

An Antitrust Analysis of the Case for Wireless Network Neutrality

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ABSTRACT

The ongoing debate about possible implementation of regulatory rules requiring “network neutrality” for wireless telecommunications services is inherently about whether to impose a prohibition on the ability of network operators to control their vertical relationships. Antitrust analysis is well suited to analyze whether a wireless network neutrality rule is socially beneficial. Implementing network neutrality rules would be akin to using a *per se* antitrust rule regarding vertical relationships instead of the rule of reason analysis typically applied to vertical relationships in antitrust. *Per se* rules are used to prevent actions that rarely, if ever, have any pro-competitive benefits, such as price-fixing agreements. Rule of reason analysis is used when there are potential efficiency gains from the actions under investigation.

Some vertical practices of the wireless carriers, such as bandwidth restrictions, may appear to be anticompetitive, but may also have plausible efficiency justifications so should be judged under rule of reason analysis. Economic examination of the wireless industry shows significant competition between networks which reduces the concern about vertical relationships, but some areas that should be monitored by antitrust and regulatory authorities. We propose several regulatory changes that would likely increase wireless competition and lessen the perceived need for prophylactic network neutrality rules while at the same time allowing efficiency-enhancing vertical relationships.

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I. Introduction

Antitrust and regulation are closely linked because ideally both are invoked to correct market failures and to enhance social welfare. Currently there is a debate about possible implementation of a regulatory rule requiring “network neutrality” for wireless telecommunications services. Inherently, the network neutrality debate is about whether to impose a prohibition on the ability of network operators to control their vertical relationships.¹ Implementing network neutrality rules would be akin to using a *per se* antitrust rule regarding vertical relationships instead of the rule of reason analysis typically applied to vertical relationships in antitrust. *Per se* rules are used to prevent actions that rarely, if ever, have any pro-competitive benefits, such as price-fixing agreements. Rule of reason analysis is used when there are potential efficiency gains from the actions under investigation.

In this article, we argue that antitrust analysis is well suited to analyze whether a wireless network neutrality rule is socially beneficial. Then we apply such an analysis to the wireless industry to examine the costs and benefits from a network neutrality rule. Finally, we propose several alternative mechanisms for the regulator to pursue prior to instituting prophylactic network neutrality regulations. Our suggested mechanisms are all designed to increase competition at the network level because a lack of market power at the network operator level should reduce the risk of harm from vertical restrictions. Procompetitive actions to reduce market power are more likely to result in the goal of increased social welfare than restrictions that might prevent efficiency-enhancing vertical relationships.

In its 1968 *Carterfone* decision the Federal Communications Commission (“FCC” or “Commission”) required the Bell System to allow customers to attach telephone devices from independent, unaffiliated manufacturers to the Bell System network.² Some recent academic articles, regulatory efforts and public press have suggested that wireless network providers also be subject to *Carterfone*-type regulation.³ Similar to network neutrality proposals for wireline high-speed Internet access,⁴ “wireless *Carterfone*” or “wireless network neutrality” policies would subject wireless providers to regulation regarding restrictions the wireless providers could

¹ See Shelanski (2007) and Nuechterlein (2009).

² *Use of the Carterfone Device in Message Toll Telephone Service*, 13 FCC 2d 420 (1968). The *Carterfone* decision built on the earlier *Hush-A-Phone* decision (*Hush-a-Phone v. United States*, 238 F. 2d 266, 1956).

³ Wu (2007), Skype (2007), Scott (2007), Mossberg (2007), Frieden (2008).

⁴ See Lessig (2002) and Lessig (2004) for discussions of wireline network neutrality.

impose on equipment suppliers, application providers, and end-consumers. Advocates of wireless Carterfone regulation claim that preventing discrimination by wireless network providers will give entrepreneurial firms greater ability to access wireless networks and ensure a market for their products without fear of expropriation by the network providers.

For example, Wu (2007) called for applying Carterfone rules to wireless networks and subjecting wireless providers to the “core network neutrality principles under which the cable and DSL industries currently operate.” Relying on the Wu article, Skype (2007) proposed that the FCC “enforce Carterfone” in the wireless industry by prohibiting certain contractual arrangements and requiring open access to devices, content and applications. The FCC (2007) required “open access” on the Upper 700 MHz C Block in the 700 MHz spectrum auction that closed in March, 2008.⁵ These proposals for wireless network neutrality, openness and non-discrimination are in part motivated by various practices used by wireless providers, including disabling phone features, limiting data bandwidth, device certification requirements, and application developer restrictions.

Critics of wireless Carterfone regulation claim that (1) these network provider practices benefit wireless consumers, (2) the competitiveness of the current wireless market in the U.S. does not justify Carterfone regulation, (3) network neutrality requirements placed on wireless providers are likely to stymie beneficial and efficient vertical integration and endanger legitimate and important network management practices, and (4) wireless Carterfone regulation would make it harder for firms to coordinate to innovate, reduce incentives for innovation, and in the process raise service provision costs and harm consumers.⁶

Policy makers should be concerned not only with whether wireless network providers restrict third-party firms from providing equipment and applications that they would like to offer in conjunction with a wireless network, but also, importantly, with whether such restrictions harm consumers. Unfortunately, many analyses of the situation have focused simply on whether

⁵ Licenses must “allow customers, device manufacturers, third-party application developers, and others to use or develop the devices and applications of their choosing in C Block networks, so long as they meet all applicable regulatory requirements and comply with reasonable conditions related to management of the wireless network (i.e., do not cause harm to the network.)” and licensees “may not block, degrade, or interfere with the ability of end users to download and utilize applications of their choosing on the licensee’s C Block network, subject to reasonable network management.” *700 MHz Second Report and Order*, 22 FCC Rcd at 15360.

⁶ See, for example, CTIA (2007), Hahn, Litan and Singer (2007), Hazlett (2007), Mayo (2008), Schwartz and Mini (2007), and Wallsten (2007). See Woroch (2004) and Owen and Rosston (2006) for a discussion of investment incentives.

there are restrictions and only tangentially on whether those restrictions harm consumers. Additionally, policy makers should consider whether wireless network neutrality regulation imposes its own inefficiencies; these regulatory costs need to be evaluated against potential benefits.

Our economic framework discusses the circumstances under which network operators have the incentives and ability to inefficiently restrict third-party providers of equipment and applications from providing services. Then we examine the current wireless marketplace to see how it fits in this framework.

Wireless is not a textbook perfectly competitive market – deploying a network involves substantial fixed costs. Thus, average prices must be greater than marginal cost to cover the fixed costs. Where that markup is achieved and how that would change with the imposition of new wireless network neutrality regulations is an important part of the overall analysis.

In response to the competitive concerns and issues with possible unintended inefficiencies due to regulation, we propose an antitrust approach that recognizes the potential efficiencies of current carrier practices, and suggest that the FCC introduce new regulation only after a careful evaluation of the wireless market shows that particular carrier practices are on balance anticompetitive and that consumers are better served by prophylactic regulation. In general, FCC policies that foster competition among wireless providers, such as making more wireless spectrum available to spectrum-constrained firms and giving firms considerable freedom in deploying their spectrum, reduce incentives for anticompetitive foreclosure and thus the need for Carterfone-style regulatory intervention.

The article proceeds as follows: Section II provides a review of the economic theory of vertical restraints to provide a basis for evaluating wireless network neutrality proposals. In that context, we review the original Carterfone economic rationale for regulating interconnection of customer premises equipment to the Bell System network. Section III examines the competitiveness of the current wireless sector in the U.S.; Section IV assesses the case for Carterfone style regulation of wireless providers; Section V discusses the recent FCC C block openness decision and the implications of that decision; and Section VI discusses policy options for the FCC in addressing the concerns raised by advocates and critics of wireless network neutrality.

II. Vertical Restraints

The policies challenged by Skype and other wireless network neutrality proponents can be viewed as “vertical restraints” placed by wireless network providers on independent upstream suppliers.⁷ Vertical relationships between network operators and upstream suppliers—equipment manufacturers and applications providers—are already an important part of the wireless industry and they are likely to increase as wireless consumers buy and use more wireless data devices and services.⁸ It is likely that no wireless provider will ever provide all the equipment, content and applications that its consumers want, so if these customer wants are to be satisfied, wireless providers and independent upstream providers will have to interact in some fashion to provide equipment and services. The relationship between upstream suppliers and wireless network providers raises the potential competitive concern that a network provider with market power might favor its own equipment, applications, or content (or those of an affiliate) over that of an unrelated competitor, leading to an important public policy question – when should a wireless network provider be regulated regarding the terms and conditions of access to its network?

At the heart of the policy debate over wireless Carterfone regulation is an economics question – do wireless providers have the incentive and ability to profitably favor their own affiliates and discriminate against competing upstream providers, harming competition and ultimately consumers?⁹ This economics question highlights the questions and concerns that policy makers should have in thinking about applying Carterfone style regulations to the wireless world. Moreover, regulation is not costless; blanket rules can stifle efficient vertical arrangements, and reduce the incentives both for incumbents and new entrants to develop innovative new wireless service packages. Thus, there is another hurdle to consider in wireless network neutrality regulation – is regulation better suited to determine the appropriate degree of vertical integration than competitive rivalry among wireless providers? And these questions are

⁷ For the purposes of this article, we treat wireless network providers as “downstream” firms and application, equipment and content providers as “upstream” firms.

⁸ One can also think of equipment manufacturers (eg. Apple) as upstream of network providers (eg. AT&T), and applications developers as upstream of both Apple and AT&T.

⁹ For purposes of this paper, we consider discrimination to be artificially treating content or applications of unaffiliated providers in a way that increases the cost or decreases the attractiveness of the product.

not limited to wireless. The FCC is wrestling with similar issues in its decisions about acceptable practices by operators of wired broadband networks.

