94 percent less 80 percent) experienced one extra choice in just the past five years implies that the supply of wireless service is increasing and that there are few barriers to entry.

Entry into wireless services can occur through expansion of regional wireless networks or through new entry or both. Both kinds of entry occurred in the FCC's recent Advanced Wireless Services spectrum auction, which closed in September 2006 after raising roughly $13.7 billion for the U.S. Treasury.[25] Regional operators like MetroPCS (the fourth biggest winner) and Cricket (the sixth biggest winner) expanded their existing wireless footprints and acquired sufficient spectrum to offer broadband services.[26] Cable operators Comcast, Cox, and Time Warner also acquired spectrum in the auction.[27] According to FCC Chairman Kevin Martin, "more than half of the winning bidders were small business."[28] And the entry process is nowhere near complete. In addition to spectrum acquisition,[29] firms such as Disney Mobile, Microsoft Media Mobile-Zune, Wal-Mart, and Virgin Mobile have entered the market as mobile virtual network operators (MVNOs), which involves reselling wireless capacity of an incumbent operator under a different brand name.[30] The variety of categories of MVNOs, which range from "Prepaid" to "Ethnic" to "Youth," demonstrates the niche markets that are now being served by entrants.[31] Thus, applications developers, including Skype, could make use of unused spectrum—either by acquiring it from the FCC or by purchasing it from wireless operators—as a way of resolving their concerns with the alleged buying power of incumbent wireless operators.

2. *There Should Be Clear Evidence That the Proposed Intervention Is Likely to Do More Good than Harm*

Proponents of regulation should also demonstrate that the proposed intervention will improve efficiency relative to the status quo. The efficiency

23. *Id.* at tbl. 11.

24. *Id.*

25. FCC, Auction 66 Advanced Wireless Services (AWS-1), All Bidders Spreadsheet, *available at* http://wireless.fcc.gov/auctions/66/charts/66bidder.xls.

26. *Id.*

27. *Cable Consortium Acquires Spectrum Licenses Covering National Foot*, PR NEWSWIRE, Oct. 5, 2006, *available at* http://sev.prnewswire.com/entertainment/20061005/PHTH01505102006-1.html.

28. *FCC Spectrum Auction Closes, T-Mobile Among Top Winners*, XCHANGEMAG, Sept. 19, 2006, *available at* http://www.xchangemag.com/hotnews/69h198599.html.

29. The FCC's Broadband Personal Communications Services auction (auction #71) is scheduled to begin in May 2007. *See* FCC, Scheduled Auctions: Auction 71 Broadband PCS, *available at* http://wireless.fcc.gov/auctions/default.htm?job=auction_summary&id=71.

30. *See* THOMAS WINTER AABO, US MOBILE VIRTUAL NETWORK OPERATORS 2007: THE DEFINITIVE GUIDE AND CRITICAL ANALYSIS OF THE US MVNO MARKET, Mind Commerce, Mar. 2007.

31. *Id.* at 11.

criterion considers the welfare of consumers and producers in both a static and dynamic sense. Wu does not provide any quantitative evidence that his proposed remedies are likely to be more efficient than the status quo. Instead, he simply asserts that the conduct in question "may be harmful for consumers and society."[32] Skype similarly asserts without empirical proof that "consumers are worse off as competition . . . is diminished."[33] The problem with this argument is that, even if it were true, it is not clear that a change in conduct would represent a net improvement for consumers and producers. Given the lack of evidence of any significant market failure, and given the rapid change in wireless technology, we think that the efficiency associated with the status quo cannot be easily improved upon.

The prospects of improving welfare through regulation of industries characterized by rapidly changing technology are even more difficult. Wireless services are evolving rapidly, from analog voice to digital voice (2G) to data (3G) to video (4G). This remarkable progress occurred in the span of one decade. As explained by the late William Baxter, who headed the antitrust division of the U.S. Justice Department, it would be dangerous to interfere with this kind of dynamic industry.[34] For example, who in the later 1990s would have foreseen Google's rise to Internet prominence in just a few short years?[35]

In assessing specific regulatory proposals, researchers should clearly identify the benchmark for comparison, or counterfactual. In this example researchers should identify what the world would look like with and without the alleged anticompetitive conduct. Wu implicitly assumes that innovation at the "edges" of the network (that is, application developments) would occur at a faster pace in the absence of wireless operators' conduct, but the evidence from the marketplace suggests that innovation at the edges has been flourishing. A review of FCC annual competition reports and the wireless operators' websites reveals that there have been over 50 significant innovations in wireless applications since 1999 (see Appendix 1).

Wu also notes the lack of diversity in wireless handsets.[36] Table 2 shows the number of unique brands and models of handsets sold by the top five U.S. wireless operators as of March 2007. Our estimate is conservative because it does

32. Wu at 6.

33. *Skype Petition* at 23.

34. According to Baxter, regardless of the evidence of consumer harm, if "there is no assurance that appropriate relief could be obtained," then the government must question the value to consumers of imposing a remedy. *In re International Business Machines Corp*, 687 F2d 591, 594 (2d Cir 1982) (quoting William F. Baxter, Assistant Attorney General, U.S. Department of Justice); Russ Mitchell and Marianne Lavelle, Road Runner v. Coyote: As Microsoft Case Shows, Markets Move Faster than Justice, US NEWS & WORLD REP 58, 59 (Dec 15, 1997) (quoting Baxter as saying that in dynamic industries "companies will compete for markets, rather than in markets.").

35. For the seminal treatment of the role of innovation in the economy, see JOSEPH A. SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT (Oxford University Press 1949) (explaining how innovations by entrepreneurs disturb the static equilibrium and are the cause of all economic development).

36. Wu at 13 ("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. 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.").

not include models that are purchased from a third party, such as Amazon.com, that does not provide the wireless service. Nor does it include models offered by MVNOs, which offer branded handsets that are unique to their network.

TABLE 2: NUMBER OF UNIQUE BRANDS AND MODELS SOLD BY THE TOP FIVE U.S. WIRELESS OPERATORS

Wireless Carrier	Number of Brands*	Number of Handsets
Verizon	7	36
Cingular/AT&T	9	45
Alltel	9	23
T-Mobile	4	27
Sprint/Nextel	6	41
Total	**12**	**154****

Source: Verizon Wireless, www.verizonwireless.com (last visited Mar. 13, 2007), T-Mobile, www.t-mobile.com (last visited Mar. 13, 2007), Alltel Wireless, www.alltel.com (last visited Mar. 13, 2007), AT&T Wireless, www.cingular.com (last visited Mar. 13, 2007), Sprint, www.sprint.com (last visited Mar. 13, 2007).

Note: * The brands represented include Blackberry, Firefly, Kyocera, LG, Motorola, Nokia, Palm, Pantech, Samsung, Sanyo, Sony Ericsson, and UTStarcom. ** The total figure eliminates any redundant phones (for example, the Palm 700p is offered by Alltel, Sprint, and Verizon, but is only represented once in the total). Several carriers, including Verizon, Sprint, AT&T, and T-Mobile, have devices with no easily ascertained brand (for example, the T-Mobile Sidekick). These fifteen handsets are captured in the total number of handsets. Therefore, the total figure comprises all unique handsets available.

Table 2 reveals that a wireless customer has more than 154 unique handset options before committing to a particular wireless operator. Conditional on choosing an operator, the customer has on average 34 choices. This estimate is highly conservative because it does not include handset options that are not sold by the issuing operator. It is incumbent upon those seeking regulation to demonstrate that, in the absence of the alleged anticompetitive conduct identified here, wireless consumers would currently enjoy more application innovation and more choices in handsets. Moreover, even if one could demonstrate greater application innovation from the regulation, it is not clear that the benefit of the additional application innovation exceeds the additional cost. For example, achieving more innovation at the "edges" may come at the expense of less innovation at the "core" of the network.

3. *The Intervention Should Take into Account All Important Benefits and Costs*

The third principle is that those seeking intervention must account for the regulatory impact on *all* important benefits and costs. There is no economic rationale for giving more weight to one type of benefit from innovation than another. But that tunnel vision is exactly what proponents of wireless net neutrality are inclined to do. In particular, Wu elevates "edge" innovations by applications developers above innovations at the "core" of the network by

wireless operators.[37] It is not clear that innovations at the edges of the network are more valuable than innovations at the core.[38] Without innovations at the core of the network, it is difficult to support innovation at the edge. The two areas of innovation are generally complementary. For example, a video-enabled handset is useless on a network with analog spectrum; telecommunication-devices-for-the deaf handsets cannot work effectively if there are no corresponding capabilities in the network; and GPS-enabled handsets depend on specific capabilities in the network.[39] Any attempt to favor producers at the edges could undermine the incentives of producers at the core, which could decrease overall welfare.

4. The Proposal Should Draw Constructive Lessons from Earlier Attempts at Regulation

Price and entry regulation in competitive industries do not generally make for good public policy.[40] While it is true that regulation is sometimes warranted, the history of regulatory intervention is replete with examples of good intentions gone awry.[41] This is especially true in wireless telephony. The wireless industry has been subjected on several occasions to regulation[42] and taxation,[43] and the inefficiency of such reforms should not be ignored by proponents of wireless net neutrality. On other occasions, regulatory proposals for the wireless industry have been rejected by federal agencies.[44] In what follows, we briefly review one such experience.

37. Wu at 25 ("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."). Wu fails to consider innovation by wireless network operators in his objective function.

38. Hahn & Litan, *supra* note 2.

39. For more examples of the interdependency between application innovation and network innovation, see Charles Jackson, Wireless Handsets Are Part of the Network, Apr. 24, 2007.

40. *See, e.g.*, Paul L. Joskow, Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks, AEI Brookings Joint Center Working Paper 05-18, Sept 2005.

41. *See* Paul L. Joskow & Robert Noll, *Regulation in Theory and Practice: An Overview*, in STUDIES IN PUBLIC REGULATION 1-65 (Gary Fromm, ed., MIT Press 1981); George Stigler, *The Theory of Economic Regulation,* 2 BELL J. ECO. & MGMT. SCIEN., 3-21 (1971); Sam Peltzman, *Toward a More General Theory of Regulation,* 19 J. L. & ECON. 211 -240 (1976); Richard Posner, *Theories of Economic Regulation,* 5 B ELL J. ECON. & MGMT. SCIEN. 335-358 (1974).

42. *See* J. Gregory Sidak, Hal J. Singer & David Teece, *A General Framework for Competitive Analysis in the Wireless Industry*, 50 HASTINGS LAW REVIEW 1639 (2000).

43. *See* Allan T. Ingraham & J. Gregory Sidak, *Do States Tax Wireless Services Inefficiently? Evidence on the Price Elasticity of Demand*, 24 VIRGINIA TAX REVIEW 249-261 (2004) (showing that we find that reducing the taxation of wireless services by one dollar would improve economic welfare by between $1.23 and $1.95).

44. *See* Thomas W. Hazlett, *Is Federal Preemption Efficient in Cellular Phone Regulation?*, AEI Brookings Joint Center Related Publication 03-21, Sept. 2003 (explaining that contrary to arguments made by the California PUC, wireless rates did not rise with the elimination of state rate controls); Jerry Hausman, Expert Declaration, in CTIA Petition for Expedited Declaratory Ruling on Early Termination Fees (explaining

Before 1993, states had the power to regulate prices and terms of service of wireless providers. The Omnibus Budget Reconciliation Act of 1993 preempted state authority over rate and entry regulation in wireless telephony. The FCC chose to waive its right to regulate rates and entry. The states retained some authority to regulate wireless service under the general rubric of consumer protection wherever state regulation did not interfere with rates and terms.

For example, the California Telecommunications Bill of Rights sought to limit wireless operators' discretion in a wide range of activities, with the focus on disclosure of contract terms and redress in cases in which customers are not satisfied with service. In particular, the Bill of Rights, which was approved by the California Public Utilities Commission (CPUC) in May 2004, required that wireless operators (1) supply detailed service agreement information when customers sign up, (2) produce bills that are "clearly organized," containing only charges for products and services the customer has authorized, (3) adds thresholds for charging late fees, and (4) requires wireless carriers to separately list all federal, state and local taxes, surcharges, and fees.[45]

Because many wireless operators use the same billing system to cover multiple states, the Bill of Rights forced wireless operators to decide how to generate one bill type for the California customers and another for their customers elsewhere. A second cost of the regulation was the requirement that wireless operators obtain subscribers' authorization for charges, which adversely affected the market for wireless downloads. While traditional billing systems can track content charges and render them on a bill, it was not clear how to efficiently track customer authorization that often takes the form of printed approvals and voice recordings.

Recognizing these burdens were "too onerous for the cell phone industry," in January 2005, the CPUC voted to suspend and redraft the legislation.[46] In March 2006, the CPUC approved a revised form of the original "Bill of Rights," which created a fraud unit to investigate sellers who mislead customers about fees and services and called for greater state intervention in educating consumers to prevent contract abuses.[47]

In addition to demonstrating how regulation of a competitive industry imposes unforeseen costs on society, the California Bill of Rights undermines Wu's suggestion that wireless consumers lack "meaningful information regarding their service plans."[48] There is little theoretical basis for thinking that the U.S. wireless industry will produce something less than the efficient level of information for wireless customers. For example, Sprint recently announced a

that such fees are part of a carrier's pricing structure for recovering revenues to offset costs.)

45. Karen Brown, *Breaking Down The Bill: New California regulations require carriers to beef up wireless bill information and that may cause them more than a few headaches*, WIRELESS WEEK, Aug. 15, 2004, *available at* http://www.wirelessweek.com/article/CA445086.html?text=bill+audit.

46. Jordan Robertson, *California Regulators Pass 'Wireless Bill of Rights'*, Sacramento Uniion, Mar. 2, 2006, *available at* http://sacunion.com/pages/state_capitol/articles/7879.

