# The Design of the 700 MHz Spectrum Auction: An Opportunity to Promote Competition and Public Safety

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## 1 Summary

We comment on the service and auction rules discussed in the Report and Order and Further Notice of Proposed Rule Making, FCC 07-72, 27 April 2007. We recommend that the FCC designate one license for a wholesale operation that provides open access nationwide on nondiscriminatory terms. This is necessary to enable entry of new businesses offering wireless services in retail markets. It also enables local operators to offer roaming at competitive prices. The new license accords with the Commission's policy to encourage competition, and recognizes the benefits to consumers from low prices and expanded services.

Strengthening competition is especially important now after recent mergers that consolidated the wireless industry into at least two dominant firms with wide coverage and vertically integrated networks; moreover, the major firms' leverage is magnified by their dominant positions in the markets for wireline telephony and broadband. These developments circumvent the Commission's longstanding efforts to sustain competitive pressures in the market for wireless services.

Certain restrictions on this new nationwide license may be necessary to ensure that it is used as the FCC intends. We intend to comment separately on what restrictions might be appropriate at a later time.

We endorse the proposal that the licensee should develop its network in cooperation with public safety agencies for which the FCC has reserved adjacent spectrum, allowing however that these agencies can opt out.

We suggest that the auction rules enforce anonymous bidding, and allow bids for a designated set of packages of regional licenses and multiple bands. Because the current largest two holders of low-frequency spectrum have strong incentives to thwart entry of new retailers, we recommend that the FCC provide bidding credits for small businesses and other designated entities.

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## 2  Introduction

The auction of 700 MHz spectrum is a critical event for the future of wireless services in America. This low-frequency spectrum is scarce and allows much better propagation than the less scarce higher-frequency spectrum. It enables better coverage at lower cost, especially outside metropolitan areas. These superior physical properties translate into economic considerations—this spectrum will play a crucial role in shaping the industry and its products and prices for decades to come. The spectrum is particularly important for the prospect of new entrants in the market for wireless broadband services. FCC decisions regarding the service rules and the auction design will be as important as the decisions before the auction of the PCS spectrum in 1994, which unleashed a wave of increased competition that benefited consumers.

In this paper we discuss the proposals for service rules and auction design for which the FCC sought comments in the Report and Order and Further Notice of Proposed Rule Making, FCC 07-72, 27 April 2007 (hereafter "the Notice"). The Commission calls these the "Frontline proposals," but in this economic report we address the generic features of these proposals.[2] The main ingredients of the proposals are an *open-access network integrated with public safety*. We focus on three issues related to the proposals: auction of a license for the "E Block" that requires (1) open access on nondiscriminatory terms; (2) wholesale operation of that spectrum by the licensee; and (3) development of the public safety network. We also briefly discuss other issues related to the auction rules: anonymous bidding, package bidding, and bidding credits.

Since the removal of the spectrum caps in 2003 the commercial mobile radio industry in the United States has steadily consolidated. Currently, two firms account for 53% of all industry revenue, and four firms account for 90%. According to the Department of Justice's common measure of market concentration, the wireless market is highly concentrated. Moreover, the two largest firms offer the broadest coverage for wireless, which allows them to charge wireless prices much higher than small firms. Verizon and AT&T have the great advantage of owning spectrum derived from the original cellular grants in the late 70s and early 80s, which like the 700 MHz spectrum, came from UHF channels. The long wavelengths, relative to PCS or AWS spectrum, lead to unique coverage advantages. Additionally, the two leading firms each have even greater shares in their home wireline markets, and are in a unique position to offer a triple-play of wireless service, broadband (DSL or fiber), and wireline phone. As they build out their fiber optic facilities they will offer a quadruple play that also includes video programming.

Coverage, or easy roaming, is an important feature of wireless service. In order to couple coverage/roaming with local service, any firm that wants to compete effectively with Verizon and AT&T either must build a nationwide network or acquire at wholesale the use of such a network. But this auction is the only major auction of low-frequency spectrum suitable for constructing coverage networks at low cost. AT&T and Verizon therefore have substantial incentives to acquire the 700 MHz spectrum, even if they have little intention to build on it for years to come, since winning the spectrum would deny this competitive advantage to rivals. These firms also have an incentive not to offer roaming service at competitive wholesale rates.

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[2] Although the Notice refers to several aspects of the issues we address as "Frontline proposals," our view is that the main ingredients could have been proposed by any party before the Commission, and it is immaterial that they were initially proposed by the firm that funded the preparation of this economic report. Specifically, the primary features in the public interest are designation of a spectrum band reserved for a wholesale-only business providing open access on nondiscriminatory terms, and design and operation conducted in cooperation with public safety agencies.

Denying roaming or charging high prices for roaming exploits Verizon and AT&T's competitive advantage, raising retail prices at the expense of consumers and efficiency.

Action now by the Commission can break the current spectrum gridlock and begin a new phase of rapid innovation in the wireless industry. The essential ingredient is an open-access infrastructure that sustains market conditions favorable to new entry and intensified competition.

Several recent developments significantly affect our analysis of the wireless industry and the potential impact of the 700 MHz auction.

First, consumers now expect their wireless providers to offer services on a nationwide basis, even if most of their usage is in their local areas. Access to nationwide coverage is hence crucial for operators or potential new operators serving local markets.

Second, as we stated above, in recent years the industry consolidated, leaving only four nationwide vertically-integrated service providers and only niche local players. The wave of mergers largely reversed the results of Commission policies that introduced additional competitors into the market. Moreover, the pace of consolidation is increasing as the two largest providers, Verizon and AT&T, add customers at a much faster rate than the others.[3] Together, Verizon and AT&T account for two-thirds of industry net additions. These are nationwide averages, and evidence suggests that on the regional level the concentration is more severe—one or two firms may dominate in many geographical markets. Moreover, Verizon and AT&T also have the advantage of offering bundled products, in the form of the so-called triple play, where each is allied with its wireline progenitor.

Third, the roaming proceedings remain in impasse, with both sides offering good arguments: the incumbents argue that a vertically integrated business is more efficient and that obligatory roaming would make that business model difficult to sustain, and potential competitors ask for obligatory roaming to allow them to offer nationwide coverage at fair prices without threats of holdup.

Fourth, in addition to out-of-market roaming coverage, in-market network coverage and reliability (a byproduct of coverage) has become a major factor—perhaps *the* major factor—in customer buying decisions. Customer surveys routinely indicate in-market coverage to be a major reason for switching carriers. Verizon and AT&T routinely advertise "It's the Network" and "Fewest dropped calls," respectively. As mentioned above, these carriers are adding customers at the fastest rate, faster than competitors Sprint and T-Mobile, who tend to advertise price, value, and network features. Verizon and AT&T also have seen their customer churn rates drop.[4] The carriers who lead the market on network coverage are the holders of the original low-frequency cellular licenses.

Fifth, as a result of customers' demand for nationwide services, and the proprietary character of the existing networks, the two nationwide dominant low-frequency wireless providers offer preferential pricing for calls "on the network" or "in network." Such pricing generates network effects and attracts customers to the small number of providers with large networks. As a result, consolidation and increasing concentration could accelerate in the future. In network industries with large fixed costs—such as the transmission segment of wireless communications—it is difficult to sustain large numbers of firms, since these tend to be natural oligopolies. Maintaining

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[3] *See* Merrill Lynch, "US Wireless Matrix," 4th Quarter 2006. Table 6 (pg. 14).

[4] *See* Merrill Lynch, "US Wireless Matrix," 4th Quarter 2006. pg. 31.

competition in wireless transmission is especially difficult because the limited amount of usable radio spectrum imposes additional physical barriers to entry.

The Commission faces the difficult task of auctioning scarce spectrum in a way that promotes social welfare. This task is best served by providing an infrastructure that promotes competition and allows innovative technologies to develop. In order to assure that any firm, especially a small firm, is able to effectively compete with Verizon and AT&T, the firm must have access to nationwide coverage at competitive rates. We discuss here one sensible approach: the FCC demarcates some of the 700 MHz spectrum for a licensee that will commit to selling at wholesale to all buyers and not primarily the top-two firms. In particular, we make the following observations:

First, it is possible to establish a license that obligates the winning licensee to operate a wholesale network that supports multiple retail competitors. Such a network would enable existing firms and new entrants—including Mobile Virtual Network Operators (MVNOs)—to compete among themselves, and importantly, also with the retail operations of the vertically-integrated incumbents. This opportunity exists because consumers buy wireless service that is a bundle of two components: wholesale access to a nationwide connectivity service and the provision of retail services to particular consumers. For example, a cell phone first provides access to a network and then enables a voice conversation under terms specified by some calling plan purchased at retail by the cell phone owner. Large investments and high operating costs are required only to establish the network connectivity part of the bundle, while the retail service component has much lower fixed and variable costs and can be implemented with many different marketing strategies and calling plans. Although physical limits on spectrum availability and high capital costs limit the number of providers providing transmission access, a wholesale network can support many retail competitors. The current industry structure—a few proprietary networks—prevents such a favorable outcome by perpetuating the control of the available spectrum most suited for that purpose by the top two low frequency wireless providers, AT&T and Verizon.

Second, given the concentrated market structure, the participants in the auction for new spectrum have different economic incentives depending on whether they are new entrants or existing incumbents. An entrant that wins a license wants to operate so as to maximize the value of the license. In contrast, an incumbent bidding for a new license takes into account that new licensees can attract customers from its existing business and thereby jeopardize its profits and diminish the scarcity rents from its current licenses. As a result an incumbent is not neutral about how the spectrum is allocated and used, even if it does not win a new license itself. This is a major difference from auctions where all players start on equal footing. We argue in this report that the dominant low-frequency incumbents' incentives to protect current profits are large, and could undermine the efficiency of the auction outcome. In particular, this distortion leads incumbents to value the new licenses more than the true economic value to society and thus is likely to lead to a misallocation of the scarce spectrum.

Owing to these two observations, we recommend the following solution:

- Require that at least one licensee, the E Block, must provide open access on nondiscriminatory terms. The winner of this license should be primarily or entirely a wholesale operator (hereafter, "wholesale-only") offering nationwide access and transparent pricing to third-party retail service providers. This provides a level playing field for retail service competition in the wireless market.

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This solution enables the FCC to eliminate the bottleneck on access to wide-area networks. It avoids *de facto* endorsement of vertical integration as the only viable business model, and re-asserts the Commission's expressed intent to promote competition in the market for wireless services. Establishing the E Block license assures that for at least one segment of the spectrum there is a wholesale market for nationwide network connectivity unbundled from retail services. It establishes the infrastructure needed to promote a more competitive market. Even though necessarily there will be few operators of networks, there can be unhindered entry into retail services.

We do not recommend mandating open access on the whole spectrum, only on the E Block. This recommendation leaves ample spectrum for integrated business models that may turn out to be more efficient for some applications than the open-access model.

The ultimate beneficiaries of new business plans will be retail consumers. Intensified competition lowers prices and strengthens incentives for innovation. Instead of possibly zero new entrants—if the Commission declines to prevent dominant low-frequency incumbents from foreclosing entry—or one new entrant, nondiscriminatory open access to the E Block's wholesale network enables many entrants to compete for retail customers with a variety of business plans and an array of services. Increased competition will benefit customers by reducing prices, increasing coverage, and encouraging a wider array of service offerings of higher quality.