A. Carterfone and the Part 68 Rules

At the time of the *Carterfone* decision, Western Electric, a Bell System entity, was the exclusive manufacturer of telephones and customer premises equipment for the Bell System telephone network.¹⁰ The Commission's decision allowed customers to purchase telephones and other equipment, such as answering machines from independent, unaffiliated manufacturers and to connect these to the Bell System network. The equipment provided by unaffiliated manufacturers needed to meet detailed technical standards, but any equipment that met those standards could be attached to the Bell System network via a standardized interface without restriction or additional charges.¹¹ These FCC regulations on network attachments are known as Part 68 rules.¹²

B. Economic Rationale for the Carterfone Decision

It is well understood in the economics literature that the tactics of a regulated firm with market power can differ from those of an unregulated firm with market power, even though both have the same overall goal of maximizing profits. A firm facing binding price regulation of its core monopoly product has incentives to circumvent price regulation by discriminating against unaffiliated firms in adjacent markets and charging supra-competitive prices on its own products.

These discrimination incentives arise if regulation prevents the regulated firm from fully exploiting its market power in the core regulated market. One way to do this, as discussed by Brennan (1987), is for the regulated firm to engage in "cost-shifting" and increase its overall profits by producing both regulated and unregulated products. The firm, because of information asymmetries, can shift some of the costs from its unregulated products into the regulated "rate base" and increase the overall allowed profits of the firm even while profit regulation remains "binding." Noll and Owen (1994) discuss other theories about the differences between regulated

¹⁰ "No equipment, apparatus, circuit or device not furnished by the telephone company shall be attached to or connected with the facilities furnished by the telephone company, physically, by induction or otherwise." AT&T Tariff 132 (as cited in Oxman (1999))

¹¹ Development of the Carterfone principle is described in more detail in Robinson (1988).

¹² Part 68 of the FCC Rules, (47 C.F.R. Part 68).

and unregulated firms in the context of regulation of the integrated Bell System and the U.S. v. AT&T case. Other ways for the regulated firm to increase profits include mis-estimation of common costs (Burton, Kaserman and Mayo, 2009) and sabotage (Beard, Kaserman and Mayo, 2001).

Carterfone was applied to the vertically integrated Bell System at a time when it faced price regulation of its core monopoly telephone service, when equipment used in the Bell System was provided by its Western Electric affiliate, and when independent equipment manufacturers had very limited alternative outlets for selling telephones and other customer premises equipment. Thus, Carterfone was applied at a time when the Bell System had both the incentive and the ability to restrict consumer use of third-party equipment as a way to shift sales in adjacent customer premises equipment markets to its Western Electric affiliate. In this context, there was a strong economic rationale for neutrality regulation.

C. Vertical Relationships in the Absence of Binding Regulation

In the case of an unregulated firm, or one where profit regulation is non-existent or not binding, the tactics to maximize profits are different. In particular, without such regulation the firm faces no such incentives to shift profits from the regulated side of its business to the less regulated portion of its business.

Under the classic Chicago School “one monopoly rent” theory, a firm with market power at one stage of the production and distribution process can extract all of the monopoly rent without integrating or contracting with other levels of the production or distribution process.¹³ However, the “post-Chicago” economics literature shows that under certain conditions a firm with monopoly power in one market can potentially use such power to increase profits by influencing competition in related lines of commerce.¹⁴

The economic literature on vertical relationships has gone through a significant transformation, from broad agreement that vertical integration was bad to the Chicago School view that close vertical relationships are usually motivated by procompetitive efficiency reasons, to the current nuanced “post-Chicago” view that under certain conditions there can be

¹³ The Chicago school view is that vertical restraints can only be anticompetitive if they somehow lead to a reduction in competition in the upstream market. For example, there could be a competitive problem if wireless carrier handset restrictions reduced competition in the handset industry.

¹⁴ See, for example, Farrell and Weiser (2003).

competitive concerns with vertical relationships. Economic thinking informs current antitrust doctrine, which generally presumes that vertical relations are not anticompetitive, unless a fact intensive investigation shows otherwise.

In antitrust, “naked price fixing” is *per se* illegal since, almost by definition, it rarely has any efficiency-enhancing justification.¹⁵ In contrast, most vertical relationships are treated under the “rule of reason” standard because there can be procompetitive efficiency justifications for practices even if they also have anticompetitive effects.

A large economics literature details efficiency rationales for vertical restrictions on suppliers or distributors. The efficiency rationales usually involve an attempt to align incentives of upstream and downstream firms. For example, firms may want to ensure that downstream distributors do not exercise market power and mark up prices too much (avoiding double marginalization), provide sufficient customer support and product promotion (solving free rider problems), and maintain quality (avoiding misplaced blame for product problems).¹⁶ Similarly, firms may want to ensure that upstream suppliers conduct the optimal amount of investment (avoid the hold-up problem), produce compatible, complementary products, and maintain quality (avoiding misplaced blame for product problems). In these cases, vertical restrictions can align the incentives of the monopoly provider and upstream and downstream players in a way that can increase economic efficiency and lead to the development of new and/or improved products and services.

In telecommunications and media, network providers want to enhance the demand for their services, in part by promoting complementary services, such as with the early cable content investments discussed below. A network provider cannot extract rents from services that do not exist. Thus, there may be a number of efficiency rationales for a telecommunications network provider to implement vertical restrictions. There may also be an incentive to exclude or raise the costs of those that offer content that competes with its own, especially if the content produces negative external effects on the overall consumer demand.¹⁷

In a competitive network market, network providers have an added incentive to incorporate third-party content or applications into their service offerings. Network providers

¹⁵ Naked price fixing is an agreement to fix prices without any offsetting benefits such as integrating production or distribution.

¹⁶ For a summary, see Rey and Tirole (2007).

¹⁷ For a discussion of incentives for a “platform monopolist” to exclude upstream suppliers see Farrell and Weiser (2003).

profit by offering attractive packages to consumers. A network provider that restricts access to desirable third-party content will lose business to rivals that are open to that content. Thus, one dimension of the competitive rivalry between network providers is how open they make their networks to third-party content and applications.

For example, early cable system operators invested in cable programming channels to ensure availability of programming. Waterman and Weiss (1997) discuss how cable system operators had an incentive to expand their systems if they also had additional programming, but programmers would be reluctant to invest in programming without an assured outlet for their product. By investing directly in the early cable programming channels, cable system operators were able to break the logjam created by this “chicken and egg” problem and at the same time alleviate the bilateral monopoly bargaining problem that could have ensued once each of the parties had made major sunk investments (in programming or in cable infrastructure).

In theory, vertical relationships when there is market power at some level could hurt consumers, help consumers, or both help them in some ways and hurt them in others. The outcome will depend on market structure and the competitive and regulatory environment. In almost all models that predict adverse competitive effects from vertical relationships, the adverse effects arise because of market power at one level of the vertical chain. However, vertical relationships often raise no competitive issues even if a firm has market power. In other cases, adverse effects may be less costly to consumers than inefficiencies that might arise from regulatory intervention. The regulatory and antitrust authorities should only intervene when it is determined after a detailed factual investigation that: 1) a firm with market power takes actions that harms not just competing firms, but the competitive process and consumer welfare; and 2) that the regulatory intervention promotes, rather than hinders consumer welfare.

There have been situations where vertical restraints imposed by telecommunications network providers harm consumers and regulatory intervention ameliorates the problem without consumer harm. One recent regulatory investigation found that a telecommunications network provider had the ability and incentive to harm competition in vertically-related markets. In the 2005 *Madison River* case, Madison River, an incumbent local wireline telephone provider had been blocking ports that would have allowed its high-speed DSL customers to use Vonage, a voice-over-Internet-Protocol (“VoIP”) provider. Vonage’s service competes directly with the voice telephone service provided by Madison River. Without access to the blocked ports,

Madison River's DSL customers would not be able to access a competing wireline voice service unless they could and did switch to cable high-speed service. Ultimately, the FCC entered into a consent decree with Madison River, a rural local exchange carrier, in which Madison River agreed that it would not block ports used for VoIP applications.¹⁸ In this case, the FCC moved relatively quickly, which is important when relying on ex post enforcement.

There are also situations where vertical restraints imposed by telecommunications network providers may restrict consumer choice, but the impact of the restriction or regulatory intervention on overall consumer welfare is unclear. AT&T has not allowed the Skype application for the iPhone to work on its 3G data network. AT&T does not impose the same restrictions on most other third-party applications. One explanation for the Skype restriction may be that AT&T does not want users to substitute Skype minutes for voice minutes. Alternative explanations could be that the quality of the Skype experience would be degraded and users might view that as a network problem creating a bad reputation and increased costs for AT&T or that Skype uses a disproportionate amount of bandwidth and AT&T is not set to charge for the bandwidth usage. Under antitrust principles, there is no general duty to deal with rivals. However, in networked industries working with rivals may be critical to a competitor's success, even for a more efficient and innovative competitor, so blanket immunity from a duty to deal may not be the best competition policy.

The recent relationship between Yahoo! and AT&T also provides an example of the concerns expressed about and potential efficiencies from vertical relationships. Yahoo! and AT&T have had an agreement jointly to provide service for AT&T's DSL customers. This vertical relationship advantaged Yahoo! relative to other information portals such as AOL, MSN, and Google.¹⁹ But it does not appear to have harmed consumers. Bundled AT&T/Yahoo! service does not prevent subscribers from using any other Internet services, including Yahoo!'s most direct competitors. In principle, AT&T could make it more difficult for users to turn to rival sources of aggregated content and premium service, but we are not aware of any allegations of such behavior. In these circumstances, a policy that prevents a relationship between AT&T

¹⁸ FCC, *Consent Decree*, In the Matter of Madison River Communications, LLC and affiliated companies, File No. EB-05-IH-0110, March 3, 2005.

¹⁹ In a similar vein, Microsoft is the default search engine for Verizon Wireless, but users can still access Google and Yahoo! search engines on their phones.

and Yahoo! could deny consumers a more attractive product or lower cost. And AT&T, because it competes with other high-speed Internet providers has a strong incentive to provide an attractive package of content to consumers. Rivals to Yahoo! may protest the vertical relationship Yahoo! has with AT&T. But their protests need not stem from fear of discriminatory treatment by AT&T; they may fear a more effective competitor in Yahoo!