47. *Id.*

48. Wu at 32.

new billing format for its wireless customers,[49] which suggests that carriers pay attention to these matters. There are many places where a wireless consumer can obtain information. And aggressive state public utility commissions, like the CPUC, will be quick to intervene whenever they believe such intervention would serve their constituency. Thus, calls for federal intervention to produce more information are unwarranted.

B. Assessing the Benefits and Costs of the Proposal to Prevent Wireless Operators from Imposing Certain Limitations on Suppliers

When evaluating whether to prevent a certain type of contracting between a distributor and its suppliers, one must carefully weigh the benefits against the costs. Economists describe the constraints imposed on a supplier (by a distributor) or on a distributor (by a supplier) as "vertical restraints." There is a large economic literature on the efficiency rationales for imposing vertical restraints on suppliers or distributors. The most common rationale for imposing a restraint on a distributor is to avoid what economists call the "double marginalization problem," in which the distributor marks up the price a second time above the wholesaler's markup.[50] In his textbook on industrial organization, Jean Tirole explains that "[r]estraints that correct this externality tend to be welfare improving."[51] A second efficiency justification for vertical restraints is to promote pre-sale information by retailers, which is costly to produce and therefore invites free-riding.[52] Tirole concludes that these and other "vertical restraints can increase or decrease welfare, depending on the environment."[53] Failing to recognize this literature, Wu considers and rejects only one efficiency rationale that could explain the wireless operators' conduct—namely, price discrimination.[54] He then concludes incorrectly that the operators' conduct is

49. Press Release, Sprint Nextel, Wireless Customers Now Have The Power Of Simplicity (Apr. 03, 2007) (on file with author).

50. Because the cost faced by the retailer (the price charged by the wholesaler) is higher than the true cost to the wholesaler, the retailer's profit-maximizing calculus will cause it to purchase a quantity of the intermediate good from the wholesaler that is too low. The sum of the profits of the wholesaler and the retailer will be lower than the profit that would accrue to a hypothetical vertically integrated firm that fulfilled the roles of both wholesaler and retailer. By placing vertical restraints on retailers, a wholesaler can capture the benefits of a vertically integrated firm and thus obtain the largest possible profit.

51. JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 186 (MIT Press 1993).

52. *Id.* at 183. For example, consider the case of an intermediary that invests a significant amount of money educating end-users in a particular geographic market about a particular brand. If, as a result of these efforts of that intermediary, demand for that brand increases in the geographic market, the benefits from that increased demand would accrue to both that intermediary and to all other intermediaries that offer that brand but engaged in no efforts to develop the brand. Thus, intermediaries would have little incentive to engage in product development in the absence of exclusivity, which is why suppliers grant exclusive contracts.

53. *Id.* at 186.

54. Wu at 35 ("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

most likely explained as an anticompetitive attempt to "protect an existing revenue source."[55] As we demonstrate below, Wu failed to consider other plausible efficiency justifications.

1. *Banning Certain Limitations Imposed by Wireless Operators Would Not Generate Any Benefits for Consumers*

Before considering the costs of banning the alleged anticompetitive conduct by wireless operators, we examine the asserted benefits of the proposal. A nearly identical anticompetitive theory that is being offered to the FCC in support of wireless net neutrality was considered and rejected by an antitrust court in 2005. In her opinion in *Wireless Telephone Service Antitrust Litigation*, Judge Denise Cote of the Southern District Court of New York ruled that no individual wireless provider had sufficient market power to foreclose an unaffiliated handset maker by tying the purchase of the handset to the wireless subscription.[56] The plaintiffs, a class of wireless subscribers, argued that the defendants (the wireless operators) threatened to foreclose a number of handset makers by leveraging their wireless networks to act as a gatekeeper for handsets.[57] In rejecting the plaintiffs' theory, Judge Cote relied on testimony by representatives from some of the handset makers to show that the wireless providers did not have the requisite market power to foreclose handset makers.[58] She explained that the fact that the majority of handsets were sold through the wireless carriers did not imply that handset makers could not sell through an outside distributor or that they have not done so already.[59]

In what follows, we provide an economic analysis that is consistent with the framework used in that litigation. Although it is conceivable that regulation is needed to fill some gaps in antitrust enforcement, we conclude that regulatory

seems to raise doubts as to whether what the carriers are engaged in what can properly be called a price discrimination strategy."). Skype does not appear to consider efficiency justifications at all.

55. *Id.*

56. *In re Wireless Telephone Services Antitrust Litigation*, Opinion and Order, 02 Civ. 2637 (DLC) (2005).

57. *Id.* at 47.

58. For example, a Kyocera representative explained that a number of new manufacturers have entered the market by selling their products through an alternate distributor rather than a wireless carrier and by developing products that they then sold to other manufacturers that work with the wireless carriers such as Motorola or Nokia who could then provide it to the wireless carrier. *Id.* at 49. In addition, the representative testified that the wireless carriers, when presented with an interesting product made by a manufacturer not under contract with that particular carrier, often encourage these handset makers to work through an existing supplier. *Id.*

59. In fact, an LG representative testified that there is nothing that would stop his company from selling directly to consumers in the United States rather, his company simply chose not to. *Id.* at 52. In 2006, Nokia opened a few retail stores in New York and Chicago, and it is experimenting with direct sales. *See* Press Release, Nokia, Start spreading the news: Nokia Flagship Store makes its debut in New York City (Aug. 1, 2006) (on file with author); Press Release, Nokia, Nokia Flagship Stores to offer unique wireless shopping experience for US customers (Jun. 19, 2006) (on file with author).

intervention is not warranted here. We begin by defining the relevant geographic market for analyzing the competitive effects of the alleged conduct.

a. Antitrust Analysis Should Start by Defining the Relevant Market

When evaluating whether a particular type of conduct is anticompetitive, antitrust analysis begins with a definition of the relevant product and geographic market, which serves as a proxy for the scope of the alternative paths that are available to the alleged harmed party. The ability of a wireless operator to inflict harm on a handset maker or applications provider depends critically on the buying power of the wireless operator. This power depends, in turn, on the availability of alternatives for wireless customers. If there are few alternative paths, then the operator may have the ability (but not necessarily the incentive) to harm rivals. When a buyer controls all of the available paths to the end-users, it is said to have "monopsony" power.

Although there is little dispute as to the relevant product here (the sale of wireless handsets or the sale of wireless applications), the relevant geographic market may not be as obvious. One possibility is the geographic territory covered by a regional U.S. wireless operator that is engaging in the alleged anticompetitive conduct. The *Horizontal Merger Guidelines* provide the relevant question for determining the relevant geographic market: Could a hypothetical monopsony buyer of wireless handsets in that region profitably decrease its offer price below the competitive rate?[60] If handset suppliers constituting a critical share of the market shifted their sales to wireless operators outside of that region, then the attempted price cut would be defeated, in which case the geographic market would have to be expanded to the entire United States. Of course, a monopsony in the purchase of handsets throughout the United States might not be sufficient to exercise market power over handset makers (by imposing a price cut below competitive rates), in which case the geographic market might have to be expanded beyond the United States, and perhaps to the world.

Indeed, Wu acknowledges that the relevant geographic market for assessing the market for the purchase of wireless handsets may be worldwide: "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.'"[61] If a U.S. wireless operator refuses to carry one of Nokia's telephones—the most extreme form of foreclosure that is not even contemplated by Wu—then Nokia is free to sell its handsets to hundreds of non-U.S. operators. The larger the relevant geographic market, the smaller are the likely benefits of restricting the contracting practices of U.S. wireless operators.

60. The Department of Justice and Federal Trade Commission Horizontal Merger Guidelines, revised Apr. 8, 1997, § 1.2

61. Wu at 10. The likely reason why Nokia does not sell its entire line of handsets in every geographic market is that the frequency bands and consumer preferences differ across markets.

b. The Market Structure of the U.S. Wireless Industry Is Not Conducive to Foreclosure of Unaffiliated Equipment or Applications Providers

In the previous section, we explained that the relevant geographic market for assessing the conduct identified by Wu is conservatively the United States, and more realistically, the world. To assess a wireless operator's ability to harm upstream suppliers, one must next examine the degree to which any single operator possesses buying power in the relevant geographic market.

Wireless operators are alleged to have imposed certain restrictions on handset makers, such as requiring that all handsets be sold through the wireless operator. A more extreme form of foreclosure, and one that is useful for clarifying the potential benefits of banning the alleged anticompetitive conduct, is complete foreclosure, in which case the wireless operators refuses to deal entirely with a given handset maker. Table 3 shows the maximum foreclosure of the wireless market that a single operator could impose assuming conservatively that the relevant geographic market is the United States.

TABLE 3: MARKET SHARES OF TOP TEN U.S. WIRELESS OPERATORS AS OF DECEMBER 2005

Operator	*Subscribers (thousands)*	*Share*
Cingular/AT&T	54,144	26.8%
Verizon Wireless	51,337	25.4%
Sprint Nextel	44,815	22.2%
T-Mobile	21,690	10.7%
Alltel	10,662	5.3%
US Cellular	4,945	2.4%
Nextel Partners	2,018	1.0%
MetroPCS	2,000	1.0%
Leap	1,668	0.8%
Dobson Comm.	1,543	0.8%

Source: FCC Eleventh CRMS Report, tbl 4.

As Table 3 shows, the largest possible foreclosure share of any single wireless carrier is roughly 27 percent (by Cingular/AT&T). This implies that Cingular/AT&T, if it were so inclined, could prevent an equipment provider[62] or applications provider from reaching *at most* 26.8 percent of all U.S. wireless customers under the most extreme form of foreclosure. Of course, Cingular/AT&T does not appear to be considering such a strategy.

The relevant question for antitrust economists is whether an unaffiliated handset maker could achieve the lowest point of its cost curve by serving the remaining 73.2 percent of all U.S. wireless operators (not to mention the millions of non-U.S. subscribers). If the answer is "yes," then Cingular/AT&T lacks the ability to foreclose an upstream supplier. Because Cingular/AT&T is the largest provider, it follows that, if the answer is "yes," then any other U.S. wireless

62. This assumes that the equipment provider sells handsets that can operate on both GSM and CDMA networks. If the equipment provider sold handsets that worked on one technology only, then the foreclosure share in the United States would be larger.

operator lacks the ability to foreclose an unaffiliated handset maker. Recognizing this lack of buying power, and excluding the possibility of collusion among providers, it is unlikely that Cingular/AT&T (or any other provider for that matter) would attempt to foreclose a handset maker.[63]

c. There Can Be No Significant Anticompetitive Effects without Foreclosure

Antitrust economists focus on price as a proxy for short-term consumer welfare. Any conduct that undermines the price-disciplining ability of a rival can be considered anticompetitive.[64] Forcing a rival to exit the industry entirely (that is, "complete foreclosure") is not necessary to establish consumer harm. Rather, anything that undermines a rival's ability to discipline prices, including raising a rival's cost, is sufficient to generate consumer harm via the price channel. While it is possible that a certain type of conduct may harm a *competitor* (for example, by having a smaller incentive to invest), the only mechanism through which the conduct can have an anticompetitive price effect on *consumers* is by undermining a rival's ability to discipline price. Stated differently, some foreclosure is not anticompetitive foreclosure.

As we demonstrated above, complete foreclosure by a single wireless operator would not likely prevent a handset maker from achieving the requisite economies of scale (that is, the cost of making the handset would be no higher). Because the targeted handset maker could supply at a minimum the other U.S. wireless operators', there would be no foreclosure. And without foreclosure, there is no prospect of higher prices for consumers, as higher prices require higher costs of rival handset makers. Thus, without foreclosure, there can be no anticompetitive harm.

Wu fails to connect his theory of *competitor* harm with *consumer* welfare: "Yet at the same time, we also find the wireless operators aggressively controlling product design and innovation in the equipment and application markets, to the *detriment of consumers*."[65] It is one thing to claim that such conduct will redound to the harm of consumers. It is quite another to explain the mechanism by which the harm is transmitted to consumers in the absence of foreclosure. Because the anticompetitive harm under this extreme form of foreclosure is zero, it follows that the anticompetitive harm under a less restrictive form of foreclosure (such as the alleged product crippling) is zero as well.

2. Limitations Imposed by Wireless Operators Likely Generate Significant Efficiencies

Although many of Wu's allegations regarding the nature of restraints are exaggerated, wireless operators do exert some influence over upstream suppliers in several dimensions. For example, Cingular/AT&T requires device certification

63. It is not clear why operators would want generally to foreclose the development of new handsets that could enhance the value of their networks.

64. Einer Elhauge, *Defining Better Monopolization Standards*, 56 STAN. L. REV. 253-344 (2003).

65. Wu at 1 (emphasis added).

for Cingular/AT&T-sold devices activated on its network to help ensure that customers have an optimal experience when using a device with Cingular/AT&T service. Several operators, including Verizon and Cingular/AT&T, impose usage restrictions through the terms and conditions on the service contract. In this section, we analyze the efficiencies that would be sacrificed by banning the conduct identified by Wu.

The goal of vertical restraints generally is to align the incentives of the retailer with those of its suppliers. One way to think about such restraints is to imagine how a vertically integrated firm would behave in the same circumstances.[66] In the case of wireless service, vertical restraints are used to encourage wireless operators to promote the handset aggressively and discount the price of handsets. Operators impose limitations on customers relating to the types of attachments and types of applications to ensure a high quality of service. The demand for bandwidth-intensive applications is growing significantly, and will soon outstrip the capacity of existing wireline and wireless networks. Because (1) the capacity constraints facing wireless operators are more stringent than those facing their wireline counterparts, (2) wireless networks are shared networks, and (3) some features are not supported by the core network, it is not a coincidence that wireless operators are imposing more limitations to manage a relatively scarcer resource.

a. Use of Exclusive Distribution Contracts Encourages Wireless Operators to Promote the Handset Aggressively

Suppliers in many industries employ exclusivity provisions to induce intermediaries to invest in brand development and promotion.[67] The same is true in the wireless industry. For example, Wu notes that "in the United States, AT&T is the exclusive vendor of the [Nokia] e62. . . ."[68] Handset makers like Nokia and Samsung enter into exclusive contracts with wireless operators to ensure that the operators are properly motivated to market the handset. In the absence of exclusivity, a wireless operator might lack the incentive to invest sufficiently in brand development because other operators would free-ride on the efforts of the investing operator. That is, the benefits from investment would have to be shared with other, non-investing operators.