We also address the public safety component of the proposal. In its design of the 700 MHz service rules and auction rules, the FCC has an historic chance to ensure high quality, nationwide, interoperable, low-cost service for public safety uses. The proposal circumvents the roadblocks that could delay or eliminate the possibility of a top-quality public safety network. It ensures that public safety organizations have an option to contract for a private-public partnership that will build an efficient system compatible with their requirements. The plan has the potential to produce a high-quality, interoperable, open-access network with substantial cost savings due to economies of scope.

Finally, we discuss the bidding rules and recommend the following ingredients:

- Structure the spectrum blocks and auction rules to promote efficient geographical coverage. Due to spatial economies in construction and wholesaling, and the advantages of a reliable nationwide interoperable public safety system, we recommend that the E Block be a single nationwide license.

- For the remaining blocks, we recommend smaller service areas, especially because availability of access to the nationwide open-access E Block enables a business model based on a local license to be complemented by nationwide roaming on the E Block. We also recommend simple package bidding that allows bidders to aggregate licenses over geographical areas without exposure risks—i.e. risks amplified by competitors' strategic bidding.

- Use anonymous bidding to prevent bidding strategies aimed at reducing competition.

- Provide bidding credits for new entrants to counterbalance the low-frequency nationwide incumbents' incentives to deter new entrants, and to recognize the benefits for consumers from renewed competition due to new entry.

In this report we first provide background on the state of the industry and then discuss details of the proposed solutions and the economic rationales behind them, as well as the economic tradeoffs.

## 3  The wireless industry is vulnerable to inadequate competition

In this section, we outline the current market structure of the wireless industry and explain why, absent Commission action, continuation of that structure will inhibit the development of new products and services and cause consumers to pay higher prices.

### 3.1  *The market for wireless services is highly concentrated*

Beginning in 1995, consumers enjoyed the remarkable benefits of competition in the wireless services market. Consumers benefited from both lower prices and improved services as a result of new entry into the wireless market. The new entry was a direct response to Commission policies that made spectrum available to entities other than the low-frequency incumbent providers. Demand expanded in terms of both subscribers and minutes to the point that now wireless communication rivals wireline in terms of minutes of use.

However, some of those same changes produced market conditions that led to the demise of regional operators. Customers have expressed strong preferences for nationwide service, absent exorbitant roaming charges. As a result, even large and formerly strong regional carriers such as US West and Bell South were forced into mergers that resulted in six nationwide carriers. Aside from some niche operators, nationwide service now appears to be an essential service in mobile telephony. In 2006, vertically-integrated, nationwide operators provided 90% of the retail wireless market, as shown in Table 1.
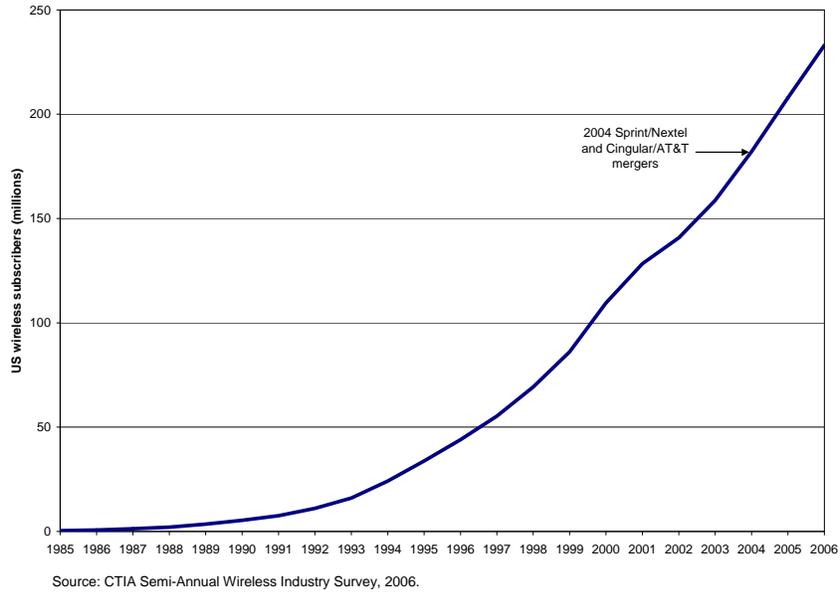
**Table 1. Wireless market share by year**

| Carrier | Market share by year (%) | | | | |
|---|---|---|---|---|---|
| | 2002 | 2003 | 2004 | 2005 | 2006 |
| Verizon | 23 | 23 | 28 | 25 | 26 |
| Cingular | 18 | 16 | 29 | 27 | 27 |
| AT&T | 19 | 18 | | | |
| Sprint | 14 | 13 | 13 | 25 | 25 |
| Nextel | 11 | 11 | 7 | | |
| T-Mobile | 6 | 8 | 10 | 12 | 12 |
| Others | 8 | 10 | 15 | 11 | 10 |
| Total | 100 | 100 | 100 | 100 | 100 |

Note: Totals do not sum due to rounding.
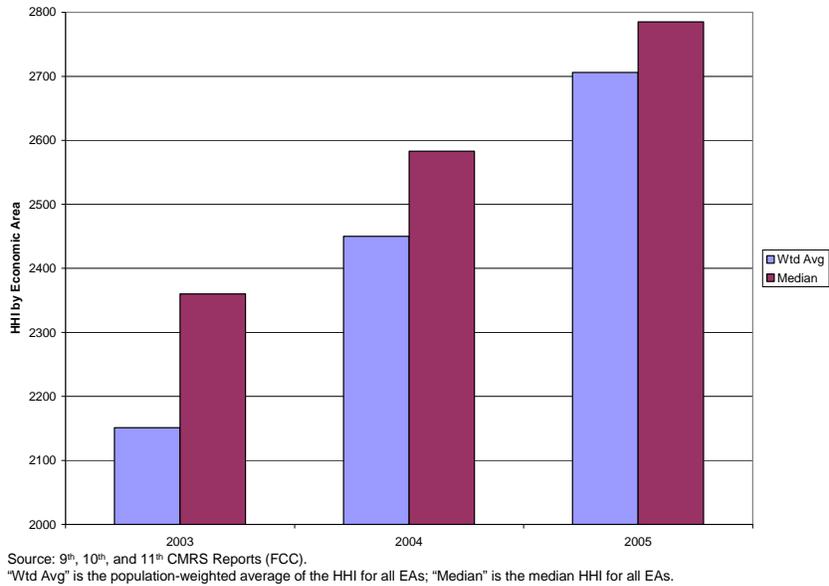Source: Merrill Lynch "Global Wireless Matrix 4Q06," pg. 178.

The initial consolidation of local and regional licensees into nationwide providers was followed by a second wave of mergers among the larger providers. First, Cingular merged with AT&T Wireless in October 2004, and then Nextel merged with Sprint in December 2004. The industry now has only four nationwide operators: AT&T, Verizon, Sprint, and T-Mobile. Consolidation often occurs in industries, but typically in *declining* industries where there are not enough customers for existing firms to maintain efficient scale. Shakeouts also do occur in new industries in which demand is growing. Nonetheless, we are concerned that this consolidation occurred at a time of tremendous growth, as shown in Figure 1.

**Figure 1. Consolidation at a time of rapid growth**



2004 Sprint/Nextel and Cingular/AT&T mergers

Source: CTIA Semi-Annual Wireless Industry Survey, 2006.

The most widely used measure of market concentration is the Herfindahl-Hirschman Index, HHI.[5] HHI in the wireless services industry at the end of 2005 was over 2,700.[6] By this measure, the wireless services market is highly concentrated. Figure 2 shows how market concentration has increased steadily in the last three years.

**Figure 2. The wireless market has become more concentrated**



Source: 9th, 10th, and 11th CMRS Reports (FCC).
"Wtd Avg" is the population-weighted average of the HHI for all EAs; "Median" is the median HHI for all EAs.

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[5] The U.S. Department of Justice, for example, uses the HHI for evaluating mergers. A market with an HHI less than 1,000 is considered to be competitive, one with an HHI between 1,000 and 1,800 is considered to be moderately concentrated, and one with an HHI of 1,800 or greater is considered to be highly concentrated. To compute the HHI, one sums the squares of the sellers' market shares. The HHI can range from a minimum of close to 0 to a maximum of 10,000. An HHI approaching zero would indicate near-perfect competition, with many thousands of sellers with negligible market shares. An HHI of 10,000 indicates the existence of a single firm with 100% market share.

[6] HHI is from the FCC's 11th CMRS Report, September 2006.

Together, Verizon and AT&T have:[7]

- 52% of the subscribers and 53% of the revenues as of December 2006,

- two-thirds of the net subscriber additions in the fourth-quarter of 2006, and

- a unique ability to directly offer a "quad-play" bundle (wireline, wireless, TV, and broadband).

An important element of their dominance is the competitive advantage derived from being the only nationwide carriers whose primary networks use low-frequency spectrum. We expect Verizon and AT&T to compete vigorously in the auction for at least part of the 700 MHz spectrum in order to preserve and strengthen this competitive advantage, even if consumers would benefit much more from the entry of a non-vertically-integrated competitor.

The four nationwide operators all provide similar vertically integrated wireless services, combining both wholesale and retail. AT&T and T-Mobile use the GSM standard; Verizon and Sprint use the CDMA standard. Often there are only two providers in a given area that are true head-to-head competitors for services such as roaming, and in some areas roaming is available only from a single party. Our fear, which is grounded in both economic theory and empirical analysis, is that this pattern of consolidation will lead to higher prices, poorer service, and reduced innovation.[8]

Our apprehension is well-founded. Dominant operators, such as Verizon, have taken actions such as disabling valuable phone features on their phones. For example, on 14 May 2007, a Google search of "Verizon Wireless disable features" finds over one million hits, many of which are consumers complaining and even suing Verizon for disabling features on phones. Such behavior is a common problem in monopolistic or oligopolistic markets, but can be driven out by competition. Other carriers have also disabled phone features that consumers value. The motive is to sell "value added" services to the consumers who are less price-sensitive. If they were not disabled, these features could enable customers to avoid paying extra for certain "value added services." For example, a customer could directly download songs to her phone over Bluetooth, rather than downloading it over the Verizon network. Verizon apparently finds it profitable to engage in such practices despite the fact that disabling features annoys some customers and outrages others.

Consumer monthly bills for wireless services also suggest weak competition. As shown in Figure 3, the inflation-adjusted monthly bill initially fell, but since 1999, consumers' monthly bills have been increasing.

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[7] Data from Merrill Lynch, "Global Wireless Matrix 4Q06," 28 March 2007 at 177-178.

[8] See for example, William J. Baumol, *The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism*, Princeton University Press, 2002.

**Figure 3. Wireless monthly bills initially fell but now are rising**
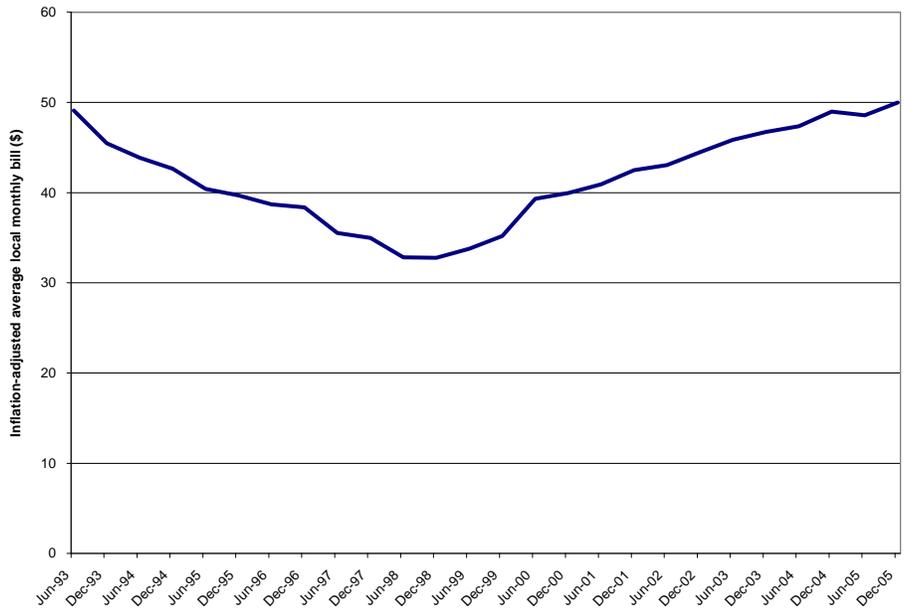


Source: CTIA report, pg 200 (table 105). CPI data from BLS, Dec 2005 dollars.