In a network market with considerable competition between network operators there is little competitive concern about preferred supplier relationships. Competing providers have a strong incentive to provide the most attractive package to their end consumers, and will enter into agreements with content providers for obtaining the content that gives them a competitive advantage. For example, consider the audio systems installed in all new cars as the default option. Car manufacturers (like network operators) have entered into agreements with various audio system providers to provide audio system options. The competition among car manufacturers for sales to end consumers causes manufacturers to provide the most attractive package of options, including audio systems. And the various suppliers of audio systems, such as Pioneer and Alpine, compete with each other to be primary providers for different manufacturers. In such a market there is little competitive concern about vertical restrictions and exclusive relationships.

In a recent article, van Schewick (2007) argues that certain environments will make it more likely that network operators discriminate against upstream providers. Her analysis reinforces the idea that such possibilities depend on the economic circumstances. Upstream, complementary markets that exhibit increasing returns to scale, network effects, externalities to the network provider, or products that can be easily banned from a network, make it more likely that a network provider will find it profitable to discriminate. There is a tradeoff between the possible welfare loss from restricting complementary service and the benefits that network providers and their consumers receive when complementary products enhance and improve the customer's experience of the network.²⁰ The magnitudes of these costs and benefits are industry and company specific. Importantly, the van Schewick article: 1) is based on a model in which specific circumstances will overwhelmingly dictate the efficient result; 2) simply assumes that if discrimination could occur, it is bad for competitors, but does not evaluate the resulting impact

²⁰ Farrell and Weiser (2003) discuss these conditions and term it ICE (internalizing complementary externalities). The extent to which the network provider can internalize these complementary externalities will affect the incentive to restrict inefficiently.

on consumer welfare; and 3) does not assess the costs of preventing potentially efficient integration. A consumer welfare analysis must look at both the costs and benefits of potential rules – whereas the van Schewick analysis focuses only on the gross potential benefits from instituting a non-discrimination rule.

D. Procompetitive Reasons for Wireless Carriers to Restrict Access

As discussed above, wireless providers might restrict access to their networks for a number of reasons. For example, wireless providers have to manage their networks to serve a large number of heterogeneous customers, which can mean denying some groups certain features and rights to increase the experience for other groups. For example, bandwidth intensive users downloading video may reduce the quality of service for other users who are making voice calls.

A wireless provider wants to maximize profits from its network and from services riding on top of its network, in competition with other wireless (and wireline) networks and their associated services. The wireless provider has an incentive to maximize profit over the entire set of possible groups of consumers. At the same time, technology entrepreneurs might develop a product or service targeted at a subset of the entire population, such as in the video example above. The incentives of the technology entrepreneur may differ from those of the network operator and servicing the technology entrepreneur's niche group of consumers may cause disruption to the service available to the provider's other customers.²¹

Consider a simple, stylized model of a network provider and an upstream provider whose application rides on top of the network. For simplicity, assume a monopolistic network provider. This provider sells access to its wireless network to q_1 customers at a price of p_1 . Quantity demanded is a downward sloping function of price such that $q_1 = q_1(p_1)$ and $q_1'(p_1) < 0$. Each additional customer on the network imposes a cost of $c_1 > 0$ on the provider.²²

A second good, an application, can be sold on the network. Assume for simplicity that demand for this second good is completely independent of demand for the wireless network and that there are no vertical efficiencies.²³ The application has a downward sloping demand $q_2 = q_2(p_2)$ where $q_2'(p_2) < 0$. Like most software, the marginal production cost for this

²¹ We want to be clear that this is simply an example that shows that there can be procompetitive vertical restrictions and justifications for service restrictions. Similar justifications may not always hold.

²² Note that with congestion costs, $c_1' > 0$ also and the results from this section would be stronger.

²³ At the end of this section, we discuss some implications of relaxing this assumption.

application is close to zero. However, because this application utilizes the wireless network's resources, each customer who uses this application imposes a cost, $c_2 \geq 0$, on the wireless provider.²⁴

If the network provider supplies both the network and the application, the provider will maximize its profit function: $\max_{p_1, p_2} \pi^N = q_1(p_1)p_1 - c_1q_1(p_1) + q_2(p_2)p_2 - c_2q_2(p_2)$. Because demand for the two goods are independent, the first order condition for the application good is:

$$p_2^N = c_2 - \frac{q_2}{q_2'}$$

If an outside entrepreneur supplies only the application, because he does not internalize the cost of the application imposed on the network, the entrepreneur will maximize the following profit function: $\pi^E = \max_{p_2} q_2(p_2)p_2$ with the corresponding first order condition: $p_2^E = -\frac{q_2}{q_2'}$.

Since c_2 is positive and q_2' is negative, $p_2^N > p_2^E$. Since demand is downward sloping, $q_2^N < q_2^E$ where q_2^E is the application quantity sold by the entrepreneur.

The assumption of independent demands makes the result simpler and stronger. If the demand for the application increases demand for the network, then the price differential would be less. For example, voice telephone service rides on top of the wireless network. The network provider in all cases provides the voice application because of the beneficial effects it gets for network demand.

Because the incentives of wireless network providers can differ from a technology entrepreneur developing a niche service, it may be procompetitive for the network operator to restrict the ability for the entrepreneur to serve some subset of customers. Of course, such restrictions could also be motivated by anticompetitive incentives.

One critical aspect of this model is the inability or unwillingness of the network provider to charge exactly the cost that usage imposes on the network. If a wireless network provider were able to charge differentially for all usage, then incentives would be aligned. However, there are a number of reasons why networks may be unwilling or unable to charge consumers for every cost-causing use of the network. For example, with uncertainty, consumers may

²⁴ The cost from congestion can be thought of as poorer network quality for the other subscribers, but that could be mitigated by additional capital investment by the network operator.

sufficiently value “unlimited” or high usage plans such that marginal charges may not be optimal for a profit maximizing network provider.²⁵ As a result, a provider may not price network usage at its cost for specific times and locations where costs are high. While wireless networks offer lower priced voice packages on nights and weekends, they do not charge higher prices for data usage at their most congested cell sites as such plans could be very complicated for consumers. Instead of pricing usage on a real-time, location-specific basis, one way to deal with the congestion issue is to prevent (or charge a premium for) the most likely causes of congestion – services that demand high bandwidth in a short period of time.

This simple model provides a framework for understanding much of the debate about “network management.” Wireless network providers claim they need to be able to impose restrictions on usage for “reasonable network management” but “reasonable network management” has no clear definition. There are circumstances in which a network provider could restrict certain uses to enhance the overall value of the network to its customers and other circumstances in which the network provider could restrict certain uses in a way that harms consumers.

1. Example: High Bandwidth Use Restrictions

Some wireless providers have imposed usage restrictions on high bandwidth users of wireless data cards (Verizon, Sprint and AT&T offer 5GB per month plans with charges for usage beyond that amount; T-Mobile offers an unlimited data plan).²⁶ One explanation for the cap is that the wireless providers do not want some users to consume disproportionate amounts of bandwidth and want all users to receive good quality of service.

Wireless providers have a scarce resource – network bandwidth – that they need to manage to ensure that they can provide services for which their consumers wish to pay. As such, they have acquired licenses to spectrum (although licenses may not be absolutely necessary to provide wireless service) and invested in cell sites, backhaul, switching, and interconnection facilities. And they have millions of customers on their networks. Capacity of a wireless network is essentially a function of the amount of bandwidth, the amount invested in cell sites

²⁵ There is a lengthy literature on consumers choosing plans for telephone and electricity suitable for much higher usage than they end up using. *See* Grubb (2008).

²⁶ Carrier websites, accessed March 29, 2009. Wireless carriers do not at this time appear to have limits on data usage for non-tethered handheld devices.

(both the number of sites and the number of radios, smart antennas, and other equipment at each site) and the backhaul capacity of the network. To manage network capacity, wireless providers decide how much to invest and how much to charge customers for their usage. Also, of particular import to this policy discussion, they decide which devices and applications can run on their networks.

Because at any point in time, there is a limited amount of spectrum and the wireless network configuration has a fixed number of cell sites (and sectors), there is a bandwidth limit in each (small) geographic area that has to be shared among users in the same cell sector. If one user is downloading video, she may be using a disproportionate share of the available bandwidth, which in turn can affect the experience for other users.

Thus, there is a need for the wireless provider to manage this scarce resource. As discussed above, the current responses by wireless providers to impose monthly download limits do not seem to address optimally the scarcity problem because scarcity occurs at specific cell sites at specific times. One way for a network provider to manage its spectrum is to limit bandwidth intensive uses. Another network management tool would be if the provider were able to determine which types of applications were delay-tolerant, and then allocate bandwidth among delay-tolerant and delay-intolerant uses so as to increase network quality for its customers.

This network capacity allocation problem is an example of the more general economic issue of managing scarce common resources. For example, restaurants serve dinner to multiple customers who all enjoy the same ambience and service staff. One noisy or especially demanding diner affects how much other patrons enjoy their meals. Society relies on market forces (competition among restaurants) to give restaurant owners appropriate incentives to deal efficiently with such patrons, but owner's decisions may not mean that all customers get the same service even in the same restaurant when they order exactly the same meals. In a competitive business like restaurants, management of the common resource will differ based on the demands of customers, costs, and other factors and restaurants offer different "business models" to attract different types of patrons.

Like restaurants, wireless networks must satisfy widely varying demands for service. Some people use their connections sparingly, while others consume large amounts of bandwidth. On the wireline side, initial proposals for network neutrality and openness did not differentiate among different types of users. This type of network management regulation could harm

consumers even if there were only a single, monopoly, broadband network. More recent proposals recognize the need to allow network owners to charge for bandwidth or usage in some circumstances. For wireless users, there is already a well-accepted set of monthly charges for certain “buckets” of voice usage and additional charges for minutes of use above the buckets.

Differential pricing can be an important tool for allocating the scarce capacity needed to provide higher-value services. All packets do not have equal value. Voice service places a premium on instantaneous communications. But delay is acceptable for some data services and not for others. For example, e-mail is generally somewhat delay-tolerant, but delay on a VoIP service makes the service much less usable.