The exclusive contract between Samsung and Cingular relating to the *BlackJack* handset is an illustrative example of the benefits of exclusive deals in the wireless industry. As of March 2007, Cingular/AT&T was the exclusive provider of the Samsung *BlackJack* smart phone.[69] As a result of this exclusivity, Cingular/AT&T featured the *BlackJack* prominently in television advertisements.[70] The exchange of exclusivity for promotional efforts has

66. *See* Ronald Coase, *The Nature of the Firm*, 4 ECONOMICA 386-405 (1937).

67. Continental T.V., Inc. v. GTE Sylvania, 433 U.S. 36, 55 (1977) (asserting that vertical restraints have "redeeming virtues" in that they can induce downstream firms to engage in promotional marketing efforts that would otherwise be precluded by the free-rider effect).

68. Wu at 17.

69. Eric Benderoff, *White Pearl added at T-Mobile*, CHI. TRI., Jan. 16, 2007, at 2.

70. Eric Benderoff, *Cingular Places its Bet on BlackJack as Smart Phone Sales Increase,* CHI. TRI., Nov. 14, 2006.

become common in the wireless industry.[71] Other examples include the *Blackberry Pearl*, offered exclusively by T-Mobile, and the *Motorola Q*, offered exclusively through 2006 by Verizon.[72] Both of these models were promoted aggressively. Finally, as we demonstrate below in the case of Apple's iPhone, the exclusive contracts are often imposed by handset makers, not the wireless operator, which undermines Wu's central claim that wireless operators wield significant bargaining power vis-à-vis handset makers.

b. Eliminating Uncertainty with Contract Duration Allows the Wireless Operator to Discount the Price of a Handset

Requirements that customers purchase their handsets in conjunction with wireless service—that is, pursuant to a bundled rebate—allow wireless operators to discount the price of the handset. In exchange for purchasing a handset at a discounted price, wireless customers are expected to use that handset with the operator's service for a fixed duration. This fixed duration guarantees the wireless operator a stream of revenues, which can be used to discount the price of the handset. Customers can typically choose between buying handsets at one price with no term commitment or buying handsets at a lower price with one or two-year commitments. For example, in March 2007, Verizon Wireless sold a LG Strawberry Chocolate handset for $99.99 if purchased with a two-year contract for wireless service. If purchased with a one-year contract for wireless service, the price of handset increased to $199.99.[73] If purchased without a wireless service contract, the price increases to 269.99.[74] Thus, the price of the LG Strawberry Chocolate handset under a two-year commitment is roughly 37 percent of the uncommitted price. This long-term agreement is like an "installment contract"[75]

Wu acknowledges this efficiency justification for restraints imposed on customers without recognizing that, by doing so, he undermines his call for greater regulation: "The primary reason is very well known, and even beloved by consumers: the practice of subsidizing equipment purchases with subscription fees."[76] Wu admits that it is the discounted price of the handset, not the restraint imposed on the customer *per se*, that limits entry by unaffiliated vendors: "It is possible to buy handsets from unaffiliated vendors in the United States, but they

71. *See, e.g.* David Pringle, *Cell Division: After Long Peace, Wireless Operator Stirs Up Industry—U.K.'s Vodafone Is Dictating Handsets' Look and Feel; Nokia Tries Resistance—Hiding the Logo on the Back*, WALL ST. J., Nov. 12, 2004, at A1.

72. Benderoff, *White Pearl*, *supra* note 69.

73. Phone interview with Verizon Wireless representative Sharine (ext. 5545) on March 21, 2007.

74. *Id.*

75. In its petition to the FCC, Skype notes that an installment contract is a legitimate reason for phone locking. *See* Skype Petition at 17 ("While regulators in most countries do not prohibit handset locking outright, they typically ensure that locking is done for legitimate purposes only—such as to prohibit theft or fraud and the enforcement of a rental or installment contract, rather than for anti-competitive reasons—and that consumers are made aware of handset locks and how to unlock them.").

76. Wu at 10.

cost far more because of the lack of the subsidy."[77] Remarkably, Wu dodges the very issue that is critical in determining whether regulation would impose net benefits on society: "Whether the phone subsidies and other barriers to network attachments are ultimately a pro- or anti-consumer practice we do not address in this paper."[78] This admission is highly significant: It reveals that his analysis on its own cannot justify regulation of wireless operators.

c. Restrictions on Certain Attachments Help to Ensure the Quality of Service for Wireless Customers

Wireless operators impose certain performance requirements on equipment and applications suppliers to ensure that the attachments perform properly. If a customer is dissatisfied by the performance of a new feature, the complaint will be directed to the operator, not to the upstream supplier. Because the operator manages this relationship with the customer, the operator should be able to impose requirements on upstream suppliers that ensure high quality of service. Preventing it from doing so could give rise to the kind of complaints about service quality that Wu raises elsewhere.[79] New equipment needs to be tested to ensure that the features function properly on the operator's network without causing interference. The operator's requirements are likely motivated by the requirements imposed by the FCC on device makers relating to power limits and out-of-band emissions. Wu fails to distinguish between restrictions motivated by FCC compliance or by anticompetitive intent. Because the operator expects to earn a steady flow of revenues from satisfied customers, a wireless operator is willing to devote significant resources to handset testing. The devices that a particular operator sells are designed to be fully compatible with its network. It is reasonable for an operator to require the same level of compatibility for a foreign attachment.

d. Restrictions on Customer Usage Can Be an Important Tool for Efficient Resource Management

In addition to imposing performance requirements on equipment and applications suppliers, at least one wireless operator imposes usage limitations on customers even in an "unlimited" plan. As we demonstrate in Part II.B.3 below, Sprint-Nextel, T-Mobile, and Cingular/AT&T place no limitations on data usage with the appropriate wireless mobile phone plan. Like any network operator, a wireless operator has limited tools to manage its scarce resource. A wireless operator must manage network resources so that all customers sharing those resources receive a reasonable quality of service. Placing direct restrictions on

77. *Id.* at 11.

78. *Id.*

79. *Id.* at 4 ("In Washington, D.C., the wireless world is sometimes described as a nirvana for consumers brought on by competition and enlightened government policy. Some consumers and groups depict a very different story: a "cell hell" of "dropped calls, dead zones, billing errors, and unexpected fees and charges." The truth lies somewhere in the middle.").

usage can actually increase economic welfare when metering usage is costly.[80] For example, restricting certain bandwidth-intensive applications, such as streaming video or audio, webcam posts, automated data feeds, or VoIP,[81] can help ensure that all customers receive a high quality of service on today's primary services—namely, wireless voice and data transmission.

Resource management is a significant issue for network owners generally, but they are especially important for wireless networks. For example, DSL can offer to a home or business data rates up to 6.1 megabits per second (Mbps), which will support applications that require continuous transmission of video and audio. In contrast, wireless technologies like general packet radio service (GPRS) offer peak achievable user rate of 56 kilobits per second (kbps),[82] while EDGE technologies offer average speeds of 70 to 135 kbps uplink and downlink stream, with maximum speeds of 240 kbps.[83] Wireless 3G technologies like universal mobile telecommunication system (UMTS) offer average downlink speeds of 400 to 700 Kbps.[84] Current High-Speed Downlink Packet Access (HSDPA) devices average 600 kbps to 1.4 Mbps downlink with peak rates of 3.1 Mbps and average 350 to 500 Kbps uplink data rate per user.[85] Thus, the *fastest* wireless broadband systems do not exceed 3.1 Mbps, which implies that the capacity constraint could bind more often for a wireless operator than a wireline operator. Accordingly, wireless operators should be given great flexibility to impose usage restraints to manage the resources of the network.

80. *See* Yoo, *supra* note 2 (showing that when transaction costs render metering network-usage uneconomical, imposing restrictions on bandwidth-intensive activities may well enhance economic welfare by preventing high-volume users from imposing uncompensated costs on low-volume users.).

81. Although VoIP may not be considered a bandwidth-intensive application, unless all related network components (for example, the compression settings) are optimized to handle VoIP, VoIP traffic can consume significant bandwidth. Thus, for all intents and purposes, VoIP can be fairly characterized as a bandwidth-intensive application.

82. T-Mobile Website, Feature Summary, http://support.t-mobile.com/knowbase/root/public/tm22892.htm#top. "GPRS speeds up to 56 kbps."

83. *See, e.g.,* AT&T Wireless Website, Laptop Connect, http://business.cingular.com/businesscenter/solutions/wireless-laptop/laptop-connect.jsp. "BroadbandConnect compatible devices that are backward compatible with EDGE Network, Average download speeds of 70-135 kilobits per second."; T-Mobile Website, Feature Summary, http://support.t-mobile.com/knowbase/root/public/tm22892.htm#top. "EDGE speeds up to 240 kbps."

84. Verizon Wireless, BroadbandAccess/NationalAccess, *available at* http://support.vzw.com/capability/broadband_access_popup.html. "Using one of our wireless PC cards or BroadbandAccess Connect capable wireless devices with your laptop, you can connect to the Internet, corporate intranet, check your email and download attachments with average download speeds of 400 - 700 Kbps."; Sprint Website, *What is Mobile Broadband, available at* http://support.sprint.com /doc/sp9807.xml?id16=kbps. "EV-DO Rev 0: Download: 400-700 Kbps average, 2.4 Mbps peak; Upload: 50-70 Kbps average, 153 Kbps peak".

85. Sprint Website, *What is Mobile Broadband, available at* http://support.sprint.com/doc/sp9807.xml?id16=kbps. "EV-DO Rev A:Download: 600-1400 Kbps average, 3.1 Mbps peak; Upload: 350-500 Kbps average, 1.8 Mbps peak."

3. *Other Limitations on Service Identified by Wu Are Generally Not Used by Wireless Operators*

Wu identifies other limitations that are generally not used by wireless operators. Yet by identifying these practices in his article, Wu appears to suggest that these practices are widespread.[86] In some instances, Wu is careful to note that not all operators are engaged in the allegedly anticompetitive conduct. For example, regarding the requirement that handsets be sold by the operator, Wu admits that Sprint-Nextel allows wireless telephones that are not sold by that operator to function on its network.[87] Wu is silent about the relevant policies of two other carriers (Cingular/AT&T and T-Mobile), saying only that those carriers do not allow their telephones to work on other operators' networks.[88] A survey of the four largest wireless operators reveals that Cingular/AT&T and T-Mobile both allow their customers to purchase a handset from an unaffiliated vendor. See Table 4. Indeed, with one exception (preventing the use of a handset on a rival operator's network),[89] the survey reveals that Cingular/AT&T, T-Mobile, and Sprint-Nextel do not impose *any* of the other restraints identified by Wu.

TABLE 4: OTHER RESTRAINTS IDENTIFIED BY PROFESSOR WU

Restraints	**Page in Wu**	**Verizon**	**Cingular/ AT&T**	**T-Mobile**	**Sprint Nextel**
ON SUPPLIERS					
Require handset be sold by operator (or agent of operator)	11, 12	Yes[1]	No[2]	No[3]	No[4]
Prevent use of handset on rival's network	12,13	Yes[5]	No[6]	No[7]	Yes[8]
Require manufacturers to remove or limit call timers	13, 14	No[9]	No[10]	No[11]	No[12]
Disable certain Bluetooth functionality	16	Yes[13]	No[14]	No[15]	No[16]
Disable Wi-Fi	17	Yes[17]	No[18]	No[19]	No[20]

86. Wu at 13-14 ("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.") (emphasis added).

87. *Id.* at 12.

88. *Id.*

89. Preventing a handset from functioning on a rival's network does not likely harm customers due to the relatively short useful life of a handset. Consumers tire of their handset models roughly every 18 months with improvements in battery life, weight, and additional features prompting them to buy newer models. Indeed, consumers likely perceive the contract's expiration as an opportunity to purchase a new handset and dispose of their outdated version. Thus, preventing customers from keeping their outdated handsets is akin to preventing them from exercising an option that is out of the money at expiration.