## 3.2   The market for broadband is highly concentrated

The broadband market is even more highly concentrated than the market for wireless services. Most customers have only two choices for residential broadband access: the phone company or the cable company. In 2005, one quarter had only a single choice, as shown in Figure 4. And some have no choice at all—broadband is simply not available.

**Figure 4. One quarter of broadband subscribers have only one choice**
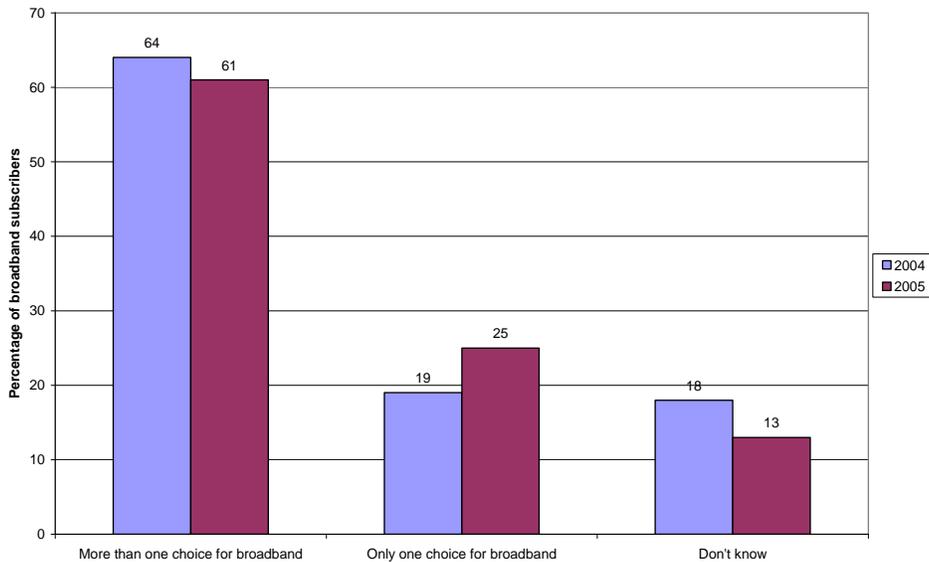


Source: "Home Broadband Adoption 2006," Pew Internet and the American Life Project, pgs. 7-8.

Like wireless service, broadband service has experienced rapid growth that is sure to continue. Despite the growth, broadband penetration in the U.S. lags behind many other countries as shown in Figure 5. Some of the wireless carriers have responded to this growth with broadband wireless services. However, the coverage is often quite limited, especially for true broadband speeds.

**Figure 5. Many countries have greater broadband penetration than the U.S.**



Source: OECD broadband statistics, December 2006.
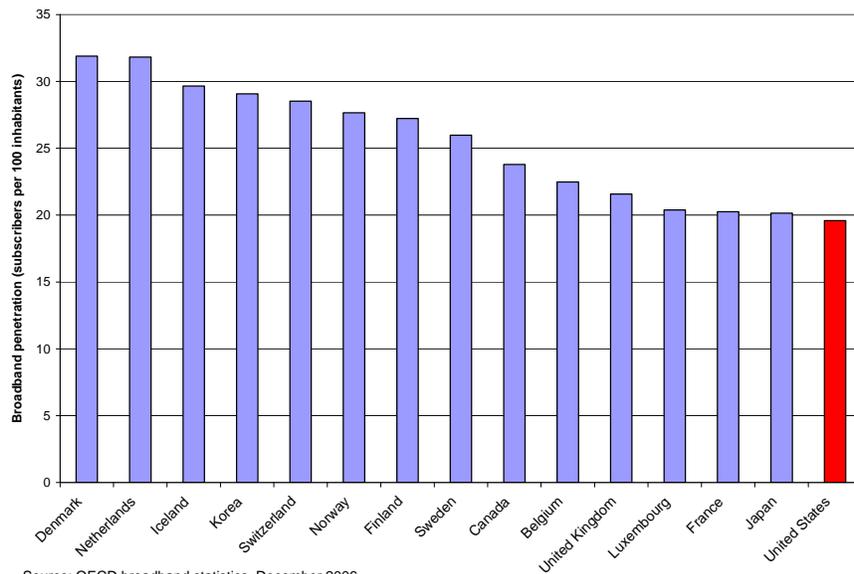
The FCC recognizes the importance of having a *third pipe for broadband*. For example, Chairman Kevin J. Martin states:

> "In much of the country, however, consumers have a choice of only two broadband services: cable or DSL. And in some parts of the country, consumers don't even have that choice. The most important step we can take to provide affordable broadband to all Americans is to facilitate the deployment of a third 'pipe' into the home. We need a real third broadband competitor. And we need a technology that is cost-effective to deploy not just in the big cities, but in the rural areas, as well. All Americans should enjoy the benefits of broadband competition—availability, high speeds, and low prices."[9]

Because the two largest vertically-integrated wireless providers (AT&T and Verizon) are also wireline telephone companies that have made huge investments in DSL service, the current industry structure is not conducive to wireless becoming a third, independent competitive option for broadband access. The E Block proposal would, by creating an additional nationwide wireless network, offer a greater opportunity for retail providers of broadband services (through their own local networks combined with the open-access network) to develop and compete with existing broadband offerings.

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[9] Statement of Chairman Kevin Martin, Report and Order and Further Notice of Proposed Rule Making, FCC 07-72, 27 April 2007.

Thus, we believe that the Commission is correct in emphasizing the importance of a third mode of access to broadband, and the opportunity that the 700 MHz spectrum offers to facilitate the introduction of a wireless alternative.[10]

## 3.3 Barriers to entry mean the existing concentration levels (and the attendant lack of competition) are unlikely to decrease absent structural changes

The barriers to entry are severe for both wireless and broadband services. For wireless service, a spectrum license is one important barrier. One cannot provide any service without a license, and one cannot provide nationwide service without either a nationwide license or agreements with parties that do have nationwide service. With respect to broadband, the two current physical networks most commonly used for broadband service are proprietary networks. Although wireless networks offer a third method of providing broadband service, including through non facilities-based operators (MVNOs), the existing wireline providers also own the economically feasible low-frequency spectrum needed for high quality wireless service. Thus they have drastically reduced incentives to develop wireless broadband. The second barrier to entry, for both wireless and broadband, is substantial capital investment in network infrastructure. The cost for a nationwide network is tens of billions of dollars.

As we describe later, incumbents can foreclose entry by outbidding new entrants in spectrum auctions. The low-frequency wireless incumbents have an especially strong interest in preventing a new nationwide competitor. This is an important issue that the FCC should address.

## 3.4 Additional retail competition is needed and would provide a check on oligopolistic behavior by Verizon and AT&T

In the presence of extremely large infrastructure costs and a limited amount of usable spectrum, there is not room for many nationwide operators of overlapping physical networks. The physical limitation on the viable number of wireless networks does not, however, necessarily limit the number of retail businesses that could provide service using network capacity acquired on a wholesale basis. There is room for more than one business model in the wireless industry, and introducing a new business model will enhance competition. The vertically-integrated proprietary networks adopted by the four nationwide providers may be particularly suited for some applications or for a certain percentage of the market as a whole. But if that business model is used exclusively, then competitive pressures could be diminished. The lack of feasibility for alternative business models prevents or reduces competition at the margin, namely competition from small companies that would readily pay competitive wholesale rates for nationwide access. These companies bring innovative ideas and technologies, but the nationwide operators have no incentive to offer a competitive wholesale service.

One expects that after there are enough companies competing for final consumers, competition among them will lead the vertically integrated firms to open their networks to third-party retail operators as a source of additional revenue. Once the competition for the final consumer is strong, the incumbents may compete for third-party providers that offer customers

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[10] As discussed more below, one possible use for the open-access spectrum would be as a complement to other facilities-based networks that would be able to deliver higher speed fixed access and combine with the E Block spectrum to provide ubiquitous coverage. In this way, the E Block would not necessarily be the third "pipe" but would enable a provider of broadband services to compete effectively as a third pipe against the existing dominant providers, especially for "cord cutting" customers who value mobility.

additional value. However, it is not clear how many firms are needed—that is an empirical question. As the current state of the industry demonstrates, the current structure *does not* encourage Verizon and AT&T to compete for wholesale business. Such limitation of output is a hallmark of anticompetitive behavior. For this reason, we believe that FCC action is necessary.

## 4 The 700 MHz auction provides the best opportunity to promote additional competition

The 700 MHz auction is the last big auction on the horizon and is the only auction ever of large blocks of prized low-frequency spectrum. This spectrum has propagation characteristics that would enable new entrants to compete in network coverage and quality with the cellular incumbents. Figure 6 shows the relative cell sizes of the various bands: BRS/EBS (2.5 GHz), PCS (1.9 GHz), cellular (850 MHz), and the 700 MHz band. BRS/EBS is well-suited to provide enormous capacity in urban markets where small cell-sizes are required. However, for the vast majority of the U.S., the 700 MHz band has a clear advantage in providing economic coverage, requiring approximately one-tenth the number of cell sites for the same coverage as a network built at 2.5 GHz.
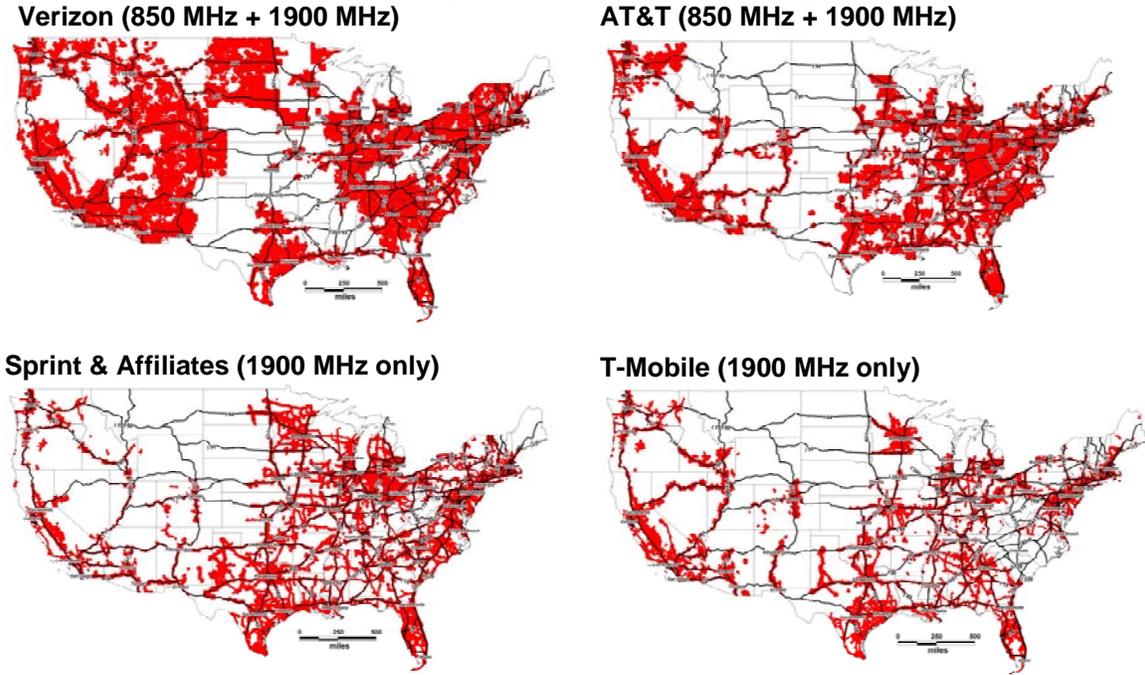
**Figure 6. 700 MHz spectrum has a ten-fold coverage advantage over 2.5 GHz spectrum**