Given capacity constraints in the network, the lack of prioritization could cause the VoIP quality to be suboptimal, even though delay in delivering e-mails to or from the iPhone would be completely inconsequential because such transmissions are easily buffered. Requiring a network operator to treat all bits equally would needlessly harm certain high-value services, reducing consumer welfare.

Network management issues are not unique to wireless. Many industries have customers that make intensive use of resources, and those users typically pay for that usage. Wireless should be no different – those who cause the costs should be charged for their usage if that is not too burdensome. The degree of competition among network providers is irrelevant to the argument that users who impose costs on others should pay for those externalities. When there are competitive networks, rivalry among providers includes differing approaches to network management.

While there may be anticompetitive incentives for network operators in their network management, it is well-accepted in antitrust that competition at the network level reduces the ability of network operators to impose anticompetitive restrictions. The next section looks at the nature of competition in the wireless industry to assess the ability of wireless providers to impose inefficient restrictions that harm consumers.

III. Competition in the U.S. Wireless Industry

An antitrust evaluation of the need for Carterfone style regulation of wireless providers depends on the current and future state of competition in the wireless industry and in upstream

markets for equipment and applications. In an environment of vigorous competition, there is little incentive for competing wireless providers to impose restrictions on upstream equipment and application suppliers unless those restrictions are efficiency enhancing. If on the other hand, a wireless firm has substantial market power, then it might be able to use that power to exclude or extract rents from upstream providers and harm consumers through a variety of vertical restraints. Whether a firm with such market power would take advantage of its power would also depend on the nature of demand of its subscribers.²⁷

We start by examining the downstream market, the market where wireless providers compete to offer wireless service to consumers.²⁸ We do not undertake an examination of the relevant antitrust market, but instead rely on the Department of Justice and FCC findings in several merger cases and use wireless network operation as the relevant market for analytical purposes. The wireless marketplace is not perfectly competitive – the cost to set up a wireless telephone network is substantial, and there are a limited number of licenses for spectrum suitable to provide high-quality mobile wireless service in an economical manner. At the same time, the four major national wireless providers face considerable competitive pressures, and operate in a market environment very different from the AT&T regulated monopoly that existed at the time of the Carterfone decision. The FCC has consistently found that there is effective competition in the wireless market, most recently in the Thirteenth Annual CMRS Report that was released in January 2009.²⁹ In this section we assess the evidence about the competitiveness of the wireless sector.

A. Downstream Market Structure

1. Nationwide Wireless Providers

There are 4 major “nationwide” wireless providers: Verizon Wireless (“Verizon”), AT&T, Sprint Nextel (“Sprint”) and T-Mobile USA (“T-Mobile”). Verizon and AT&T have a technical advantage in many areas because they have 850 MHz cellular licenses covering a large part of the U.S. while Sprint and T-Mobile primarily rely on higher frequency PCS (1.9GHz) spectrum. For comparison purposes, using CDMA2000 technology, a cell site broadcasting at

²⁷ See Cramton, Skrzypacz and Wilson (2007).

²⁸ This analysis follows Mayo (2008).

²⁹ FCC (2009) (“Thirteenth CMRS Report”).

850MHz has a radius of 29.4 km while a cell site broadcasting at 1.9 GHz, the PCS spectrum, has a radius of 13.3 km and a cell site broadcasting at 2.5 GHz has a radius of 10.0 km.³⁰ The lower frequency spectrum is particularly valuable outside major metropolitan areas because the greater coverage per cell site reduces capital and operating costs.³¹ Due in part to their better coverage, which comes in part due to their “better” spectrum, AT&T and Verizon have more subscribers and have been increasing subscribers more rapidly than their nationwide competitors. In addition, Verizon and AT&T were the top two purchasers of spectrum in the 2008 700 MHz auction, which has similar coverage characteristics as the 850 MHz frequencies.

At the same time, there is competition from Sprint, T-Mobile and regional providers. T-Mobile has been increasing its absolute and relative share of subscribers even though its primary operations are on high-frequency PCS spectrum. In 2006, T-Mobile purchased a large amount of spectrum in the Advanced Wireless Services (AWS) band and has been working on increasing its capacity and coverage with this newly acquired spectrum.

The four nationwide carriers built their current nationwide footprints through primary and secondary license acquisitions and build out. The competitive consequences of consolidation need to be examined on a case-by-case basis. While consolidation can potentially lead to increased market power of certain providers, it can also enable a provider to achieve economies of scale and operating efficiencies that reduce costs and allow the newly merged firm to compete more aggressively. Several recent acquisitions have enabled the nationwide carriers to continue to expand and fill in their footprints and increase the capacity of their existing networks. In November 2007, AT&T acquired Dobson Communications, which used the Cellular One brand in rural and suburban areas in several states. In February 2008, AT&T completed its acquisition of spectrum licenses from Aloha Partners and T-Mobile completed its acquisition of SunCom Wireless Holdings, a regional wireless provider in the Southeast. In August 2008, Verizon acquired Rural Cellular, which provided wireless service in rural areas in several states. In November 2008, Sprint and Clearwire closed their transaction to form a new wireless company potentially offering mobile WiMax service. And in January 2009, Verizon completed its acquisition of Alltel. While these acquisitions have reduced the number of wireless providers

³⁰ CDMA Development Group (2004).

³¹ In more densely populated urban areas, the larger coverage radius is less of an advantage, because capacity rather than coverage is important. However, the lower frequency transmissions are also better at penetrating buildings, giving them an operational advantage in urban areas also.

nationwide, they were all approved by the Commission and Department of Justice, sometimes with requirements to divest licenses in specific geographic markets.

2. Regional Wireless Providers and MVNOs

In addition to the nationwide providers, there are a number of significant regional providers, including Leap Wireless, US Cellular, and MetroPCS. These regional providers, and other smaller providers, can offer nationwide coverage to their subscribers through roaming agreements. Leap and MetroPCS also acquired AWS spectrum to allow them to build out networks across the country. In addition, regional providers can serve those consumers who primarily value wireless service for use in their local areas and are not willing to pay much more for nationwide service, or only use out of area service sparingly. Consumers can also purchase wireless service from mobile virtual network operators (MVNOs) who lease wholesale capacity from the facilities-based carriers, but set prices independently. MVNOs typically use different branding strategies to market to particular niche groups. The most significant MVNOs include TracFone Wireless, Virgin Mobile, and Boost Mobile. Industry commentators debate the competitive importance of MVNOs, but they offer service alternatives.

3. Concentration in the Wireless Industry

A first cut in assessing competition in an industry is to look at measures of the Herfindhal-Hirschman Index (HHI).³² In the Thirteenth CMRS Report, the Commission calculated that the average HHI for mobile wireless services for 176 Economic Areas was 2,674 as of December 2007.³³ This compares to Commission calculations of an average HHI of 2,674 in 2006, 2,706 in 2005, 2,450 in 2004 and 2,151 in 2003.³⁴ In all of these years, the HHI is in what the DOJ/FTC Merger Guidelines calls “Highly Concentrated.” The jump in the HHI in 2004 was a mainly result of the Cingular/AT&T Wireless and Sprint/Nextel mergers. The generally flat recent trend in HHIs since 2004 suggests that even though there has been

³² HHIs are calculated by summing the squares of the individual market shares of the firms participating in a relevant market. A market with a monopoly provider has an HHI of 10,000. A market with five equally sized competitors has an HHI of 2000, calculated as $5 \times (20 \times 20)$.

³³ The Commission calculates the HHI based on the number of subscribers served by each carrier in 176 Economic Areas (“EAs”). HHIs for each EA are weighted by the EA population to come up with a nationwide average. Thirteenth CMRS Report, ¶¶45-46.

³⁴ Ninth, Tenth, Eleventh and Twelfth CMRS Reports.

consolidation as measured at the national level, major providers have expanded their geographic footprints rather than increased concentration within established markets.

Another indicator of industry structure is the number of wireless provider choices available to consumers. In the Thirteenth CMRS Report, the Commission estimates that as of July 2008, 90.5% of the total U.S. population had four or more wireless service providers in the census blocks in which they live.³⁵ Table 1 shows that in general more and more of the U.S. population live in areas with more and more choice in providers, although in 2006 there was some decrease after the Sprint Nextel merger. Most of the U.S. population has more wireless choices than eight years ago.

A potential concern is the weakening position of Sprint. Sprint has experienced two straight years of subscriber losses, losing 5.1 million direct wireless subscribers in 2008 and 659,000 direct subscribers in 2007.³⁶ Sprint credits most of this loss to higher churn rates relative to competitors, already high penetration rates in most markets, and a move towards increasing the credit quality of its customers.³⁷ To the extent that Sprint's declining customer base and market position continue, there could potentially be concerns related to concentration within the industry, but it could also lead to more aggressive pricing and competition by Sprint to regain lost share. For example, Sprint appears to be very active in the wholesale market which could lead to new products and services.

4. Entry and Potential Barriers to Entry

The next thing to consider is the ability of wireless providers to enter and compete in various geographic markets, either by existing providers expanding their footprints or by new entry. There are two potential barriers to entry in the wireless market: spectrum and economies of scale.

Mobile wireless service requires access to spectrum. The U.S., has two categories of spectrum – licensed and unlicensed. To date, unlicensed spectrum has been useful for portable use such as WiFi, but not mobile use. The only significant providers of mobile wireless services use licensed spectrum.

³⁵ Thirteenth CMRS Report, ¶¶39-43.

³⁶ SprintNextel 2008 10-K, p. 30.

³⁷ SprintNextel 2008 10-K, p. 34.

As a result, for now, available spectrum is limited by the licenses issued by the FCC in frequencies capable of providing mobile service.³⁸ Starting in the mid 1990s, a series of FCC auctions significantly increased the amount of spectrum available for mobile wireless, which in turn led to a significant increase in the number of providers offering wireless service in most geographic areas. Most recently, the 2006 Advanced Wireless Services (AWS) auction (Auction 66) increased the spectrum available for wireless by 90 MHz and the 700MHz auction (Auction 73) increased the amount of available spectrum by another 62 MHz.