Must use additional service to transfer photos	14	Yes[21]	No[22]	No[23]	No[24]
ON END-USERS					
Prevent users from downloading music from certain websites	18, 19	Yes[25]	No[26]	No[27]	No[28]
Prevent users from downloading videos from certain websites	18, 19	Yes[25]	No[26]	No[27]	No[28]

Sources: (1) Section 7, Customer Agreement, *available at* http://www.verizonwireless.com/b2c/globalText?textName=CUSTOMER_AGREEMENT&jspName=footer/customerAgreement.jsp. (Though the Customer Agreement reads "Whether you buy your wireless phone from us or someone else is entirely your choice," Customer Service representatives make clear that "someone else" refers to an agent of Verizon's; for example, a Verizon customer can buy a Motorola Phone directly from Motorola, but she must get the Verizon version, which will not work for any other carriers.); (2) Cingular uses GSM-type phones (http://www.cingular.com/about/our-technology.jsp). Cingular representatives verified that an unlocked GSM-type phone can be used with the Cingular network; (3) Paragraph 8, "Terms and Conditions," *available at* www.t-mobile.com. ("You may buy a Phone from us, or from someone else, but it must be GSM/GPRS equipment that is compatible and approved for use with our network and Services and we do not guarantee that all T-Mobile features will be available with such equipment. A T-Mobile Phone may be programmed to accept only a T-Mobile SIM card."); (4) Terms and Conditions, *available at* http://coverage.sprintpcs.com/IMPACT.jsp. ("Our services will only work with our phones"); (5) Verizon phones cannot be used with other carriers; (6) Cingular phones can be "unlocked" from the Cingular newtwork. Cingular customer service representatives report that Cingular will do this upon request after 3 months of use of a Cingular contract or if the customer claims she is traveling internationally. Additionally, there are third-party firms that offer unlocking services, such as www.gsmliberty.com; (7) T-mobile's policy is similar to Cingular's (see previous footnote), *available at* http://search.t-mobile.com/inquiraapp/ui.jsp?ui_mode=question&question_box=unlock.; (8) "Terms and Conditions," linked to at the bottom of http://coverage.sprintpcs.com/IMPACT.jsp. ("Your Device is designed exclusively for use on our network and in other coverage areas we make available to you. It will not accept wireless service from another carrier."); (9) While Verizon may have asked some manufacturers to disable call timers, they did not require it of all. The Verizon Motorola RAZR v3m, for example, has a call timer. See the user manual for the Motorola RAZR v3m *available at* www.motorola.com/mdirect/manuals/v3m_9501A90O.pdf. Also see the answer to the question "Why does my call timer differ from my bill?" on Verizon's FAQ, *available at* http://support.vzw.com/faqs/Account%20Management/faq_billing.html; (10) Some phones have call timers; (11) Some phones have call timers; (12) Some phones have call timers; (13) Verizon's Bluetooth Functionality Chart shows that the functionality of many of their Bluetooth phones is limited. The chart is available at http://support.vzw.com/pdf/BT_Chart_Handsets.pdf. This can also be seen by comparing Verizon's Motorola RAZR V3m to Sprint's Motorola RAZR V3m. Though the hardware is the same, Verizon's does not support file transfer profiles while Sprint's does. *See* V3m User Manual, at 32, *available at* www.motorola.com/mdirect/manuals/v3m_9501A90O.pdf; Sprint's Motorola RAZR V3m Feature Summary page, *available at* http://support.sprint.com/doc/sp9444.xml?id16=razr_v3m_bluetooth_profile.; (14) The Cingular version of the popular Motorola RAZR is able to transfer files, whereas the Verizon version is not. Source: Cingular Customer service; (15) T-Mobile RAZR V3 Product Page, *available at* http://www.t-mobile.com/shop/phones/detail.aspx?tp=tb2&device=dfb10fd8-c36d-4e2b-a440-6d2a92b2cdb6 ("Bluetooth lets you connect your phone to your headset or computer wirelessly."); (16) Sprint's Motorola RAZR v3m has more Bluetooth functionality than Verizon's. Sprint's allows the user to "[t]ransfer addresses to other Bluetooth-compatible devices and use it as a dial-up modem for Internet access," which Verizon's does not, as discussed in footnote 13; (17) Verizon does not currently offer a standard handset, Smartphone or PDA with WiFi capabilities. This can be seen by looking through Verizon's catalog. While this does not mean they disable WiFi technology on devices, it does suggest Verizon is careful to not sell any devices with WiFi capability; (18) Like Verizon, Cingular itself does not sell a handset, PDA or Smartphone with WiFi capabilities. One could, however, buy a phone with WiFi capability and use it on Cingular; (19) T-mobile sells the MDA and SDA handhelds (those are model names), which are WiFi-enabled; (20) Sprint also does not sell WiFi capable devices on its website, however one can buy a WiFi capable phone for use on Sprint (such as the UTStarcom PPC-6700). *Available at* UTStarcom phones, *available at* http://www.utstar.com/pcd/view_phone_details.aspx?mcode=PPC6700&sAct=0; (21) Though users with a little technical savvy can figure out a way to transfer pictures without using Verizon's services, Verizon does not support a workaround. A Customer Service representative confirmed this; (22) Pictures can be transferred using a data cable or Bluetooth. Customer Service Rep; (23) Same as Cingular; (24) Same as Cingular; (25) Contractually user is forbidden from using data plans to download music, videos and the like. The data use is intended for basic browsing and checking and downloading emails. *See* Additional Calling Plan Information,

available at http://www.verizonwireless.com/b2c/store/controller?item=planFirst&action=viewPlanList&sortOption=priceSort&typeId=3&subTypeId=4&catId=448; (26) With the appropriate plan, there are no limitation placed on data usage. *See, e.g.*, Shop for Phones, Plans and More, *available at* http://www.cingular.com/cell-phone-service/cell-phone-plan-details/?q_sku=sku1030031&q_planCategory=cat1460005. Wu's cite was from October 16, 2006.; (27) With the appropriate plan there are no limitations placed on data usage. *See* Sidekick Data, *available at* http://t-mobile.com/shop/plans/detail.aspx?tp=tb1&id=90ff4d79-019c-43a6-89f8-c2bb14781ce9; (28) With the appropriate plan there are no limitations placed on data usage. *See* Sprint Service Plans, *available at* http://www1.sprintpcs.com/explore/servicePlansOptionsV2/FreeClearFairFlexiblePlans.jsp?FOLDER%3C%3Efolder_id=1477387&CURRENT_USER%3C%3EATR_SCID=ECOMM&CURRENT_USER%3C%3EATR_PCode=None&CURRENT_USER%3C%3EATR_cartState=group.

Table 4 shows that no operator requires manufacturers to remove or limit call timers.[90] More importantly, many of the practices challenged by Wu are attributed to the carrier that a 2006 survey by J.D. Powers ranked the highest in call quality performance in five of six U.S. regions.[91] Ironically, this high level of customer satisfaction may very well be a function of a more vigorous policing of network management. Wu fails to consider the tradeoffs between certain limitations imposed by network operators on their subscribers and higher quality of service. Indeed, to the extent that consumers do not value the "freedoms" that Wu seeks, the tradeoffs cut strongly in favor of greater policing and higher quality of service. The network that ranks lowest according to Wu's idiosyncratic preferences ranks highest with consumers.

Finally, given the level of competition in the wireless industry, an individual operator should be entitled to experiment with different business models. Wireless consumers' preferences are evolving, thereby compelling network owners to change their offerings. AOL's "walled garden" approach was very successful with consumers at one point in time. As expectations evolved, however, this approach, which was mimicked by Prodigy, ultimately proved to be a failure. To the extent that competition and changes in demand undermine the "walled garden" approach of a single firm,[92] as it has in other industries, regulation would not be necessary and, in fact, would likely be counter-productive.

90. Wu at 13 ("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.").

91. J.D. Power and Associates Reports: The Number of Call Quality Problems Experienced with a Wireless Service has Declined for a Second Consecutive Year, Mar. 16, 2006, *available at* http://www.jdpa.com/pdf/2006037.pdf.

92. A walled garden refers to providing access to content from affiliated providers only, in contrast to content from both unaffiliated and affiliated content providers. The classic case in dial-up Internet access was America Online. *See* Robert W. Crandall & Hal J. Singer, *Life Support for ISPs*, REGULATION (Fall 2005).

III. SPECIFIC PROBLEMS WITH PROFESSOR WU'S ANALYSIS

In this section, we identify other problems with Professor Wu's analysis. Based on that analysis, Skype has petitioned the FCC to extend *Carterfone* rules to the wireless industry.[93] We explain why the market and regulatory conditions that potentially justified *Carterfone* regulation in the late 1960s do not exist in the current U.S. wireless industry. Next, we demonstrate that Wu and Skype cannot reject the hypothesis that certain services, such as making the phone operate like a fully functional camera, are not offered by wireless operators because they are not demanded by a sufficient number of wireless customers. We also explain why exclusive contracts between wireless operators and content providers are unlikely to harm consumers in the wireless market.

A. *The Market Conditions That Supported* Carterfone *Do Not Exist in the Current U.S. Wireless Industry*

In 1968, Carterfone filed a complaint with the FCC regarding AT&T's refusal to allow a device that directly connected a mobile radio to the landline network.[94] The FCC concluded that AT&T had not adequately demonstrated that Carterfone's device would harm AT&T's network.[95] In a subsequent rulemaking, the FCC expanded *Carterfone* by allowing users to connect any type of customer premise equipment to the telephone network as long as the equipment meets certain technical criteria.[96] Wu laments the fact that, "like in the pre-Carterfone world, innovative [wireless applications] companies must seek the permission and cooperation of the carrier oligopoly. Consequently, the market for consumer devices is unusual and distorted."[97] He credits *Carterfone* for fostering the creation of the fax machine and the answering machine,[98] both of which are now obsolete technologies.[99] The proponents of wireless net neutrality fail to note four critical differences between the competitive and regulatory environment that existed when *Carterfone* was enacted and the wireless industry of today.[100]

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93. *Skype Petition* at i ("The Commission should act now to enforce *Carterfone* and unlock the full benefits of wireless price competition and innovation.").

94. Use of the Carterfone Device in Message Toll Telephone Services; Thomas F. Carter v. AT&T, Dkt. Nos. 16942 and 17073, 14 F.C.C.2d 571 (1968).

95. *Id.* at 571.

96. 47 C.F.R. 68.3. To be classified as customer premise equipment—and to attain the associated rights of network attachment—the equipment must not present a risk of any one of four specified harms: (1) electrical hazards to operating company personnel, (2) damage to network equipment, (3) malfunction of billing equipment, and (4) degradation of service to customers other than the user of the customer premise equipment and that person's calling and called parties.

97. Wu at 9-10.

98. *Id.* at 9.

99. The functionalities of the fax machine and the answering machine have moved to the network. Skype also refers to the "celebrated *Carterfone* decision." See *Skype Petition* at 4.

100. The closest Wu comes to making this comparison occurs on page 9: "Carterfone freed innovators to invent the personal modem, and then ever faster versions of the personal modem, without seeking approval from the owners of the telephone lines. In the wireless world, the Carterfone rule does not exist. Instead, like in the pre-

1. There Is No Monopoly Provider

All theories of vertical foreclosure begin with the premise that the firm has monopoly power in the "primary" or "tying" market.[101] Monopoly power in one market can be leveraged into a "secondary" or "tied" market. For example, the relevant case law for refusals to deal with upstream rivals discourages a *monopolist* from engaging in such conduct where denying access to rivals enhances *monopoly* power.[102] Because AT&T was a monopolist in the supply of voice service in the United States in the late 1960s,[103] the FCC's case against AT&T fit the mold of a classic anticompetitive foreclosure.

AT&T's monopoly power in voice service in the late 1960s stands in sharp contrast to what Wu and Skype refer to as the wireless "carrier oligopoly" of today,[104] as if the phrase "oligopoly" had some negative connotation in economics.[105] As Table 3 indicates, the *largest* U.S. wireless operator supplies about 27 percent of all wireless customers. It is highly unlikely that a provider with such a small share could leverage its alleged power in the "tying" market into the "tied" market. Given this fact pattern, it would be unlikely that a plaintiff could bring a successful antitrust case against a single wireless operator. Indeed, an antitrust complaint brought against *several* U.S. wireless operators in 2005 was denied because other critical components of an anticompetitive foreclosure case were missing.

2. Lack of Vertical Integration into Applications or Equipment

A second critical component of any foreclosure theory is vertical integration or affiliation. Without having an affiliated supplier in the secondary market, the "monopolist" lacks the incentive to steer customers towards one vendor over another. To make matters concrete, consider a vertically integrated cable operator that (1) supplied video service to over 80 percent of video subscribers in a given locality and (2) supplied its own local sports programming. Given this conflict of interest, the vertically integrated cable operator is not indifferent between its

Carterfone world, innovative companies must seek the permission and cooperation of the carrier oligopoly."

101. *See generally* Dennis W. Carlton, *A General Analysis of Exclusionary Conduct and Refusal to Deal—Why Aspen and Kodak Are Misguided*, 68 ANTITRUST L.J. (2001)

102. *See e.g.*, Einer R. Elhauge, *Defining Better Monopolization Standards*, 56 STAN. L. REV. 253 (2003).

103. *See* ROBERT W. CRANDALL, AFTER THE BREAKUP: THE U.S. TELECOMMUNICATIONS INDUSTRY IN A MORE COMPETITIVE ERA 17 (Brookings Institution 1991) ("After Congress liberalized the antimerger law for telephone mergers in 1921, AT&T increased its share of the local exchange business to 80 percent of the country's telephones.").

104. Wu at 9; Skype at 21 ("One basic change has been in the structure of the wireless marketplace; following consolidation, there are a smaller number of carriers in the market, a market many regard as oligopolistic.").

105. Oligopoly simply means an industry that is supplied a small group of firms, often characterized by entry barriers. *See, e,g.*, DENNIS CARLTON & JEFFREY M. PERLOFF, MODERN INDUSTRIAL ORGANIZATION 7 (Addison-Wesley 3rd ed. 2000). Given the significant fixed costs in wireless telephony (acquiring spectrum and building a network), marginal-cost-based pricing—a result of perfect competition—could not be maintained.

video subscribers watching its affiliated sports programming and watching unaffiliated sports programming, as it profits from higher advertising from the affiliated programming only.[106] The same was true for AT&T in the late 1960s. At that time, AT&T owned an equipment company, Western Electric, which manufactured all of the customer premises equipment for AT&T's customers, including telephone sets and other terminal equipment.[107] Indeed, AT&T's local services operating companies were separated from its equipment division under a settlement with the Department of Justice in 1982.[108] Before this mandatory divestiture, AT&T had strong incentives to favor its own equipment division over unaffiliated equipment makers like Carterfone.

Once again, this vertical integration in the wireline voice market of the late 1960s stands in sharp contrast to the modern wireless industry. None of the wireless operators owns equity in any of the major handset manufacturers, including Blackberry, Kyocera, LG, Motorola, Nokia, Palm, Samsung, Sanyo, and Sony Ericsson.[109] Thus, the wireless operators lack a financial interest in steering their customers to one handset maker over another. Similarly, the wireless operators have not significantly integrated into wireless applications markets. For example, none of the top content sites as ranked by visits, including Google, eBay, ESPN, and Amazon, are subsidiaries of the major wireless operators. The lack of vertical integration—a prerequisite for extending market power in an adjacent market—is a key ingredient that is missing from Wu's case that *Carterfone* rules are needed here.