*Relative Cell Sizes*
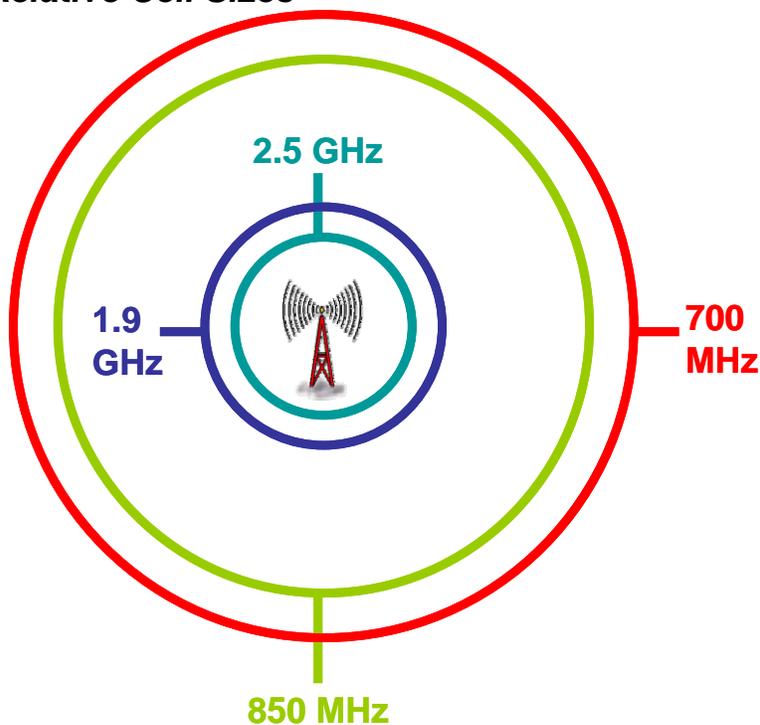
The coverage advantage of the lower frequency spectrum is seen in the coverage maps of the four nationwide incumbents shown in Figure 7. Given this coverage advantage, it is not surprising that the original two cellular incumbents, Verizon and AT&T, have a dominant position in the wireless market.[11]

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[11] Both the Verizon and AT&T networks of today resulted from numerous mergers and acquisitions beginning in the 1980s. Initially, there were two cellular incumbents in each region; today there are virtually two cellular incumbents nationwide.

**Figure 7. Lower frequencies result in a coverage advantage**

**Verizon (850 MHz + 1900 MHz)**  **AT&T (850 MHz + 1900 MHz)**

**Sprint & Affiliates (1900 MHz only)**  **T-Mobile (1900 MHz only)**

Source: CoverageRight.

The coverage advantage that Verizon and AT&T enjoy appears to enable them to charge higher per-minute prices than their PCS-only competitors, as shown in Figure 8. It also leads to lower churn, as shown in Figure 9.

**Figure 8. 850 MHz Cellular operators charge more than 1900 MHz PCS-only operators**
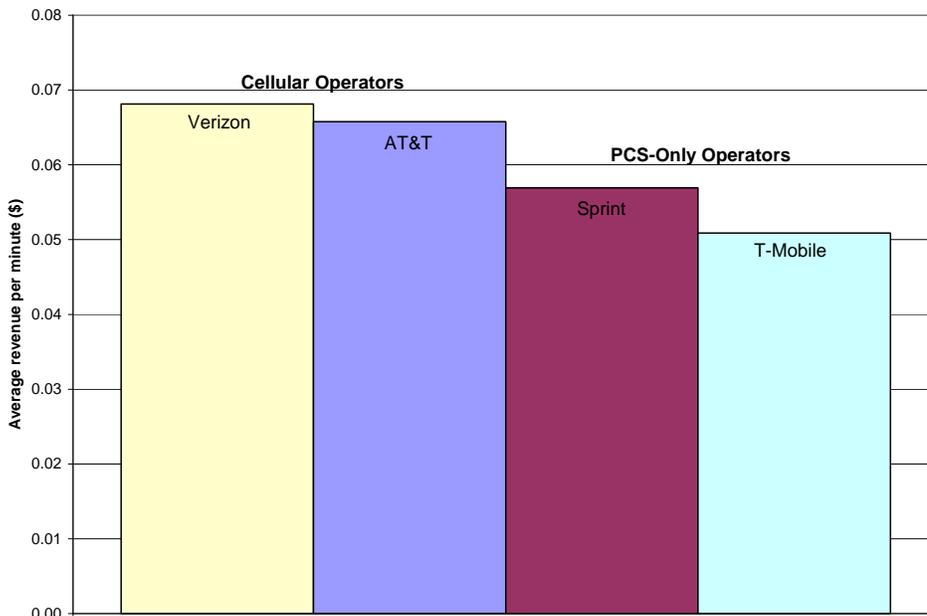
Source: Merrill Lynch US Wireless Matrix, 4th Quarter 2006. pg. 31.

**Figure 9. 850 MHz Cellular operators have lower churn rates**
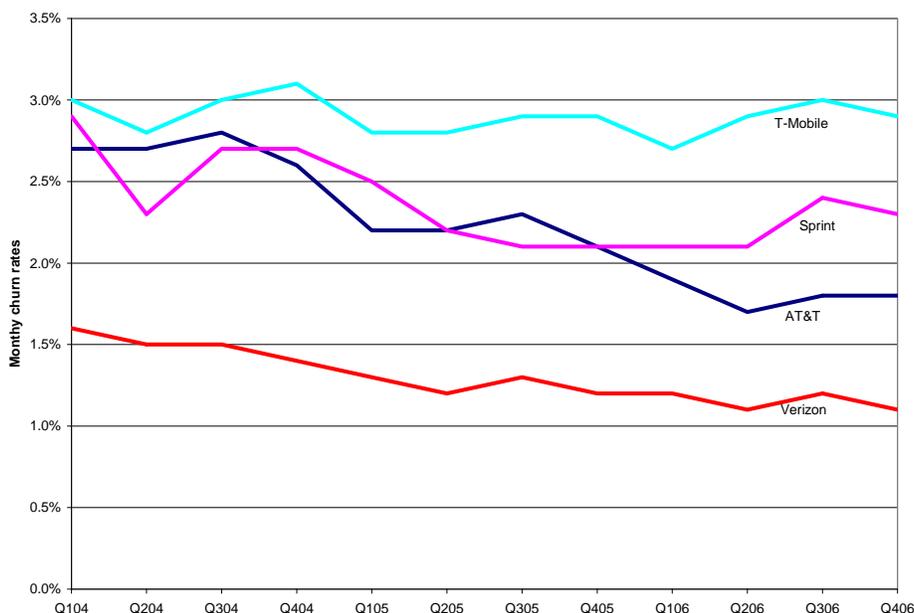
An open-access regime on just a small portion of the newly-available 700 MHz spectrum would make these coverage benefits available to whole classes of new entrants and existing rural/regional CMRS providers. The competitive benefits would be dramatic. Most importantly, these benefits can be realized by requiring open access on only a small portion of the CMRS spectrum. Thus, to the extent that a closed, proprietary network model is seen as most efficient, for some purposes, it will be able to co-exist with the newly available wholesale, open-access provider. Alternatively, the introduction of the wholesale provider may break down the current lock-step movements of the two largest low-frequency incumbents, Verizon and AT&T, to deny access to innovators and bring forth expanded use of all areas of the spectrum wherever the marginal costs justify it. If nothing is done, Verizon and AT&T will have the incentive and ability to prevent efficient entry and attendant consumer benefits.

# 5  An open-access requirement for the E Block will enable many new competitors and benefit consumers

In this section we argue that a creation of an open-access network available to all interested firms at transparent prices without the threat of holdup would dramatically reduce entry costs for many business models and open entry to a completely new set of firms and services. In our opinion such a network would dramatically change the competition in the wireless and broadband markets and greatly benefit customers. This conclusion accords with the views expressed by the FCC in the Notice that consumer welfare will be well-served by enhanced competition in the wireless and broadband markets, and that competition will be served by making new spectrum available and by offering that spectrum in ways that would allow a variety of business models to compete.

## 5.1 There are large barriers to entry in the wireless service market

The main barriers to entry in the market for wireless services are currently the limited amount of usable spectrum and the large fixed costs/capital requirements necessary to acquire that spectrum and to deploy the physical infrastructure for wireless transmission.

By making more spectrum available, the FCC reduces the first barrier to entry. Initially, the FCC made two cellular licenses available in each geographic area. In 1994, the FCC added the broadband PCS spectrum, making it possible for up to seven new large competitors to enter each market. In order to ensure that the incumbent cellular providers would not act on their incentives to frustrate new entry and forestall competition, the FCC set out "spectrum caps" for the auction. The caps were designed specifically to promote new entry by multiple providers in every single geographic area in the country while ensuring that they had sufficient spectrum to pursue efficient business plans.

One may perceive that a lot of spectrum has been sold already and hence the availability of spectrum is not an important impediment to entry. That is wrong. First, as shown in Section 3, the costs of developing a network on the less-scarce high-frequency spectrum are much higher than on the scarce low-frequency spectrum. Second, the prices of spectrum in recent auctions show that even the high-frequency spectrum is highly valuable because of its scarcity–the high auction prices in the AWS auction reflect in part the weakness of competition in the wireless market.

When analyzing barriers to entry, one must account for the fact that, analogous to many other products and services, a wireless service is a bundle of multiple components. In the current market, the main two components are a *national connectivity service* and the provision of retail services to particular consumers. That is, a customer using a wireless device first connects to an available wireless network and then receives retail service via that network. Economists recognize that it is important to think about the components of the product separately in order to inform competition policy.[12] Such "unbundling" of product components led to many successful changes (such as the Carterfone decision and the equal access provisions), promoting competition and innovation, reducing costs, improving quality and extending the range of products and solutions available to customers. We believe that such a perspective on the wireless market can be extremely useful in informing the FCC policy regarding the upcoming auction.

Therefore, we argue that it is important to consider barriers to entry in these two components of the wireless service separately and to consider the feasibility and desirability of separating the "national connectivity services" and "retail services" segments of the market that are currently combined in the offerings of the vertically-integrated wireless providers. Seen in this way, the barriers to entry to the business of providing "national connectivity" are the two barriers discussed above: limited spectrum and the costs of building and deploying the physical infrastructure. With respect to the "retail services," the main barrier to entry is achieving access to a high-quality nationwide network.