In the 2006 AWS auction, T-Mobile acquired licenses that should enable it to offer a wireless broadband network, and smaller regional wireless providers such as Leap and MetroPCS acquired licenses that allow them to expand their geographic coverage areas. In the same auction, new entrant SpectrumCo LLC, an entity owned by the major cable companies acquired a near national spectrum footprint of 20 MHz. However, SpectrumCo indicated in its press release that its members “did not approach this investment with the intent of becoming the nation’s fifth wireless provider but rather to gain the flexibility to develop advanced wireless services...[and] no specific plans to build out the networks at this time.”³⁹

In the 700 MHz auction, several new and/or smaller providers were also able to acquire spectrum, although no party other than Verizon and AT&T acquired enough two-way spectrum for a national footprint.⁴⁰

Starting in 2004, the FCC began modifying the band plan and rules for 2500-2690 MHz (“BRS/EBS band”) spectrum. This spectrum is being used by Clearwire to develop a WiMAX network that will offer wireless broadband service.⁴¹ As of December 2008, Clearwire’s U.S. network covered 47 markets and 15.3 million people with a subscriber base of 475,000. As a complement to its broadband services, Clearwire offers VoIP telephony services to 45 U.S. markets.⁴² In October of 2008, Clearwire combined WiMax capabilities with Sprint.⁴³

³⁸ Mayo and Wallsten (2009) document the rise of secondary market transactions for spectrum use that can help to increase the efficiency of spectrum use, but not increase the amount of licensed spectrum.

³⁹ Comcast (2006).

⁴⁰ The FCC’s Thirteenth CMRS Report states that new entrant Frontier Wireless, owned by the satellite television company Echostar, won enough licenses to establish a near national footprint, but that was 6 MHz of unpaired spectrum, leading some to speculate that it will add video to mobile phones (Avery, 2008).

⁴¹ WiMax is an IEEE 802.16 standard for broadband wireless access.

⁴² Clearwire (2009), p. 2.

⁴³ Clearwire (2008).

Thus, recent auctions have allowed some new entrants and regional players to build and expand their geographic footprints. Because many of the new entrants are still starting their businesses, only time will tell whether these auctions will facilitate significant new competitors.

New entrants also face non-spectrum barriers to entry, arising from economies of scale in production and marketing. Wireless service requires significant investment in network infrastructure, with large upfront fixed-cost capital investments. And to compete against nationwide incumbents, a new entrant or regional provider needs to acquire a significant geographic footprint or enter into roaming agreements

Moreover, the 700 MHz auction was likely the last auction of significant amounts of spectrum for some time and offered highly valuable low-frequency spectrum. The largest incumbent nationwide providers, AT&T and Verizon, acquired considerable additional spectrum in that auction and through secondary market transactions. Sprint and T-Mobile did not participate in that auction.

B. Wireless Market Performance: Prices, Quantities, and Quality

1. Prices

While structural measures such as HHIs provide a starting place, industry structure is just a first step in an antitrust analysis assessing the competitiveness of the wireless market. The next step is to assess the actual performance of the industry, as measured by prices and quantities consumed. Table 2 and Chart 1 show the significant decrease in average revenue per minute (ARPM) and average voice revenue per voice minute (AVRPM) from 1995 through 2007.⁴⁴ As of 2007, ARPM was \$0.06 and AVRPM was \$0.05. And while the pace of declining prices has slowed as the industry has matured, price declines in the last 5 years are still substantial, with AVRPM falling by over 50% since 2003.

The distinction between ARPM and AVRPM has become important only in the last few years with the growth of data services. Because ARPM is calculated using voice minutes as the

⁴⁴ Based on Thirteenth CMRS Report, ¶193, Table 12. The FCC's analysis is based on data from CTIA's semi-annual surveys. CTIA's semi-annual surveys are voluntary, meaning the companies that respond to particular questions may differ from year to year and not all companies respond to every question each year. CTIA reports the raw results from the survey and does not attempt to adjust the figures for the non-respondents or to make the results exactly comparable year-to-year. Thus, the figures from the CTIA surveys indicate trends, but cannot be presumed to show the precise level of changes.

denominator, it has become inaccurate as a price metric. AVRPM, which excludes revenue from data services, is a more accurate measure of price trends for voice services.

The national providers and the major regional providers all offer calling plans with various buckets of minutes (e.g., 900 minutes for \$59.99 per month) that can be used without roaming or long distance charges. There are many variants of these plans, including plans with free calling to designated numbers or to customers using the same wireless provider, unlimited local calling plans, and unlimited national calling plans. Carriers continue to experiment with different plans, and consumers typically have considerable choice among plans within and across carriers.

Some evidence suggests that the price of data services has been declining in the last few years, after increasing between 2002 and 2005. Although pay-as-you-go text messaging prices have increased recently, the Thirteenth CMRS Report indicates that average revenue per text message declined from \$0.037 per text message in 2005 to \$0.025 in 2007 as monthly text messaging plans (as opposed to pay-as-you-go pricing) became more prevalent.⁴⁵ By the first half of 2008, average revenue per text message fell to \$0.013.⁴⁶

2. Subscribers, Minutes of Use and Data Usage

Wireless use has also increased significantly, whether measured by subscribers, minutes of use or data usage. In its most recent data, the FCC estimates that there were 263.0 million subscribers at the end of 2007, implying a penetration rate of 86% and a 23% increase in subscribers between December 2005 and December 2007.⁴⁷ See Table 3. And an increasing number of subscribers are “wireless only;” recent estimates suggest that more than 20% of households are wireless only.⁴⁸

Average voice minutes of use have also continued to increase. As shown in Table 3, average monthly voice minutes of use per subscriber increased to 769 in 2007, an increase of 80% since 2002.

⁴⁵ Thirteenth CMRS Report, ¶194; Twelfth CMRS Report, ¶¶202-203.

⁴⁶ This is calculated using data from the CTIA mid-year 2008 report. Six month text revenues are divided by six month text traffic.

⁴⁷ The FCC estimates subscribers using NRUF data filed by all wireless carriers with the FCC. CTIA survey data shows a similar pattern. See CTIA Midyear 2008 Results.

⁴⁸ Blumberg and Luke (2009).

Many indicators suggest that mobile data usage has also increased significantly in recent years. According to CTIA (2008), data revenues accounted for 20.37% of total wireless service revenues in the first half of 2008. Several sources indicate that the percentage of subscribers using their wireless phones for data services continues to increase. For example, Nielsen (2008) indicates that 37% of subscribers paid for access to the mobile Internet in the first quarter of 2008. CTIA (2008) data indicate that the volume of text/SMS messages in the first six months of 2008 increased to 384.97 billion, an increase of 162% over the first six months of 2007 and 494% over the first six months of 2006. See Table 4. CTIA (2008) data also indicates that the volume of multimedia messages (MMS) such as photo messaging has been increasing dramatically, with 5.63 billion MMS messages in the first six months of 2008, an increase of 116% over the first six months of 2007.

3. Churn

Monthly churn statistics provide a measure of consumer switching between carriers. Most carriers have been reporting churn rates in the range of 1.5% to 3.0% per month, with an average churn rate of 1.9% in first quarter 2008, implying annual churn of more than 20%.

Despite FCC rules adopted in 2003 that require wireless providers to allow customers to port their phone numbers, churn rates have been declining in recent years. Providers have been investing in their networks – digital technology has been increasingly deployed and cell sites grew about 15% per year over the past 10 years and about 9% per year for the past 5 years.⁴⁹ Although concerns about network quality are still raised, recent survey evidence suggests that call quality is improving,⁵⁰ and that poor call quality is highly correlated with customers' desire to switch carriers.⁵¹

Because call quality affects customer churn, it is not surprising that as customers gain experience on wireless networks and call quality improves that churn would decrease. Even without increasing call quality, customer sorting as customers gain experience with different wireless networks would decrease churn. For example, if new customers are likely to churn, but existing customers are not, a decreasing proportion of new customers as the installed base grows

⁴⁹ CTIA (2008), Table 64.

⁵⁰ J.D. Power and Associates (2006); and Gonsalves (2005).

⁵¹ J.D. Power and Associates (2006); and Gonsalves (2005).

would naturally lead to a smaller churn. Experienced customers would be less likely to churn because they have already had the chance to try one or more networks at home and at work so are more likely to have found the most appropriate carrier for their individual calling patterns.

AT&T and T-Mobile provide prospective customers with detailed coverage information to encourage customers to enroll in their plans.⁵² Analysts believe that these efforts coupled with improved customer care, better deals on handsets, and bigger incentives for longer contracts have helped to reduce the level of churn.⁵³ Thus, decreasing churn rates probably do not reflect a decrease in consumer choice but rather an increase in the quality of customer experience and, over time, the ability of continuing wireless customers to sort to their preferred provider.

4. Technological Innovation

In the U.S., wireless providers use two main digital technologies, CDMA and GSM.⁵⁴ CDMA and GSM are referred to as “2G” technologies. Equipment manufacturers have been developing more advanced “next generation” technologies that allow for increased voice capacity and higher transfer rates for mobile broadband.⁵⁵ The four nationwide wireless providers and the significant regional providers have been deploying these next generation technologies, leading to much greater availability of mobile broadband, which is now generally available to most consumers.⁵⁶ The FCC estimates that as of May 2008, 92.5% of the population lived in census blocks with one or more provider of mobile broadband and 72.5% of the population lived in census blocks with two or more providers of mobile broadband.

Deployment of next-generation technologies is an important part of the competitive dynamic in the wireless industry. Next-generation network upgrades allow carriers to improve the coverage, capacity, and capabilities of their networks, leading to improvements in service quality improvements for voice calls,⁵⁷ and the development of new mobile data services. The

⁵² Kesmodel (2005); T-Mobile, “Personal Coverage Check,” *available at* <http://www.t-mobile.com/coverage> (hyperlink “check your coverage now”) (last visited March 27, 2009); <http://www.wireless.att.com/cell-phoneservice/welcome/index.jsp> (hyperlink “Coverage Viewer”) (last visited March 27, 2009).