The only possible upstream application that represents a threat to the profits of wireless network operators is VoIP. Even here, however, regulation to protect VoIP providers is not necessary. Given the lack of market power of any individual wireless operator, any duty to support VoIP will not likely come from antitrust enforcement. One could reasonably ask whether regulation is needed to fill the potential gap from antitrust enforcement in a case of collective foreclosure, in which each wireless operator unilaterally chooses not to support VoIP. Because VoIP providers could achieve the requisite economies of scale by selling to wireline broadband customers (cable modem and DSL providers), even

106. *See* Hal J. Singer & J. Gregory Sidak, *Vertical Foreclosure in Video Markets*, REV. NETWORK ECONOMICS (forthcoming 2007).

107. CRANDALL, *supra* note 103, at 33-34 ("All telephone sets, private branch exchanges, and other standard equipment used by residences or businesses were owned and leased by the telephone company. Nearly all of AT&T's customer premises equipment was manufactured by Western Electric and sold to the operating prices not subject to competitive bid.").

108. *Id.* at 38 ("After several months of deliberation, the Justice Department and AT&T announced their agreement to settle the case. AT&T would divest itself of all [local service] operating companies but retain its Western Electric and long lines Divisions.").

109. Among the major equipment vendors, the only "cross-ownership" issue that we could identify was between Motorola and Sprint. Motorola owned shares in Sprint, but according to Motorola's SEC filing, Motorola sold its remaining shares in late 2006. *See* MOTOROLA INC., 2006 ANNUAL REPORT (SEC Form 10-K), at 41 (Feb. 28, 2007) ("In 2006, the $41 million of net gains primarily reflects a gain of $141 million on the sale of the Company's remaining shares in Telus Corporation, partially offset by a loss of $126 million on the sale of the Company's remaining shares in Sprint Nextel Corporation ("Sprint Nextel").").

the collective foreclosure that would ensue in this example would still not require regulatory action.[110]

3. *Existence of Countervailing Bargaining Power Among Applications and Equipment Suppliers*

A third factor that distinguishes the current wireless industry from the wireline industry circa 1968 is the existence of countervailing market power among equipment and applications providers. Wu suggests that "it is de facto necessary to obtain the *permission* of the carrier to market a wireless device in the United States,"[111] as if the wireless operators had all the bargaining power. Similarly, Skype claims that "[s]uch a 'permission-based' approach to innovation creates an innovation bottleneck. . . ."[112] Wu cites Apple's iPhone as an example of wireless operators exercising market power:

> 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 cannot 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? The main reason is the lack, in the wireless world, of basic network attachment rules.[113]

Contrary to Wu's characterization of how the industry operates, Apple did not need the "permission" of a wireless operator to market the iPhone. Indeed, this anecdote suggests the exact opposite—namely, that unaffiliated equipment suppliers can wield significant market power over the wireless operators. It was Apple, not the wireless carriers, who insisted on an exclusive contract. The story of the iPhone illuminates who wields the power in these negotiations.

As the *Wall Street Journal* reported in February 2007, Apple offered Cingular/AT&T a five-year exclusive deal as an incentive to accept the heavy and unprecedented demands made by Apple.[114] In particular, Apple demanded, among other items, that (1) Cingular/AT&T leave its brand off the phone, (2) Cingular/AT&T share with Apple a portion of monthly subscriber revenues, (3) the iPhone only be sold through Apple and Cingular/AT&T stores and not through other stores with which Cingular usually works, and (4) Apple have sole power to decide whether to repair or completely replace a malfunctioning

110. Even if all wireline broadband providers opted not to support VoIP applications, the collective foreclosure across wireline and wireless network owners would still not be anticompetitive foreclosure: Although VoIP providers may be harmed, the price of voice service in the United States would not likely be affected by the elimination of VoIP providers. In conclusion, in the single application in which wireless network owners could be said to compete with unaffiliated upstream suppliers, there is no need for regulation.

111. Wu at 10 (emphasis added).

112. Skype Petition at 13.

113. Wu at 7.

114. Amol Sharma, Nick Wingfield & Li Yuan, *Apple Coup: How Steve Jobs Played Hardball In iPhone Birth*, WALL ST. J., Feb. 17, 2007, at A1.

iPhone.[115] Apple also demanded complete secrecy on the project, allowing only three Cingular/AT&T executives to see the phone before its release and severely limiting the role of Cingular/AT&T technicians on the project.[116] Moreover, the exclusive deal with Cingular/AT&T pertains to the United States only, allowing Apple to sell its phone to wireless operators around the world.[117]

Citing Apple's demands as problematic, Verizon declined Apple's exclusive offer two years before the Cingular deal was announced.[118] For example, Apple would not allow Verizon to use its V CAST technology on the iPhone. Second, Verizon refused to exclude its outside distributors such as Wal-Mart and Circuit City from the iPhone deal. Third, Verizon did not want to allow Apple to intervene between Verizon and its customers when making decisions on phone maintenance.[119] The iPhone anecdote on which Wu relies seems to undermine his claim that upstream suppliers require the "permission" of a wireless operator.

4. *Wireless Operators Are Not Subjected to Price Regulation That Could Allow Them to Benefit from Tying*

Anything that prevents a single-product monopolist from extracting 100 percent of the consumer surplus (another name for consumer welfare), including price regulation, can motivate that firm to look to other markets to increase profits. Unlike AT&T in the late 1960s, wireless carriers of today are not subjected to price regulation. Thus, wireless carriers lack a powerful incentive (possessed by AT&T in the late 1960s) to seek profits in other markets such as equipment or applications.

Antitrust scholars recognized that a monopolist generally lacks anticompetitive motives to engage in vertical restraints. They concluded that such restraints were motivated for efficiency reasons only. So long as the monopolist can extract the entire consumer surplus from the "tying" market, there is no incentive to earn more than "one monopoly profit." Of course, there are some exceptions to this rule, such as when the monopoly must charge a single price for the tying product, consumers purchase multiple units of the product, and their demand is downward sloping.[120] Another impediment to extracting the entire consumer surplus is price regulation. When the FCC imposed *Carterfone*, AT&T was subjected to price regulation in the provision of local service.[121] Thus, AT&T

115. *Id.*; Leslie Cauley, *Verizon Rejected Apple iPhone Deal*, USA TODAY, Jan. 29, 2007.

116. Sharma, Wingfield & Yuan, *supra* note 114, at A1.

117. Cauley, *supra* note 115.

118. *Id.*

119. *Id.*

120. *See, e.g.*, Patrick Greenlee, David S. Reitman & David S. Sibley, *An Antitrust Analysis of Bundled Loyalty Discounts* (Economic Analysis Group, Discussion Paper No. 04-13, Oct. 30, 2006), *available at* http://ssrn.com/abstract=600799.

121. CRANDALL, *supra* note 103, at 24-25 ("The formula—the subscriber plant factor—used in allocating the local loop costs was changed twice more, in 1965 and 1969, in each case raising the interstate share of local costs."); Nicholas Economides, Telecommunications Regulation: An Introduction, Sept. 2003, *available at* http://www.stern.nyu.edu/eco/wkpapers/workingpapers03/03-22Economides.pdf ("In the 1960s regulators did not let prices of basic local service rise in their attempt to achieve

had an anticompetitive motive to tie its customer premise equipment with its telephone service—namely, to extract additional consumer surplus in the "tying" market.

This price regulation faced by AT&T in the late 1960s stands in sharp contrast to today's wireless industry. The pricing by a wireless operator is constrained by the prices of its rivals. There is nothing that prevents a wireless operator from customizing its offering for wireless customers. Thus, wireless operators lack an anticompetitive motive to engage in vertical restraints that motivated the *Carterfone* rules.

B. Certain Services May Not Be Offered by Wireless Operators Because They Do Not Pass a Market Test

Wu is concerned that wireless operators have failed to supply what he thinks are obvious wireless applications. In a well-functioning market, however, there is little reason to believe that suppliers will not respond to consumer demand. One assumption under which the market will undersupply wireless applications is that the marginal private benefits of developing such applications are less than the marginal social benefits (the classic positive externality). However, Wu does not offer examples of spillovers in use or development of an application, which might make a wireless operator reluctant to invest in that application.

Wireless operators have strong incentives to attract new customers and please their current customers. One of the ways to do that is by offering the latest technology. As we demonstrate below, many of the allegedly missing applications identified by Wu are, in fact, available in the marketplace. Moreover, we explain that many of these applications are not prevalent because they do not pass a market test. Stated differently, Wu's preferences over wireless applications may not reflect the general preferences of wireless customers.

1. Printing Phone Numbers or Addresses from a Wireless Telephone

Wu suggests that wireless consumers seek to print address contacts directly from their wireless handsets but are prevented from doing so by wireless operators: "Obvious uses of the [Bluetooth] technology might include transferring photos off of camera-phones, printing information from a telephone, or backing up address books."[122] As it turns out, wireless customers can print from some handsets. To determine whether such applications are "obvious," however, one must access the demand for printing address books from handsets.

As of March 2007, there were a handful of wireless phones that allowed direct communication with printers. For example, Verizon offered the Samsung SCH-a990, which can print directly to a Bluetooth enabled printer.[123] Online

"universal service," i.e., including as many households as possible in the telecommunications network, on the basis that this was desirable even if it were allocatively efficient.").

122. *Id.* at 16.

123. Verizon Wireless Website, Samsung SCH-a990, *available at* http://www.verizonwireless.com/b2c/store/controller?item=phoneFirst&action=viewPhoneDetail&selectedPhoneId=2406. The functionality of the Bluetooth printing is confirmed in a Cnet review. "Alternatively, you can take advantage of the SCH-A990's

reviews confirm the functionality: "Alternatively, you can take advantage of the SCH-A990's TV-out capability to display photos on your TV, or you can send them to a Bluetooth-enabled printer right from your phone."[124] Sprint offers the M610 by Samsung, which supports the Basic Printing Protocol, an emerging Bluetooth standard for connecting with printers.[125] Thus, any suggestion that wireless printing capabilities are completely absent from the marketplace is factually inaccurate. Wu also ignores the complexity at issue in getting a wireless device to work with a printer—namely, the printer must be Bluetooth-ready to receive signals from a wireless device. Until printer manufacturers equip their printers with Bluetooth receivers, wireless network owners will be reluctant to make the necessary investments.

Wu cannot reject the hypothesis that such functionality is not readily available because it is not generally demanded by wireless consumers. Indeed, this functionality has been introduced and subsequently abandoned by operators. In late 2002, Research in Motion, the maker of the Blackberry, allowed users to print directly from their wireless device.[126] As of March 2007, however, this feature was no longer listed on its website. This should come as no surprise for those who take part in the "digital economy." The need to print documents appears to be diminishing for most workers, including workers with wireless devices.[127] The same trends would compel a wireless customer *not* to print a document.

Moreover, there are likely to be superior alternatives to printing contacts from a cell phone. With respect to a single phone number, it is more convenient to write a number on a Post-It note rather than printing it on an 8.5 x 11 inch piece of paper. With respect to an entire contact list, the same address book that resides in a wireless device also resides in a user's desktop with the help of automatic "syncing." Syncing can be accomplished through a wireless connection, Bluetooth, or a USB cable.[128] The cables and software needed to sync a handset with a desktop come standard with most phones and are readily available in the after-market.[129] Thus, printing an address book from one's cell

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TV-out capability to display photos on your TV, or you can send them to a Bluetooth-enabled printer right from your phone."

124. Bonnie Cha, Samsung SCH-A990, CNET.com Review, Jul. 20, 2006, *available at* http://reviews.cnet.com/Samsung_SCH_A990/4505-6454_7-31968249.html.

125. *Sprint Power Vision Phone M610 By Samsung Not Your Average Mobile Phone*, PC TODAY.COM, Vol. 5, Is. 5, *available at* http://www.pctoday.com/Editorial/article.asp?article=articles/2007/t0505/30t05/30t05.asp&guid=.

126. RIM PRESS RELEASE, *NeedTEXT Attachment Opener Chosen by Leading Law Firms for Wireless Users on RIM BlackBerry*, (May 2, 2002), *available at* http://www.rim.net/news/partner/2002/pr-02_05_2002.shtml.

127. *See, e.g.* Jaclyne Badal, *Technology (A Special Report): Office Technology – Goodbye Briefing Book; A Paperless Board Meeting? It's Starting to Happen*, WALL ST. J., Oct. 23, 2006, at R11.

128. Detailed instructions on printing an address book can be downloaded from Microsoft's website, *available at* http://office.microsoft.com/en-us/outlook/HP030656981033.aspx.

129. Cingular sells cables to sync phones, such as the LG C2000, with computers.Cingualr Website, (last accessed March 26, 2007), *available at*

phone can be easily accomplished by printing from one's desktop. To the extent there is very limited demand for printing directly from a wireless device, it is no surprise that such functions are not available in the marketplace.