If the current competition policy and the existing market structure are retained, then we worry that entry into the "retail services" segment of the market will remain blocked for all

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[12] There are many markets with similar characteristics. For example, a wired service consists of providing the connection to the home via cable and the service provided via that cable. Residential use of electricity consists of generation, transmission and service. Although such distinctions are clearer in products rather than in services (for example, a computer consists of hardware and software), the same economic reasoning applies to services.

practical purposes. There is currently no spectrum available that would support an economically viable open-access network (other than in some high density areas where it may become economical to use higher-frequency networks). Moreover, the economically optimal policies of current nationwide incumbents in the lower frequencies are to restrict access to their networks. The terms of the previously sold licenses encourage owners to control access to their networks, and as we argued above, their incentives are to prevent entry into service provision in the markets where they operate. As documented by the filings of non-incumbents in the roaming proceedings, these barriers to entry are affecting potential new entrants.

One can view the problem of reducing entry costs/barriers in the "retail services" market as separate from issues about how to organize the current auction, i.e., that the connectivity and access issues could be resolved independently in roaming proceedings after the auction. We disagree. It is important to appreciate that there may be times or products for which vertical integration is more efficient and hence the optimal policy may be to not force universal roaming on all licensees. The question comes down to the tradeoff between potential efficiencies of vertical integration and the dominant low-frequency incumbents' incentives and ability to foreclose efficient entry in one of the interrelated markets, using the "bottleneck" at one of the other markets. Hence, we argue that right now is the best—or even only—chance of creating a market structure open to both business models and letting competitive forces, instead of regulatory proceedings, choose which products will be offered within each of the business models.

Barriers to entry have become more daunting as wireless has become a nationwide service. Unfortunately, if the same rules previously used to sell spectrum are used in the upcoming auction, the nationwide nature of the product will make it especially easy for the dominant low-frequency incumbents to prevent entry.

Without roaming, a new entrant must aggregate the footprint of a nationwide license and it must amass capital to build a nationwide network; otherwise, it must contract with a nationwide incumbent for expensive roaming or accept affiliation, or be limited to a local niche product. The fundamental fact is that, without acquiring low-frequency spectrum, entry into provision of retail services is blocked by the proprietary networks held by the nationwide incumbents in a concentrated industry.

Importantly, in order to limit new entry, nationwide incumbents do not need to acquire all of the spectrum available in the 700 MHz auction. Because an entrant requires nationwide coverage to succeed, the nationwide incumbent can block entry by buying only local pieces of that spectrum. In fact, even the mere threat of an incumbent using such a bidding strategy could forestall entry because of the attendant exposure risk faced by the entrants. The two low-frequency nationwide incumbents have strong economic incentives to use such bidding strategies to preclude entrants from access to genuinely nationwide roaming.

### 5.2 A national open-access network can reduce barriers to entry and enable many new business models

In order to open entry dramatically in the provision of wireless services, we recommend creating at least one national license, the E Block, with an open-access requirement. The winner of this license would be required to be a wholesale-only operator offering ubiquitous connectivity to third-party service providers with transparent pricing, available to any service provider on equal terms and without threats of holdup. Such features create a level playing field

for competition in the wireless market. The open-access network requirements should have two main components:

**Pricing.** To guarantee a level playing field, we recommend a transparent openly available tariff with a menu of contracts and services. This tariff is required to be non-discriminatory, enforced by Most-Favored-Nation provisions that ensure no discrimination by the identity of the retail service provider. Because the market can support many different business models, we envision different firms wanting different forms of contracts and services. Hence we expect that the tariff's menu of options can depend on economic variables, for example the interconnection standard, congestion conditions, location, service priority, etc. As an alternative to a fixed tariff, an auction mechanism might provide additional price transparency.

**Access for variety of technologies.** The operator of this network should allow various protocols and devices to connect to the network. Since it is not possible to foresee how the technology will evolve in the future, we recommend against imposing narrow technical requirements on access. If the FCC prevents the operator from withholding or hoarding the spectrum (in ways discussed in the next section) then the operator will have the right economic incentives to offer such ubiquitous connectivity.

The chief benefit of an open-access network is that it reduces the cost of entry into provision of nationwide services by unbundling "national connectivity" from "retail services," namely by separating them into two markets. Such a solution promotes new mixed-entry models, in which a firm acquires local licenses for spectrum capacity to provide coverage in high demand areas, and then is able to provide roaming coverage via a contract with the operator of the open-access network.

The opportunity to contract on non-discriminatory terms with the operator of the open-access network reduces dramatically the investment and fixed costs necessary to implement a wireless service. It also allows unbundling of the business of technical operation of the network (and providing access) from the business of providing retail services to customers, which in turn allows firms to focus on their core competences—to run smaller or more customized operations.

As we argued before, the 700 MHz spectrum, due to its superior propagation properties, offers a unique opportunity to create such a nationwide platform that would enhance competition by enabling entry of local retailers with new business models. Using a high-frequency spectrum to provide regional or nationwide coverage is a daunting economic prospect. As mentioned covering 95% of the population with a 700 MHz network requires approximately one-tenth the number of sites required using 2.5 GHz spectrum. Therefore, it is crucial for the FCC to introduce open-access provisions in this auction for some block of the 700 MHz spectrum to gain true nationwide open access and competition.

The establishment of an open-access network increases the value of regional and local licenses held or newly won by smaller operators. It dramatically reduces their entry costs, allowing smaller operators to buy spectrum and develop the network infrastructure only in their core geographic area. Assured access to nationwide roaming via contracts on non-discriminatory terms enables these operators to compete for retail customers on terms comparable to those of the large incumbents with proprietary nationwide networks.

An open-access network as defined above also increases the social value of abundant high-frequency licensed and unlicensed spectrum. It does so by allowing owners of networks

operating in those bands to combine local high-frequency capacity with nationwide roaming coverage at 700 MHz. For example, the EBS/BRS bands provide nearly 200 MHz of bandwidth around 2.5 GHz, but the high frequency currently limits deployments to more densely populated areas. Using a 2.5 GHz network with a 700 MHz open-access network allows a 2.5 GHz operator to offer the best of both worlds to customers using dual-band devices: ample capacity in densely populated areas (via the 2.5 GHz spectrum) and competitive coverage/reliability (via the 700 MHz spectrum). Essentially the open-access model allows the emergence of "synthetic" multi-band operators via wholesale agreements, to mirror the multi-band networks of Verizon and AT&T, who pair their PCS licenses with their valuable 800 MHz licenses. The difference, of course, is that the open coverage network would be broadly available on a wholesale basis, unlike the closely-held low-frequency facilities of the incumbents.

Currently, as evidenced by the Commission's roaming proceeding, smaller operators desire access to nationwide roaming, but the nationwide incumbents actively oppose the Commission's action to mandate such roaming. By instituting the open-access network on the E Block, the Commission solves this problem with limited intervention in the market. At the same time, it leaves most of the spectrum under the current rules that favor business models dependent on vertically-integrated proprietary networks. This policy would let the market eventually decide whether both models are viable in the long run.

To be concrete, we describe a few examples of business models that an open-access wholesale-only license enables:

a)  A small service provider can provide primary service in a smaller geographical area and still offer a nationwide service to its customers. This provider can build local networks for capacity in areas of high demand and rely on coverage from the open-access network in other areas with low demand from its customers. This business model intensifies competition in high-density areas without replicating infrastructure in low-demand areas—which would be economically inefficient.

b)  A startup or an existing small firm that is introducing a new service or wireless product can create innovative devices or services without fear of being blocked by the incumbent providers. The devices and services could be purchased at retail by any user and activated on the network, without the prior permission of the carrier. The device maker might even purchase wholesale network capacity and bundle it into the retail price of the device, so that end users do not have to think about network connectivity—they just turn on the device and it connects.

c)  Operators in higher-frequencies (e.g., in the 2.5 GHz bands) can bolster their networks with a low-frequency roaming partner that can more efficiently cover lower density non-metropolitan and rural areas.

d)  Unlicensed operators can obtain recourse to licensed spectrum as a "safety net" for in-market services and roaming out-of-market.

e)  The Mobile Virtual Network Operator (MVNO) becomes a viable retail service model—we envisage firms entering the market for wireless services without acquiring spectrum. For example, some firms can use this mode of entry to customize their services to the needs of small customer groups. Importantly, a wholesale-only provider has incentives not to limit its supply of network capacity to MVNO wholesale customers.

### 5.3 The open-access benefits and easier entry will lower prices through competition

Retail consumers will be the ultimate beneficiaries of new business plans. Intensified competition lowers prices and strengthens incentives for service innovations. Instead of possibly zero (if the Commission declines to prevent dominant low-frequency incumbents from foreclosing entry) or one new entrant, the open-access requirement leads to the potential of multiple new entrants competing for retail customers with a variety of business plans and services.

The 1.9 GHz spectrum is presently the "marginal spectrum," meaning that wireless prices are largely determined by the cost of providing service using frequencies in the 1.9 GHz spectrum. The better propagation properties of the low-frequency spectrum translate to lower marginal costs to develop wide-area network connectivity. Hence, if access to a network using the more efficient spectrum becomes open, the price of access will be determined by that lower cost, leading to lower prices, especially in low-density and rural areas.

Increased competition from new retail service providers puts pricing pressure on existing operators and leads to price reductions across the whole market. Indeed, this price pressure is the main reason for the incumbents' incentives to prevent the development of an open-access network.

Increased price competition provides additional incentives to find cost-saving solutions both in network operation and in provision of network services, leading to additional price decreases at the retail level. As experience has shown in many industries, the threat of losing customers to competitors provides strong incentives to innovate, and it encourages firms to reduce costs, develop higher quality products, and introduce a wider variety of products and services.[13]

### 5.4 The open-access benefits and lower entry barriers will stimulate innovation

An open-access network assures connection to a nationwide network on non-discriminatory terms, and protects entrants from future hold-up actions by dominant incumbents. This assurance creates new opportunities for entrepreneurs and small businesses, and unleashes their creative abilities in devising products and services. Price competition and the ubiquitous coverage offered by the open-access licensee forces firms to differentiate their products and to compete in quality and variety instead of the current struggle to gain access to wide-area coverage from the four incumbents with nationwide networks.

A prominent example of how the existence of an open-access network creates incentives for innovation is the Internet: free entry to the Internet was undoubtedly one of the engines driving rapid growth of the Internet. Many firms succeeded on the Internet because they knew that if they came up with a good business idea, the open nature of the Internet with the standard TCP/IP protocol assured them a fair chance to succeed. That knowledge reduced substantially the risk of investment in developing the idea into a commercial product and spurred innovation in both services (e.g., the web, email, voice over IP, social networking, search, music stores, video sites) and devices (laptops, desktops, WiFi devices, webcams, etc.).

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[13] *See* for example, N. Economides, K. Seim, and B. Viard, "Quantifying the Benefits of Entry into Local Phone Service." Working Paper, Stanford University, August 2006.

In general, the incentives to innovate to improve products are different under unrestricted entry and restricted entry conditions. In a regime of restricted entry, an incumbent firm internalizes the consequences of new products cannibalizing old products; hence, after initially developing viable products, an incumbent has less incentive for further innovation than new entrants have. In contrast, in a regime of unrestricted entry, a firm runs the risk that innovation by competitors may offer superior products—a threat that is reduced in a regime of restricted entry. As a result, protection against entry can promote innovation initially at the expense of stagnation in the long run. We view the wireless market as beyond its infancy stage; hence, we are apprehensive that the incentives of incumbents are now to protect their current products and business plans, rather than to invent new products that would replace them. Therefore, we put greater weight on the importance of continued innovation in this market, and favor provisions that encourage entry of retail competitors.