⁵³ Eleventh CMRS Report ¶148.

⁵⁴ AT&T and T-Mobile use GSM; Verizon and Sprint use CDMA.

⁵⁵ The many variants of next-generation technologies are sometimes referred to as 2.5G, 3G, or 4G, depending on their technical characteristics.

⁵⁶ For these purposes “mobile broadband” is defined as WCDMA/HSPDA or EV-DO/EV-DO Rev. A technologies. Thirteenth CMRS Report, ¶146.

⁵⁷ J.D. Power and Associates (2009).

Twelfth and Thirteenth CMRS Reports highlight some of the recent mobile data developments: music playing services, handsets equipped with GPS technology, streaming video services, Verizon's Spring 2007 launch of V CAST Mobile TV, AT&T's Spring 2007 launch of the Apple iPhone, and AT&T's July 2008 launch of the 3G iPhone. In the fall of 2008, Blackberry released its Blackberry Storm smartphone, and Sprint made available the Palm Pre with its new mobile operating system on Sprint's network in June of 2009.⁵⁸ According to Greenstein's (2009) framework for innovative health, continuing innovation and investment in the network along with competition between different standards is indicative of a healthy, competitive industry.

5. Conclusion on Downstream Wireless Markets

The decreases in prices, increases in quantities consumed, improvements in quality, and ongoing technological innovation suggest a market, where, despite an increase in the HHI since 2003, consumers have benefited tremendously from vigorous competition among wireless providers. That said, the FCC and DOJ/FTC should carefully monitor further consolidation and changes in pricing to ensure that consumers continue to benefit from ongoing technological improvements.

C. Upstream Equipment and Applications Markets

As discussed above in Section II, the ability and incentives of a wireless provider to restrict upstream suppliers anticompetitively depends not just on the competitiveness of the wireless market, but also on the extent of vertical integration by wireless providers into upstream markets for the provision of equipment (such as handsets) and applications, and the degree of competition in those upstream markets. In this section we assess these issues. We find that there is little integration by the wireless carriers into handsets and applications, and many independent competitors provide handsets and applications.

1. Equipment Markets

The nationwide wireless providers do not manufacture their own wireless handsets; nor do they own equity in any major equipment manufacturers. Instead, most of the handsets used

⁵⁸ Blackberry (2008); SprintNextel (2009).

by U.S. consumers are sold by large electronics firms that are not affiliated with U.S. wireless providers including the top selling brands (Motorola, Samsung, LG, Nokia, and Blackberry).⁵⁹ Moreover, these top selling handset manufacturers provide handsets for all of the major U.S. wireless providers.⁶⁰ Consumers have considerable choice regarding handsets. One recent study found that in early 2007, consumers had 154 unique handset options available directly from the four nationwide carriers plus Alltel, with an average of 34 handset choices per carrier, with additional handset models available from third-party sources.⁶¹ Upstream suppliers of handsets sell in a global market and compete aggressively with each other for market share. Although the nationwide US wireless providers are important customers for handset manufacturers, they also sell to many other wireless providers around the world.⁶² U.S. wireless network operators may require handset manufacturers to make modifications prior to allowing usage on their systems. These modifications may be for network management or may serve other purposes. Regardless, it does not change the competitiveness of the handset market, but can affect the features available on specific U.S. networks.

2. Applications Markets

Most wireless providers control which applications are available and offer content through service provider branded and controlled portals. In its 700 MHz Second Report and Order released in August 2007, the FCC, referring to its 2007 Wireless Broadband Classification Order, noted “in some cases, providers use filters to limit the web sites that a customer can access, and, in other cases, subscribers can enter any URL using a handset but the site may not be viewable due to software, processing, or other constraints of the device.”⁶³ However, different wireless carriers employ a variety of terms and conditions, and T-Mobile’s contracts in the U.S. have not contained such restrictions. Moreover, none of the top Internet content sites,

⁵⁹ Based on U.S. market share in the first quarter of 2008. NPD Group Press Release, “The NPD Group: U.S. Consumer Mobile Phone Unit-Sales Declined 13 Percent Year-over-Year in Q2 2008,” August 19, 2008.

⁶⁰ Verified by information contained in manufacturer websites (LG, Motorola, Nokia, Research in Motion’s Blackberry, and Samsung). All manufacturers listed except for LG listed phones for all of the 4 major carriers. LG did not list a phone for T-Mobile. Apple’s iPhone is currently limited to the AT&T network.

⁶¹ Hahn, Litan and Singer (2007), p. 14.

⁶² Even if there were vertical integration, that would not necessarily be bad for consumers. Since there is no vertical integration, we do not address that issue in this analysis.

⁶³ *700 MHz Second Report and Order*, 22 FCC Rcd at 15360, ¶198.

such as eBay, Google, Yahoo, Microsoft Networks, AOL, or Amazon, are affiliated with mobile wireless network providers.⁶⁴

Recent developments suggest that wireless providers are responding to consumer demands for more “openness” to third-party content and applications without the need for regulatory mandate. One example is the popular Apple iPhone. When the iPhone was first introduced in July 2007, Apple did not use AT&T’s own web browsing and entertainment service to access the Internet, but kept significant control over applications and services. Then in Fall 2007, Apple announced a software development kit allowing software developers to develop third-party applications for the iPhone. Apple launched its AppStore, a platform for third party developers to market applications in July 2008.

In late 2007, Verizon announced a new open access policy to provide consumers with access to its wireless network using “wireless devices, software, or applications not offered by the company” that meets certain technical standards.⁶⁵ During 2008, Verizon began implementing its open-access policy.⁶⁶ For example, Verizon now offers month-to-month agreements that allow consumers to use their own CDMA handsets without long-term service contracts. In addition, Verizon acquired 7 of the 12 C Block open access licenses in the recent 700 MHz auction, and has stated that it will use that additional spectrum for its “Open Development Initiative.”⁶⁷ It is unclear how these initiatives will play out as much will depend on interpretations of “reasonable network management.”

Another “open access” initiative is Android, the mobile operating system developed by Google. Android is a collaboration between Google, T-Mobile, HTC, Qualcomm, and Motorola. According to a Google press release:

A broad alliance of leading technology and wireless companies today joined forces to announce the development of Android, the first truly open and comprehensive platform for mobile devices... By providing developers a new level of openness that enables them

⁶⁴ Based on unique visitors in January 2009. comScore Media Metrix Press Release, “comScore Media Metrix Ranks Top 50 U.S. Web Properties for January 2009,” February 19, 2009. Google has an investment in Clearwire which may offer mobile wireless service in the future.

⁶⁵ Verizon Wireless (2007).

⁶⁶ Sharma (2008).

⁶⁷ Verizon Wireless (2008).

to work more collaboratively, Android will accelerate the pace at which new and compelling mobile services are made available to consumers.⁶⁸

The first phones running Android, for use on T-Mobile's network, were available to consumers in the second half of 2008. The development of service offerings with varying degrees of "openness" suggests that "open access" is one important dimension in which carriers are competing for consumers.

However, apparently Google restricted "tethering" applications on Android phones as part of its agreement with T-Mobile.⁶⁹ Tethering applications allow a subscriber to use a handset as a modem for a laptop computer. Such uses tend to be more bandwidth intensive and are restricted by some providers. However, providers have subscription plans for dedicated laptop cards (with some usage limits as discussed above), which would presumably have similarly intensive bandwidth demands. Similarly, as discussed above, AT&T has barred the iPhone Skype application from working on its 3G network (but allows it to work over WiFi).

3. Conclusion on Upstream Markets

There is little integration by wireless providers into equipment and applications, and many independent competitors provide equipment such as handsets and applications. In the absence of vertical integration into applications or equipment – without an affiliated supplier in the adjacent market, a "monopoly provider" does not have an incentive to steer customers to its non-existent affiliate. The situation at the time of Carterfone, when nearly all equipment used in the Bell System was supplied by Western Electric, is very different from the current situation. Wireless operators do not have an incentive to discriminate against equipment manufacturers, who are typically very large firms selling equipment into many international markets. Similarly, wireless providers are not substantially vertically integrated into content and applications. And while wireless providers have imposed limitations on applications, there are often legitimate network management justifications for doing so, and carriers appear to be responding to consumer demands for "openness."

⁶⁸ Google (2007).

⁶⁹ Davies (2009).

D. *Per Se* versus Rule of Reason

Antitrust analysis counsels that there are limited circumstances to apply *per se* bars against behavior – when such behavior is so likely to be harmful to consumers and it is very unlikely that there could be any efficiency justification for the actions. In addition to the lack of efficiency justifications, one of the pre-conditions for a *per se* bar is that a firm or group of firms have market power.

Our analysis of the wireless industry shows that there are plausible efficiency justifications for many vertical restraints on equipment and application providers. In addition, while still a highly concentrated industry, there is evidence of competition between the major wireless providers. As a result, a *per se* bar on potentially pro-competitive behavior would not be in consumers' interests. However, there are alternative regulatory policies that could benefit consumers – increasing competition at the network level so there would be even less incentive to engage in exclusionary conduct that harms consumers.

IV. Increasing Consumer Welfare in Wireless

A. General Principles of Regulatory Intervention

The goal of antitrust law in particular and competition policy in general is to increase overall welfare and generally relies on increasing competition as a tool. Because of fixed costs, most unregulated markets are not like the perfectly competitive benchmark and virtually no regulated market approaches the perfectly competitive threshold. In some cases, regulation can have perverse effects. For example, regulation can distort economic decision making, reduce the incentive to innovate, and raise consumer prices. As a result, there is a long-standing view in economics that regulations should pass a reasonable cost-benefit test – does a new regulation increase consumer welfare more than it reduces producer surplus? Unfortunately, regulations generally cannot precisely target a specific imperfection in the market and cure that imperfection without having any other (possibly positive or negative) effects.