2. *Using a VoIP Phone with a Laptop That Connects to the Internet via a Wireless PC Card*

Wu complains about the lack of mobile VoIP options.[130] In particular, he is concerned that wireless customers cannot cancel their voice plan and instead use a VoIP-enabled device in conjunction with (1) a laptop that connects to the Internet via a wireless PC card[131] or (2) a nearby "friendly wireless network."[132] He cites handsets like the Netgear SPH101 that "do not work on the cellular networks operated by the commercial wireless carriers" but "are Wi-Fi 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 Wi-Fi network."[133] Similarly, Skype complains in its petition of restrictions placed on consumers using data packages for VoIP calls.[134]

The availability of VoIP-enabled wireless cards is likely to be determined by the simple economics facing end-users. A comparison of the monthly cost of a VoIP plan *plus* an unlimited mobile data plan ("mobile VoIP option") versus a standard wireless voice plan is illustrative. The cost of a monthly unlimited data plan from either Cingular/AT&T or Verizon is $79.99.[135] The cost of a VoIP service that allows users to make unlimited calls from Vonage is $24.99.[136] The

http://cingular.scp4me.com/ItemDetail.aspx?ItemNo=81571CW&make=LG&model=C2000&ProductClass=DATA. See also, Kent German, Weekend Project, Sync your cell phone with your computer, ZDNet.com, Jan. 23, 2006, *available at* http://review.zdnet.com/4520-11400_16-6416968-1.html?tag=bnav.

130. Wu at 17.

131. *Id.* at 19.

132. *Id.* at 19. By advocating a "friendly wireless network," Wu appears to demand a network that allows users to do virtually anything they want. This would include downloading any bandwidth-intensive content, attaching any foreign device, and making phone calls—the lynchpin of any wireless service—for free. In the absence of market failure, the interests of wireless carriers generally coincide with the interests of their customers. It is not necessary to seek regulation that would alter the behavior of wireless operators for the sake of promoting the interests of VoIP providers only.

133. *Id.* at 17.

134. Skype points to the terms of service for Verizon and AT&T, arguing that their terms go beyond prohibiting activities that might harm the network. *See Skype Petition* at 19.

135. Verizon Website, *available at* http://www.verizonwireless.com/b2c/store/controller?item=planFirst&action=viewPlanList&sortOption=priceSort&typeId=5&subTypeId=13&catId=409. *See* also, Cingular Website, *available at* http://www.cingular.com/ cell-phone-service//cell-phone- plans/laptop-connect-plans.jsp.

136. Vonage Website, http://www.vonage.com/services.php?lid=nav_services. Vonage also offers a plan with 500 minutes, but this is not economically viable at any usage level. *Id.*

cost of unlimited calls from Skype is $2.50 a month.[137] These combined costs exceed the cost of a traditional wireless voice plan, which begin at roughly $40 per month. To be indifferent between the two options, a consumer would have to consume 1350 minutes (using Skype) or 2010 minutes (using Vonage). According to the most recent FCC report, however, the *average* mobile user consumed 740 cellular minutes a month.[138] At this level of usage, a subscriber would clearly be better off using a standard wireless voice plan.[139] The same calculus applies for a customer who wants to use VoIP in conjunction with a T-Mobile account in a "friendly wireless network" such as Starbucks. Because the very consumers who would be interested in mobile VoIP are "the more frugal who may be limiting their usage and spending",[140] it is highly unlikely that they would be willing to incur the high cost for mobile VoIP calling.

3. Using Wi-Fi Connectivity to Write Emails and Browse the Internet with a Wireless Telephone

Wu claims that "with a few notable exceptions, it is difficult today to find a Wi-Fi capable cell phone."[141] He also claims that "[m]ost carriers will not sell a

137. Skype Website, *available at* http://www.skype.com/ ($29.95 yearly cost divided by 12).

138. *Eleventh CMRS Report*, *supra* note 12, at 106.

139. The numbers used in this example are likely to be conservative for several reasons. First, by removing restrictions on usage, the cost of data services would almost surely increase, raising the cost of the mobile VoIP option relative to a standard wireless voice plan. Second, this example ignores the free nights and weekends offered under standard wireless voice plans. Third, it ignores the upfront cost of VoIP phones and wireless PC cards. Phones that can be attached to a computer for VoIP services cost anywhere from $19.95, to $149.95, and low end data connection cards cost $49.99. *See* Skype Shop, *available at* http://us.accessories.skype.com/store/skype/DisplayHomePage; Cingular Website, Phones and Devices, *available at* http://www.cingular.com/cell-phone-service/cell-phones/pc-cards.jsp?zipPass=true. Fourth, Vonage's unlimited plan states that Vonage can discontinue service for usage above acceptable levels: "We reserve the right to immediately disconnect or modify your Service if we determine, in our sole and absolute discretion, that your use of the Service or the Device is, or at any time was, inconsistent with normal residential usage patterns." *See* Vonage Terms of Service, *available at* http://www.vonage.com/features_terms_service.php. It is not clear whether Vonage would consider three times the average cell phone usage to be "inconsistent with normal residential usage patterns."

140. *In-Depth Analysis: Consumer Demand for Cellular/Wi-Fi Services*, Mindbranch Research Summary, Dec. 2006, *available at* http://www.mindbranch.com/Consumer-Demand-Cellular-R97-2670/ ("Instead, the more frugal customers who may be limiting their usage and spending to avoid unexpected bills are a more important—but difficult to identify—market."

141. Wu at 17. Wu notes two exceptions in his footnotes, saying that the iPhone and the Dash will both feature Wi-Fi. *Id.* ("AT&T will soon offer the Apple iPhone, which has Wi-Fi capabilities. Also, since October 2006, T-Mobile has offered a plan in the city of Seattle whereby consumers can use a hybrid telephone, sold by T-Mobile, in T-Mobile's 'hotspots,' although this feature also entails an extra monthly fee. In addition, also in October 2006, T-Mobile began to make available the 'Dash' smartphone with Wi-Fi capabilities. Users can also buy Wi-Fi phones in Europe or Asia and import them.")

Wi-Fi phone at any price."[142] Using a Wi-Fi connection, Wu asserts, a wireless handset operating on a "friendly wireless network" could be used to write emails and browse the Internet without having to subscribe to a traditional mobile data plan.[143]

There are numerous explanations (unrelated to protecting an ancillary revenue stream) for why a wireless operator would limit Wi-Fi capabilities in a handset. The most obvious is battery life. Batteries are one of the chief limiting factors for handsets,[144] and consumers often make choices among handsets based on battery life.[145] Accordingly, operators evaluate features, including Wi-Fi, on the basis of power consumption. Wi-Fi consumes more power in both transmit/receive mode and standby mode. In transmit/receive mode, Wi-Fi requires between 12 and 16 percent more power than cellular radios.[146] The disparity is even greater in standby mode, where Wi-Fi uses between 130 and 150 milli Amperes per hour (mAh). A standard cellular connection requires between 2 and 4 mAh. Thus, a Wi-Fi connection requires between 37 and 75 *times* the power required by a standard cellular connection.

Wu's example of the Nokia e61 and e62 underscores the trade-off between advanced features and battery life. In standby mode, the e61 can operate up to 9.5 days with Wi-Fi activated;[147] the 362, which lacks Wi-Fi capabilities, can operate up to 14 days.[148] Given the choice between extending battery life and enabling Wi-Fi functionality, it is perfectly reasonable for a wireless operator to choose not to include Wi-Fi functionality in some of its handsets.

Wu's claim that it is difficult to find Wi-Fi enabled phones in the United States is false. As of March 2007, all five nationwide service providers offered at least one Wi-Fi enabled phone. In addition to the examples provided by Wu, the following Wi-Fi phones are available in the United States: Cingular's 8525,[149] T-

142. *Id.* at 35.

143. Wu at 17 (Wu cites an MSN columnist saying that "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 Wi-Fi on the e62.") (emphasis added).

144. Mike Hughlett, *Batteries Hit Their Boundaries; Engineers are Working To Make Fuel Cells Fit in Cell Phones, Laptops and More, Giving Users More Juice and Time,* CHI. TRIB., Nov. 3, 2006, at 1 ("The battery craftsman is the cold voice of reality, reminding gadget designers that there are limits. 'There's an old maxim that engineers will consume all the energy you give them and scream for more,' Howard said.")

145. *See, e.g.* Walter Mossberg, *BlackJack Beats Out Palm 750, but iPhone May Well Top Both*, WALL ST. J., Jan. 11, 2007, at B1 ("Also, the BlackJack claims 38% better battery life than the Treo, and it runs on a faster data network than the Treo.")

146. Arjun Anand, et al., A Quantitatvie Analysis of Power Consumption for Location-Aware Applications on Smart Phones, Dept. of Computer Science, Electrical and Computer Engineering, and Information Systems, New Jersey Inst. Of Tech, at 4, *available at* http://web.njit.edu/~borcea/papers/isie07.pdf.

147. Nokia UK Website, e61 Page, *available at* http://www.nokia.co.uk/A4221032 (last accessed Mar. 28, 2007).

148. Nokia US Website, e62 Page, *available at* http://www.nokiausa.com/phones/E62/0,7747,feat:1,00.html. (last accessed Mar. 28, 2007).

149. Cingular Website, Cingular 8525, *available at* http://www.cingular.com/cell-phone-service/cell-phone-

Mobile's MDA,[150] Verizon Wireless's XV6700,[151] Sprint's PPC-6700,[152] and Alltel's UTStarcom PPC6700.[153] These Wi-Fi models were identified using a simple search on the operators' websites.

Finally, Wu cannot reject the hypothesis that Wi-Fi capabilities in handsets are generally limited because consumers do not demand those features. Market research indicates that there is little consumer interest in the actual technology requirement for special mobile phones.[154] Market research also indicates that the market for Wi-Fi phones is difficult to identify, or else it would be served already.[155] Given this market research, the most likely explanation for the lack of Wi-Fi functionality in wireless handsets is insufficient demand.

4. Uploading Pictures Taken from a Wireless Telephone

Wu claims that "when camera capabilities began appearing in telephones, equipment developers and carriers came into conflict."[156] He argues that "many carriers successfully forced equipment developers to make photo-sharing services the only way to get photos off of a camera-equipped phone."[157] He concludes that "it seems hard to see how consumer interests are served by making it harder for consumers to send photos to themselves."[158]

details/?q_list=true&q_phoneName=Cingular+8525&q_sku=sku310005 (last accessed Mar. 27, 2007).

150. T-Mobile Website, T-Mobile MDA, *available at* http://www.t-mobile.com/shop/phones/Detail.aspx?device=8802ddeb-1ee4-477a-9608-d9cd1e2a903f (last accessed Mar. 27, 2007).

151. Verizon Wireless Website, Verizon Wireless XV6700, *available at* http://www.verizonwireless.com/b2c/store/controller?item=phoneFirst&action=viewPhoneDetail&selectedPhoneId=2200&changingCompletedOrder= (last accessed Mar. 27, 2007).

152. Sprint Website, Sprint PCS Vision Smart Device: PPC-6700, *available at* http://www1.sprintpcs.com/explore/PhonesAccessories/PhoneDetails.jsp?navLocator=%7Cshop%7CphonesAccessories%7CpdaPhones%7C&selectSkuId=sprintppc6700&FOLDER%3C%3Efolder_id=1476427&CURRENT_USER%3C%3EATR_SCID=ECOMM&CURRENT_USER%3C%3EATR_PCode=None&CURRENT_USER%3C%3EATR_cartState=group (last accessed Mar. 27, 2007).

153. Alltel Wireless Website, UTStarcom PPC6700, *available at* http://www.alltel.com/phones/audiovox/6700.html (last accessed Mar. 27, 2007).

154. *In-Depth Analysis: Consumer Demand for Cellular/Wi-Fi Services*, Mindbranch Research Summary, Dec. 2006, *available at* http://www.mindbranch.com/Consumer-Demand-Cellular-R97-2670/ ("There is strong consumer interest in the types of billing and service plans that VoWLAN/cellular converged services could provide. However, there is little interest in the actual technology requirement for special mobile phones and a Wi-Fi connection to an existing broadband service."). *See* also, *In-Depth Analysis: Consumer Demand for Cellular/Wi-Fi Services*, In-Stat Mobile Consumer Catalog, Dec. 2006, *available at* http://www.instat.com/catalog/wcatalogue.asp?id=231.

155. *Id.*

156. Wu at 14.

157. *Id.* at 14.

158. *Id.* at 15.

In contrast to Wu's characterization, many handsets allow users to transfer photos through a memory card.[159] This method is identical to the way that photos are transferred from dedicated digital cameras.[160] Service providers such as Verizon are making it easier to transfer photos directly to Internet video sharing sites such as YouTube and Revver.[161] Wu's observation that Bluetooth transfers are unavailable can likely be explained by the fact that such transfers are more complicated than other methods.[162]

Furthermore, the availability of photo transfer capabilities is also likely to be determined by the demand for such services. As of March 2007, most handsets did not easily transfer photographs to the Internet because most wireless consumers did not demand that service. According to Forrester Research, only 28 percent of cellular subscribers use their phone to take digital photos.[163] Moreover, only 15 percent of cellular subscribers ever transfer photos from their handset to another device.[164] Most consumers prefer to use dedicated digital cameras, especially for travel.[165] While the demand may vary around the world, the

159. Terry Mason, *Smile! Phone Takes Nice Pix,* SEATTLE TIMES, Aug. 28, 2006, at E2 ("On the bottom, there's a slot for a micro SD card to store images, which can also be stored on the phone. You'll want to use that memory card to transfer the photos to your computer.").

160. Sascha Segan, *Camera Phone; We take our Best Shot at Helping You Pick the Right Camera Phone,* PC MAGAZINE, Jun. 20, 2006 ("If you intend to use your phone's camera frequently, make sure it has removable memory. That way, you can pop a mini-SD or micro-SD card into your phone, take some pictures, pull it out and drop it into a PC card reader-just as you would with a 'real' digital camera.").

161. Jessica Vascellaro, *News Picture Changes With Cellphone Video,* WALL ST. J., Jan. 3, 2007, at D4 ("Carriers also are making it easier for customers to send videos straight to Web video sites. For example, Verizon Wireless recently announced that subscribers to its $15 a month V CAST service will soon be able to upload their video clips directly to video-sharing sites YouTube and Revver Inc. from their phone. Doing so is expected to cost 25 cents a clip, unless photo and video messages are covered by their messaging plans.").

162. *Id.* ("Bluetooth file transfer, though, is overrated; it's more complicated to use than either of the other two options.").