In the wholesale component of the market, one might worry that a vertically-integrated firm could capture more of the benefits of its innovation than an open-access network operator, and as a result the open-access provider will have less incentive to innovate. In our opinion, however, down-stream competition among retail service providers enables the open-access network operator to capture part of the value added that it creates by investments and innovations in the access technology; hence this concern is of second-order importance. The competitive force that is most important in this case is the competition among network operators—both open access and closed-proprietary. We believe that competition among them will force innovation to keep their businesses viable.

Competitive pressure from an open-access operator, and from retail service providers who buy access from it, spills over to the other parts of the spectrum where nationwide incumbents must keep improving their products to compete with entrants.

An additional important advantage of an open-access network is that, by enabling retail entry, it allows market forces to choose the solutions that best reflect the preferences of retail customers. This leads to efficient selection among available technologies and the retail products and services they enable. Because technical proposals vary widely, evaluation of different solutions is difficult without a market test. One cannot expect a perpetually closed set of dominant incumbents to always produce the best ideas or to buy the best ideas from third parties—entry barriers affect not only incentives to innovate but also restrict what ideas are brought to the market. Opening access will enable the market to choose from a much larger set of possibilities.

Finally, the reduction in the fixed costs of entry—since open access enables an entrant to avoid the cost of acquiring regional or national licenses and building out a wide-area network— makes more business plans financially viable, and leads to a wider variety of services available to retail customers.

Summing up, we see many benefits of an open-access license for the incentives to innovate in both the "national connectivity service" and "retail services" segments of the market. Moreover, it is possible to create most of the benefits from open access by creating just one block that serves this crucial role. By creating an open-access license and while not forcing open access on the whole spectrum, the FCC creates an opportunity for different categories of business models to co-exist. Different forms of innovation will use the channel where they will be most profitable.

### 5.5 Nationwide open access and unrestricted entry creates additional competition for broadband

Finally, intensified competition in wireless services will impact the related market for broadband services, leading to similar benefits in that market. Voice transmission has already shifted substantially to mobile devices. Broadband will likely follow this path too—mobile wireless broadband is likely to grow. Hence the proposal to create an open-access license must be considered also in terms of its benefits for the broadband market and the services it provides.

Although a mobile broadband connection may not have as high capacity as a fixed-line connection, mobility may make it a viable substitute for fixed-line broadband usage, just as mobile voice has substituted for fixed-line voice usage. Even if a wireless connection is slower than a fixed-line connection, mobility may offer enough value for users to be interested in using it together with, or instead of, the wired connection. Many customers are switching to mobile voice service (to complement or substitute fixed-line service) despite the superior quality of fixed-line voice service.[14] One expects the same to happen in part of the mobile IP data market. That is, even though slower than fixed-line broadband, the wireless product can provide substantial value to some customers.

As we noted above, competition in broadband is quite limited. Competition will be improved if the FCC creates multiple "pipes" into homes, as well as portable ones. An open-access network enables more modes in which customers can use broadband services. Moreover, the 700 MHz spectrum allows for better coverage, creating for some customers their first broadband connection. By providing another alternative to fixed-line broadband, we anticipate that mobile offerings will introduce more price competition to the market for broadband services.

To create these benefits for customers and wireless businesses in the most efficient way, the open-access network should be built on a nationwide scale, both to exploit scale economies, and to bypass negotiating with various national and regional network owners, which would introduce unnecessary transaction costs and vulnerabilities to holdup. Also, the open-access network should have wide coverage to achieve universal service even in areas with very low average demand. In such areas it is not economical to build multiple networks, but still occasional connections are beneficial for customers. To achieve that goal it is necessary to auction the E Block as a nationwide license. Moreover, it is crucial to locate the open-access license in the 700 MHz band because its superior propagation properties make it the most economical spectrum to develop for wide-area broadband coverage. Finally, since there are large geographical areas where it is not economical to develop more than one network, it is efficient to bundle the development of the open-access network with the public-safety network. We describe the important public safety issues later.

## 6 Block size and package bidding are important features of the competitive plan

There may be a variety of different business plans that providers want to pursue. Both the design of the band plan and the specification of the auction rules can affect the viability of different business plans. Generally, most consumers demand nationwide coverage even if the vast majority of their use is in local areas. The vast majority of consumers have signed up with

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[14] *See* CTIA, *Semi-Annual Wireless Industry Survey*, p. 10. At the end of 2006, there were 1.8 trillion wireless minutes with annual growth of over 20%.

one of the providers offering nationwide coverage, even though the local-coverage-only firms typically offer cheaper plans to niche customers (Leap and Metro PCS are examples). It makes sense therefore to allow a new entrant to purchase spectrum in a way that enables it to compete with the existing nationwide providers.

There may also be some providers who can offer service to consumers efficiently with a local business plan. Such smaller coverage areas will be more viable and valuable if the Commission creates the open-access license, because then local providers can use the guaranteed nationwide roaming partner to provide complete products. Hence we think that some spectrum should be made available with blocks divided into smaller geographic areas.

In particular, we suggest offering the nationwide open-access E Block in conjunction with smaller geographic areas on the C and D Blocks. That way, bidders in the auction can acquire small geographic areas in those two blocks. However, bidders for the C and D Blocks may have high-value nationwide business plans and face high exposure risk. To allow them to compete successfully, we strongly suggest allowing limited package bidding that will enable efficient aggregation of licenses.

While SpectrumCo was able to obtain a nearly-nationwide block of spectrum in the AWS auction, it is not clear that such a bidding strategy can be replicated in the 700 MHz auction, nor would it necessarily have been an appropriate strategy for another bidder with a different business plan and a different risk of exposure if the aggregation had failed.

Adding package bidding on the C and D Blocks can solve a potentially severe problem that apparently frustrated at least one potential entrant during the AWS auction. (Purportedly, the consortium of DBS providers wanted a nationwide block of spectrum but was unwilling to undertake the risk of buying some licenses and overpaying for others to complete its desired package.) Package bidding would have enabled DBS to bid on smaller license blocks without risking a failed national aggregation.

Package bidding has another benefit for new entrants. This benefit arises because package bidding can increase substantially the cost to dominant low-frequency incumbents of blocking a nationwide strategy. Consider a new entrant who needs each of six licenses. A dominant low-frequency incumbent could bid on just one of the six to block entry. By raising the price of each of the six licenses sequentially, it could raise the price of the package enormously while only risking purchasing $1/6^{th}$ of the entire package. The threat of such strategic blocking by a dominant low-frequency incumbent could be sufficient to make a new entrant drop out of an auction before participating seriously. Package bidding can ameliorate that risk—if the incumbent is forced to bid on a nationwide package, then it risks buying the package, and it must spend six times as much money to increase the total price to the same level.

Package bidding creates a "threshold" problem whereby bidders on smaller licenses may have a higher valuation than the package bidder, but they cannot easily coordinate their bids to increase them substantially, since each bidder wants to act as a free rider on bid increases offered by the other bidders. The FCC has incorporated rules in its auction procedures to minimize such problems by requiring bid increases.

Another concern about package bidding is that in general it can be very complex. We think that there is great potential value in a full package bidding system, but if such a system is too complex or risky for this auction, it would still be good to use a limited form of package bidding such as that put forth by Milgrom and Wrege and by Rosston in earlier comments to the

Commission. The upshot of their proposals is to allow a limited number of non-overlapping packages and a nationwide package, and a combined package across the D and F blocks. These limited packages are likely to eliminate a large part of the exposure risk without adding substantially to the complexity or riskiness of the auction.

## 7 Anonymous bidding will promote competition and enhance auction revenue

There are advantages and disadvantages to balance in deciding about the bid disclosure policy during the auction. Revelation of bidders' identities can in some cases allow more accurate value assessments by bidders during the auction. Without knowing who is bidding on complementary licenses, a bidder may not be able to know what technology choices would be made. This lack of information could, for example, impact valuation because of an expectation of roaming.

However, there are a number of reasons why that consideration may be less important in general for the FCC now than it was in 1994 when the FCC first began auctions of spectrum. First, the technology is more advanced and established so that new entrants will have a reasonable idea of potential roaming partners even without knowing who is bidding on particular geographic areas. Second, the presence of the E Block and the open-access requirements reduces the need to know about other bidders if there is a carrier required to allow roaming at posted prices.

There are two major problems with revealing bidder identities in the auction: it gives bidders the ability to signal to each other, thus reducing auction revenues and possibly resulting in an inefficient assignment of licenses; and, it may make it easier or less costly for dominant low-frequency incumbents to target new entrants and thereby prevent additional competition.

In general, the greater the number of bidders, the more competitive the auction will be and the less concern there should be about "signaling" during the course of the auction. The FCC recognized this concern when it set forth rules covering the revelation of bidder identities in the AWS auction contingent on the eligibility ratio being greater than three. However, the magnitude of the eligibility ratio is not necessarily inversely related to incumbents' ability to forestall entry. For example, if all entrants need specific licenses or a minimum scale to compete efficiently, even a high eligibility ratio would not necessarily limit a dominant low-frequency incumbent's ability to bid strategically to deny entrants the necessary licenses or raise the prices of those licenses. In fact, simply knowing that they might be subject to such strategic bidding in the auction might cause entrants to hold back in the auction or decline to participate at all, thereby satisfying the incumbent's plans at no cost.

Because of the limited upside to revelation of bidder identities and the possible harm to competition and efficient license assignment, we recommend that the Commission not reveal bidder identities during the auction.

## 8 Bidding credits for new entrants will promote competition

One of the goals of the Commission is to sustain as competitive a market as possible. One tool to help new entrants would be to use a bidding credit. Bidding credits can make a new entrant more competitive against a dominant incumbent in the auction and thereby affect the competitiveness of the subsequent market. However, we understand that the statute authorizing bidding credits only allows their use to promote the entry of small businesses and other

"designated entities." Although it would be better to have bidding credits for new entrants in general, using them for small businesses would help small new entrants compete and provide similar benefits on all blocks.

It is important to understand that the price paid in the auction should not affect the price for service later, since the auction price is a sunk cost. So, at first glance, one would not expect bidding credits to have an impact on the prices for wireless service. However, bidding credits may actually have a large impact on prices if bidding credits change the winner of the auction from a dominant low-frequency incumbent who wants to protect its existing market share and income stream, as compared to a new entrant who wants to acquire customers and therefore prices more aggressively.

With bidding credits there could be a concern that a small business entity that qualifies for a bidding credit may act as a "front" for a larger entity that would not qualify or would undermine the open access model adopted by the Commission. We think that targeted requirements could be placed on the E Block that would be sufficient to ensure that an entity benefiting from the bidding credit would be consistent with the Commission's goals for that slice of spectrum.

There has been some discussion that a bidder's eligibility for bidding credits should depend on its operating its own retail service on 50% or more of its spectrum. Such a restriction is viewed by some as being necessary to discourage fronts. To us, this is not necessary, and in fact is counter productive, given the wholesale mandate we propose for the E Block and the accompanying restrictions on self-dealing. Such a requirement might well defeat the entire purpose of bidding credits—to promote small businesses and, most importantly, to get new competitive entry.

Consistent with economic theory and empirical evidence, bidding credits typically *do not* cause a reduction in auction revenues.[15] Rather the bidding credits typical motivate the participation of small entrants, which intensifies competition and raises auction revenues. This tendency is seen in Table 2, which displays auction prices net of bidding credits for each of the broadband wireless auctions.