For example, Hausman (2002) shows that rules designed to promote competition from wireless resellers led to substantially higher prices in those states than in states that did not enact such laws. He claims that resellers pushed for higher prices because the regulation ensured

them a percentage markup so higher wholesale prices increased their profit margins. In other states, the prices without the additional retail competition turned out to be lower, in part possibly because of the efficiencies of vertical integration that were denied by the resale mandates.

Importantly, regulation is difficult in a dynamic industry like wireless, where innovation and investment are key to competition among incumbent firms and potential entrants. Preventing a firm from reaping the rewards of its investments and ingenuity or the threat of taking away such rewards can change a firm's actions. In fact, such worries help to motivate some of the proponents of network neutrality – they worry that the threat that network operator(s) will exclude innovators or expropriate their innovations will in turn cause a much lower level of innovative activity. Innovation and investment incentives are important considerations and the same issues of incentives apply to network operators' decisions to continue to invest in their networks to provide the services that consumers want.

B. The 700 MHz Openness Provisions

In the 700 MHz spectrum auction that concluded in March, 2008, the FCC mandated that one band of the auctioned spectrum, the 700 MHz Upper Band C Block, have an open platform for devices and applications, subject to “reasonable network management.”⁷⁰ The Commission's order was vague on the actual requirements for openness, and it was also vague about the meaning of “reasonable network management.” We expect those meanings to be the subject of contention as firm's challenge Verizon's implementation of the openness provisions on the C Block. The ensuing policy debate about these openness provisions highlights some of the issues associated with Carterfone style regulation of wireless networks: competition, complexity and regulatory uncertainty.

As discussed above, vertical relationships are only likely to be a competitive problem when a firm possesses significant market power, and even then, only in certain circumstances. While wireless service is not a perfectly competitive market, the Commission's annual CMRS Reports have consistently found that wireless service is competitively provided. Despite having deemed wireless service provision to be competitive, the FCC nevertheless required “openness.” With competitive wireless networks, an openness requirement is likely to have little incremental impact on preventing anticompetitive activity. However, the openness provision may entail cost

⁷⁰ *700 MHz Second Report and Order*, 22 FCC Rcd at 15360.

as firms may assert and defend this openness “right” at the FCC and in court. In addition, openness in a competitive market can prevent efficient vertical relationships. Given these costs with little apparent benefit in a competitive market, this openness provision may do little to improve consumer welfare.

In addition, the vagueness of the openness requirements and network management exceptions make it difficult to believe that the enforcement will be satisfactory. Proponents of openness are likely to say that the licensee has not gone far enough in opening its network and the network operator is likely to say it has gone further than necessary. In addition, there are likely to be disputes about what “reasonable network management” for a wireless provider means. It may well be different than “reasonable network management” for a wireline broadband operator.

One potential benefit of the imposition of the openness requirements on the C block is the ability to use this “experiment” in openness to shed some light on the costs and benefits of such provisions on a more widespread scale and to clarify just what “openness” means. If openness is problematic, the interactions between the C block licensee and upstream providers and downstream customers are likely to reflect such problems. If openness provides large benefits and works smoothly, then other carriers, having to compete with an open access provider, may also adopt open platforms. If openness is a severe competitive disadvantage, it is likely that there will be complaints against the provider if it unilaterally decides not to continue openness, or the provider may petition the FCC to relax the rules.

In addition, by limiting the scope of the openness provisions to a single block of spectrum that it was auctioning for the first time, the Commission was able to avoid any concerns about “takings” due to a change in rule for existing licensees. Instead, bidders knew upfront (to some extent) the rules on the spectrum they were buying.

C. Alternatives to Carterfone Style Regulation in Wireless

Policy proposals for wireless networks should have as their primary focus increasing consumer welfare. In general consumer welfare is enhanced by removing obstacles to competition by private firms, and not by favoring any one particular firm. While there is already significant competition in the provision of wireless services, there are ways that wireless services can be even more competitive. And more competitive wireless services have the added public

policy benefit of becoming a more competitive alternative to wireline voice and broadband data services.

Since most concerns about vertical restraints arise from concentration at the local access level, the most important thing that the FCC should do is to stimulate competition at that level. Obviously, competition would be enhanced if it was economic for multiple firms to string fiber optic cable around all neighborhoods in the United States and there was enough spectrum available so that the auction price for spectrum was close to zero. That is unlikely to happen. But the FCC has tools at its disposal to make facilities-based competition more likely and more viable even with these constraints. In particular, the FCC can develop policies that facilitate new entry, investment in network infrastructure, and new service offerings both by incumbents and new entrants.

1. Increasing competition through spectrum policy

First, the FCC should get even more spectrum out into the marketplace, using well designed auctions to encourage the most highly valued use of that spectrum.

One quick way to get more spectrum into the market is to push government users to relocate from AWS spectrum more quickly. Leap Wireless, MetroPCS and T-Mobile all bought spectrum in the AWS band in 2006, but cannot fully use it because the U.S. Government has not completely vacated the spectrum.⁷¹ The FCC should do whatever it can inside the government to expedite this process and enable these competitors to use their AWS spectrum fully.

Second, the FCC should re-auction the 10 MHz of 700 MHz D block spectrum rapidly.⁷² Although the 10 MHz may not be enough spectrum to operate a full capacity system in dense urban areas, because of its technical characteristics, the D block can be used to provide the necessary “coverage” spectrum while AWS, PCS and other higher frequencies provide the “capacity” spectrum necessary in urban areas. As a result, it may be a perfect complement to the

⁷¹ For list of spectrum reallocation status as of December 2007 see U.S. Department of Commerce, 1710-1755 MHz Spectrum Band Relocation, First Annual Progress Report, March 2008, <http://www.ntia.doc.gov/reports/2008/SpectrumRelocation2008.pdf>
Also http://wireless.fcc.gov/auctions/default.htm?job=auction_factsheet&id=66#Incumbents, last visited April 3, 2009.

⁷² In the 700 MHz auction, the FCC imposed onerous restrictions on the D block related to public safety combined with a high reserve price. As a result, no firm was willing to meet the reserve price for that block of spectrum and the licenses were not sold in the auction.

spectrum held by competitors to Verizon and AT&T (who already have the bulk of the low frequency CMRS spectrum). As a result, the D block spectrum can help to increase competition in wireless if it is auctioned rapidly.

Third, the FCC should ensure that the “white spaces” are made available to the market in a reasonable way that allows them to provide competitive service to other low frequency spectrum.⁷³ While we think that licensing the spectrum and auctioning is the preferable method of doing this, if the Commission decides to make the spectrum available on license-free basis, it should do that without forcing the spectrum to remain fallow for a long period of time.

An important consideration in auction design is the potentially different incentives of Verizon and AT&T compared to other providers. After consolidation among wireline local exchange carriers, Verizon and AT&T are the largest incumbent landline telephone companies; they also hold licenses for valuable 850 MHz spectrum. In the 700 MHz auction, Verizon and AT&T each bought large amounts of spectrum and, in many geographic areas, control more spectrum than the FCC’s threshold of 95 MHz.⁷⁴ While Verizon and AT&T are using that spectrum to build out their networks and develop better services, because they also own wireline networks in many areas they do not have the same competitive incentives that independent non-wireline competitors have to compete with wireline voice and data services. It will be important for the FCC to consider, using appropriate competition policy analysis *in advance* of the next spectrum auctions, whether to allow Verizon and AT&T to acquire more spectrum, or more low-frequency spectrum. Obviously, there are tradeoffs – Verizon and AT&T will have incentives to use additional spectrum and may introduce new services with additional spectrum. At the same time, allowing other firms to acquire spectrum may enable competitive alternatives that lead to better wireless options for consumers. Any spectrum restriction should not be simply based on size, but on competitive analysis. For example, a spectrum cap would have to take into account the fact that Sprint also has a large amount of spectrum, but limited spectrum below 1 GHz and a policy would have to assess the implications of the differences, if any, in spectrum at different frequencies.

⁷³ “White spaces” are frequencies allocated to broadcast television, but not licensed to a television station in a specific area and thus potentially available for other use.

⁷⁴ In its Verizon/Alltel merger Order (FCC, 2008), the FCC reaffirmed a screen for mergers that led to the merged firm controlling more than 95 MHz of spectrum capable of providing mobile service.

Finally, the FCC should consider all other mechanisms, such as the “Big Bang” (Kwerel and Williams, 2002) where all unallocated spectrum is combined with spectrum put up by private licensees in a single auction or some variant to rationalize spectrum rights to make them allocated to the public more efficiently. As Kwerel and Williams discuss, the ability to auction large blocks of underutilized or inefficiently utilized spectrum rights in a single marketplace can substantially reduce aggregation risks for spectrum buyers and also ensure that sellers realize the value of their spectrum.

2. Allowing operating flexibility

With the potential for additional competition, one would not want to institute rules that would frustrate new competitors and new investments. If vertical integration was an important competitive strategy, new entrants might be frustrated from entering if they could not vertically integrate. For example, some new wireless entrants have usage restrictions to manage their networks and make entry more attractive. For example, XOHM, the Sprint WiMax service which has been combined with Clearwire, and Lariat Networks, a wireless internet access provider, impose acceptable use and network management policies on their users. Among other restrictions, XOHM may restrict downloading specs and transfer rates or limit the number of sessions or applications of protocols to manage its network most efficiently for all users.⁷⁵

Owen and Rosston (2006) discuss how policy can affect the entry incentives of new entrants and investment incentives of incumbents. Although the Owen and Rosston analysis focuses on wireline broadband access, similar incentive issues arise in the wireless context. For any investment to take place, firms have to believe they will be better off from having made the investment than not. If policy reduces the returns to investment, at the margin, firms are less likely to invest. For new entrants, more onerous regulation can affect the scale and scope of entry, or make entry unviable. Similarly, uncertainty over future regulation may reduce the incentives for new entrants to innovate and invest.

Finally, operating flexibility should also be reflected in rules and regulations that help to promote an active secondary market for spectrum and spectrum services (Mayo and Wallsten, 2009). While initial allocations may be optimal at the time of the allocation, both demand and

⁷⁵ XOMH (2009).

technology will change, leading to different valuations for spectrum in providing different services.