163. James Granelli, *Picture Gets Clearer for Cellphone Camera Users; The Industry Improves Photos' Quality and Makes It Easier to Move Them to a PC or Printer,* L.A. TIMES, Dec. 28, 2006, at C1 ("About 40% of cellphone customers have cameras in their handsets, according to a survey by Forrester Research Inc. But 30% of them never use the camera and 46% say the photos they take have never left their phones."). Multiplying the percentage of subscribers *with camera phones* (40 percent) by the percentage of those users who use their camera phones (70 percent) equals 28 percent.

164. *Id.* Multiplying the percent of users *who use their camera phones* (28 percent) by the percent of those users who transfer photographs from their camera (100 – 46 = 54 percent) equals 15 percent.

165. Sarmad Ali, *Three Phone Makers Point to Advances in Camera Cellphones,* WALL ST. J., May 25, 2006 ("Camera phones are steadily improving, but my guess is that most consumers use them as backup cameras. They prefer digital cameras for big events, such as weddings and vacations.").

segment of the U.S. market that is potentially interested in such services is probably too small to justify more advanced camera capabilities.[166]

Finally, a "hedonic" valuation approach can be used to estimate a consumer's willingness to pay for advanced photography features on a wireless handset. By comparing two handsets that differ only in a single dimension (photo capabilities), one can infer the incremental price or value of that feature. Of course, the incremental price serves as a lower bound for the value of that feature for those customers who elect that option. Nevertheless, it provides a crude estimate of the value for wireless customers. Consider the Samsung D347, which is identical to the Samsung D407 in features, size, and standby time with the exception that the D407 has a camera. Without a contract, the D347 retails for $199.99, while the D407 retails for $219.99.[167] Using this example, a camera increases the value of a phone across all wireless customers by roughly 10 percent. (Of course, those customers who select that option value the photo capabilities by more than the incremental price or $20.) Wireless operators and their handset vendors cannot increase photo capabilities, and thereby increase the cost of a handset, by more than what consumers are willing to pay for those enhancements.

5. Transferring Ringtones from a Laptop to a Wireless Telephone

Wu argues that wireless customers should be able to transfer files downloaded from a laptop or a desktop to a wireless handset. Although such a transfer sounds plausible, most customers are not willing to incur the aggravation of getting two electronic devices to communicate. Wu is particularly critical of the apparent difficulties in transferring ringtones to a wireless device:

> For example, again, many carriers cripple 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."[168]

According to Wu, operators prevent such transfers to compel subscribers to download the ringtones using the operator's preferred service. But if subscribers prefer to download ringtones directly to their handsets, which makes infinite sense, then "preventing" them from involving an intermediate step does not amount to a binding constraint. Once again, Wu seemingly ignores a widespread demand by consumers to simplify life in the digital age. Even if one could save

166. One important impediment to transferring other types of content from a wireless handset relates to intellectual property rights. For example, if a network owner can demonstrate to a music label that a song can be listened to only once, then the network owners can negotiate a lower royalty rate. Wu fails to consider the role of property rights in the transfer of content from wireless devices.

167. Cingular Website, Phones and Devices, *available at* http://www.cingular.com/cell-phone-service/cell-phones/cell-phones.jsp?startFilter=false&typcat1000=cat1000&allFeatures=on&mansamsung=samsung. Confirmed with call to Eric at Cingular Customer Service on March 23, 2007.

168. Wu at 35-36.

money by involving a laptop in the ringtone purchase, it is not clear that the monetary savings could offset the added time invested, not to mention the mental anguish of getting multiple devices to communicate.

C. *The Blocking of Bandwidth-Intensive Applications such as Videos or Games Is Not Discriminatory and Therefore Is Not Anticompetitive*

According to modern antitrust law, a refusal to deal with a rival or upstream supplier is anticompetitive only if it is done (1) by a firm with monopoly power (2) on a discriminatory basis.[169] Clearly, the first condition is not satisfied here, which makes the following explanation (of why a wireless operators refusal to support a particular bandwidth-intensive application is not anticompetitive) largely academic. It is perfectly legal under the antitrust law for a firm—even a monopolist—to deny a supplier from accessing the firm's customers so long as the denial is uniformly imposed across all suppliers. When a network operator chooses to limit certain bandwidth-intensive applications, it limits such content on a non-discriminatory basis. That is, it does not permit the use of bandwidth-intensive applications from preferred content providers while blocking bandwidth-intensive applications from others. Such treatment, if it were to occur, would constitute a "discriminatory refusal to deal" under the antitrust laws.

Professor Einer Elhauge argues that duty-to-deal claims should be limited to cases in which a monopolist discriminates against rivals by refusing to deal with them on the same terms that it deals with others.[170] Discriminatory refusals to deal with rivals are considered anticompetitive because they cannot be justified by any effect on investment incentives.[171] Moreover, discriminatory refusals to deal with rivals are easier to remedy because the remedy does not require courts to set prices but only to require the defendant to charge rivals the same rates as it voluntarily charges others.

These insights of modern antitrust law could, in principle, be applied to the question of whether wireless operators would have a duty to deal with content providers (assuming counterfactually that the operators are somehow monopolists). Wireless operators generally have *not* discriminated against bandwidth-intensive content providers. In the rare exceptions,[172] the apparent

169. *Verizon Communications Inc. v. Law Offices of Curtis V. Trinko* is the most recent Supreme Court case on the duty to deal. It involved a claim against Verizon, an incumbent local exchange carrier, for failing to treat customer orders filed by a competitive local exchange carrier as well as it treated its own customers' orders. The Court held that Verizon did not have a duty to deal with its rivals because, as explained further below, Verizon did not discriminate against its rivals in favor of non-rivals but rather discriminated against everyone else in favor of itself. For a more detailed review of the implications of *Trinko* in broadband markets, see Sidak, *supra* note 2.

170. *See* Einer Elhauge, *Defining Better Monopolization Standards*, 56 STAN. L. REV. 253, 308-10 (2003).

171. *Id.* For an example of a discriminatory refusal to deal in broadband, see Hal J. Singer, *The Competitive Effects of a Cable Television Operator's Refusal To Carry DSL Advertising*, 2 J. COMPETITION L. & ECON. 301-31.

172. For example, Verizon Wireless's customers who sign up for V CAST wireless Internet service are able to access "a sampling of the most popular videos" from YouTube. *See Verizon to Offer YouTube Videos*, THE CONSUMERIST, Nov. 28, 2006,

discrimination—that is, preference for one content provider over another—appears to be a byproduct a policy designed to manage a scare resource, which we explain in greater detail below. In general, the limitations apply equally to *all* bandwidth-intensive applications. It is thus reasonable to infer that these limitations are motivated by technological considerations, most likely relating to capacity constraints on wireless networks that were originally designed to carry voice signals only.

D. Professor Wu's Claim Regarding Application Innovation Is Based on a Handful of Quotes from Anonymous Vendors Who Were Rejected by Operators

Wu offers a pessimistic assessment of the current state of wireless applications: "Application development for mobile devices is stalled, and it is in the carriers' own interest to try and improve the development environment."[173] To support this assessment, he points to a handful of anonymous quotes from applications developers who were presumably rejected by a wireless operator. Six of the quotes are reproduced below:

- 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."[174]

- "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."[175]

- 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."[176]

- 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?"[177]

- 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."[178]

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available at http://www.consumerist.com/consumer/youtube/verizon-to-offer-you-tube-videos-217818.php.

173. Wu at 3.
174. *Id.* at 9.
175. *Id.* at 13.
176. *Id.*
177. *Id.*
178. *Id.*

- In the words of another commentator: Developing any kind of mobile application is a tarpit. A tarpit of misery, pain and destruction.[179]

Such evidence may be suggestive, but it is hardly persuasive. It is almost always possible to identify one spurned vendor who believes his product was rejected by incumbent buyers for the wrong reasons—that is, unrelated to economic merit. Even under a completely merit-based procurement system without any favoritism towards preferred developers, there will be winners and losers. Thus, Wu's quotes from anonymous developers who may represent the losers should be viewed with a healthy skepticism. It would be just as easy to supply quotes from a handful of successful applications providers, which should also be viewed with skepticism.

E. So Long as the Content Is Easily Replicable, There Can Be No Harm from Exclusive Contracts

The consumer welfare effects of exclusive contracts for programming, whether it is video or audio in nature, depend on the availability of substitutes for the exclusive content. In some cases, the content can be easily replicated; in other cases, it cannot. Regulators should focus more on those cases where the content is difficult to replicate because it is in these cases where the possibility of consumer harm is most likely. Fortunately, it appears that content that is subject to exclusives in the wireless industry, such as music libraries and ringtones, is relative easy to replicate. Thus, regulators should permit the use of exclusives, as they are likely motivated by efficiency justifications.

A simple example can help to illustrate the idea. If Verizon Wireless exclusively uses V CAST for its music library, and if Cingular/AT&T exclusively uses iTunes for its music library, then, to the extent that the two libraries are overlapping, a Verizon subscriber does not need to subscribe to Cingular/AT&T to access songs for her handset. Contrast this situation with the use of exclusive contracts for content by multi-video programming distribution (MVPD) providers. If DIRECTV enters into an exclusive contract with Major League Baseball (MLB), and if Comcast enters into an exclusive with the National Basketball Association (NBA), then an MVPD subscriber who wanted to watch both professional baseball (MLB) and professional basketball (NBA) would have to subscribe to both DIRECTV and Comcast. Although such a scenario may not invoke much sympathy among economists (who subscribe to "no free lunch" ethic), it is reasonable to argue that such customers would be better off if exclusives were banned.

Such arguments have no merit in the wireless industry. Yet Wu suggests that regulators should "scrutinize" these practices:

> At a minimum, 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

179. *Id.* at 21.

> purposes, such as buying music from iTunes or downloading videos from YouTube.[180]

Wu fails to appreciate the fact that capacity limitations may prevent an operator from allowing subscribers to download bandwidth-intensive applications from multiple sources.[181] For these reasons, his call for greater regulatory scrutiny of wireless operators should be rejected.

IV. BECAUSE WIRELESS NET NEUTRALITY IS UNLIKELY TO PASS A COST-BENEFIT TEST, THERE IS NO APPARENT ECONOMIC JUSTIFICATION FOR REGULATION

We have argued that Wu has failed to satisfy the relevant economic criteria for wireless net neutrality regulation. In this section, we briefly review the specific policies that he and other proponents of wireless net neutrality advocate.

A. Should Wireless Operators Be Compelled to Allow Customers to Attach Any Safe Device to the Wireless Network?

In competitive markets like wireless services, a network operator has an incentive to make reasonable economic decisions concerning the devices that can be attach to its network. In the absence of market power and vertical integration, it is not appropriate for a regulator to second guess a wireless operator regarding decisions that affect network performance. If a device increases a consumer's willingness to pay for the service, and if the device does not unduly strain network capacity, then the operator will be inclined to allow that device to be attached to the network so long as the transaction is profitable. The only potential for conflict is a device that threatens ancillary revenues; however, the consumer welfare implications of those incentives are not likely to be significant here because VoIP providers can achieve the requisite economies of scale from wireline broadband providers. Because a VoIP phone connected to a laptop connected to a wireless card (three devices) is a poor substitute for a traditional mobile telephone (one device), any restrictions on attachments are more likely motivated by legitimate operational concerns, and should therefore be allowed.

B. Should Wireless Operators Be Compelled to Allow Customers to Use the Applications of Their Choice and View the Content of Their Choice?

Before embracing a proposal to compel wireless operators to allow customers to use any application of their choice, regulators should carefully consider how such rules would affect the operation of wireless networks. In the

180. *Id.* at 32.

181. The same arguments justify a DSL provider that offers high-definition video signals over a broadband connection—there is not sufficient capacity for the DSL provider to allow its customers to download multiple streams of HD video from multiple sources. Indeed, HD video over broadband was exempted from the net neutrality provisions in the AT&T-BellSouth merger agreement for this reason. *See* FCC Approves Merger of AT&T Inc. and Bellsouth Corporation, released Dec. 29, 2006, *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-269275A1.pdf.

absence of a market failure, a network provider is likely to make all Internet content available to customers, subject to capacity constraints, because it is in its interest to do so. Thus, we observe that non-bandwidth-intensive content is available to customers. No operator would prevent a customer from accessing a text-based website because it contained inflammatory content. By contrast, a network operator may prevent its customers from continuously accessing bandwidth-intensive applications such as webcam posts, streaming video, or VoIP for extended periods. In general, these restrictions apply equally to all bandwidth-intensive applications. In the rare exceptions in which a wireless operator allows a single bandwidth-intensive application, the restrictions are likely motivated by a concern for spectrum management. Forcing a wireless operator to accept bandwidth-intensive applications would be akin to forcing a DSL operator to accept streaming video signals in high definition from multiple sources. There is simply insufficient capacity to allow such freedom.

C. *Should Wireless Operators Be Compelled to Disclose Any Limits Placed on Devices and on Bandwidth Usage?*

Greater disclosure generally has benefits, but the costs of such disclosure can outweigh those benefits. Before considering disclosure regulation, analysts should examine whether (1) there is a demonstrated market failure and (2) the economic benefits of mandatory disclosure outweigh the costs. Wu does not identify a clear market failure. Instead, he simply asserts that: "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."[182] But in fact, there already are multiple information resources, including the Internet and consumer surveys, to help consumers make decisions in the wireless market. The availability of this information makes any disclosure mandate unnecessary.