#### Table 2. Small business share of winnings and net prices for broadband auctions

| No. | Auction | Spectrum (GHz) | Bandwidth (MHz) | Start Date | Number of licenses won | | | Quantity of spectrum (MHz-pop) | | | Net bids ($M) | | | Net price ($/MHz-pop) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Total | DE | Share | Total | DE | Share | Total | DE | Share | |
| 4 | Broadband PCS A and B Block | 1.850 | 60 | 12/5/1994 | 99 | 0 | 0% | 13,553 | 0 | 0% | 7,019 | 0 | 0% | 0.52 |
| 5 | Broadband PCS C Block | 1.895 | 30 | 12/18/1995 | 493 | 493 | 100% | 7,577 | 7,577 | 100% | 10,072 | 10,072 | 100% | 1.33 |
| 10 | Broadband PCS C Block Reauction | 1.895 | 30 | 7/3/1996 | 18 | 18 | 100% | 466 | 466 | 100% | 905 | 905 | 100% | 1.94 |
| 11 | Broadband PCS D, E, & F Block | 1.865 | 30 | 8/26/1996 | 1472 | 598 | 41% | 7,577 | 3,204 | 42% | 2,517 | 761 | 30% | 0.33 |
| 12 | Cellular Unserved | 0.869 | 25 | 1/13/1997 | 14 | 0 | 0% | 31 | 0 | 0% | 2 | 0 | 0% | 0.06 |
| 22 | C, D, E, and F Block Broadband PCS | 1.885 | 30 | 3/23/1999 | 302 | 277 | 92% | 2,703 | 2,390 | 88% | 413 | 390 | 94% | 0.15 |
| 35 | C and F Block Broadband PCS | 1.890 | 35 | 12/12/2000 | 422 | 422 | 100% | 4,029 | 4,029 | 100% | 16,857 | 16,857 | 100% | 4.18 |
| 45 | Cellular RSA | 0.824 | 25 | 5/29/2002 | 3 | 0 | 0% | 5 | 0 | 0% | 16 | 0 | 0% | 3.22 |
| 58 | Broadband PCS | 1.850 | 30 | 1/26/2005 | 217 | 47 | 22% | 2,136 | 668 | 31% | 2,043 | 632 | 31% | 0.96 |
| 66 | Advanced Wireless Services (AWS-1) | 1.710 | 90 | 8/9/2006 | 1087 | 215 | 20% | 25,706 | 2,192 | 9% | 13,700 | 551 | 4% | 0.53 |

Notes
All data from www.fcc.gov. All auctions are simultaneous ascending.
Spectrum is the location of the first band in GHz. Bandwidth is the sum of all bandwidths in MHz.
DE includes all winnings by designated entities (small businesses). Share is the share of winnings by DEs. Net bids are gross bids less bidding credits for DEs.

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[15] Peter Cramton and Ian Ayres, "Deficit Reduction Through Diversity: How Affirmative Action at the FCC Increased Auction Competition," *Stanford Law Review*, 48:4, 761-815, 1996.

**Figure 10. Small business share of winnings in broadband auctions have declined**
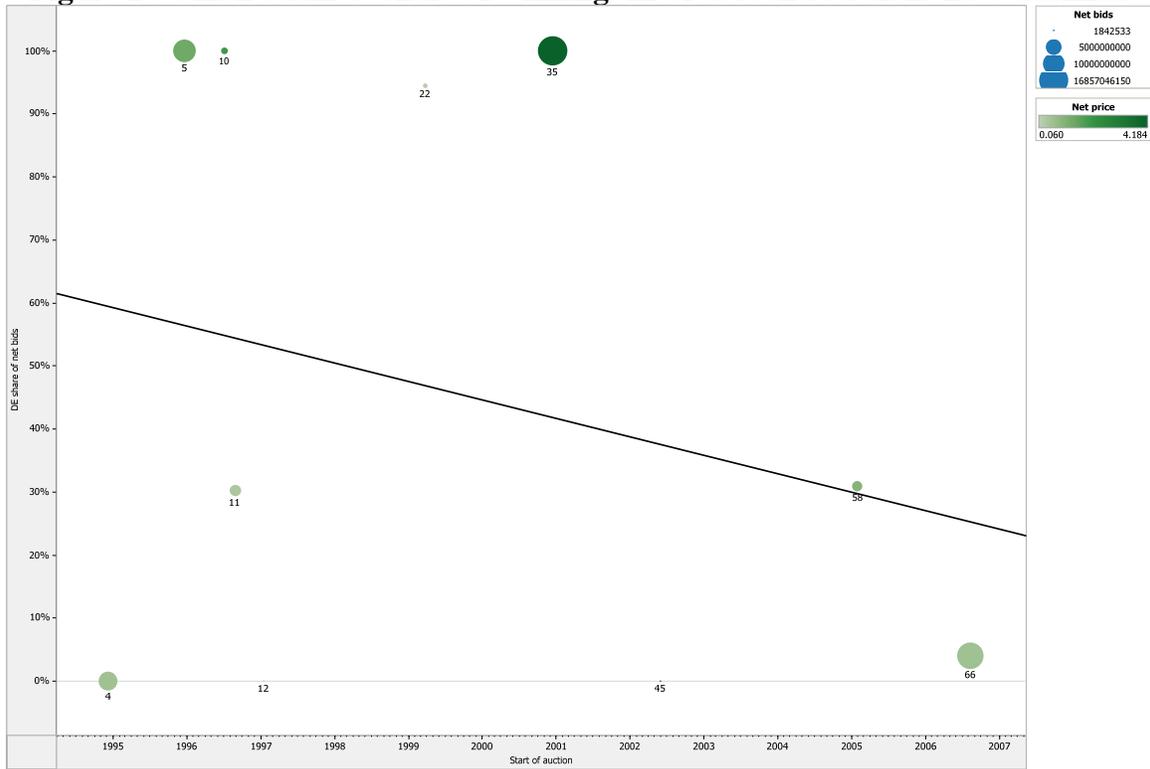


Source: FCC. Designated Entity share of net bids in broadband auctions. Color depth shows net price. Size shows net bids. The labels indicate the FCC auction number.

Figure 10 presents graphically the data of Table 2. Each dot represents an FCC broadband auction. The auctions are plotted over time (the x-axis). The height of the dot is the small business share of the winnings in net bid terms. The size of the dot is the size of the auction, again in net bid terms. The color depth indicates the net price ($/MHz-pop). Notice that the darker dots (higher prices) tend to have greater small business participation. Finally, the downward sloping trend line indicates that the small business share of winnings has declined over time.

One explanation for this decline is the dominance of the vertically integrated nationwide operators. With the absence of a wholesaler offering nationwide roaming, there is little room for the small regional operators. We think that this is part of the reason why only 4% of the AWS spectrum was won by small businesses.

## 9 Public safety can benefit from cooperation with the E Block licensee

In a perfect world, there would be an economically efficient allocation of spectrum, and public safety providers would have the resources to compete for the use of spectrum in the same way that other providers compete for scarce spectrum, and in the same way that public safety agencies buy other supplies such as cars, ambulances and personnel. In addition, spectrum policy would be such that the supply of spectrum, and the network connectivity that uses it, would not be artificially limited.

However, there are numerous constraints that depart from that ideal situation. First, public safety agencies are generally awarded exclusive use of specific blocks of spectrum that are not transferable. Second, public safety agencies are not awarded resources sufficient to acquire rights

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to use additional spectrum, nor to build and operate high quality networks on the spectrum they have. Finally, achieving nationwide compatibility, while extremely useful, may be difficult to achieve with the balkanized structure of public safety agencies across geographic areas and across services within the same geographic area.

In our view, these constraints imply that the public safety can be well served by creating the basis for a public-private partnership that has the following elements:

1. The E Block licensee will build a nationwide interoperable public safety network subject to requirements negotiated in a network sharing agreement. Broad requirements and a mechanism for ongoing coordination and monitoring should be established before the auction.
2. The E Block licensee is allowed to use both the private spectrum and the excess parts of the public safety spectrum to provide service to both groups of clients, with the public safety agencies having priority access to the public safety network, and to additional spectrum in major emergencies.
3. Public safety would control the spectrum allocated to public safety, and retain the option to pursue alternatives other than a shared network with the E Block licensee.

There are several implementation and technical issues regarding such a plan. In this paper we focus on the main economic issues. In particular, the public safety part of the proposal can create the following economic benefits:

1. Solve the coordination problems faced by diverse and decentralized public safety agencies.

2. Achieve economies of scope in construction and operation of the network.

3. Achieve additional savings and more efficient use of spectrum by shared use of the two parts of the spectrum by the public safety agencies in times of emergency, and by private users at other times, leveraging the different demand patterns of the two groups of users.

4. Bring competitive pressure to reduce the pricing of network access for the public safety users.

5. Provide efficient financing for the buildout and operation of the public safety network.

## 9.1 The FCC can help solve coordination problems

Until now, development of a public safety network has been controlled by local organizations. It is very difficult for them to develop the network efficiently for three major reasons: 1) Being decentralized and fragmented, they face severe coordination problems in agreeing on timelines, technical specifications, cost sharing etc.; 2) Many agencies face tight budgets that would lead to delays in rolling out a truly nationwide network, and delays in adopting the equipment and standards that would be optimal for public safety across the country; 3) As we explain below, the costs of building a separate public safety network are much higher than necessary, making the financing problems much worse.

Under the public safety part of the plan, there would be a single nationwide network with a common technology. All public safety agencies across the country would be able to communicate with each other and take advantage of the additional spectrum during times of emergency. By centralizing the decision-making, the plan provides a solution to balkanized and incompatible public safety systems.

Without a nationwide standard and guaranteed interoperability, if the Menlo Park (California) Search and Rescue squad were again sent to New Orleans, it could not be sure that its radio equipment would work in New Orleans at all, or be able to communicate directly with workers from the various New Orleans agencies. More commonly, users within one jurisdiction are guaranteed access to the network if they cross into neighboring jurisdictions. A nationwide system could have all of these features built into the software so that different groups could be established "on the fly" and have many other features, depending on public safety requirements. National standardization will also reduce the cost of public safety equipment, particularly on an open-access network where vendors are free to introduce new devices and to compete for public safety agencies' business.

The budget constraint problem should be ameliorated as well. Because the E Block licensee pays for the upfront capital costs, public safety will not bear the cost of initially constructing the network. In addition, because each public safety agency will be able to choose the most favorable rate plan among those available to commercial customers, even the smallest public safety agency will be protected by competition for the price it has to pay for service, since other networks will compete with the E Block licensee for retail providers.

## 9.2 There are large cost savings (economies of scope) from building and operating a joint network

Estimates of costs to build a stand-alone robust high quality public safety wireless network exceed $10 billion. These estimates include only the construction of the network; public safety agencies would also be required to pay for the operation of the network as well.

Economists use the term "economies of scope" for situations where a single provider can produce two (or more) different goods or services using fewer resources than would be required for two different entities to each produce one of the two goods or services.

According to the proposed plan, the E Block licensee would build a single network to provide two different services: public safety radio and commercial radio services that will provide the full panoply of voice, data and some video. There are some differences between the two services in addition to the identity of the end user. However, those differences appear to be easy to incorporate in a single pervasive network. With a single network, the provider would be able to share cell sites.[16] The economies of scope in network construction mean that while the cost to the E Block licensee of building the combined network may be more than the cost of building a single network alone, it should be far less than the cost of building the two networks separately.

Second, there can be operating cost efficiencies. For example, sharing of the operating systems, maintenance and personnel would reduce the cost of operating the system.