3. Increasing competition through universal service policy

The current universal service program is also a barrier to competition and is so inefficient that it should be scrapped.⁷⁶ Instituting a low-cost, efficient and competitively neutral universal service program would be much better for promoting competition between wireless providers, and between wireless and wireline providers. The most anticompetitive aspect of the current universal service program is the proposal to pay incumbent telephone providers more than new competitors for providing the same services. The incumbents are right that new entrants should not be paid the same high rates that incumbents get – instead, all providers, including the incumbents, should be paid the minimum amount necessary for the most efficient provider to provide service. But incumbents have been able to use the regulatory process to forestall competition.

Without these artificial barriers, more wireless providers with low costs would have an incentive to build out networks in rural areas (and in urban areas because their tax rates for USF would be lower). The more network build out by additional competitors, the stronger competition will be. Getting rid of the pro-incumbent bias in the universal service program would help competition and diminish the need for *ex ante* regulation of vertical relationships.

4. Antitrust Enforcement

As described above in Section II, vertical restrictions can be on balance procompetitive or anticompetitive, depending on the particular circumstances. Regulation that is preemptive and overly broad will prevent pro-competitive vertical arrangements alongside anti-competitive anticompetitive ones. *Ex post* situation-specific antitrust enforcement is better able to target just the anticompetitive relationships. Thus, the antitrust authorities and the FCC should continue to

⁷⁶For more background on the universal service program see Riordan (2002). For a set of guideposts for future universal service policy, see Mayo (forthcoming).

be vigilant in investigating specific practices that may on balance be found to be anticompetitive.⁷⁷

However, antitrust enforcement introduces new potential costs. A targeted antitrust investigation is likely to require detailed and expensive investigation, is time consuming, and may not be completed until long after the alleged anticompetitive restrictions were put in place.

V. Conclusion

It is important for policymakers to think about the possible outcomes, intended or otherwise, of any network neutrality regulation. The competition policy analysis in this article has been focused on the wireless marketplace, but the framework is applicable to other network settings as well.

Policymakers have two broad choices – institute prophylactic network neutrality rules or forebear from such rules and rely on situation specific analysis and enforcement. (Obviously, there are a number of different intermediate options available as well, and the details are likely to matter.) In antitrust terms, this is the difference between a *per se* rule prohibiting certain actions and a “rule of reason” approach.

If policymakers adopt network neutrality rules and such regulation is effective, it will be more difficult for network operators to charge different prices for similar uses of bandwidth. If network operators try to raise price for some services, third-party providers will be able to enter and provide the same services at a lower price. For example, when AT&T was the dominant provider of long-distance telephone services, a set of court decisions allowed resellers to buy packages of services and resell them to end users, reducing substantially AT&T’s ability to charge higher prices to customers with more inelastic demand.

As a result of wireless network neutrality rules, pricing for network services would likely move toward pricing for a single product – bandwidth. There may be differential pricing with some volume discounts, and possibly some form of congestion pricing, but essentially the network operators will move toward single product providers. If there are no big benefits from

⁷⁷ FTC Chairman Leibowitz discussed this recently. PC World (2009).

vertical integration or the ability to engage in Ramsey pricing, then this would lead to an efficient form of segregation of the network provision from content and application provision.

If competition between network operators would ultimately lead to a breakdown of price discrimination, network neutrality rules will have little effect. But in the wireless market with its significant fixed costs and network investment, some services will have prices above short-run marginal cost to pay for the network, even with vigorous competition between network operators. To cover network costs efficiently in such a market setting, it is likely there will be price discrimination, but such discrimination is not necessarily a measure or indicator of consumer harm. On the other hand, if network neutrality regulation forces firms to a solution that would not arise from market forces, then it will shift returns away from the network operators and possibly cause a reduction in network investment.

If policy makers do not force network neutrality, there are several possibilities: competition might force firms closer to non-discriminatory pricing schemes; competition might lead to pricing of services with some discrimination that is pro-competitive (see the rationales discussed above for procompetitive vertical restraints); firms might choose a neutral pricing scheme even without competitive pressure; or firms might discriminate in an anticompetitive manner that harms wireless consumers.

The policy question for a regulatory agency is whether it thinks that competition will not be sufficient to force firms into efficient behavior. If regulators intervene, they risk reducing the incentive for firms to invest in their networks and can prevent efficiency enhancing investment both upstream and downstream. On the other hand, if they do not intervene, they risk a firm frustrating consumers and entrepreneurs who would otherwise invest to complement the network and compete with services of the network.

Regulators should consider the competitive nature of the market and the potential procompetitive aspects of vertical restrictions before making blanket decisions – a rule of reason approach is more appropriate when actions can have both procompetitive and anticompetitive results. Some behaviors are viewed as problematic in a concentrated market when a firm is dominant, but procompetitive and to the benefit of consumers when there is sufficient competition. Moreover, regulators should account for the challenges of adopting effective regulation, especially in an industry with rapid innovation and the potential adverse consequences of regulation.

The competition analysis in this article shows that the wireless market is not “perfectly competitive,” but that despite significant fixed costs wireless is a market with significant competition among network operators. As in any market, it would be better to have more competition. However, there are better policy tools for increasing wireless competition than ex ante Carterfone-style regulation of wireless providers. Increasing the amount of spectrum, providing operational flexibility to network operators, speeding the relocation of government users, vigorous antitrust enforcement (including the prevention of excessive aggregation of wireless spectrum) and revamping universal service to be competitively neutral all have the effect of harnessing market forces, and give consumers, rather than regulators or specific firms, a big vote in the future development of wireless voice and data services.

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Table 1
Percentage of Population with Access to Wireless Services by Number of Providers
2000 – 2008

Source: 12th FCC CMRS Report; 13th FCC CMRS Report

Number of CMRS Providers in a County	7/2000	7/2001	7/2002	7/2003	7/2004	7/2005	7/2006	7/2007	7/2008¹
3 or More	87.8%	90.8%	94.1%	94.7%	96.8%	96.9%	98.0%	98.0%	95.5%
4 or More	79.8%	84.4%	88.7%	89.3%	93.0%	93.2%	93.8%	93.6%	90.5%
5 or More²	68.5%	75.1%	80.4%	82.6%	87.5%	87.3%	50.8%	59.1%	64.9%

Notes:

[1] For 7/2008, data at the census block level is used because data at the county level is not available. Thus, the data from 2008 may not be directly comparable to previous years' data.

[2] The the percentage of the population living in counties with 5 or more providers fell in 2006, primarily because of the mergers between Sprint and Nextel, and Alltel and Western Wireless Corporation.

Table 2

Wireless Service Revenue

1993 – 2007

Source: Table 12 of 13th FCC CMRS Report

Date	Monthly Average Revenue per Unit ¹ (ARPU)	Average Minutes ²	Average Revenue per Minute (ARPM)	Average Voice Revenue per Minute (AVRPM)
1993	\$61.49	140	\$0.44	\$0.44
1994	\$56.21	119	\$0.47	\$0.47
1995	\$51.00	119	\$0.43	\$0.43
1996	\$47.70	125	\$0.38	\$0.38
1997	\$42.78	117	\$0.37	\$0.37
1998	\$39.43	136	\$0.29	\$0.29
1999	\$41.24	185	\$0.22	\$0.22
2000	\$45.27	255	\$0.18	\$0.18
2001	\$47.37	380	\$0.12	\$0.12
2002	\$48.40	427	\$0.11	\$0.11
2003	\$49.91	507	\$0.10	\$0.10
2004	\$50.64	584	\$0.09	\$0.08
2005	\$49.98	708	\$0.07	\$0.06
2006	\$50.56	714	\$0.07	\$0.06
2007	\$49.79	769	\$0.06	\$0.05

Notes:

[1] The 13th FCC CMRS Report used "Average Local Monthly Bill" for the measure of ARPU.

[2] Average minutes of use per subscriber per month (MOUs).

Table 3

Wireless Subscribers, Minutes of Use, and Penetration 2001 – 2007

Source: 13th FCC CMRS Report; CTIA's Wireless Industry Indices Midyear 2008; *Wireless Substitution*

Date	CMRS Wireless Subscribers ¹ (Millions)	CTIA Wireless Subscribers ² (Millions)	Average Minutes ³	Wireless Penetration Rate ⁴	Percent Wireless Only ⁵
2001	128.5	119.9	380	45%	
2002	141.8	131.8	427	49%	
2003	160.6	152.7	507	54%	3.5%
2004	184.7	173.8	584	62%	5.4%
2005	213.0	200.5	708	71%	7.7%
2006	241.8	225.9	714	80%	11.8%
2007	263.0	245.8	769	86%	14.5%

Notes:

- [1] Year end data from 13th CMRS Report.
- [2] Year end data from CTIA's Wireless Industry Indices Midyear 2008.
- [3] Average minutes of use per subscriber per month (MOUs).
- [4] Estimated from NRUF (FCC's Numbering Resources Utilization/Forecast).
- [5] Percent of adults living in household with only wireless phones. Data from Stephen J. Blumberg, Ph.D., and Julian V. Luke, *Wireless Substitution: Early Release of Estimates From The Data* from the National Health Interview Survey, July – December 2007, National Center for Health Statistics, Centers for Disease Control. Data is not available prior to 2003.

Table 4
Reported Six-Month SMS and MMS Traffic
Volume
2004 – 2008

Source: CTIA's Wireless Industry Indices Midyear 2008

Date	Text/SMS Volume (billions)	MMS Volume (billions)
Dec 2004	24.71	
Jun 2005	32.54	0.28
Dec 2005	48.66	0.85
Jun 2006	64.82	1.14
Dec 2006	93.83	1.59
Jun 2007	146.99	2.61
Dec 2007	215.56	3.49
Jun 2008	384.97	5.63

Notes: Figures are for the 6 months ending in the period given.

Chart 1

Average Revenue per Minute and Average Revenue per Voice Minute 1993 – 2007

Source: Table 12 of 13th FCC CMRS Report