Thus, recognizing the power of the Internet to shape opinions, wireless operators are quick to respond to anything that could undermine their images. Verizon's recent announcement to phase out the use of the term "unlimited" for its data plans is a case in point.[183] Verizon's terms and conditions of its largest data plan now clearly states that using more than 5 GB of bandwidth during the course of a month will result in service termination.[184] According to a Verizon Wireless spokesman, the 5 BG limitation is not new: "The terms and conditions remain the same. We are changing graphically how we explain it to customers and providing more information to help customers decide if this is the right plan for them."[185] The announcement is significant *because it occurred in the absence of regulation.* Although proponents of wireless net neutrality may claim that the decision was motivated by the threat of regulation, another explanation is that

182. Wu at 32.

183. Verizon clarifies limit on "unlimited" data plan, Apr. 4, 2007, *available at* http://www.uptilt.com/c.html?rtr=on&s=69l,rejj,8mg,rsv,cby1,27i2,k82z.

184. The exact language reads as follows: "Anyone using more than 5 GB per line in a given month is presumed to be using the service in a manner prohibited above, and we reserve the right to immediately terminate the service of any such person without notice." *Id.*

185. *Id.*

consumer sentiment—likely informed by web postings and surveys—pressured Verizon into voluntarily making the disclosure clearer. There is no compelling case for imposing an additional layer of regulation for mandatory disclosures, which can become inflexible in the face of continuing technological change.[186]

D. Should the Wireless Industry Work Together to Create Clear and Unified Standards for Developers?

Wu's final recommendation is that wireless operators adopt uniform standards for developers. This could take the form of regulation, but could also result from a voluntary agreement. It is not clear that the benefits of embracing a single standard outweigh the costs. Again, Wu does not offer any empirical evidence on the likely costs and benefits. Given the fact that there are five national providers, it may not be difficult to select a standard if the net benefits of doing so were large. However, there are clear costs to standardization, one of which is that it has the potential to lock in inefficient technologies. We are not persuaded based on the evidence that a uniform standard should be required.

Finally, any proposal for standardization should be cognizant of prior attempts to use standards in the industry. The most notable experience was the Wireless Application Protocol (WAP), an example that Wu himself cites in his paper:

> The carriers, however, supported a different approach, embodied in the WAP protocol. As opposed to adapting the Internet to the technical constraints of mobile phones, WAP created an entirely new set of protocols, and contemplated, in essence, the creation of an alternative, cell-phone only Web. The carriers *pressured* manufacturers to offer WAP-compatible browsers only, and then, at least initially, a 'walled garden' of WAP-compatible sites. . . . Eventually the carriers relented, demanding only that their site be the first site available on any browser. Ultimately, WAP proved a *commercial failure* and has been abandoned in the United States.[187]

Given what Wu describes as the "commercial failure" of WAP, it is not clear that standardizing around a new technology would produce better results. Moreover, once they adopt a new standard and make standard-specific investments, the operators would again have incentives to "pressure" manufacturers, which Wu apparently dislikes. By embracing an inefficient standard, wireless operators could undermine innovation at all levels of the network. If experience is any guide, standardization for the sake of standardization could decrease social welfare.

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186. For example, mandatory disclosure has proven inadequate in the credit card industry. *See* General Accounting Office, Credit Cards: Increased Complexity in Rates and Fees Heightens Need for More Effective Disclosures to Consumers GAO-06-929, Sept. 12, 2006, 2006, *available at* http://www.gao.gov/new.items/d06929.pdf (explaining that "These weaknesses may arise from issuers drafting disclosures to avoid lawsuits, and from federal regulations that highlight less relevant information and are not well suited for presenting the complex rates or terms that cards currently feature.").

187. Wu at 15 (emphasis added).

CONCLUSION

This is the first paper to rigorously analyze the concept of wireless net neutrality as defined by Professor Wu. Although it is hard to resist policies that allegedly may be associated with the phrase "net neutrality," when applied to the wireless industry, there is a strong economic basis for doing so. Our principal conclusion is that the costs of implementing proposals to promote wireless net neutrality are likely to exceed the benefits. Given the lack of market power among wireless operators, the likelihood that any particular applications provider or equipment provider could be foreclosed by the conduct of a single wireless network owner is remote.

Our analysis suggests that technological change occurs at a very rapid rate in the highly competitive market for wireless services. We believe that regulators should take particular care in regulating such markets. Regulation is typically a very crude instrument that could easily do more harm than good if, for example, it blunts the incentive for technological innovation. Given the rapid pace of innovation in the wireless industry, combined with the rapidly decreasing prices, it is hard to imagine that a regulatory elixir could actually improve on the status quo. For that reason, Wu's calls for wireless regulation should be rejected.

APPENDIX 1: EXAMPLES OF WIRELESS APPLICATION INNOVATION, 1999-2006

Application	Description	Date	Source
Wireless Application Protocol ("WAP")	Allows mobile phones to access the Internet. Shipped originally by Nokia in 1999, the "7110."	1999	Fifth CMRS Report, p.47
Bluetooth-enabled wireless headset	Allows people to answer their wireless phones from up to 30 feet away. Unveiled by Ericsson.	1999	Fifth CMRS Report, p.48
Sprint Wireless Web	Nationwide wireless web service offering connectivity up to 14.4Kbps through an Internet-ready handset.	1999	Fifth CMRS Report, p.51
Two-way text messaging	Introduced by T-Mobile in the US, Verizon and AT&T followed later in 2000.	2000	Eighth CMRS Report, ¶144
Alltel "Web-Unwired"	Wireless web services.	2000	Sixth CMRS Report, p.61
MyBiz Interactive	Cingular and RIM Blackberry service that offers messaging and e-mail services.	2000	Sixth CMRS Report, p.70
Nextel Online	Wireless Internet service offered data speeds up to 19.2 Kbps for business customers. Partnered with Microsoft for access to MSN Hotmail, Money, and Expedia.	2000	Fifth CMRS Report, p.52
Cross-carrier SMS capability	Allowed subscribers to exchange text-messages with subscribers in other services.	2001	Ninth CMRS Report, ¶157
Pocket PC 2002 PDA Operating System (Phone Edition)	Operating system for phones and PDAs that allows establishment of a secure VPN connection to corporate servers.	2001	Eighth CMRS Report, ¶167

Application	Description	Date	Source
Instant Messaging ("IM") services	Services such as AIM and MSN Messenger offered on mobile devices, enabling users to send and receive messages from a community of users, creating a chat-style atmosphere, versus the one-on-one style of SMS.	2001	Seventh CMRS Report, p.69
cdma2001 1X	First phase of 3G technology rollout – Verizon and Sprint.	2001	Sixth CMRS Report, p.49
Enterprise Solution	Arch Wireless product that allows employees to access firewall protected files, e-mail, calendar functions, and enterprise applications on a variety of devices.	2002	Seventh CMRS Report, p.75
cdma2000 1xEV	Second phase of 3G rollout – boosting network data speeds up to 2.4Mbps.	2002	Sixth CMRS Report, p.49
MobiTV	Real-time video programming service with 15 cable news, sports, and entertainment channels – powered by Idetic, Inc., which streams the programs onto the phones via the Internet. Also includes radio channels, notable Yankees games.	2003	Ninth CMRS Report, ¶154
Multimedia Messaging Services ("MMS")	Exchange of photo, video, animation, and audio files using mobile phone.	2003	Eighth CMRS Report, ¶155
AT&T mMode	AT&T data service that also incorporated MobiTV services.	2004	Tenth CMRS Report, ¶140
T-Mobile CallerTunes	Allows user to select ringtones for caller to hear, including downloadable songs.	2004	Press Release, T-Mobile, T-Mobile USA Launches CallerTunes; The Nationwide Ringback Tone Service That Lets Users "Represent Their Style," Dec. 8, 2004.
Sprint Music Store	Enables purchase and downloads of full-length songs over a wireless telephone network directly onto cell phones.	2005	Eleventh CMRS Report, ¶137

Application	Description	Date	Source
Verizon V CAST	Purchase and download full-length songs over a wireless telephone network directly onto cell phones. Access to video clips and unlimited browsing of Verizon's "Mobile Web" news and information service. Additionally, 3-D games, music videos, and other premium channels are available payment.	2005	Eleventh CMRS Report, ¶137
Cingular ROKR	Cell phone that plays songs downloaded from Apple iTunes.	2005	Eleventh CMRS Report, ¶137
Sprint Power Vision	Package that allows a cell phone user to watch TV, download songs, receive information, and access other content at broadband-like speeds.	2005	Eleventh CMRS Report, ¶138
Sprint TV	Provides specially produced short clips from major networks.	2005	Tenth CMRS Report, ¶140
Handsets with EV-DO access	3G handsets introduced by Verizon that can access the EV-DO highspeed network. Allows use of V CAST services.	2005	Tenth CMRS Report, ¶141
Sprint EV-DO	Sprint rolling out EV-DO service to at least 60 metropolitan, covering over 150M people.	2005	Press Release, Sprint, Sprint Begins Launch of EV-DO Wireless High Speed Data Service, Jul. 7, 2005.
Sprint Game Lobby	Mobile access to Yahoo multiplayer games. Allows playing of multiplayer games such as poker or chess against users on PCs or other mobile handsets.	2005	Press Release, Sprint, Yahoo! And Sprint Team to Offer Multiplayer PC-to-Mobile Games, May 16, 2006.
Axcess Web	Wireless Web service introduced by Alltel that allows quick access to the latest weather, news, and sports.	2005	Press Release, Alltel, Alltel Introduces New Web Service for Wireless Customers, Jan. 4, 2005.
Cingular Video	Watch video clips of television shows, sports, news, weather, and other content on advanced handsets.	2006	Eleventh CMRS Report, ¶138

Application	Description	Date	Source
ESPN Mobile	Sports news and information services running on an EV-DO network with capacity leased from Sprint.	2006	Eleventh CMRS Report, ¶138
Helio	Service to bring advanced cellphone technology to the US, bringing games, video clips, and other forms of entertainment.	2006	Eleventh CMRS Report, ¶138
YouTube services	Select video content from YouTube will be allowable on Verizon handsets.	2006	Mark Rockwell, Verizon Goes YouTubing, WirelessWeek, Nov. 28, 2006.
GPS tracking technology	Wireless providers introduced GPS tracking services for mobile handsets. Mologogo is one such application developed that works on Nextel handsets.	2006	Daniel Charles, GPS is Smartening Up Your Cell Phone, NPR – Technology, Sep. 25, 2006.
Smarter Agent	Service that utilizes GPS and mobile handsets to assist in real estate sales by showing houses for sale on a users handset.	2006	Daniel Charles, GPS is Smartening Up Your Cell Phone, NPR – Technology, Sep. 25, 2006.
Sprint EV-DO Update	By year end 2006, Sprint EV-DO network covered more than 188M people and 8,700 cities. Average download speeds increased to 450-800 Kbps.	2006	Press Release, Sprint, Sprint Sets Sights on 2007 After Continuing to "Power Up" Networks in 2006, Dec. 20, 2006.
Gmail Mobile	Gmail, the popular e-mail service offered by Google, will be available on Sprint handsets.	2006	Press Release, Sprint, Sprint and Google Team to Offer New Gmail Mobile Application, Nov. 2, 2006.
Sprint Power View	First made-for-mobile sports and entertainment video programming network for mobile devices.	2006	Press Release, Sprint, Sprint Power View Launches Today: Free, First-of-its-Kind, Made-for-Mobile Sports/Entertainment Programming Network, Sep. 12, 2006.
Sprint Movies	First "pay-per-view" service that streams full length movies onto mobile handsets.	2006	Press Release, Sprint, Sprint is First to Offer Full-Length "Pay-Per-View" Movies on Mobile Phones in the US, Sep. 9, 2006.
BiM Interactive	Fitness application that uses GPS-enabled Sprint phones for feedback for runners, walkers, and cyclists involving	2006	Press Release, Sprint, Sprint and Bones in Motion Launch Mobile Fitness Application, Feb. 2, 2006.

Application	Description	Date	Source
	performance summaries, maps, and more.		
Cingular 3G Coverage	Cingular 3G Mobile Broadband network now services over 160 markets, including most of the top 100 major cities in the US.	2006	Press Release, Cingular, Cingular 3G Coverage in More than 160 Markets, Dec. 20, 2006.
TeleNav GPS Navigator	Allows GPS navigation with a "birds-eye view" moving map. PDA-based and first offered by Cingular.	2006	Press Release, Cingular, Cingular Unveils PDA-Based Wireless GPS Navigation System with 3D Moving Maps, Nov. 20, 2006.
Pocket Express	Application that delivers news, sports, weather, stock quotes, street maps, directions, and more for smart phones.	2006	Press Release, Alltel, Alltell Wireless Offers Handmark Pocket Express on Smart Phones, Oct. 16, 2006.
Mobile XM Radio	XM Radio available through Alltel handsets. Application developed by MobiTV.	2006	Press Release, Alltel, Alltel Wireless First US Carrier to Launch XM Satellite Radio, Aug. 10, 2006.
Fleet Tracking GPS Technology	Business customers will be able to track their vehicles and other equipment using GPS technology and Alltel handsets.	2006	Press Release, Alltel, Alltel Offers Wireless GPS Vehicle Tracking for Business Customers, Feb. 20, 2006.
V CAST Mobile TV	First "true" mobile TV service, with streaming content.	2007	Press Release, Verizon Wireless, Verizon Revolutionizes TV at Home and On Mobile Phones, Jan. 7, 2007.
Sprint iX-3	GPS-technology that allows real-time tracking of school busses.	2007	Press Release, Sprint, Sprint Certifies New GPS-Based School Bus Tracking Technology, Jan. 11, 2007.
Mobile TiVo program scheduling	Verizon Wireless now offers service where the TiVO DVR box can be programmed from a mobile handset.	2007	Verizon Wireless, TiVo Connect for Mobile Program Scheduling, CTIA SmartBrief, Mar. 16, 2007.
AskMeNow	Intelligent mobile search, with the ability to ask questions and quickly receive answers via mobile handset. Alltel is first US carrier to introduce this service.	2007	Press Release, Alltel, Alltel Wireless First US Carrier to Offer AskMeNow Across All Handsets, Mar. 1, 2007.