## 9.3 It is more efficient to share the spectrum

It is apparent that public safety use of spectrum during times of emergency has very high value. Most of the time, public safety use of the spectrum is not so critical. On the other hand,

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[16] Independent tower operators allow completely separate networks to share cell sites in some cases. However, there may be some economies from integrating the sharing of cell sites, negotiation, and sharing backhaul and other factors within a single network.

one expects that most of the capacity allocated to public safety would not be used much of the time. However, there are times when even their allotted capacity would be insufficient. Hence it may be extremely valuable to have additional spectrum available for public safety agencies. The plan proposes that public safety has access as needed to an additional 10 MHz of spectrum, nearly double the amount of broadband spectrum available to public safety under the current 700 MHz plan.

Public safety agencies have different usage patterns than retail customers: very high demand (and use-value) in emergencies, and much lower demand when there is no emergency. Thus there is an opportunity to share bandwidth to increase the efficiency of usage of the spectrum by allocating additional bandwidth to public safety in times of emergency and shifting unused bandwidth from the public safety to commercial use when there is excess capacity on public safety spectrum.

The ability to make better use of its spectrum during times when it has excess capacity should be a major benefit to public safety agencies. To assure this, they should obtain guarantees of priority access to spectrum when needed, and access to additional spectrum when it is critically needed and highly valued.

Sharing the network is also a source of additional economies of scope that offset the costs of developing the network. In particular, with a limited bandwidth, to provide peak-load capacity, it is necessary to split cells and incur large fixed costs for capacity that is rarely used. The capacity of the private network can substitute for these additional cells and lead to additional savings on the order of 40% fewer cells needed to achieve the same performance.[17]

### 9.4 Competition for retail customers will spill over to the public safety pricing

Operators of public services often face weak competitive pressures because their customers rarely have the option to "vote with their feet" by changing their service providers. The lack of competitive pressure can lead to low quality and reduced incentives to innovate. The benefits of competition have been reaped mainly by programs to procure public services on the open market and let firms compete in price and customer satisfaction. However, such direct competition in the provision of the public safety network is not possible beyond the initial auction because of the high costs of developing the network. However, the operator of the E Block will be exposed to continued competitive pressure on the interconnected commercial part of the spectrum: it will need to compete for consumers (who value coverage and reliability) with operators of other commercial networks. That pressure will force it to strive for quality to retain commercial wholesale customers, and the quality and low prices will spill over to the public safety network. To guarantee that the public safety agencies have access to at least as good prices as the private sector, we recommend that the public safety agencies should be granted Most-Favored-Nation provisions that let them choose terms for comparable services that the E Block operator offers private firms. This means that public safety will, for the first time in wireless services, obtain the benefits of competitive market pressures.

In our opinion one of the key components of a good public safety solution is that public safety retains the option to decline the deal and instead to use the spectrum designated for public safety without any reliance on the public-private partnership. That way, public safety can limit

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[17] See Comments of Access Spectrum, LLC, Columbia Capital III, LLC, Pegasus Communications Corporation, and Telcom Ventures, LLC, filed with the FCC on 29 September 2006.

the deals it is willing to consider and accept only those in which it gets a better deal than it currently has. If public safety decides that the E Block licensee is not offering good enough terms, it can decide to consider other alternatives.

## 9.5 The plan achieves more efficient financing of the public safety network

Finally, the cost of the system would not be financed by inefficient taxes. Most public finance scholars estimate that the cost of taxpayer financing of projects is very expensive, on the order of $1.30 for each $1 financed. There are two reasons why the proposal will save taxpayers money. First, the cost savings outlined above should go directly to the Treasury and public safety agencies via the price in the competitive auction. Public safety will save money on service because competition for service pricing on the commercial side will give them similar competitive benefits. Second, from an economic viewpoint, the remaining costs will be financed via the auction since the winner of the E Block will be obliged to build the network without any post-auction subsidies and will take these costs into consideration in bidding for the license. Importantly, such financing will be an upfront cost, equivalent to a lump-sum tax with minimal distortion, instead of a distortionary income or other tax, and that will reduce substantially the inefficiency of financing. Both of these savings will redound to the benefit of the American public.

## 9.6 For-profit companies will be involved in construction and operation of any large public safety system

Regardless of what plan is adopted, there will be substantial involvement of "for-profit" companies in the design, construction, and operation of any public safety network. Moreover, thanks to economies of scope, the total cost of the development of the network by bundling it with the E Block will be lower.

We understand that there is concern that a "for-profit" company that is also operating a commercial wireless network will not provide the level of quality, coverage, and security that is needed by public safety agencies. For any public safety network, there will be tradeoffs between expense and quality. To get higher quality, a more robust network requires more expenditure on towers, radios, etc. The key is for public safety entities to be involved in the network design and operation planning regardless of who is building and operating the network.

It is also important to note that public safety agencies are unlikely to be the ones to build any radio network. Any such network will almost assuredly have substantial "for-profit" involvement. The vast majority of current public safety systems are based on radio systems designed by for-profit companies. The big difference in the current proposal is that the E Block licensee will want its network to be commercially viable as well as be able to provide adequate public safety services. The benefit of this aspect is that commercial customers are likely to be satisfied with the high quality and reliability of the public safety network. One concern is that the E Block licensee might want to build only a commercial system, not a more robust public safety system able to cope with extreme emergencies. This is why it is critical to ensure that public safety agencies are involved early in the negotiations and in the network design. In this way, they can ensure that the network meets their needs.

### 9.7 Pre-auction planning of implementation is important

It will be useful for the public safety agencies to set out requirements in advance of the auction so that bidders can understand the commitment entailed in the E Block license, and thus be able to value the block appropriately. These requirements should provide sufficient detail so that bidders can judge the magnitude of the additional cost that will be required to satisfy public safety agencies. Winning the E Block would oblige the licensee to build a network that meets the minimum requirements.

We should be clear that the nature of procurement in general and wireless networks in particular means that such minimum requirements will entail substantial ongoing coordination between the network operator and the public safety agencies. However, we stress that this is the general nature of commercial contracts and hence such coordination and on-going monitoring would be required in any public safety network construction, whether it is the direct result of the auction or is later procured by safety agencies.

## 10 Conclusion

Since 1994 two factors have thwarted the Commission's admirable efforts to sustain competition in the wireless industry. One is the unanticipated importance of roaming, and more generally, the value to customers of nationwide coverage. The second is the consolidation of the major firms into vertically integrated operations that bundle nationwide network access and transmission with retail services—moreover, the top two major firms, Verizon and AT&T, combine these wireless networks with nearly complete telecomm packages that include wireline and broadband. The basic ingredients for a permanent oligopoly are now in place. Unfavorable consequences for consumers are developing: increasing prices, weak competition, and lagging innovation.

Now is the crucial moment for the Commission to reassert its commitment to a competitive wireless industry. If the two dominant wireless providers are able to monopolize the last low-frequency spectrum potentially available for many years then their entrenched positions will be impregnable.

Of the possible remedies, the easiest now is to designate one license for operation of a wholesale-only network providing open access on nondiscriminatory terms. This is the lifeline that local and regional operators and new entrants need. It will yield a flowering of retail competition by enabling small or local firms to offer nationwide coverage. In economic terms, it accomplishes the essential task of unbundling—vertically disintegrating—network connectivity from retail services provided over that network. This has been the successful cornerstone of U.S. regulatory policy in other network industries.

An especially favorable development is the prospect that the open-access network can be developed cooperatively with public safety agencies, recognizing however that these agencies can opt out. The economies thereby obtained, in both construction and spectrum allocation, make the entire project feasible financially for both the licensee and the public safety agencies. We urge the Commission to recognize this unique opportunity to achieve synergies with public safety, while establishing the minimal infrastructure needed to sustain competition in the commercial segment of the wireless industry.

The auction design presents important issues because the two dominant low-frequency wireless incumbents have strong incentives to thwart entry of new competitors. The auction rules

should enforce anonymous bidding, and allow bids for a designated set of packages of regional licenses and multiple bands. Bidding credits are needed for small businesses and other designated entities because the incumbents' valuations include maintenance of their oligopolistic rents if entrants are excluded. A level playing field is an essential requirement for the auction to yield an efficient outcome that serves the general welfare of the American public. The successes of earlier auctions depended on near symmetry among the bidders, but comparability among the bidders has now been lost due to the consolidations among the major firms and their control of the nationwide networks.

The 700 MHz auction is the last chance for many years to sustain competitive pressure in the wireless industry. Without measures like the ones we endorse here, the next phase could be a continuing struggle to rein in the predictable excesses of an entrenched oligopoly by invoking the Commission's regulatory authority.

**Exhibit A**

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## Research
### Published and Accepted Papers

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Joseph E. Harrington, Jr. and Andrzej Skrzypacz (2005) "Collusion under Monitoring of Sales." Forthcoming in *Rand Journal of Economics*.

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## ROBERT B. WILSON

Robert Wilson is the Adams Distinguished Professor of Management, Emeritus, at the Stanford Business School, where he has been on the faculty since 1964. His research and teaching are on market design, pricing, negotiation, and related topics concerning industrial organization and information economics. He is an expert on game theory and its applications.

Dr. Wilson has been a major contributor to auction designs and competitive bidding strategies in the oil, communication, and power industries, and to the design of innovative pricing schemes. His work on pricing of priority service for electric power has been implemented in the utility industry. His book on Nonlinear Pricing (Oxford Press, 1993) is an encyclopedic analysis of tariff design and related topics for public utilities, including power, communications, and transport; it won the 1995 Leo Melamed Prize, awarded biannually by the University of Chicago for "outstanding scholarship by a business professor." His work on game theory includes wage bargaining and strikes, and in legal contexts, settlement negotiations. He has authored some of the basic studies of reputational effects in predatory pricing, price wars, and other competitive battles.

He has published approximately a hundred articles in professional journals and books since completing the Bachelor, Master, and Doctoral degrees at Harvard College and the Harvard Business School. He has been an associate editor of several journals, and delivered several public lectures. He is an elected member of the National Academy of Sciences, a designated distinguished fellow of the American Economic Association, and a fellow, former officer and Council member of the Econometric Society. The Norwegian School of Economics and Business Administration conferred an honorary Doctor of Economics degree in 1986, and the University of Chicago, an honorary Doctor of Laws degree in 1995.

On problems of pricing strategy, he has advised the U.S. Department of the Interior and oil companies (on bidding for offshore leases), the Electric Power Research Institute (on pricing of electric power, design of priority service systems, design of wholesale markets, funding of basic research, and risk analysis of environmental hazards and climate change), and the Xerox Palo Alto Research Center (on pricing product lines in high technology industries). With Paul Milgrom he designed for Pacific Bell the auction of spectrum licenses adopted by the FCC, and subsequently worked on the bidding strategy team, and later for other firms. He contributed to the designs of the power exchange and auctions of ancillary services in California, and he has continued to advise EPRI, the California Power Exchange, the California, New England, and Ontario System Operators, the Canadian Competition Bureau, Energy Ministries of several countries, and others involved in the design of auctions for electricity, power and gas transmission, and telecommunications in the U.S. and elsewhere. His designs of other auctions have been adopted by private firms. He has been an expert witness on antitrust and securities matters.

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    Game Theory Society: Council member 2001–2005; Morgenstern Lecturer at
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Research Programs:  Stanford Center on Conflict and Negotiation 1987-2001; Director
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Associate Editor:  Econometrica 1979-85. Mathematics of Operations Research 1988-
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Public Lectures:  Norwegian School of Business and Economics, Borch Memorial
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    Lecture 1994. Hebrew University of Jerusalem, Oskar Morgenstern Lecture
    1994. Helsinki School of Economics, Union Bank Lecture 1991. MIT, Inter-
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# PUBLICATIONS OF ROBERT WILSON

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**EDITOR**

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